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**A REVIEW OF FUNDING
AND FINANCING MODELS
FOR INFRASTRUCTURE
CORRIDOR MEGAPROJECTS,
AND IMPLICATIONS FOR THE
CANADIAN NORTHERN CORRIDOR**

David Large and Ahmad Teymouri

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FOREWORD

THE CANADIAN NORTHERN CORRIDOR RESEARCH PROGRAM PAPER SERIES

This paper is part of a special series in *The School of Public Policy Publications*, investigating a concept that would connect the nation's southern infrastructure to a new series of corridors across middle and northern Canada. This paper is an output of the Canadian Northern Corridor Research Program.

The Canadian Northern Corridor Research Program at The School of Public Policy, University of Calgary, is the leading platform for information and analysis on the feasibility, desirability, and acceptability of a connected series of infrastructure corridors throughout Canada. Endorsed by the Senate of Canada, this work responds to the Council of the Federation's July 2019 call for informed discussion of pan-Canadian economic corridors as a key input to strengthening growth across Canada and "a strong, sustainable and environmentally responsible economy." This Research Program will benefit all Canadians, providing recommendations to advance the infrastructure planning and development process in Canada.

This paper, "A Review of Funding and Financing Models for Infrastructure Corridor Megaprojects, and Implications for the Canadian Northern Corridor", falls under theme *Funding and Finance Dimensions* of the program's eight research themes:

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Dr. Kent Fellows

Program Director, Canadian Northern Corridor Research Program

A REVIEW OF FUNDING AND FINANCING MODELS FOR INFRASTRUCTURE CORRIDOR MEGAPROJECTS, AND IMPLICATIONS FOR THE CANADIAN NORTHERN CORRIDOR

David Large and Ahmad Teymouri

EXECUTIVE SUMMARY

The University of Calgary's School of Public Policy (SPP) is co-ordinating a national research program examining the feasibility of a proposed nation-building multi-use infrastructure corridor megaproject called the Canadian Northern Corridor (CNC). The objectives of this research paper are to contribute to the SPP's research program by conducting an examination of the financing and funding models employed in similar megaprojects elsewhere in the world, and to extract knowledge that would be useful to help complete the feasibility analysis.

After conducting a rigorous review of the academic and trade literatures regarding financing and funding of multi-use (e.g., road, rail, pipeline, power, telecom) infrastructure corridor megaprojects, supplemented with detailed case analyses of five infrastructure corridor megaprojects (two from Kenya, two from Australia and one from France) similar to the CNC, our key conclusions are:

1. Given the great number of corridor infrastructure megaprojects undertaken in the world in the last couple of decades, and the amount of capital investment in these projects, there appears to be no global shortage of investment capital.
2. Government financing has a role; however, for a corridor infrastructure megaproject other than a simple non-toll highway, especially a multi-use corridor, attracting substantial investment capital from the private sector appears essential.
3. To commit, the private sector stakeholder(s) must perceive a compelling business case, including strategic alignment, a feasible investment amount, a clear and simple funding model (operational revenues), a compelling return on investment and an acceptable level of risk.
4. The literature-based review of infrastructure megaproject funding and financing, including the website of Global Infrastructure Hub, showed a limited but growing array of funding models, and a large and growing array of possible financing models and controlling mechanisms.

5. The case-based analysis of five CNC-relevant corridor infrastructure megaprojects showed only a relatively narrow range of funding models used (especially subsidies and user fees), but a wider range of financing tools and controlling mechanisms (especially PPP contracts and special corporations).
6. These analyses suggest that sufficient funding and financing models exist for infrastructure megaprojects. This may in turn suggest that the long gestation period for the CNC is not due to a lack of funding, financing and/or controlling mechanisms; instead, the long gestation period may have more to do with the absence of a compelling business case for any one private industry partner.

POLICY RECOMMENDATIONS

Our research suggests that the long gestation period for the CNC may not be due to a lack of options for funding, financing and/or controlling mechanisms; indeed, the long gestation period may have more to do with a perceived absence of a compelling business case for any one private industry partner. Assuming that the business cases for private industries need further exploration, these are our principal policy recommendations to help finalize the feasibility study of the CNC:

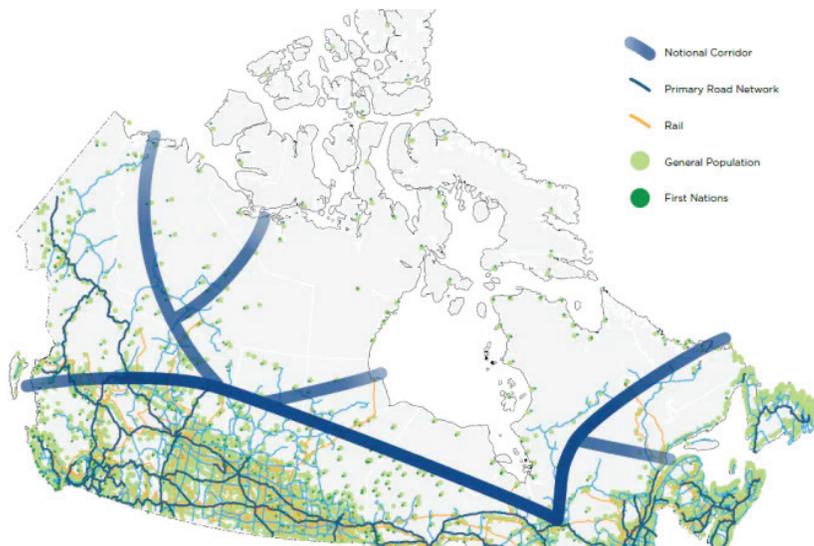
1. Infrastructure Canada should convene a workshop with senior representatives from Canada's major private industries who might see the highest profit potential arising from at least one sub-network of the proposed CNC. The workshop's objectives would be to identify the sub-network(s) with the highest profit potential, to gauge the level of private sector excitement and potential commitment and to explore the general CNC configuration.
2. Assuming that the workshop identifies one or more high-potential sub-networks and that there is at least some cross-industry level of excitement and potential commitment, then Infrastructure Canada should convene a conference with senior representatives from all of the key stakeholder sectors. This would include the most interested private operating companies, plus the relevant federal, provincial and territorial ministries, the Assembly of First Nations and the major financial institutions. The conference's objectives would be to gauge the level of cross-sector excitement and potential commitment and to identify each sector's principal conditions required for engagement.
3. If the conference achieves a threshold level of cross-sector excitement and conditional engagement, then the federal government should declare the CNC to be a strategic priority and commit funds for stakeholder and community engagement, detailed corridor planning, environmental assessment and land assembly.

1. INTRODUCTION

1.1 CONTEXT

For many years, Canada has had a nation-building vision of an east-west-north multi-purpose infrastructure corridor to provide an equal access economic opportunity for all regions of the country. The Canadian Northern Corridor (CNC) would be a multi-use corridor infrastructure megaproject spanning Canada's east-west mid-latitude with several northern spurs, approximately 7,000-10,000 km long and costing roughly \$100-150 billion (Sulzenko and Fellows 2016), depending on the spur configurations (see Figure 1).

Figure 1: Schematic of Canadian Northern Corridor Megaproject



Source: Provost (2018)

Since 2016, the University of Calgary's School of Public Policy (SPP) has specified and supported a substantial series of research-based articles to explore all aspects of the CNC concept and its feasibility. This article is part of that series, wherein we present results of an investigation into the funding and financing models of similar megaprojects completed elsewhere in the world, to explore which models are associated with a greater measure of project completion and/or success. Thus, this article complements a prior CNC funding and financing article (Boardman et al. 2020), whose cases were focused primarily in the Canadian context.

1.2 DEFINITIONS

This report focuses on a multi-use linear corridor infrastructure megaproject. The *Oxford Handbook of Megaproject Management* defines megaprojects as “large-scale, complex ventures that typically cost \$1 billion or more, take many years to develop and build, involve multiple public and private stakeholders, are transformational, and impact millions of people” (Niedermaier 2020). While megaprojects can refer to the construction of major facilities such as hydroelectric power dams or major urban complexes such as Expo 2020, we focus on linear corridor-based infrastructure projects such as highways, railroads,

power transmission, pipelines and communications. More precisely, we look at multi-use (multimodal) and multi-jurisdictional (cross-boundary) megaprojects.

The term “financing” refers to the sourcing of capital investment required to: 1) acquire the land corridor; and 2) design, construct and commission the embedded infrastructure systems. Financing can be provided by some or all of various stakeholders, including all levels of government, private infrastructure owners, development banks, pension funds, etc.

The term “funding” refers to: 1) the pre-construction sources of cash required to cover scoping, feasibility and environmental studies; and 2) the post-construction sources of cash required to cover operational and maintenance costs of the megaproject’s infrastructural systems and provide the requisite financial returns to the public and private investors. Typical funding sources comprise infrastructure access fees and/or user fees such as pipeline transit fees, highway tolls, royalties and government support from general and/or special tax pools.

1.3 LEARNING FROM OTHER MEGAPROJECTS

While the CNC, if fully realized, would be the largest single project ever undertaken in Canada, it would be far from the only infrastructure megaproject undertaken in the world. As megaprojects stand apart from smaller projects in terms of their complexity, there is much to be learned from examining the experiences of other nations and corporations involved in multi-use infrastructure corridors concerning planning, financing, execution, operation and funding. A significant pool of megaprojects in the world have been completed in recent decades from which lessons can be learned. For example, the Refinitiv Infrastructure 360 database (Refinitiv n.d.) listed over 650 megaprojects (over US\$1billion) completed since 1995 with an average cost of US\$3.4 billion per project. As another less formal benchmark, Wikipedia (2020) lists several hundred road and transport infrastructure megaprojects worldwide, with a total investment amounting to several trillion US dollars. As a final benchmark, the OECD (2018) estimates that China’s Belt and Road pan-Eurasian infrastructure investment initiative (BRI) alone will inject over US\$1 trillion in the 2017-2027 timeframe.

While these benchmark lists are not scientifically complete, we can comfortably conclude that hundreds of infrastructure corridor megaprojects completed or in progress worldwide in the previous two decades have much in common with the proposed CNC. The implications are several:

1. There is much to be learned from other megaprojects regarding feasible and effective financing and funding models and how governments and other institutions may have played both a facilitative and/or risk management role;
2. There does not seem to be a shortage of financing available for infrastructure corridor megaprojects, so Canadians may not need to be concerned about gaining access to sufficient investment capital if the economic case is compelling; and
3. Evidence from the Wikipedia (2020) list, even if not scientific, does suggest that the \$100-\$150 billion approximate cost estimate of the CNC may be significantly understated for a fully built multi-use corridor. For example, the list shows a cost

estimate of more than US\$90 billion for the multi-use Delhi–Mumbai Industrial Corridor, which at 1,400 km is just one-fifth of the length of the CNC. Another example shows a US\$85 billion cost estimate for Japan’s single-use Tokyo–Nagoya–Osaka high-speed maglev railroad, a distance of only 500 km.

1.4 PURPOSE AND STRUCTURE OF THIS PAPER

This paper’s overarching purpose is to contribute to the feasibility study of the Canadian Northern Corridor. We are primarily seeking evidence regarding funding and financing models of corridor infrastructure megaprojects completed or under construction elsewhere to explore what might be most applicable and effective to the proposed CNC. We will address these three research questions:

1. What are the different funding and financing models for existing major projects (including infrastructure and/or public works projects) in other jurisdictions, and how do they vary with regard to construction, operation and maintenance of physical infrastructure projects?
2. Are there innovative, collaborative financing approaches to crowd in capital to trans-boundary infrastructure corridor projects like the Belt and Road Initiative and the Mediterranean Corridor?
3. What are the roadmaps developed in other jurisdictions and/or by international bodies to standardize and streamline approaches to project identification and preparation, contract design and improve the investment environment for large infrastructure projects?

In Section 2, we will briefly outline the methodology for our research. In Section 3, we preface the presentation of our findings with an essential discussion of the complexity and risks of infrastructure megaprojects and their implications. In Section 4, we present the results of our literature-based findings regarding funding and financing mechanisms for infrastructure megaprojects. In Section 5, we present the results of a more granular case-based analysis of selected infrastructure megaprojects judged to be especially relevant to the CNC. Section 6 discusses the most significant findings relevant to the research questions posed above and Section 7 provides conclusions and policy recommendations.

2. METHODOLOGY

The data for this paper were derived entirely using secondary research methods. We investigated the literature, both academic and applied, and Google-located organizational and informational websites. All the research was conducted online and comprised three major phases:

- For Section 4’s literature-based perspective on funding and financing: An online library-based search was conducted on three premier business and engineering management databases (Proquest One Business, Business Source Complete and Factiva), augmented with content from the website of Global Infrastructure Hub (GI Hub).
- For Section 5’s compilation of a list of pertinent corridor-based infrastructure megaprojects: We conducted the same literature search as for Section 4, augmented

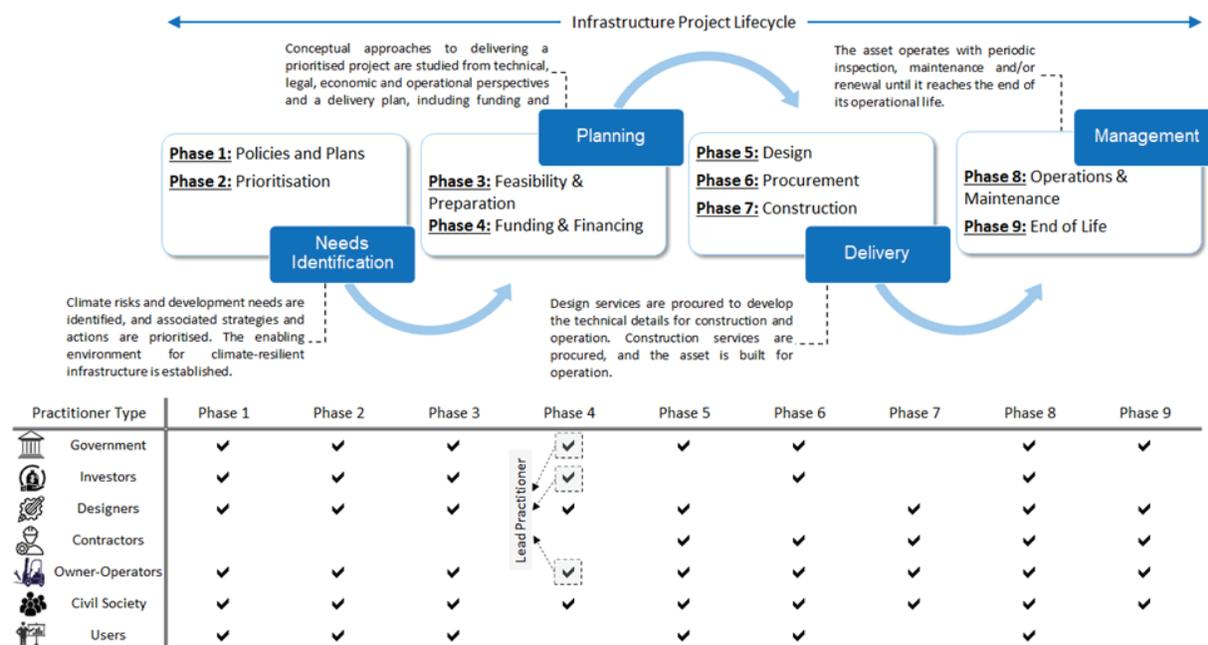
with extractions from Global 360's megaproject database, Google-located content and Wikipedia. To be kept on the list, a megaproject required these attributes: i) it must be completed or under construction; ii) it must have an investment cost of US\$10 billion or greater; iii) it must involve a land corridor; iv) it would preferably be multi-use/multimodal, i.e., with at least two infrastructure systems; and v) it would preferably be multi-jurisdictional, crossing at least one state/province/national/Indigenous boundary. The eligible list presented in Section 5 does not constitute a census or a scientific sample; rather, it captures many of the world's higher profile corridor megaprojects of the past two decades, plus several others discovered in the course of the search. Much work would remain to fully populate a census list.

- For Section 5's case analyses: To be subsequently selected from the eligible list for a detailed case study, the megaproject would need to be deemed highly similar to the CNC, thus requiring these attributes: i) it would preferably be greenfield or from scratch, rather than just an expansion or connection; ii) it would be in rural or remote territory rather than urban or suburban; iii) it would preferably involve the participation of Indigenous Peoples; iv) it must have financing and funding information; and v) it would preferably have descriptions of government and institutional facilitation and risk mitigation measures.

3. A CONTEXT OF COMPLEXITY AND RISK

Any discussion of funding and financing of infrastructure megaprojects must be prefaced by the recognition of a megaproject's great complexity, which introduces great risk, the latter being a primary determinant of accessibility to funding and financing (Cui et al. 2018). Aside from its sheer size, a megaproject's complexity originates from its many stages potentially spanning many decades and involvement of multiple stakeholders at every stage (see Figure 2).

Figure 2: Infrastructure Project Lifecycle Phases and Stakeholder Engagement



Source: ICSI (2022)

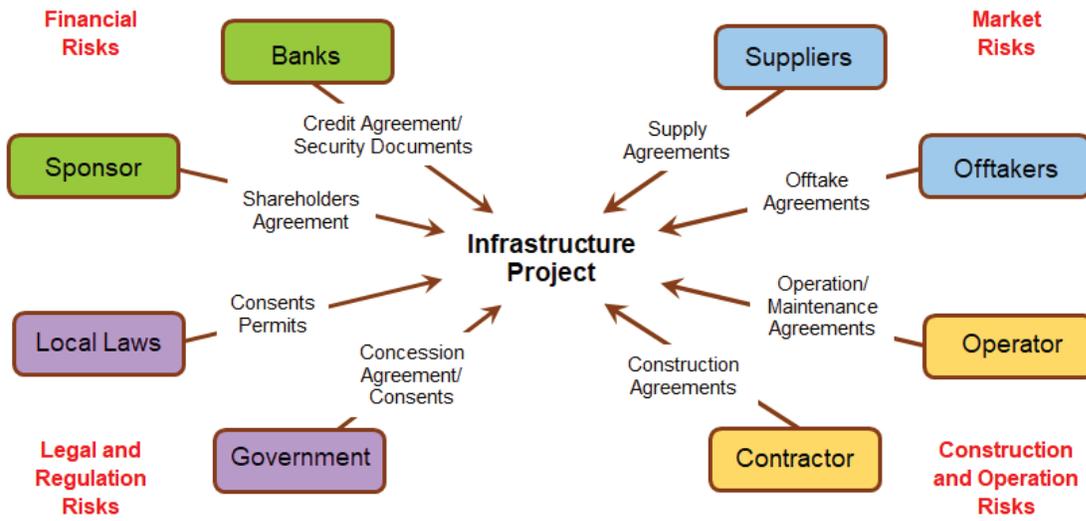
Li and Guo (2011) attempted to categorize such complexity in three dimensions: (1) technical complexity determined by the design and technologies related to construction processes; (2) social complexity from the unintentional impact of megaprojects on the environment and conflicting interests; and (3) managerial complexity caused by megaprojects' governance aspects, including financial arrangement, scheduling, resources deployment and decision management.

Pushing further, He et al. (2015) proposed a more fulsome six-category framework for the complexity of construction megaprojects:

- (1) Technological complexity (three-dimensional technology, energy conservation technologies and new construction materials);
- (2) Organizational complexity (project staff, organizational structure, number of hierarchies);
- (3) Goal complexity (stakeholder requirements, multiple objectives, goal paths);
- (4) Environmental complexity (natural, market, political and regulatory environment);
- (5) Cultural complexity (national culture, industrial culture and organizational culture);
- (6) Information complexity (information systems, the degree of obtaining information levels of processing and transmission of information).

Regardless of the categorization of the complexities, the project management literature notes that such complexities introduce risks. For example, Jovanović et al. (2020) provide an infrastructure project source-of-risk classification based on: (1) geographical location (culture, customs, methodologies, different policies, exchange rate variation); (2) size and complexity of the project (project growth and the increase of its complexity does not bring size increase to the linear risk); (3) the legal framework (contract, tort, equity or custom depending on the part of the world); (4) the effect produced by the project stage (before, during and after construction); and (5) terms of the construction contracts (specific risks allocation according to parties in the contract). Similarly, Cuthbert (2018) illustrated how the complexity of players contributes to the creation of several categories of risk (Figure 3).

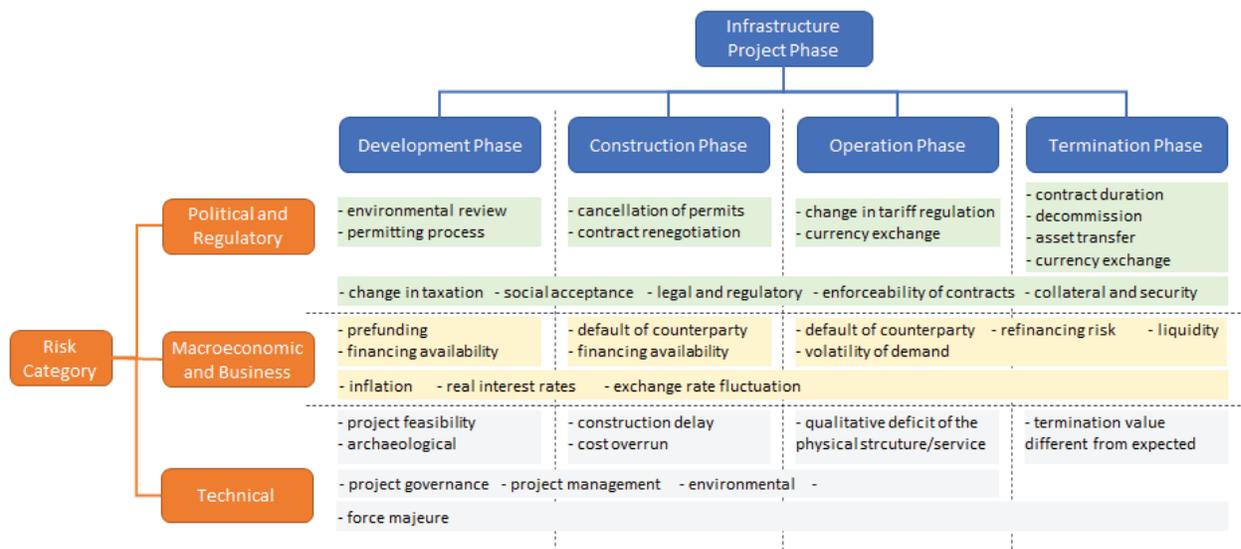
Figure 3: Key Contractual Risk Categories in Financing Infrastructure Projects



Source: Cuthbert (2018)

Della Croce and Paula (2015) pushed this idea one step further to demonstrate how sources of risk vary by project execution phase, including the infrastructure project development phase (before submission of the bid and financial close), construction phase and the operational and termination phases (Figure 4). The authors investigated how changes in policies or regulations that emerge from government actions can impact specific industries or contracts involved in infrastructure projects. The decision-making process is more challenging when industry and economic environment are subject to variations such as macroeconomic variables (e.g., inflation) and finance risks (e.g., debt maturity).

Figure 4: Classification of Risk Linked to Infrastructure Projects



Source: Della Croce and Paula (2015)

In summary, megaproject complexity contributes to several sources of risk over all of the phases, with high potential effect on: 1) the amount, uncertainty and/or the variability of project construction costs; 2) the amount, uncertainty and/or the variability of operating costs and revenues after project activation and other financial outcomes sought by the various stakeholders; and 3) the overall severity, downside cost and/or negative consequence of failure. Thus, it is clear that megaproject complexity and risk are significant factors in a project's ability to attract funding and financing and its final arrangements to mitigate the effects of negative outcomes for the various investors.

Given this introductory overview of the reality of megaproject complexity and risk, and the challenges they create for megaproject funding and financing, let us now examine what the literature contains regarding the array of funding and financing mechanisms, beginning with funding.

4. A LITERATURE-BASED REVIEW OF INFRASTRUCTURE FUNDING AND FINANCING

This section presents a more global extra-Canadian literature-based review, both academic and applied, of funding and financing models of infrastructure megaprojects, augmented with content from the GI Hub's website. Section 4.1 will present our findings regarding funding methods, Section 4.2 will present our findings regarding financing methods and in Section 4.3, we'll present our findings about how institutions can facilitate megaproject funding and financing through risk mitigation.

4.1 FUNDING METHODS

Recall that we have defined funding as pre-construction sources of cash to cover scoping, feasibility and environmental studies, and post-construction sources of cash required to cover operational and maintenance costs of the megaproject's infrastructural systems, while providing the requisite financial returns to the public and private investors. In our review of funding and financing literature and case information, we discovered much less attention paid to the discussion of funding, with frequent reference to methods such as "taxes," "tolls" and "user fees." More attention is required regarding a clear discussion and identification of funding models based on the nature, amount and variability of future operating revenues.

The funding literature paucity issue aside, let us examine the work of GI Hub (2019), which has compiled a partial list of funding options (Table 1).

Table 1: A Partial List of Funding Options

Revenue Levers	Lever Options	
Tax-Based is a core payment mechanism for infrastructure drawn from the public and generally structured as a payment stream with a lower risk rating than revenue streams exposed to degrees of commercial risk.	<ul style="list-style-type: none"> • Availability payment • Shadow toll • Tax breaks 	
User-Based is a core payment mechanism transferring varying degrees of commercial risk to the private sponsor of an infrastructure asset enabling the operator to charge customers for services directly.	<ul style="list-style-type: none"> • Toll revenues • Tariffs on regulated utilities • Unitary pricing 	<ul style="list-style-type: none"> • Segment pricing • Dynamic pricing
Ancillary Revenue is a secondary revenue stream designed to complement the core revenue by extending the scope of services. Its application is often driven by the structural features of an asset, urban densities surrounding the asset, users' income levels and the ability of project designers.	<ul style="list-style-type: none"> • Advertising • Real estate revenues • Energy solutions • Maintenance and repair services 	<ul style="list-style-type: none"> • Commercial retail revenues • Parking revenues
Value Capture is a secondary revenue stream for infrastructure relying on the capturing of spillover value created by an infrastructure asset. Its mechanism may vary widely, but general practice relies on targeted taxation, levies and rates on spatial zones surrounding infrastructure assets in urban locations.	<ul style="list-style-type: none"> • Special district taxation • Betterment levies • Developer charges • Stamp duties 	<ul style="list-style-type: none"> • Tax increment financing (TIF) • Real estate taxation • General property tax
Data is the revenue collected from monetizing data generated by an infrastructure asset. This is the least mature revenue level.	<ul style="list-style-type: none"> • Operational data • Consumer data 	

Source: Global Infrastructure Hub (2019)

Still, from the government's perspective, some interesting initiatives at the local level might also be considered. New funding sources are those different value-capture mechanisms, such as local option taxes or impact fees, that create extra revenue resources to compensate for infrastructure projects (Table 2).

Table 2: New Funding Sources for Local Infrastructure Projects

New Taxes	Value Capture
<ul style="list-style-type: none"> • Local option sales taxes • Local option fuel taxes • Local option income and payroll taxes • Local option vehicle tax 	<ul style="list-style-type: none"> • Impact fees • Special assessment districts • Tax increment financing • Joint development

Unfortunately, these very brief literature-based findings of funding methods did not provide any depth of discussion regarding facilitation and/or risk management, nor was there a connection of method with project success. As we will see in Section 4.2, literature coverage of financing methods is much more fulsome.

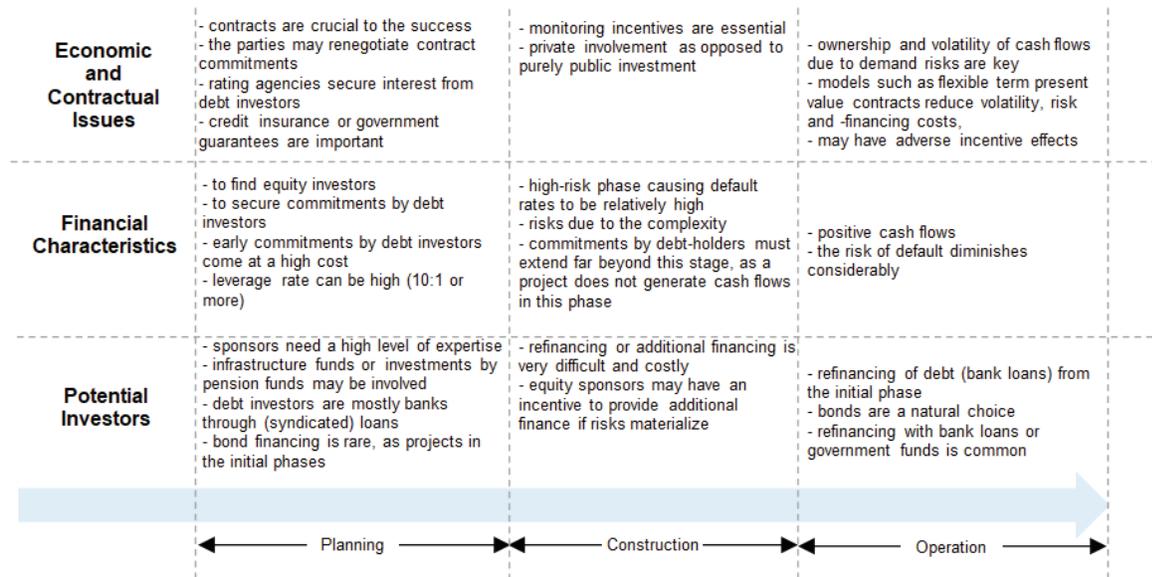
4.2 FINANCING METHODS

In this section, we present our findings regarding the spectrum of options available to finance the construction of corridor-based infrastructure megaprojects. Recall that we have defined “financing” as “the sourcing of capital investment required to acquire the land corridor, and to design, construct and commission the embedded infrastructure systems.”

4.2.1 The Difficulty of Financing Infrastructure Megaprojects

The characteristics of infrastructure megaprojects differentiate them from other asset classes that make their investment demand and financing supply more difficult. Ehlers (2014) outlined three primary factors: high and uncertain initial investment; long-term and uncertain operational cash flows; and illiquidity, all making the investment unattractive. Then there is the additional complication of complex legal arrangements between different parties such as construction companies, operators, government authorities, private investors, insurers, etc., which can vary widely by project phase. Figure 5 illustrates the interplay of these factors.

Figure 5: Key Characteristics of Infrastructure Projects' Phases



Source: Ehlers (2014)

4.2.2 Success Factors in Financing Infrastructure Megaprojects

Given megaprojects' great investment and the longer repayment periods, governments are generally unwilling to pay the entire cost of land assembly and infrastructure installation on their own; nor can they, in a global atmosphere of de-subsidization. Thus, governments must seek available, reliable and sufficient resources and private partnerships to help finance these projects (Thanh Truong et al. 2020). Different success factors are involved (Ismail 2013) and several researchers have developed frameworks or lists. Zhang (2005) ranked sub-factors of four main success groups related to financing: (1) economic viability; (2) appropriate risk allocation; (3) sound financial package; and (4) favourable investment environment.

Table 3: Financing Critical Success Factors/Subfactors for PPP Projects

Economic Viability	Appropriate Risk Allocation	Sound Financial Package	Favourable Investment Environment
<ol style="list-style-type: none"> 1. Long-term demand for the products/ services offered by the project. 2. Long-term cash flow that is attractive to lenders. 3. Sufficient profitability of the project to attract investors. 4. Long-term availability of various suppliers needed for the normal operation of the project. 5. Limited competition from other projects. 	<ol style="list-style-type: none"> 1. Concession agreement 2. Guarantees/support/ comfort letters 3. Loan agreement 4. Operation agreement 5. Supply agreement 6. Offtake agreement 7. Design and construct contract 8. Insurance agreement 9. Shareholder agreement 	<ol style="list-style-type: none"> 1. Appropriate toll/tariff levels and suitable adjustment formula. 2. Abilities to deal with fluctuations in interest/ exchange rates. 3. Sound financial analysis. 4. Sources and structure of main debts and standby facilities. 5. Long-term debt financing that minimizes refinancing risk. 6. Investment, payment and draw-down schedules. 7. Stable currencies of debts and equity finance. 8. Fixed and low interest rate financing. 9. Low financial charges. 10. High equity/debt ratio. 	<ol style="list-style-type: none"> 1. Government support. 2. Predicable and reasonable legal framework. 3. Stable political system. 4. Predicable risk scenarios. 5. Favourable economic system. 6. The project is well suited for privatization. 7. The project is in the public interest. 8. Adequate local financial market. 9. Supportive and understanding community. 10. Promising economy/ economic growth. 11. Predictable currency exchange risk.

Source: Zhang (2005)

Similarly, Osei-Kyei and Chan (2017) identified four financing success factors: (1) continuous profitability for parties during project operation; (2) reduced public sector administrative cost because major project risks are allocated to the private sector; (3) local economic development; and (4) reduced project lifecycle cost, which enhances the project’s value for money. Many other frameworks also highlight similar sets of success factors, but interestingly, most frameworks identify economic viability or profitability as a leading factor. This finding may be especially relevant for the feasibility study of the CNC, and this will be highlighted later in the paper’s discussion and conclusions.

4.2.3 Parties Involved in Infrastructure Project Financing

Project management defines stakeholders as individuals, groups or organizations with a positive or negative interest in/impact on the project’s outcome. Ninan et al. (2019) highlight that stakeholder management in megaprojects is more challenging and complicated than in small-scale projects due to the variety of parties involved. Identifying stakeholders in megaprojects is generally a difficult task because of project managers’ limited cognition of stakeholder inclusion/exclusion boundaries (Frick 2005).

Since stakeholders have different requirements, their expectations from megaprojects may not be aligned with the megaproject strategies, goals and objectives (Aaltonen et al. 2008). Specifically, a group of stakeholders outside the project organization create more complexities than internal ones. They are sometimes subject to contractual regulation (Ninan et al. 2019). It is very important to ensure all stakeholders are identified and work together efficiently during the project lifecycle. Tensions may happen between project parties located in different jurisdictions due to differing laws and practices from one

country to another. Different parties will have particular roles. One sponsor may also be the turnkey contractor (Cuthbert 2018). Table 4 lists parties and stakeholders involved in infrastructure financing and their roles.

Table 4: Parties and Stakeholders Involved in Infrastructure Financing

Party	Role
Project Company/ Borrower	It can be a company, partnership, limited partnership, joint venture or a combination.
Sponsors/ Shareholders	Agencies or individuals develop the team of the various stakeholders/parties. They also obtain the required permissions to get the project underway.
Third-Party Equity Investors	The project investors invest in the project alongside the sponsors. They expect a positive return on their investments for their shareholders' benefit.
Banks	A group of lenders should be formed for financing because many infrastructure megaprojects need huge investments that a single lender cannot finance. In international projects, lenders (usually banks) from different countries are involved in financing projects.
Facility Agent	One of the lenders is appointed as the facility agent to administer the loan on behalf of other lenders. This role is very important in infrastructure megaprojects' financings due to various administrative tasks that need to be done.
Technical Bank	It is involved in more technical aspects of the project loan, and is responsible for preparing and reviewing the banking cases and calculating the cover ratios.
Insurance Bank/ Account Bank	The insurance bank negotiates with the project insurances on behalf of other lenders. The required cash flow for the project flows through the account bank. A disbursement account and a proceeds account are used to monitor disbursements to the borrower and to pay project invoices.
Multilateral and Export Credit Agencies	They enhance the financial attraction of infrastructure megaprojects to other international commercial banks. They provide a degree of protection against various risks, specifically political risks.
Construction Company	Construction companies are key stakeholders of infrastructure megaprojects which the project company should employ. They are involved in designing, procuring, constructing and commissioning the project.
Operator	An operator is a separate company responsible for ensuring the day-to-day operation and maintenance of the project according to pre-agreed parameters and guidelines.
Experts	Consultants and professional companies to advise on certain technical aspects of the project. The lenders appoint them.
Host Government	The government of the country where the project is being implemented. Depending on the project's importance and complexity, it may have different roles and responsibilities. The host government may be required to enter into a government support agreement.
Suppliers	The supplier companies provide procurement management services to supply required material for infrastructure megaprojects. For example, the fuel supplier for the project will be one of the key parties.
Purchasers	In many infrastructure megaprojects, the project company identifies and appoints a purchaser firm for long-term procurement management and purchasing services. When the project's output is not being sold to the general public, it is required.
Insurers	It is critical to protect the infrastructure megaprojects against risks. Insurance companies should be hired in this case.

Source: Cuthbert (2018)

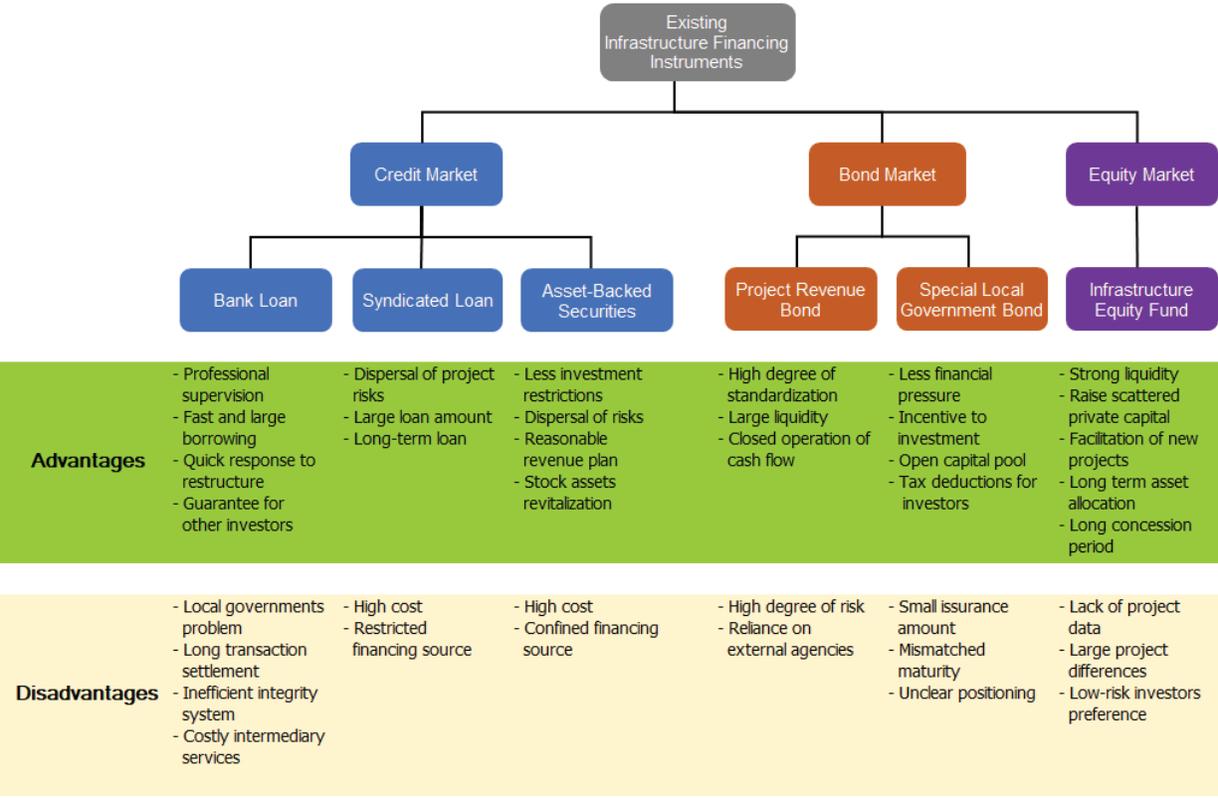
In the financing process, the lenders give close and thoughtful attention to all parties involved in any part of an infrastructure megaproject's lifecycle. For example, all parties should perform their roles according to the project plan and have sufficient financial resources to meet their obligations under the relevant project commitments (Lu et al. 2019). Guarantees or credit letters (from the bank or parent companies) may be requested if the lenders are not so satisfied. Before committing to a particular project, lenders may investigate to ensure parties have sufficient technical and management resources or experience in similar projects, etc. (Yakubova et al. 2021). Another example is when a party provides lenders with technical advice (e.g., engineers), and lenders want to ensure the party has sufficient professional indemnity insurance to cover negligent advice. Parties' independence from politics and continuity for the duration of the lender's involvement are other considerations of lenders (Ramakrishnan 2014).

4.2.4 Infrastructure Project Financing Instruments

This section examines both the traditional and emergent megaproject financing vehicles being used elsewhere to identify those vehicles that might be most relevant to the CNC. But first, we feel obliged to comment on China's financing mechanisms for its expansive Belt and Road Initiative (BRI). A significant proportion of the world's corridor infrastructure construction in the last decade is attributable to the BRI, but BRI's financing may not represent the financing tools available in most other countries. The OECD (2018) states that "while new vehicles have been formed to help with financing, most Chinese funding for these projects comes from state-directed development and commercial banks." So, while there is surely something to be observed in how China is financing its BRI, it is probably more appropriate for the CNC investigation to look at financing tools and techniques in other jurisdictions. To be fair, the OECD (2018) report notes that "China is also supporting a multilateral approach to investment including multilateral development banks and private-public partnerships," so alternative vehicles for BRI financing cannot be entirely ignored. But for the moment, let us turn our attention to what the literature says about non-BRI infrastructure financing vehicles.

Even beginning with examining more traditional financing methods, there is a very wide array of options. For example, in Figure 6, Zhang et al. (2021) discuss the advantages and disadvantages of instruments in financing infrastructure projects beyond traditional and governmental loans.

Figure 6: Comparison of Existing Infrastructure Financing Instruments



Source: Zhang et al. (2021)

However, not all may be appropriate for megaprojects. Bank loans can be an important source of financing for infrastructure projects (Thierie and De Moor 2019), but are probably more applicable for smaller and quicker projects. Bank loans require regular interest and principal repayments, which is not a good fit for the cash flow profile of a corridor infrastructure megaproject. From the bank’s perspective, the syndicated loan is safer for financial risk mitigation by spreading the huge risks of a single project among multiple banks. This method is used for debt financing in megaprojects that involve a group of banks borrowing from a single borrower. One of the key disadvantages of syndicated loans is their limited financing channels when they account for most borrowings (Sainati et al. 2020).

But from the borrower’s perspective, that the loan is syndicated does not solve the requirement for regular interest and principal repayments.

Asset-backed securities (ABS) diversify revenue-generating asset portfolios with a premium investment income. They are guaranteed by the loan assets of infrastructure projects (Cui et al. 2018). Investors show more interest in this method since converting illiquid assets into cash improves asset liquidity. Some of the key disadvantages of ABS are lengthiness, complexity and low transparency (Gupta and Sravat 1998).

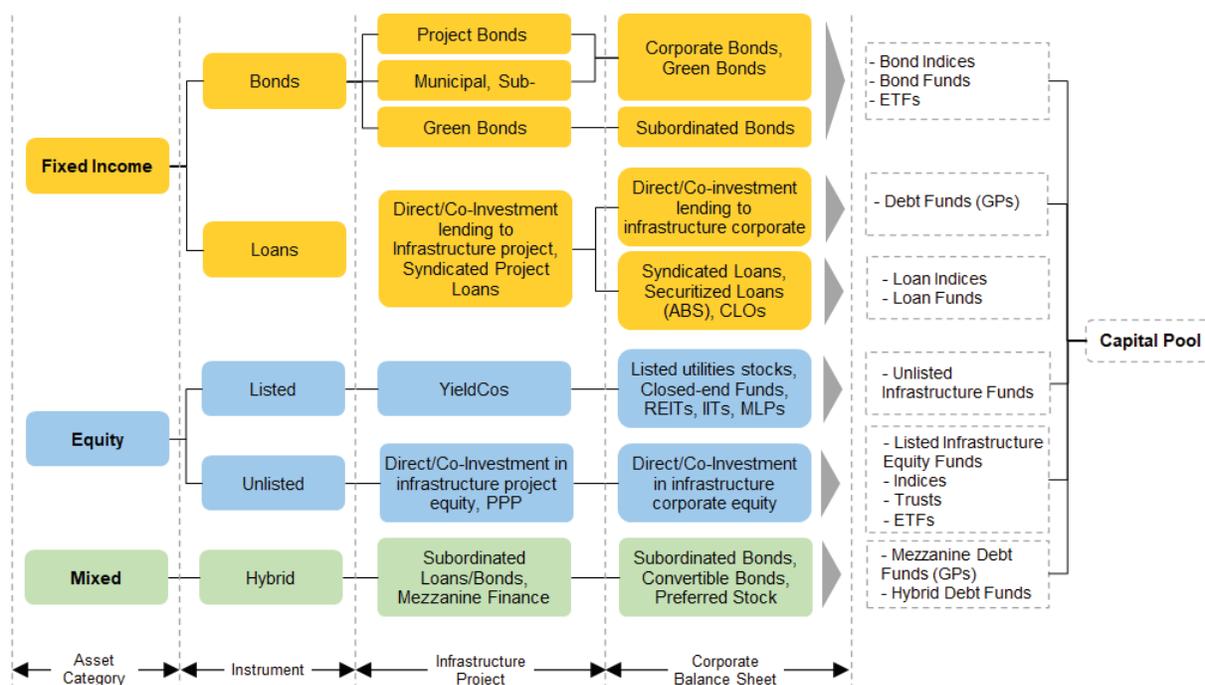
Project revenue bonds are a common method of financing public infrastructure projects. They are often used to raise funds when the project has started to generate stable returns. Generally, lenders are more likely to invest in the operating period, which means they invest in project bonds very close to the end of the construction period. One of the key disadvantages of project revenue bonds is the investors' limited ability to assess project risks that mostly rely on external rating agencies (Tang et al. 2012).

Special local government bonds are issued in the name of the state or provincial government, which has a certain degree of credibility. They are used for financing public welfare infrastructure projects where the project proceeds can repay the debt. Since the revenue and expenditure are not directly included in the government budget, bonds can reduce financial pressure on the government. One of the key disadvantages of special local government bonds is that they cannot meet financing needs, mainly because the main bond issuer is the provincial government, which is characterized by small issuance quotas (Chen et al. 2020).

The infrastructure equity fund is one of the private equity sources of financing infrastructure projects. Investors are more confident due to the strong liquidity of equity funds, such as social security and pension funds, aligned with the infrastructure projects' concession period of 25 to 30 years (Inderst 2009). One of the key disadvantages of infrastructure equity funds is their dependency on high-quality project data, which may discourage investors and lead them to invest in low-risk assets (Yen et al. 2020).

Della Croce and Paula (2015) also examine the array of instruments for financing infrastructure projects and offer an alternative taxonomy. As shown in Figure 7, asset categories (fixed income, equity and mixed) for financing infrastructure projects may use different instruments such as bonds, loans, listed equity, unlisted equity and hybrid, which can all be subclassified. According to Della Croce and Paula (2015), the number of capital resources, nature of the infrastructure asset, tax policies, regulatory considerations, diversification strategy and investor sophistication influence how investors have defined and allocated infrastructure in their portfolios. For example, a group of investors with limited resources and small amounts of capital allocated to infrastructure are limited to capital pool channels. Fixed-income assets (loans and bonds) contain the largest infrastructure finance categories structured to have long-term maturities that extend over the life of long-term assets. Debt financing can be offered in direct loans held on the balance sheets of financial institutions, resale to investors, private markets (e.g., private-placement debt) or public markets through registered corporate and government bonds. Equity assets are important in the financing/refinancing infrastructure investments to initiate a project and are provided to firms in return for an ownership interest. While this group of investors wants to maximize the total return on equity, they want to know policies regarding the exit strategy as an important consideration. In some projects, investors can sell their shares or get a share, such as indirect participation rights in corporations, projects and other entities of the proceeds if the asset is sold. Mixed assets use hybrid instruments and have the characteristics of both debt and equity. Hybrid instruments provide credit support and offer a higher return potential due to greater credit or equity risk by forming a bridge between debt and equity.

Figure 7: Taxonomy of Instruments for Infrastructure Financing



Source: Della Croce and Paula (2015)

Working in the domain of local infrastructure projects rather than megaprojects, Chen and Bartle (2017) discussed two key components of alternative financing methods: (1) new financing mechanisms; and (2) new financier/ownership arrangements. Both show creative thinking that might be transferable to the domain of megaprojects. Chen and Bartle (2017) introduced these two new financing mechanisms: (1) credit assistance tools offered by governments, such as loan guarantees and lines of credit projects; and (2) alternative bond and debt financing tools such as Grant Anticipation Revenue Vehicle (GARVEE) bonds, state bonds, green bonds and social impact bonds (Table 5).

Table 5: New Financing Mechanisms for Local Infrastructure Projects

New Credit Assistance Tools	Alternative Bonds and Debt Financing Tools
<ul style="list-style-type: none"> • Transportation Infrastructure Finance and Innovation Act (TIFIA) loans • Environmental state revolving funds • Transportation state revolving funds • State infrastructure banks 	<ul style="list-style-type: none"> • Grant Anticipation Revenue Vehicle bonds (GARVEEs) • State bond banks • Green bonds • Social impact bonds

Source: Chen and Bartle (2017)

Still in the domain of local infrastructure, new financial arrangements have evolved to involve multiple partners (Table 6), including the private sector, the private and non-profit philanthropic sector and the general public. For example, a public-private partnership (PPP) is an arrangement in which governments assign the development (design, finance,

build, operate and maintain) of infrastructure to private sectors (Hellowell et al. 2015). In privatization, governments transfer the direct control and sell the ownership (including the operation) of assets to a private party for the operation of infrastructure services. It is beneficial to transfer risky projects and leverage private sector financial resources, but it can be politically controversial (Mori and Takizawa 2019). Infrastructure investment funds (IIF) can attract large investors, such as pension funds, sovereign wealth funds and private insurance companies, to invest their fund equity into long-term infrastructure assets with low-risk investment, a reasonable return and stable cash flow.

Table 6: New Financial Arrangements for Local Infrastructure Projects

Public-Private Partnerships (PPP)	Privatization	Infrastructure Investment Funds (IIF)	Private and Non-profit Philanthropic Partners	Crowdfunding
<ul style="list-style-type: none"> • Design-build • Design-build-operate-maintain • Design-build-finance-operate-maintain • Concession 	<ul style="list-style-type: none"> • Lease 	<ul style="list-style-type: none"> • Pension funds • Sovereign wealth funds • Private companies (insurance and investment banks) 	<ul style="list-style-type: none"> • Donations • Grants • Program investment 	<ul style="list-style-type: none"> • Donation-based (Public goods)

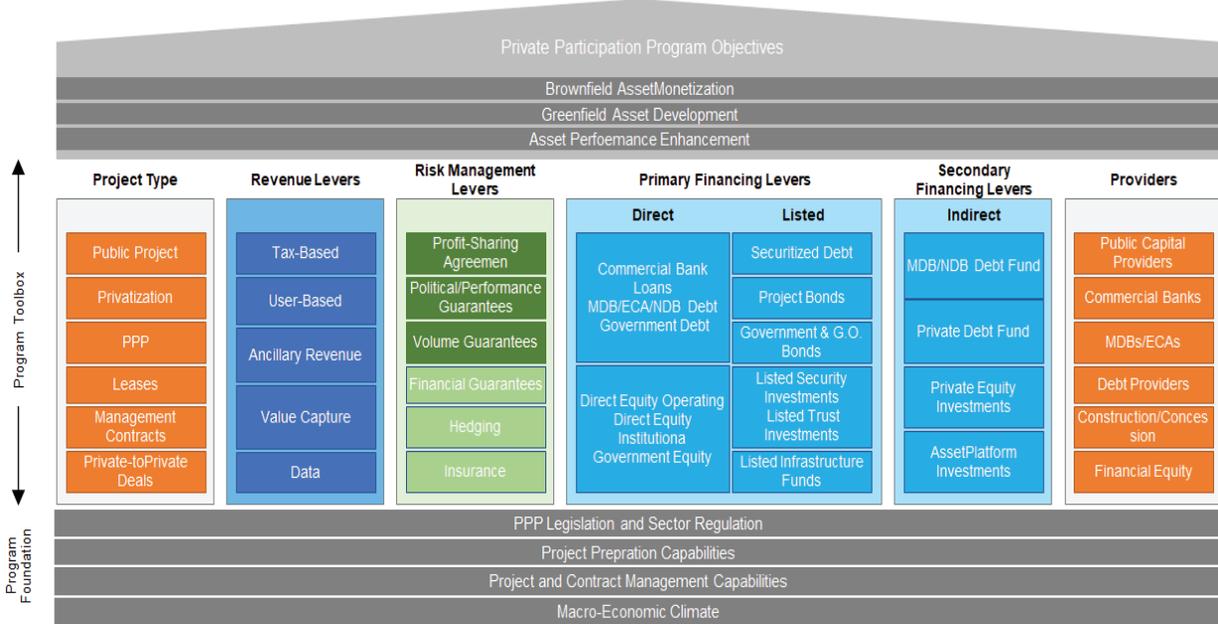
Source: Chen and Bartle (2017)

Philanthropic organizations can support a local infrastructure through donations or grants with a charitable purpose. For example, they allow the project to borrow capital at lower rates where the equity return can be recycled for future charitable infrastructure investment. They include a range of private and non-profit organizations that show a growing interest in investing in local infrastructure to support their philanthropic mission and leverage their donations.

Crowdfunding has been successful as a small funding source that connects infrastructure projects and many small investors willing to invest small amounts through an internet-based intermediary. Crowdfunding is an emerging method that provides infrastructure projects with small funds from a large group of individuals (Chen and Bartle 2017). However, as crowdfunding seems to be confined to relatively small amounts of capital, it does not seem to have high potential as a financing tool for the CNC.

GI Hub is a not-for-profit organization formed by the G20 that advances sustainable, resilient and inclusive infrastructure (GI Hub n.d.). It has assembled perhaps the most comprehensive framework of infrastructure financing options, broadly divided into the two major categories of “Direct” (unlisted) and “Listed” (within public stock exchanges). GI Hub describes both frameworks as “partial,” indicating that the range of available tools is greater than what is shown (Figure 8).

Figure 8: Primary and Secondary Financing Levers



Source: GI Hub (2019)

We have seen from the contributions of the above authors and GI Hub that the range of financial tools available for financing infrastructure projects is very great and growing. However, as the CNC would come with a \$100 billion+ cost and require many years to build with no operating cash flows to cover a loan’s requisite principal and interest repayments, we can speculate that the most appropriate tools would be bonds or equity-focused. Indeed, authors such as Babatunde and Perera (2017) have identified several barriers to the employment of interest-paying instruments such as loans. But to close this discussion of tools, it is important to note that the availability of tools by no means guarantees accessibility; that is, as noted in Section 4.2.2, there must be a solid business case and the prospect of financial returns.

4.3 INSTITUTIONAL FACILITATION? THINK RISK MITIGATION

Aside from seeking information regarding funding and financing tools, our research questions also challenged us to look for institutional roadmaps and/or facilitation practices to encourage megaproject germination and success. We were unsuccessful at discovering roadmaps per se, but the literature regarding facilitation practices, and more specifically risk mitigation practices, had much to say. Thus, the following material will focus on institutional risk mitigation practices in the domain of financing infrastructure megaprojects.

Infrastructure megaprojects are subject to considerable risks from several sources, which can heavily impact the amount of upfront financial capital required and the timing and degree of cash flows emanating from the completed project. The key financial stakeholders, including international organizations, governments, investors and infrastructure operators, need to understand the risks linked to infrastructure investments (Sundararajan and Tseng 2017). The finance literature is replete with studies about strategies to share and mitigate such risks. Here, for simplicity’s sake, we will present the work from

just two sources. Della Croce and Paula (2015) have constructed a framework for measures that institutions can use to reduce or eliminate risks, maintain a project’s bankability and protect free cash flows targeted toward specific financial instruments (Figure 9).

While some solutions can directly reduce objective and subjective risks, others may indirectly or partially mitigate risks. For example, creditors can be protected by guaranteeing the project loans or bonds. However, this may impact the financial viability of the entire project by increasing credit quality and lowering the cost of finance. Grants can reduce the need for privately sourced capital expenditures, mitigate cash flow unpredictability and improve equity holders’ credit quality (Della Croce and Paula 2015).

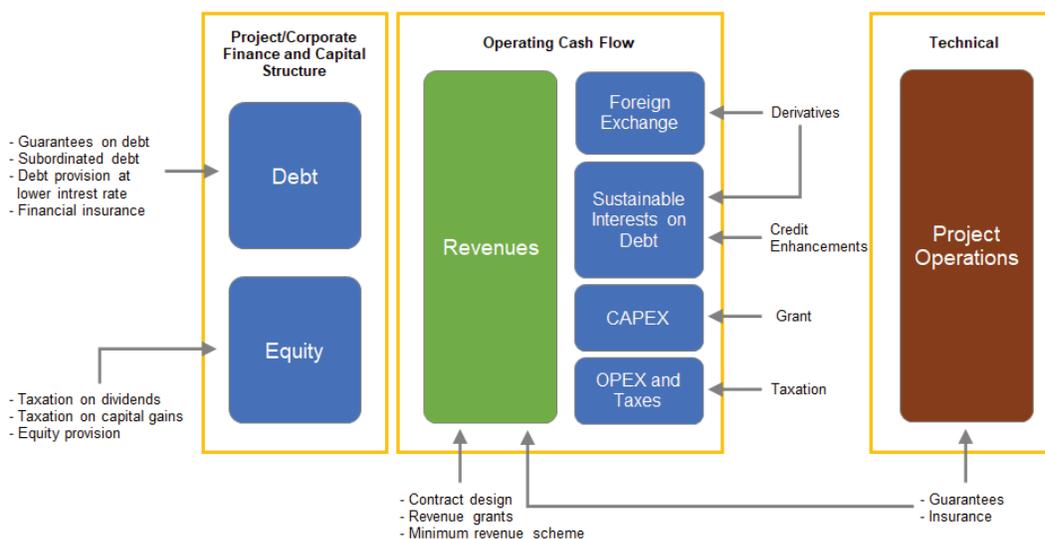
Figure 9: Financial Risk Mitigants and Incentives for Infrastructure Finance

Contract Design and Hedging	Guarantees and Insurance	Provision of Capital	Grants
<ul style="list-style-type: none"> - Payment mechanisms - Offtake contracts - Derivatives contracts such as swaps, forwards, options, etc. 	<ul style="list-style-type: none"> - Minimum payment, paid by contracting authority - Guarantee in case of default - Guarantee in case of refinancing - Exchange rate guarantees - Wrap insurance, technology guarantees, warranties, commercial and political risk insurance 	<ul style="list-style-type: none"> - Subordinated (junior) debt - Debt (at market condition and at lower interest rate) - Equity (at market conditions and at more advantageous conditions) 	<ul style="list-style-type: none"> - Lump sum capital grant - Revenue grant (periodic fixed amount and revenue integration) - Grant on debt interests - Favourable taxation schemes for SPV - Favourable taxation schemes for equity investors

Source: Della Croce and Paula (2015)

Aside from the structure of the financial portfolio itself, further measures can be taken to de-risk each financial component and the subsequent project revenues and operating costs. For example, a corporate tax rate reduction can increase the return to equity holders and improve the cash flow available for other purposes. Figure 10 summarizes different forms of support (from public and private) as the main components of the project cash flow and financing solutions. It includes revenues, capital costs, operating costs, corporate taxation, interest on debt and foreign exchange losses.

Figure 10: Private and Public Supports for Infrastructure Project Financing



Source: Della Croce and Paula (2015)

Adding to the work of authors like Della Croce and Paula, and similar to their frameworks for financing options, GI Hub also provides a framework for illustrating a range of financial risk management options (Table 7).

Table 7: Financial Risk Management Options

Risk Levers	Lever Options
Profit-Sharing Agreements stipulate the distribution of profits from the asset to specific parties under given scenarios.	Profit-Sharing Agreement <ul style="list-style-type: none"> • Cap and collar • Cap only
Political/Performance Guarantees are protection against losses resulting from a failure of a sovereign, sub-sovereign or state-owned enterprise for not honouring contractual obligations.	<ul style="list-style-type: none"> • Expropriation • War, terrorism and civil disturbance • Breach of contract • Change/sale of ownership restrictions • Step-in rights • Performance bond • Security over assets
Volume Guarantees are formal assurances that a party will receive a minimum level of revenue during a concession period.	Volume Guarantees <ul style="list-style-type: none"> • Minimum volume-based guarantee • Minimum revenue guarantee
Financial Guarantees are protection against losses resulting from a failure of a sovereign, sub-sovereign or state-owned enterprise to make a payment when due under an unconditional financial payment obligation or guarantee.	Financial Guarantees <ul style="list-style-type: none"> • Non-honouring of financial obligations • Currency inconvertibility restrictions • Condition precedent clauses • Bank guarantee/letter of credit
Hedging is an investment position intended to mitigate currency risk in the event of a downward exchange rate scenario.	Hedging <ul style="list-style-type: none"> • Long-duration swaps (>5 years) • Short-duration swaps (<5 years)
Pre-Completion Insurance is an arrangement where one entity provides formal assurances of guaranteed compensation in the event of specified losses, damages or delays	Insurance <ul style="list-style-type: none"> • Various insurance

Source: GI Hub (2019)

Studies show that investors are increasingly asking for policies to involve governments in mitigating specific risks in many infrastructure projects. The government's role can enhance the availability and reduce the cost of private capital. These policies have become a prominent feature of financing infrastructure projects in developed economies that need to upgrade aging and sometimes failing infrastructure (Khmel and Zhao 2016).

This concludes our brief literature-based findings regarding funding and financing tools for corridor megaprojects and how institutions can facilitate megaproject germination and implementation through financial risk mitigation practices.

5. A CASE-BASED ANALYSIS OF FUNDING AND FINANCING MODELS

To augment the literature-based perspective, we now present our findings from a more detailed case analysis of five corridor infrastructure megaprojects with much in common with the proposed CNC. The process for identifying the five cases was extensive, though largely subjective, and we do not claim that these would be the only cases worth examining. The first stage was identifying a high-potential list of CNC comparators, followed by a selection process and the analyses of the cases themselves.

5.1 LIST OF CNC COMPARATORS AND SELECTION FOR CASE ANALYSIS

There have been hundreds of megaprojects worldwide in the last several decades, including land-based and port-based facilities and corridor-based logistical connections. However, only a small fraction of these megaprojects can serve as relevant comparators for the proposed CNC when one considers the following CNC attributes:

- It will be essentially a greenfield or from-scratch corridor-based project requiring total corridor assembly, not simply an expansion or extension;
- It will be multi-modal for most, if not all, of its full extent, with at least two modes of infrastructure: road and rail;
- It will be located primarily in a rural and remote geographical setting, rather than urban, suburban or inter-urban area; and
- It will be multi-jurisdictional, with at least two governments (provincial and federal), plus significant Indigenous involvement.

Therefore, we reduced the large set of hundreds of megaprojects to a more manageable CNC comparator consideration set by requiring these attributes for each megaproject:

- It is corridor-based and completed or under construction with financial and funding arrangements settled, and financial commitment made;
- It is preferably a single greenfield linear land corridor;
- It is preferably rural and/or remote, not urban;
- It is preferably multi-use/multimodal, with at least two infrastructure systems; and
- It is multi-jurisdictional, crossing at least one state/provincial/national/Indigenous boundary.

The list was thus reduced to two dozen corridor and corridor-like infrastructure megaprojects completed or initiated in the last few decades (Table 8).

This should not be interpreted as a comprehensive inventory of CNC-similar corridor megaprojects, as the filtering process was subjective. For example, hundreds of simple pipeline, road, telecommunications and rail projects have been excluded, not to mention hundreds of internal Chinese projects not officially recognized in the BRI and inner-city transit projects such as Boston's Big Dig. Conversely, a few simple rail projects have been included by their newness and very high regional significance. The Trans-European Network-Transport (TEN-T) and Chinese BRI super-corridors are listed in Table 8 primarily to acknowledge their existence; each corridor is not a single new linear corridor, but instead a highly complex multi-corridor, multi-facility regional development project, generally comprising more upgrading infill and connections than significant new corridor construction. However, one sub-corridor case from each of the TEN-T and BRI super-corridors was included in the list for consideration.

The final step of case selection was again highly subjective. The five cases selected (highlighted in Table 8), including one sub-corridor from each of the TEN-T and BRI super-corridors, had these attributes in common with the CNC: (1) they were housed in a single new linear land corridor; (2) they were located in a mainly rural or remote location; and (3) they involved multiple jurisdictions. Regrettably, four of the five are single-use. The fifth, the multi-use LAPSETT Corridor in Kenya, appeared to be the most similar megaproject to the CNC, with hopefully much CNC-relevant insight garnered from the case study.

Table 8: Subjective Sample of CNC-Similar Corridor Megaprojects

Region	Corridor Name	Description	Single linear corridor	Mainly rural or remote	Selected for Case?
Africa	Rod El Farag Corridor Project (Egypt)	Highway only, urban 50 km w/2 bridges	Yes	No	No
	LAPSSET Lamu Port-South Sudan-Ethiopia Transport Corridor (Kenya)	Ports, Railways, Roads, Pipelines	Yes	Yes	Yes
	Rail connection port of Mombasa to Nairobi (Kenya, a BRI project)	Rail only, greenfield	Yes	Yes	Yes
Australia	Australian inland rail corridor (Melbourne to Brisbane)	Rail-only, 1700 km, complete 2027	Yes	Yes	Yes
	Callide Pipeline Corridor (Queensland SDA, Australia)	Pipeline only, only 44 km, up to 8 pipelines	Yes	Yes	Yes
	Pilbara Corridor (Australia from 1960s)	complex regional dev, not one corridor	No	Yes	No
China BRI	The primary BRI "Corridors":				
	China Pakistan Economic Corridor (CPEC)	complex regional dev, not one corridor	No	No	No
	New Eurasian Land Bridge (NELB)	complex regional dev, not one corridor	Mainly	No	No
	CMREC China-Mongolia-Russia Economic Corridor (CMREC)	complex regional dev, not one corridor	No	No	No
	China-Central Asia-West Asia Economic Corridor (CCAWECC=WAEC)	complex regional dev, not one corridor	No	No	No
	China-Indochina Peninsula economic corridor (CICPEC)	complex regional dev, not one corridor	No	No	No
	Trans-Himalayan Multi-dimensional Connectivity Network (to Nepal)	complex regional dev, not one corridor	No	No	No
	Bangladesh-China-India-Myanmar Corridor (BCIMEC)	complex regional dev, not one corridor	No	No	No
Europe	TEN-T Trans-European Network - Transport - 9 corridors in progress:				
	Atlantic Corridor (12 major projects, incl. 9 rail, 2 rail/port, 1 IWW*)	complex regional dev, not one corridor	No	No	No
	Tours-Bordeaux all-new high-speed rail line	one of the 12 Atlantic Corridor major projects	Yes	Yes	Yes
	Baltic Adriatic Corridor (10 major projects, incl. 6 rail, 3 port, 1 road)	complex regional dev, not one corridor	No	No	No
	Mediterranean Corridor (25 projects, incl. 19 rail, 3 ports, 2 roads, 1 IWW*)	complex regional dev, not one corridor	No	No	No
	North Sea-Baltic Corridor (11 projects, incl. 7 rail, 1 port, 1 road, 2 IWW*)	complex regional dev, not one corridor	No	No	No
	North Sea-Mediterranean Corridor (30 proj., incl. 15 rail, 5 ports, 10 IWW*)	complex regional dev, not one corridor	No	No	No
	Orient - East Med Corridor (19 proj., incl. 10 rail, 4 ports, 2 roads, 2 IWW*)	complex regional dev, not one corridor	No	No	No
	Rhine-Alpine Corridor (9 major projects, incl. 7 rail, 1 port, 1 IWW*)	complex regional dev, not one corridor	No	No	No
	Rhine-Danube Corridor (22 projects, incl. 14 rail, 2 port, 1 road, 5 IWW*)	complex regional dev, not one corridor	No	No	No
	Scandinavian-Med Corridor (24 major projects, incl. 19 rail, 5 port)	complex regional dev, not one corridor	No	No	No
	* IWW = Inland Water Way				
N.A.	Trans-Isthmus Corridor (Mexico, not underway)	complex regional dev, not one corridor	No	No	No
	Highway 407 (Canada, suburban)	suburban perimeter toll highway	Yes	No	No
	California Highspeed Rail (Anaheim to Los Angeles, 2015-2029, urban)	Rail only, 30 mi., inter-urban	Yes	No	No
S&SE Asia	Northern Corridor Economic Region (NCER) in Malaysia	complex regional dev, not one corridor	No	No	No
	Greater Mekong Subregion Program, three corridors in Southeast Asia	regional dev, existing transport corridors	No	No	No
	Delhi Mumbai Industrial Corridor (DMIC)	complex regional dev, not one corridor	No	No	No
	Multimodal Corridor from Virar to Alibaug (India, urban perimeter)	highway, metro	No	No	No
	INSTC Int'l North-South Transport Corridor (Ipr, India, Iran, Russia)	complex regional dev, not one corridor	No	No	No

Source: Authors' compilation from various secondary references

5.2 CASE 1: LAMU-SOUTH SUDAN-ETHIOPIA TRANSPORT CORRIDOR (LAPSSET) – KENYA

At first glance, the Lamu-South Sudan-Ethiopia Transport (LAPSSET) corridor in Kenya most closely resembles the proposed CNC. It is a proposed, nation-building, quadruple-use linear land corridor (anchored at a new port terminus at Lamu and other supplementary facility projects), crossing multiple provinces and Indigenous lands (Table 9). Thus, it promised to provide a great deal of insight regarding appropriate and feasible financing and funding mechanisms.

Table 9: LAPSSET Corridor (Kenya) Key Parameters

Key Dates	Start date approx. 2012, ongoing, completion date uncertain
Description	Y-shaped corridor plus facilities, total length 2,240 km, from Lamu Port inland to Isiolo, then one branch north to Ethiopia, one branch northwest to South Sudan (Wikipedia n.da.).
Single/Multi-Use	Quadruple-use (railway, highway, pipeline, communications) anchored by new port terminus in Lamu.
Costs	The current projected total cost is \$29 billion (2019), including the port terminus in Lamu and all related complementary and auxiliary projects.
Jurisdictions	Kenya, Uganda, Tanzania federal governments, four of eight Kenya's provinces, about a quarter of Kenya's 47 counties, the lands of seven Indigenous Kenyan peoples (Sena 2012).

Source: Wikipedia (2023b)

5.2.1 Financing and Funding

The LAPSSET corridor, anchored by a new port facility at Lamu, has been a focal point for Kenyan government policy for over a decade. However, its implementation has proven very difficult. Corridor disputes have imposed significant impediments and disruption of the fisheries industry near Lamu. In addition, various banks and private partners have made commitments to finance certain corridor components and have then withdrawn. For example, *infrappworld* (2017) confidently announced:

Kenya National Highways Authority (KeNHA) on Wednesday signed a KSh62 billion (US\$590 million) deal with a consortium including South African construction firm Group Five and the Development Bank of Southern Africa, to construct the Lamu-Garissa-Isiolo road. The 530km road will head northwest from the port city of Lamu to Isiolo, a city north of Nairobi, via Garissa. The Lamu Road Consortium will design, build, finance, maintain, operate, and transfer the highway. Work will start in June 2018 and be completed within four years. The operations and maintenance phase will run for 25 years. The project is being [financed] by the Development Bank of South Africa, and the repayment period is 13 years.

Unfortunately, work has not yet started on this highway, and the financing and funding arrangement appears to have dissolved, according to a status report by the Intergovernmental Authority on Development of Africa (2021). There are similar stories for the pipeline and railway. The most reliable source of information regarding the LAPSSET megaproject and its components is the November 2021 IGAD status report.

It provides a one-page synopsis for 59 current and pending African infrastructure projects, and within it are these very concise summaries of the major components of the LAPSET megaproject (except for the telecommunications component):

- Lamu Port of Phase 1's three berths: One is completed, and two are underway; the Kenya5n government has supplied the financing of \$0.5 billion for the three berths and is proposing that Phase 2's 29 berths should be privately financed, with the private consortium operating the first three berths on a concession basis, and financing and operating the next 29 berths. However, the \$2.6 billion required for the remaining 29 berths has not yet been secured;
- Railroad: It is not yet started, but feasibility studies are underway; the Kenyan government is proposing a PPP business model. The projected cost is \$12 billion, but financing has not yet been secured; the initial projected construction timeframe was 2022–2026;
- The African Development Bank (AfDB) has financed and completed highway design studies. The Kenyan government is proposing that the remaining financing be 80 per cent by the government using concessionary loans (implying a privately owned toll highway) and 20 per cent from the national budget (from counterpart funds). The required \$1.1 billion has not yet been secured; the initial projected construction timeframe was 2022–2026;
- The crude pipeline is a 75:25 private-to-public PPP being sought. It uses a build-operate-transfer (BOT) and EPC arrangement to be ultimately owned and operated by a public entity; funding revenues are to be derived from user fees. The required \$3.1 billion has not yet been secured, and the timeline is unclear.

The financing models for the above four major components have variations, but there is one common theme: the federal government will assist, but the private sector MUST be substantially committed. The federal government's investment percentage seems to vary widely, from about 16 per cent for the Lamu Port terminus to 75 per cent for the crude oil pipeline. Any private consortium would benefit from a share of user fees for either a fixed or indeterminate period.

5.2.2 Risk Management

This type of partnered arrangement acts as a measure of financial risk management for both the government and the private partners. The government is unwilling to invest its own money in something the private sector will not undertake for only a partial investment; conversely, the private stakeholders are unwilling to risk their resources on something that the government is unwilling to back.

5.2.3 Government and Institutional Facilitation

The Kenyan federal government, plus government institutions like the Kenyan National Highways Authority and African banks, such as the Development Bank of Southern Africa and the African Development Bank, have all been involved for over a decade to try to facilitate the corridor's initiation, with limited progress to date. There seem to have been great facilitation efforts, but these have been countered by resistance from the fisheries

industry near Lamu that feels greatly threatened. This might suggest that facilitation efforts, even if substantial, may be insufficient if all key stakeholders are not in favour.

5.3 CASE 2: MOMBASA-NAIROBI STANDARD-GAUGE RAILWAY (AN EXAMPLE OF A BRI PROJECT)

The Mombasa–Nairobi Standard-Gauge Railway (SGR) corridor project in Kenya (see Table 10) provides an interesting contrast to the LAPSSET corridor project. Even though they are both in Kenya, one significant difference between the two is especially relevant to this study. While it is a just single-use corridor for rail, instead of a quadruple-use corridor, the key difference is that we can see the heavy influence of China’s reach into the international corridor and economic development. Indeed, this project has been described as “a showcase for President Xi Jinping’s Belt and Road Initiative” (Herbling and Li 2019).

Table 10: Mombasa–Nairobi SGR Corridor (Kenya) Key Parameters

Key Dates	Construction start date November 2013; open for traffic May 2017
Description	Linear corridor for heavy passenger and freight rail, plus facilities, total length 580 km, from Mombasa Port inland to Nairobi
Single/Multi-Use	Single-use (heavy rail, both passenger and freight)
Costs	\$3.8 billion (2017, approx.)
Jurisdictions	Kenya federal government, four of Kenya’s eight provinces, about a quarter of Kenya’s 47 counties (Wikipedia n.d.b)

Source: Wikipedia (n.d.b)

But in contrast to many other BRI linear corridors embedded in other major regional development megaprojects, this SGR project stands out as different, with many distinct data giving us a more accurate understanding of the financing and funding arrangements.

5.3.1 Financing

Financing for the SGR was principally provided by the Export-Import Bank of China (EXIM), “which agreed to support 90%, or \$US 3.42bn, of the project’s costs. The overall loan consists of a \$US 1.6bn concessional [i.e., substantially below market rate] loan payable over 20 years and a commercial loan of \$US 1.82bn payable over 15 years. Both loans have been guaranteed by Kenya’s National Treasury” (Oirere 2016). The Kenyan government provided the balance of \$US0.4 billion, raised through a 1.5 per cent railway development levy (Business Daily 2014). However, these loans from Exim came with several stringent conditions attached to favour Chinese companies: 1) that China Road and Bridge Corporation would build the railroad on a sole-source contract; 2) that Afristar, owned by China Road and Bridge Corporation, would operate the railroad for a fixed monthly fee from the Kenyan government; 3) operation of the SGR cannot be transferred back to the Kenyan government until debts have been cleared; and 4) that the engines and rolling stock would be purchased from China (Chaudhury 2021). The Kenyan government did receive an assurance that 40 per cent of the total project costs “would be spent on local supplies including sand, cement, electric cables, galvanized iron and steel” (Business Daily 2014).

5.3.2 Funding

The primary funding model appears simple. Kenya Railways Corporation, the owner of the SGR, has been generating revenues via passenger tickets, freight levies and freight handling service charges at the port of Mombasa and inland depots (Mutua 2021), which are in turn used to pay the operating contract fees to Afristar. The plan was for the ticket and service revenues to cover both the operating contract fees and the loan repayments. However, as recently as 2020, “this has not been the case. While revenues are up, the system is still running at a loss. The Kenyan government has struggled to get businesses to use the line. The cost of moving freight on the SGR is higher than the equivalent journey by truck, mostly because of last-mile costs” (Gorecki 2020). We have been unable to determine how the Kenyan government raised funds to cover operating shortfalls in the period after launch.

5.3.3 Government and Institutional Facilitation

The Kenyan federal government took appropriate measures to activate and complete this megaproject:

1. They made it the main plank of their Vision 2030 economic policy;
2. They assembled and purchased the land, though not without difficulty;
3. They entered negotiations with another country (China) which had the incentive and the money to finance 90 per cent of the project in return for certain conditions;
4. They agreed to significant lender conditions;
5. They imposed several import regulations to convert road transport of imports to rail transport.

While this may appear impressive, it can be argued that the impact of the government’s facilitation efforts for this megaproject were minimal, as the Export-Import Bank of China agreed to finance 90 per cent of the project. That the forecasted economic outcomes for this project have failed to materialize suggests that unilateral policy-driven megaprojects, rather than multilateral private sector-inclusive megaprojects, may be a suboptimal application of government funds.

5.3.4 Risk Management

Based on the literature, it would be fair to state that the Kenyan government shouldered a significant majority of the financial risk of this project, even though China, at first glance, appeared to supply 90 per cent of the financing via loans. With the loans guaranteed by the Kenyan Treasury, the only plausible scenario that might prevent repayment might be the country’s total economic collapse. As events have transpired, repayment conditions have indeed created some hardship for Kenya, contributing to accusations of China’s predatory financing practices and influencing China to rethink its infrastructure development strategies. According to Pilling and Feng (2018), “China’s President Xi Jinping said in September (2018) that ‘vanity projects’ must be shunned in favor of more carefully conceived initiatives that address proven economic bottlenecks.”

5.4 CASE 3: INLAND RAIL CORRIDOR FROM MELBOURNE TO BRISBANE (AUSTRALIA)

As with the Mombasa–Nairobi rail corridor, this case study examines a single-use rail corridor, but this time in Australia, from Melbourne to Sydney. Though just single-use, it is relevant to the CNC project as it’s a single definable land corridor; it’s positioned as a nation-building project; it’s largely located in a rural location; it has a multi-jurisdictional pathway; and it requires a significant portion of new build (Table 11).

Table 11: Inland Rail Corridor Melbourne to Brisbane Key Parameters

Key Dates	Construction start date 2018; forecast completion 2027
Description	1,700 km of fast freight backbone (1,100 km of current upgraded line, 600 km of new build), with 13 distinct sub-projects
Single/Multi-Use	Single-use fast freight
Costs	\$14.5 billion as of 2022 (might exceed \$20 billion) from the federal government (May 2022) investment through PPP for one of the 13 segments
Jurisdictions	The federal government, three states (Victoria, New South Wales and Queensland), cross Indigenous territories (ARTC 2022b)

Source: ARTC (2022b)

5.4.1 Financing

The financing of the Inland Rail comes from two principal sources. First, a federal government equity investment was made in the federally owned Australian Rail Track Corporation (currently \$14.5 billion). Second, there was an investment from the private sector through a PPP to build a particularly difficult project segment from Gowrie to Kagaru (ARTC 2022b). The amount that the PPP will inject is unknown, as three PPP bids are being evaluated, but an early estimate for one-third of that segment was \$1.4 billion (Infrastructurepipeline 2022).

5.4.2 Funding

Post-completion funding for the project appears to be fairly straightforward, stemming entirely from user fees: (1) Inland Rail will offer a price to the market, giving a one-third saving against the road; and (2) the 2015 business case found that Inland Rail will generate positive operational cash flows from the commencement of operations, enough to cover all operating and maintenance costs plus a margin. It would recoup the capital outlay over 35 years from the commencement of operations (Senate Standing Committees on Rural and Regional Affairs and Transport 2019).

We could not discover what proportion of the user fees would accrue to the PPP versus the ARTC. However, it would be reasonable to assume that the PPP would receive a slightly higher pro-rata fee in return for assuming the construction and operating costs of the highest risk segment of the project.

5.4.3 Government and Institutional Facilitation

The federal government and the government-owned ARTC have played a facilitative role from the project's inception, undertaking essential actions to keep the project moving forward without doing anything extraordinary. For example, the 2013–14 federal budget initially contained an “initial grant funding allocation of \$300 million for pre-construction activities” (Senate Standing Committees on Rural and Regional Affairs and Transport 2022). Subsequently, the government and ARTC appropriately engaged with the key stakeholders to keep the process moving ahead. To illustrate:

- “ARTC and the Department have been working closely with State Governments, principally through their transport agencies, to progress the project” (ARTC 2022a);
- “We will be consulting with Indigenous leaders at every opportunity to ensure progress on the Inland Rail program is carried out in cooperation with those Indigenous communities” (ARTC 2022c); and
- “The Australian Rail Track Corporation (ARTC) wants to provide certainty to landowners who may be affected by property acquisitions in relation to timing of negotiations and key milestones during the acquisition process. Each state's acquisition process, including reimbursement of fees, is designed to be fair, easy to understand and transparent” (ARTC 2022a).

The process has not been entirely smooth. For example, well after construction started in 2018, the government and the ARTC faced stiff resistance from angry farmers (Ludlow 2019), but negotiations and route adjustments have kept the project moving.

5.4.4 Risk Management

The government and the ARTC have managed the risk of stakeholder disruption quite well by establishing connections and communications with the major stakeholder groups early in the process and engaging in consistent and productive discussions.

A good attempt to mitigate the risk of project cost overruns was handled by creating a PPP for the most complex segment of the project, which involved a tunnel, viaducts and several bridges. This likely required a higher negotiated user fee to accrue to the PPP, extending the payback period from the government's perspective.

Still, such an arrangement was likely essential for the project to initialize. What remains to be seen is how well the freight transportation industry will adopt the use of the railroad. As we saw earlier, as an incentive, the ARTC plans to charge a user fee that will be one-third less than trucking market rates, but how this will influence adoption is unknown.

5.5 CASE 4: CALLIDE PIPELINE CORRIDOR THROUGH QUEENSLAND SDA (AUSTRALIA)

The Callide Pipeline Corridor in eastern Australia is part of a much greater effort by the Queensland government to support the liquefied natural gas (LNG) industry development. At only 44 km long, the Callide corridor is much shorter than many other corridors in that same development zone. For example, the nearby Stanwell–Gladstone Infrastructure

Corridor (SGIC) is 90 km long. However, even though it is not in the category of a short, transformational, nation-building corridor, the Callide corridor has been built to accommodate up to eight underground gas pipelines from different owners. Therefore, it does speak well to the CNC-relevant logic of creating one corridor to co-ordinate multiple users (Table 12).

Table 12: Inland Rail Corridor Melbourne to Brisbane Key Parameters

Key Dates	Corridor declared established by Queensland in 2009 as part of Queensland’s State Development Area (SDA); currently, three pipelines operating
Description	44 kilometres long, generally 200 metres wide, built to accommodate up to eight underground gas pipelines for coal seam gas to LNG plants
Single/Multi-Use	Single-use for coal seam gas pipelines, but available for multiple users
Costs	The state covered the cost of land easement from private landowners (cost not found), and private pipeline companies covered the investment cost of building a pipeline.
Jurisdictions	In one state (Queensland), with no mention of Indigenous lands found: (Office of the Coordinator-General 2021)

Source: Office of the Coordinator-General (2021)

5.5.1 Financing

The Queensland government’s total cost of establishing the corridor could not be determined, but it appears to be limited to the cost of acquiring an easement from private property owners: “The Coordinator-General acquired an easement through privately owned land for the corridor” (Office of the Coordinator-General 2021). This easement acquisition cost could not be discovered through our secondary search, but a patchwork of evidence suggests a low number of millions of dollars.

After that, the cost of building any pipelines themselves would be financed by the private pipeline operating companies.

5.5.2 Funding

From the Queensland government’s perspective, the financial return for acquiring the easement and providing operational permits to the pipeline companies comes in the direct form of royalties on the sale of refined LNGs. “The large volumes of gas that are involved mean that royalty revenue will increase markedly with the emergence of this new industry. The 10 percent royalty rate provides a fair return to the people of Queensland for the use of our valuable petroleum resources. Modeling indicates that, should a 28 Mtpa LNG industry emerge, the State could receive over \$850 million in royalties from gas sold as LNG” (Bligh and Fraser 2009). Even if it is optimistic, that figure would provide a generous return.

5.5.3 Logic for a Multi-User Corridor

The government-provided information (Queensland SDA 2021) regarding this case does a good job of highlighting the logic for establishing a multi-user corridor:

1. Provides greater certainty about approval processes;
2. Ensures the land is safeguarded from inappropriate uses;
3. Ensures co-ordination with the private landholders, including consultation to determine the preferred corridor alignment and negotiation of an easement;
4. Co-ordinates the acquisition of an easement through the privately owned land and provision of a licence to the LNG proponents;
5. Minimizes impacts to landholders and the environment through efficient use of land.

5.5.4 Government and Institutional Facilitation

The key finding concerning government facilitation is that the state government has established the Coordinator-General's office (CGO) to look after all government co-ordination and facilitation aspects. By many accounts, the CGO, in this case, performed well. For example, "Without the coordination and development of a common corridor facilitated by the Coordinator-General's team, gas proponents would have had to negotiate easements with respective landholders individually. This would have caused considerable and unnecessary stress on individual landholders. The certainty of access for construction within the SDA also meant that construction methods, materials, and design could be managed more effectively in a common corridor, with less impact on landholders" (Office of the Coordinator-General 2021).

In addition to land assembly, the CGO also looked after the interests of industry stakeholders' concerns and compliance; government policy stakeholders; industry-government relations; farming relations; environmental concerns, especially regarding groundwater, flora and fauna; community relations, especially concerning safety and infrastructure; and Indigenous relations in particular (Bligh and Fraser 2009).

It is possible that the other cases above, and many other governments facilitating other megaprojects, may have implemented an organizing role such as the Queensland Coordinator-General, but if so, it was not apparent. Given the complicated relationships involved in creating a multi-use corridor, having such a role seems appropriate.

5.5.5 Management

The primary risk, in this case, did not seem to be financial from the government's perspective, as the financial commitment was low and the return high. But given the complexity of the set of stakeholders and the potential environmental consequences, the primary risk seemed to stem from stakeholder resistance and/or industry's non-compliance and/or environmental carelessness. These latter risks seem to have been well-addressed by the Coordinator-General.

5.6 CASE 5: TOURS-BORDEAUX ALL-NEW HIGH-SPEED RAIL LINE (A SUB-COMPONENT OF TEN-T)

5.6.1 Overview

According to railway-technology (2023) “the €7.8bn (\$10.06bn) Tours-Bordeaux project (in the TEN-T Atlantic Corridor) involved construction of a new 302km high-speed link between Tours and Bordeaux, as well as 38km of connecting lines to the existing rail network along the corridor. Preliminary studies on the Tours-Bordeaux line were conducted between 1995 and 2002. Early design studies were completed in 2007, while the process for selecting the concessionaire started in 2009. Project implementation followed concession contract award in June 2011. Construction of the project started in mid-2012 and was completed in early 2017.” It is worth noting, then, that this project required over 20 years from concept to completion (railway-technology 2023).

The project was made possible through a special PPP, wherein a 50-year operating concession was awarded by the French rail operator Réseau ferré de France (RFF) to a special concession company called LISEA, whose shareholders are VINCI

Concessions (leader) and VINCI SA (33.4 per cent); CDC Infrastructure, a wholly owned subsidiary of Caisse des dépôts (25.4 per cent); SOJAS, a dedicated investment entity (22 per cent); and investment funds managed and advised by AXA Private Equity (19.2 per cent) (VINCI 2023).

5.6.2. Financing

A detailed account of the financing of this project was released by VINCI Construction, a major stakeholder. According to VINCI (2023), the capital financing was contributed from a substantial number of stakeholders, as follows:

LISEA is providing €3.8 billion of the financing, comprising:

- €772 million of equity contributed by LISEA shareholders, pre-financed by commercial banks and the European Investment Bank (EIB);
- €1,060 million of bank debt guaranteed by the French government;
- €612 million of non-guaranteed bank debt;
- €757 million provided by Fonds d'épargne, managed by the Caisse des dépôts and guaranteed by RFF;
- €400 million of EIB credit guaranteed by the French government;
- €200 million of non-guaranteed EIB credit.

Also, the European Investment Bank (EIB) is contributing €1.2 billion via the combination of the senior debt, the portion of the equity bridge loan financed by the EIB and the loan guarantee on TEN-T projects (LGTT), an instrument put in place jointly with the European Commission. This is the largest loan ever awarded in France by the EIB. Also, the Fonds

d'Epargne contributed €757 million repayable over 40 years, the largest loan of its kind ever made by the Caisse des Dépôts. Finally, according to railway-technology (2023), Réseau ferré de France (RFF) will invest €1bn (\$1.3 billion) in the project” (railway-technology 2023).

5.6.3 Funding

Details regarding post-construction funding were difficult to find, but the model appears to be simple, with two main components. First, in return for LISEA's contribution to the financing, LISEA was awarded a 50-year operating and maintenance contract by RFF (Railway Technology 2020). During this period, “LISEA will be remunerated in the form of traffic-related fees paid by users operating trains” (VINCI 2023). Second, Railway Technology (2023) also reports that “Public subsidies offered by the French Government, local communities, and the EU will amount to nearly €3bn (\$3.8bn).”

5.6.4 Government and Institutional Facilitation

It was previously noted that this one sub-component of the TEN-T Atlantic Corridor took over 20 years from the initial studies to the completion of construction. Consistent progress and ultimate completion seem to be the outcome of constant facilitation by the French government, French institutions like Réseau ferré de France, several French communities, the European Union, the European Commission and several financial institutions such as the Caisse des dépôts, Fonds d'épargne and the European Investment Bank.

This large set of stakeholders may seem to counter the argument that things are simple if there's a clear business case for the major private sector stakeholder(s), but in this case, the complexity of the location in a developed part of Europe, and the importance of this link in the TEN-T Atlantic Corridor, may have dictated that extensive involvement was essential and wise.

5.6.5 Risk Management

The financial risk associated with the construction costs seems to have been managed by involving nine investors, including a major private sector special concession consortium. Post-construction, the financial risk to the private sector concession operator was managed by a 50-year operating licence plus subsidies from the French government, local communities and the European Union. That such a great number of investors was required, and such a long operating concession was necessary (plus subsidies) may suggest the business case for the private operator was neither clear nor strong. But the importance of this link in the TEN-T Atlantic Corridor seems to have dictated a “whatever makes it work” approach to facilitation and financial guarantees. Should the CNC ever initialize, this case does illustrate that a formula of multiple financiers and an attractive concession contract for a private operator may be able to compensate for an unclear and/or weak business case for the private stakeholder(s).

This concludes our presentation of findings from the case-based analysis of financing and funding models for five infrastructure megaprojects, with accompanying institutional facilitation and risk management techniques.

6. DISCUSSION

In this section, we summarize and discuss our findings in a framework guided by the research questions we noted in Section 1.4:

1. What are the different funding and financing models for existing major projects (including infrastructure and/or public works projects) in other jurisdictions and how do they vary with regard to construction, operation and maintenance of physical infrastructure projects?
2. Are there innovative, collaborative financing approaches to crowd in capital to trans-boundary infrastructure corridor projects like the BRI and the Mediterranean Corridor?
3. What are the roadmaps developed in other jurisdictions and/or by international bodies to standardize and streamline approaches to project identification and preparation, contract design and to improve the investment environment for large infrastructure projects?

6.1 RELEVANT AND EFFECTIVE FUNDING MODELS

Recall that by “funding,” we refer primarily to post-construction operational cash flows streaming back to the institutional and private investors, which must be sufficient to cover all of the infrastructure’s operational and maintenance costs and requisite returns on the investors’ capital investment. Compared to the plethora of financing models we discovered, the range of funding models we found is relatively narrow. For example, from the literature, GI Hub provided the simple taxonomy of: 1) tax-based; 2) user-based; 3) ancillary revenue from extra services; 4) value capture (special tax on value-enhanced proximal real estate); and 5) data sales. As simple as that taxonomy is, in the case studies we noted an even shorter list of methods actually used, particularly subsidies, user fees and royalties. Furthermore, the projects that seemed to progress the fastest seemed to have the simplest funding model of user fees and royalties, with a multi-decade operational contract attached. This should not be surprising. Given the significant capital investment required, particularly from the private sector stakeholders, there needs to be a very simple, clear, reliable and significant source of operational revenues in the form of user fees that meet a threshold for providing a satisfactory return on investment. Anything beyond that might be considered gravy. And to the contrary, if the base case were judged to be insufficient to meet the threshold, then there might have to be a guaranteed level of government subsidy to generate sufficient interest. In that case, governments would probably need a significant non-economic incentive for the project to go ahead and might then question the wisdom of proceeding.

The question of funding gets to the heart of the CNC’s feasibility. The CNC, as envisioned, goes far beyond a simple new non-toll highway, which governments have typically built over the decades using a normal infrastructure budget and for which they have charged no user fees. Instead, the envisioned CNC would be a multi-use corridor requiring the participation of one or more private sector investors/owners. Thus, regardless of the amount of investment required to complete a multi-use infrastructure megaproject, there needs to be a simple, clear, reliable and sufficient cash flow from operations returning to the investor(s), especially to the private sector investor(s).

Without this cash flow, the private investment community will not participate and the CNC megaproject will likely not get built as envisioned. This requirement limits the discussion of relevant funding models for infrastructure megaprojects. At the core of its business case, the owner/operator of a complex highway, pipeline, railroad, power transmission system or telecom system needs to receive a user toll or transit fee.

Certainly, these can be supplemented by ancillary revenues like extra service packages, parking fees, data sales and other relevant parameters. However, without the core user fee cash flow, these are essentially irrelevant. And certainly, the government can think about new taxes flowing from new long-term jobs and businesses and perhaps revenue from the sale of the corridor asset if they have chosen to be the initial owner. But all of that is irrelevant without a clear core cash flow from operations.

Ultimately, we believe it would be counterproductive to seek a creative funding model in the CNC discussion. Instead, the funding discussion must establish a sound business case based on simple, clear, reliable and sufficient cash flows from for-profit operations.

6.2 RELEVANT, EFFECTIVE AND/OR CREATIVE FINANCING MODELS

From our brief global overview of infrastructure corridor megaproject activity in the last two decades and in the coming decade, which altogether require trillions of dollars, we observed that there does not seem to be a shortage of financing available for infrastructure corridor megaprojects. However, a primary condition is that both the public and private stakeholders need to have a clear and compelling business case, especially a financial return, to gain access to that capital pool.

Nor does there seem to be a shortage of financing models. Our literature review disclosed a very wide spectrum of traditional and emergent financing models. For example, on the traditional side, Zhang et al. (2021) provided a taxonomy of instruments such as credit — loans, bonds and equity — which can all be subclassified. Looking at emergent methods in the field of local infrastructure projects, Chen and Bartle (2017) suggested creative new models such as IIFs, philanthropy and crowdfunding.

The latter emergent methods may or may not be suitable for megaproject financing, and indeed we did not encounter them in our case studies. Our case review demonstrated that most of the traditional types of financing tools were used, including government grants, government loans and government equity corporations in addition to classic bank loans and equity infusions.

Interestingly, we did not discover the use of bonds in the five case studies, but the lack of evidence may be just by chance. The sheer magnitude of the financing requirements probably renders largely inconsequential the smaller amounts from the more creative sources like philanthropists and community crowdfunding efforts. We did notice in four of the megaprojects that a crowd approach with multiple institutional investors (not to be confused with crowdfunding) was indeed popular, whether as a consortium or as a designated PPP. For example, for the Tours–Bordeaux high-speed rail line, there were eight institutional investors, including six within the LISEA PPP.

What we did not uncover in our literature and case reviews was an analysis of which financing tools were associated with successful infrastructure megaprojects, with success being measured by the actual financial returns to the investors versus the forecasted financial returns. Therefore, we have a limited ability to comment on which tools might best apply to the CNC. However, the magnitude of the proposed CNC, with a price tag probably greater than \$100 billion, and a longer construction period that will extend cash flows from operations into the future for decades or more, tends to constrain feasible options. For example, the delayed cash flow probably eliminates bank loans to the owner, as loans tend to require steady payments of principal and interest, although the lender may have plans to take over assets upon the original owner's default. These constraints do tend to point towards three more possible financing sources: (1) modest government contributions from an existing infrastructure budget to, for example, assemble the land or assist with building the infrastructure asset; (2) long-term project bonds, with a maturity of, say, 20 years or greater; and (3) a private equity injection, probably from a variety of sources. There is no expectation of cash return to the investors in the short term; instead, it relies on longer term cash flows from operations, bond redemption and/or sale of equity. The wisdom of this kind of logic is largely reinforced by the evidence uncovered in the five case studies.

For example, in the study of the LAPSET Corridor, the government paid for the first three of the planned 32 berths at Lamu Port. Still, the port, the road, the railroad and the pipeline have all been at a standstill for years as discussions of loans and banks and various forms of PPPs have failed to produce a viable financing plan. Similarly, the bulk of the financing of the completed Mombasa–Nairobi Railroad was a loan from the Exim Bank of China plus Kenyan Treasury loan guarantees, but the completed railroad is still operating at a loss, has created great loan repayment problems for Kenya, is regarded by many as an economic failure and/or a debt trap and has even been criticized by the Chinese government as a vanity project. These two cases support the hypothesis that loan-based financing for megaprojects tends to create difficulties. In contrast, for the Callide Pipeline Corridor, the Queensland government paid a relatively small amount for the land assembly and left the construction cost of the pipeline itself to the private pipeline owner/operator. The Queensland government easily recoups its modest contribution through royalties and the pipeline operator achieves profitability through transmission fees. This case supports the hypothesis that if the government makes a non-equity, non-loan contribution (essentially a grant), it will be a relatively minor amount.

In the case of the Inland Rail project from Melbourne to Brisbane, a federal government injection of equity investment in the federally owned Australian Rail Track Corporation (ARTC) amounted to \$14.5 billion, augmented by investment from the private sector through a PPP to build a particularly difficult segment of the project from Gowrie to Kagaru (ARTC 2022a). This case supports the hypothesis that primary megaproject financing should take a non-loan longer horizon form. It is unclear whether the government contribution came from general tax revenues, a special tax levy, a bond issue, an established infrastructure fund or others. While the source of financing is being resolved, an essential parallel discussion must also be undertaken concerning the controlling mechanism for the assembled funds.

In this regard, the PPP concept commonly surfaces. The Canadian Council for Public-Private Partnerships (2022) defines a PPP as a partnership “between governments and the private sector to build public infrastructures like roads, hospitals or schools, or to deliver services. Unlike traditional procurement, the public sector integrates all parts of a P3 project into one contract,” wherein the partners agree to supply certain percentages of the necessary financing, in return for a share of revenues from operational cash flows. The full manifestation of the CNC will require significant public-private co-operation, with a wide range of public-private agreements and controlling mechanisms ranging from contracts to jointly held corporations.

In summary, on a global basis there does not seem to be a shortage of capital sufficient to build some or all of the envisioned CNC. However, considering the megaproject’s projected substantial cost and its time to achieve operational revenues, most of the financing will probably be obliged to take the form of long-term project bonds or equity instead of loans. And again, because of the substantial cost which puts it well beyond the federal government’s capacity, the majority of the bond or equity financing will have to come from private sources, from probably a crowd of several private stakeholders. However, it will be essential to first demonstrate a financial return for the stakeholders for each major infrastructure system component.

6.3 GOVERNMENT OR INSTITUTIONAL FACILITATION AND/OR RISK MITIGATION

The third research question challenged us to discover “the roadmaps developed in other jurisdictions and/or by international bodies to standardize and streamline approaches to project identification and preparation, contract design, and improve the investment environment for large infrastructure projects.” In our literature and case reviews, we were unable to discover such best-practice roadmaps, which suggests the opportunity to undertake a separate research program with that specific objective. However, in close connection with the funding and financing issues we explored, we have indeed noted how governments and other institutions have very much played a facilitative role throughout a megaproject’s phases, including funding and financing, and especially with respect to financial risk mitigation.

Indeed, from both the literature and the case studies we have seen a significant number of best-practice facilitation and/or risk mitigation measures, such as:

- Working closely with potential infrastructure asset owner/operators and their client bases to explore the business case for each infrastructure asset component (perhaps necessitating strategic government cash injections and/or guarantees);
- Publicly declaring the megaproject as a strategic and/or nation-building policy priority, assuming at least one strong business case is identified;
- Establishing an office of the co-ordinator-general (or equivalent);
- Involving all of the many stakeholder groups in the economic, social, legal and environmental assessments, addressing concerns and gaining commitment;
- Working with the committed infrastructure asset owner/operators to 1) help assemble the necessary financing partners (probably equity); 2) provide cash injections and/or

guarantees, revenue guarantees or tax reductions, and regulatory guarantees, if essential; and 3) establish the most desirable controlling mechanism, e.g., a PPP contract versus a corporation; and if a corporation, its equity structure; and

- Financing, acquiring and assembling the land corridor.

Thus, learning from these best practices, we feel that all levels of the Canadian government should be involved in the manifestation of some or all of the CNC and work closely with the private partners. While some of the government contributions may be simple cash support for either financing or funding, a long list of non-cash contributions falls under the banner of facilitation and risk mitigation.

7. CONCLUSIONS AND POLICY RECOMMENDATIONS

7.1 PRIMARY CONCLUSIONS

1. Given the great number of corridor infrastructure megaprojects undertaken in the world in the last couple of decades, and the amount of capital investment in these projects, there appears to be no global shortage of investment capital.
2. Government financing does have a role; however, for a corridor infrastructure megaproject other than a simple non-toll highway, especially a multi-use corridor, it appears essential to attract substantial investment capital from the private sector.
3. To commit, the private sector stakeholder(s) must perceive a compelling business case, i.e., strategic alignment, feasible investment amount, clear and simple funding model (operational revenues), a compelling return on investment and an acceptable level of risk.
4. The literature-based analysis of infrastructure megaproject funding and financing, including GI Hub's website, showed a limited but growing array of funding models and a large and growing array of possible financing models and controlling mechanisms.
5. The case-based analysis of five CNC-relevant corridor infrastructure megaprojects showed only a relatively narrow range of funding models used (especially subsidies and user fees), but a wider range of financing tools and controlling mechanisms (especially PPP contracts and special corporations).
6. These analyses suggest that sufficient funding and financing models exist for infrastructure megaprojects. This may in turn suggest that the long gestation period for the CNC is not due to a lack of funding, financing and/or controlling mechanisms; instead, it may have more to do with the absence of a compelling business case for any one private industry partner.

7.2 PRIMARY POLICY RECOMMENDATIONS

Assuming, then, that the business cases for private industries need further exploration, these are our principal policy recommendations to help finalize the feasibility study of the CNC:

1. Infrastructure Canada should convene a workshop with senior representatives from Canada's major private industries who might see the highest profit potential arising from at least one sub-network of the proposed CNC. The workshop's objectives would be to identify the sub-network(s) with the highest profit potential, to gauge the level of private sector excitement and potential commitment and to explore the general CNC configuration.
2. Assuming that one or more high-potential sub-networks are identified through the workshop, and that there is at least some cross-industry level of excitement and potential commitment, then Infrastructure Canada should convene a conference with senior representatives from all of the key stakeholder sectors: the most interested private operating companies, plus the relevant federal, provincial and territorial ministries, the Assembly of First Nations and the major financial institutions. The conference's objectives would be to gauge the level of cross-sector excitement and potential commitment and to identify each sector's principal conditions required for engagement.
3. Assuming the conference achieves a threshold level of multi-sector excitement and conditional engagement, then the federal government should declare the CNC to be a strategic priority and commit funds for stakeholder and community engagement, detailed corridor planning, environmental assessment and land assembly.

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ABOUT THE AUTHORS

David Large began his professional career as a highway engineer with the federal Department of Public Works in Ottawa, progressing to project engineer with Bell Northern Research in Ottawa and senior project engineer and senior business analyst with Esso Resources Canada Ltd. in Calgary. After receiving his MBA and PhD in marketing from the Ivey School of Business, Large joined the Telfer School of Management at the University of Ottawa, and has focused his teaching, research, program administration and consulting in the fields of technology marketing, technology management and engineering management. His publications have appeared in refereed journals such as *Journal of Product Innovation Management*, *Journal of Technology Transfer* and *Venture Capital*. Currently, his interests lie in the fields of infrastructure megaproject management and environmental technology management.

Ahmad Teymouri is a professor and program co-ordinator of the Global Supply Chain Management (GSCM) program at Algonquin College School of Business. He has also served as a part-time professor at Telfer School of Management, University of Ottawa. He teaches undergraduate and graduate courses in project management, operations management and project risk management. Ahmad received his PhD in digital transformation and innovation from the University of Ottawa. He also completed his Master of Applied Science degree (2014) in project management, MBA (2008) and Master of Management Information Technology (2007). He has over 15 years of work experience in oil and gas construction projects, car manufacturing and postal service. Ahmad holds PMP, RMP and Six-Sigma Green Belt professional certifications.

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906 8th Avenue S.W., 5th Floor
Calgary, Alberta T2P 1H9
Phone: 403 210 3802

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