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Fiscal Success: Creating Quality Infrastructure in a Post-COVID World

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Abstract: Governments are engaged in unprecedented fiscal support, particularly regarding public infrastructure, as stimulus to economic recovery from the COVID-19 pandemic. It is a necessary response to increased unemployment and the collateral damage to consumer confidence and spending. Keeping people employed via nation-building projects, especially involving transport infrastructure, and their supply chains is a key objective and has the potential to deliver assets that support long-term productive capacity. Nevertheless, it is critical that public infrastructure is of appropriate quality to ensure projects are progressive, governments manage long-term benefits realization and critical resources are not wasted through hidden future liabilities. This research explores and discusses the extent of agreement between the G20 policy framework on quality infrastructure investment (process theory) against a leading project success evaluation method (process practice) by mapping both artefacts using qualitative content analysis. It is found that project success evaluation offers a 'high' thematic match against G20 policy ideals and therefore provides an opportunity for project managers to ensure investments in quality infrastructure are indeed realized. This contributes to progressive infrastructure outcomes that take into consideration financial, social, ethical and environmental consequences. Fiscal success is equated to project success in this context.

Keywords: project success; quality infrastructure; decision-making; investment; project management

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1. Introduction

Over the course of 2020, the COVID-19 pandemic has induced the most catastrophic economic recession since the Great Depression, which has, in turn, triggered the largest global downturn in economic activity since the burst of the South Sea Bubble in September of 1720 [1,2]. So far the stimulus responses by the majority of governments and central banks in advanced economies to this economic crisis can best be described as two-pronged with policies shifting from immediate crisis management measures, typified by policies that primarily act as direct cash injections to the economy often geared towards income support to individuals, to that of sector-specific macroeconomic stimulus, such as fiscal policies designed to bolster aggregate demand via planned investment [3–6]. Unfortunately, with regards to the latter, government investment particularly in the field of public infrastructure is renowned for long planning processes, deferred project approvals and regulatory postponements [5]. These delays not only result in an implementation lag in the roll-out of public works projects, which ultimately lessen desired output responses, but have been found to be correlated with negative labour and output reactions to fiscal stimulus in the short run [7]. At the ministerial level, there also remains a strong prevalence for suboptimal project selection, with governments often green-lighting or discarding public infrastructure projects owing to adjustments in political considerations [8–10]. Even when these hurdles are overcome and public infrastructure projects are executed, it remains rare that they are completed not only 'on-time' and 'on-budget', but with their desired benefits being realized.

Indeed, an empirical study on the implementation of public transport infrastructure projects in China by Ansar et al. [11] revealed that, from a solely benefits realization perspective, merely 10% of projects could be considered successful, while the frequency of cost overruns occurring on surveyed projects was 75% coupled with an average cost overrun of 30.6%. Their study further highlighted that there was statistically no significant difference in these cost overruns when compared to comparable observed projects executed in advanced economies [11].

Considering the above, and while cognizant of the current perilous state of the global economy, it is perhaps a pertinent time to re-evaluate how governments approach the project evaluation process for planning and investing in public infrastructure. This exercise should be undertaken with the intent to ensure that sparse public capital is optimally invested and that successful benefits realization of executed projects is achieved. The G20, through their Leaders Communique at the 2019 Osaka Summit, has proposed that this be accomplished via placing an emphasis on the promotion of investment in 'quality' public infrastructure [12]. As noted by one of the key architects of this document, Japanese Deputy Prime Minister and Minister of Finance Aso Taro, while a lot of the public discourse around public infrastructure investment has tended to focus on the various models of infrastructure financing; significantly less debate has surrounded the 'quality aspects' of public infrastructure development and implementation [13]. Despite helping to facilitate a renewed global discussion on how governments should approach infrastructure investment, this document ultimately serves as a policy framework guideline. Though it does promote the concepts of transparency and good governance throughout the design and delivery phases of project rollouts, it provides no tangible methodology with regards to how governments might effectively evaluate prospective infrastructure projects to achieve optimal investment outputs.

Consequently, the aim of this study is to analyze the G20 policy framework on quality infrastructure investment and map its objectives against a leading project success evaluation method to ensure that investment in new infrastructure represents collective utility. The concept of 'quality infrastructure' does not only embrace economic considerations, but social, ethical and environmental consequences as well. The extent of agreement between policy and practice for delivering quality infrastructure projects is explored and discussed.

Section 2 underscores why fiscal stimulus is needed to mitigate the economic fallout from the COVID-19 pandemic. Section 3 explores the literature for measuring the success of fiscal stimulus in terms of infrastructure investment decisions. Section 4 describes the materials and methods adopted to compare the theory of quality infrastructure with the practice of project success evaluation via qualitative content analysis. Section 5 presents the findings of this analysis and demonstrates that project success is an appropriate mechanism to measure the collective utility of infrastructure projects and thereby justify initial investment decisions. Section 6 concludes the study and highlights the role that project managers can play in ensuring that fiscal success is realized.

Fiscal success is a term that is coined in this study to refer to the effective deployment of public money, collected by governments in the form of taxes, and which primarily takes place through the construction of major infrastructure projects. These projects lead to employment opportunities, future productive capacity, and support for a wide range of businesses within the global construction supply chain. However, effective deployment is critical. In the context of infrastructure, this means that monies must be well spent to realize new projects that add collective utility across the communities they serve.

2. COVID-19 and the Need for Fiscal Stimulus

Governments are engaged in unprecedented fiscal support, particularly regarding public infrastructure, as stimulus to economic recovery from the COVID-19 pandemic. It is a necessary response to increased unemployment and the collateral damage to consumer confidence and spending. Keeping people employed via nation-building projects and their supply chains is a key objective and delivers assets that support long-term productive capacity. Nevertheless, it is critical that public infrastructure is of appropriate quality to ensure projects are progressive, governments manage long-term benefits realization and critical resources are not wasted through hidden future liabilities.

The coronavirus outbreak has had a cataclysmic impact on the global economy. World output (as measured by GDP) decreased by 3.5% over the calendar year 2020, with the adverse effects being felt greater in advanced economies, where aggregate output contracted by 4.9% [4]. In monetary terms, this is forecast to equate to a cumulative economic loss of more than USD 12 trillion over the 2020–2021 financial year—a figure which is equivalent to the entire yearly economic output of the Eurozone region [14]. From a socioeconomic perspective, the pandemic-induced recession has brought about the greatest labour market disruption since the Great Depression, with the global reduction in working hours being four times larger than that experienced during the Global Financial Crisis [15]. In the United Kingdom as of December 2020, over 9.9 million workers (approximately a quarter of the UK's total workforce) had been furloughed and placed on the governments' Job Retention Scheme (JRS), at a cost to the government of over GBP 46.4 billion [16]. On a global level, it is estimated that in total 81% of the world's workforce has been impacted by some form of either partial or full lockdown measures, resulting in the loss of 114 million jobs relative to 2019 [15,17].

The issue of how governments and central banks in advanced economies chose to enact policy responses to these troubles to mitigate their effects has been hampered by the comparative reduction in the effectiveness of crisis management tools available to them when compared to prior periods of financial crises. A former US Secretary of the Treasury acknowledged at the outset of the crisis that the advent of an era of either perpetually low zero-bound or negative interest rates has largely curtailed the beneficial impact of monetary policy, leaving central bankers with little leverage to ease rates [18]. Existing data corroborates this viewpoint, with research showing that the initial enactment of monetary policy responses to the recession have been unable to contain the economic fallout [3]. The revenue measures (taxation) component of fiscal policy toolsets has also been hamstrung, as the scale of the current recession limits their effectiveness as an automatic stabilizer of the economy. Automatic stabilizers, of which government taxation constitutes a major element, are adjustments in public spending and revenue deriving from the interaction between pre-existing government economic activity schedules and fluctuations in the broader economy, that possess a stabilizing influence on variations in aggregate demand and which automatically engage without explicit triggering actions from the government [18,19]. While revenue measures do act as an effective automatic stabilizer, there is empirical evidence from longitudinal studies that suggest at best they can only reduce initial economic shocks to GDP, and alone will not provide the requisite GDP growth required to offset current losses [3,20]. Moreover, as can be seen from the global labour figures, this is a very human economic crisis, and policy priorities should be aimed just as much on measures that combat rising unemployment as they might grow GDP. It is for these reasons that targeted discretionary fiscal stimulus policies are so vital in the effort to combat the harmful economic effects of the current recession.

Though fiscal stimulus measures are often criticized for necessitating budget deficits that lead to rising sovereign debt—which in turn entails compounding interest that needs to be serviced—the present economic climate poses a unique opportunity. That is, governments currently have greater economic leeway to enact fiscal stimulus than in prior periods of the financial crisis. The reason is the comparative robustness of financial markets (when compared to the Great Depression and the Global Financial Crisis) and historically low interest rates [18,21]. A Former Chair of the Council of Economic Advisors in the Obama Administration [21] noted that '*in January 2009, the real interest rate on a ten-year government debt—the cost of borrowing after accounting for inflation—was roughly two percent* […] *in January 2021, it is likely to be around negative one percent*' (p. 25). Consequently, while sovereign debt in many advanced economies is higher today, its associated carrying cost is significantly lower. As such, record low interest rates, the very thing which has hampered policymakers when trying to implement effectual monetary policy in response to the crisis, has alleviated the pressure off governments that choose to implement fiscal stimulus measures. The latitude this has provided has bolstered the capacity of governments to assume a greater volume of sovereign debt, thus allowing for expansive fiscal policy responses.

An example of this can be seen in Australia, where the federal government has legislated discretionary stimulus policies costing AUD 267 billion through to FY2023-24, a figure which is equivalent to 13.75% of national GDP [4]. What is clear is that governments need to enact these fiscal measures promptly, to avert the enduring impacts of recessions, such as incessant unemployment and deteriorating productivity outputs. Trend analysis commissioned by the IMF and compiled from OECD data from the past fifty years reveals the lasting ill-effects recessions can have on advanced economies. The mean result three years post-recession was an output decline of 4.75% below trend, before signs of growth began to emerge [1]. When further refined to modelling on large recessions alone, the trend analysis revealed a sustained decline in output relative to baseline projections, with GDP remaining on average 11% beneath trend five years post-recession [1]. In this analysis, a large recession was defined as a period of economic decline where the initial shock to output was in the top quartile of recessions in the dataset, equating to a decrease greater than 4.25% [1]. The latter of the two scenarios is the one which Australia, and indeed most advanced economies, are faced with. It is therefore imperative that governments move swiftly to implement nuanced fiscal policy measures focused on public investment.

3. Fiscal Success

3.1. Short-Term Fiscal Impact of Infrastructure Investment

In her remarks to the Atlantic Council on the topic of 'Infrastructure, Investment and Central Europe' delivered on 23 September 2020, IMF Managing Director Kristalina Georgieva [14] emphasized the importance of 'well targeted infrastructure investment' as a means of fiscal stimulus during the global recession brought about by the COVID-19 pandemic. She noted recent IMF modelling indicating that for every per cent of GDP invested in public infrastructure, economic output increases of between 0.5% to 0.75% in the short run, and 2% to 2.5% in the long run, can be expected [14]. These thoughts were echoed by Sayeh, who noted that if G20 member states alone were to concurrently increase their investment in infrastructure by 0.5% in 2021, and by an additional per cent per annum in the years to follow, then global GDP would rise by approximately 2% by 2025 [22].

Notionally, governments employ fiscal stimulus measures such as infrastructure investment in times of economic crises to harness the multiplier effect. The theory of the fiscal multiplier is that by injecting money into the economy through an initial investment shock, governments hope to boost aggregate demand in the short-term by inducing a string of corporate and consumer spending larger than their initial financial outlay, as the money from their initial investment circulates through the local economy [23]. In the real-world context of a recession, the applied objective of this theory is to counteract and arrest the short-term decline in both private sector and consumer economic activity and avert any resultant hysteresis effects, such as skills losses in the labour force through long-term unemployment, or a reduction in capital investment, both of which have the capacity to compromise a nation's future aggregate supply [17,24]. In the case of infrastructure investment, the socioeconomic benefits of the multiplier are augmented, as an approved project will necessitate a skilled labour force to facilitate its completion, thereby creating direct employment opportunities in the short term. Autoregressive modelling on the impact of the multiplier effect in advanced economies commissioned by the IMF revealed that the investment shocks brought about by fiscal stimulus measures are statistically significant, and correlated with enduring growth effects on aggregate output [25]. It was found that a public fiscal injection acting as a shock increase in spending equivalent to one per cent of national GDP would increase aggregate output by 0.4% within the first twelve months, and by close to 1.5% three years post the initial injection [25].

Further empirical analysis on the impact of fiscal multipliers has shown that the multiplier rate can sit even higher, achieving rates of between 1.5% to 2.5% during periods of recession [26,27]. This assertion is corroborated by the aforementioned IMF model, which suggests that the immediate impact of a public stimulus driven investment shock is greater in times of recession than in times of economic expansions [25]. There is also some evidence that shows the potential economic downsides often associated with the fiscal multiplier effect, such as the crowding out of private investment and higher inflation, are negated and unlikely to occur during periods of recession [28]. In advanced economies, the multiplier effect may even increase further, when monetary policy is ineffectual due to interest rates sitting at near zero-bound levels, such as is seen at the present [29].

Unfortunately, these benefits are often not realized. The paramount reason for this is that once the budget allocation for infrastructure spending has been approved, there is frequently a considerable schedule delay between a project being 'greenlit' and construction commencing [30]. Public infrastructure projects are repeatedly plagued by regulatory and planning delays that often result in work not starting on the project in the short-term [7,31]. These adverse trends are often exacerbated on technically complex infrastructure 'megaprojects' [32]. This is a crucial factor that should be considered when devising a fiscal policy response to a crisis, as research has shown that the actual speed of a stimulus policy's implementation is vital in ensuring its effectiveness [17]. Indeed, studies of fiscal stimulus measures enacted in the Global Financial Crisis (GFC) confirmed that the speed at which an implemented policy affects the real world is a major attribute (alongside the size of the stimulus) towards determining its overall impact on the broader economy [17,29]. It is for this reason that public investment in road construction or maintenance upgrades, such as widening or sealing a road, are often favoured in stimulus packages as they are generally quicker to implement than other infrastructure projects and often deliver greater aggregate output increases [31,33,34]. Nonetheless, with regards to public infrastructure investment, a degree of caution should still be applied during the initial project evaluation and approval phase, to ensure that in the end only quality projects are greenlit.

3.2. Long-Term Economic and Socioeconomic Impacts of Transport Infrastructure Investment

Government investment specifically directed to public transport infrastructure is a keystone of strategies for economic growth [35,36]. Acknowledging this, the World Bank has lent approximately 20% of its total dispersed funds to finance transport infrastructure projects in the last few years [37]. Research by the IMF indicates that public investment in transport infrastructure has significant long-term positive impacts on economic output in advanced economies outside of the immediate short-term benefits associated with their design and construction [25]. These long-term impacts can be divided into two separate groupings. The first is the direct impacts on aggregate production outputs because of the public capital investment, with the second being the broader benefits to the economy ensuing from this investment.

From a transport infrastructure perspective, direct impacts on production can be defined as the static effects which influence aggregate output via an improvement in productivity and a reduction in the total cost of production [33,35]. Utilizing Alfred Marshall's conceptual framework of consumer and producer surpluses (and the assumption of perfect markets in equilibrium) as a theoretical foundation for the purpose of economic assessment, they are evaluated via a traditional cost–benefit analysis (CBA) technique [38,39]. The broader benefits to the economy, commonly referred to as wider economic benefits (WEB) or wider economic impacts (WEI), could best be described as the dynamic effects on the economy that result from primarily spatial adjustments in the behaviour of firms, labour and consumers due to investment in public transport infrastructure [10,40]. This can be seen in the relocation of economic activity and consequent agglomeration of industry because of increased accessibility in a particular location.

3.3. Direct Effects of Infrastructure Investment

A variety of economic theories indicate how any type of public investment in infrastructure can increase long-term economic growth. A conventional way to measure this is by evaluating the direct impact (static effects) of an infrastructure project on total productivity outputs. Crafts [33] suggested that this can hypothetically be done in either of two ways: by incorporating infrastructure directly into a generalized production function, or indirectly as a contributing effect on total factor productivity (TFP). He explained this premise via Equation (1).

$$Y = A(K_{PUB}) \times f(K, L, K_{PUB}) \quad (1)$$

Y is output, K is (private) capital, L is labour, A is TFP and K_{PUB} is public capital [33]. It should be noted that static effects can be defined as the direct economic phenomena of an investment (public works) project [40]. In a real-world example for transport infrastructure, the static effects would be considered as the changes that occur due to a decrease in the cost of transportation and a reduction in the duration of travel time [40]. This can be expanded to some external social costs, particularly environmental impacts when quantifiable, provided they can be identified by a surplus measurement in a conceptual equilibrium environment [39,41]. It is worth observing that in the context of the static effects of transport infrastructure investment, time savings are examined and evaluated from the perspective of a reduction in travel time from location to location—with the assumption that consumers and firms have not relocated as a result of this investment [40]. The potential relocation of both firms and consumers due to transport infrastructure investment is a dynamic (behavioural) effect and is considered a WEI [40]. From a purely economic perspective, the static effects associated with increased public investment have a long-term supply-side effect on the economy resulting from increased productivity, which ultimately boosts aggregate output [25]. Holmgren and Merkel [31] confirmed these theories in a recent longitudinal study on the impact of transport investment on productivity increases in the United States (US). Their findings suggest that public investment in transport infrastructure has an overall positive impact on production. However, the final benefit is dependent upon the type of transport infrastructure invested in and varies by industry sector [31]. For example, investment in port infrastructure will have a higher effect on the productivity of bulk commodities (such as iron ore or wheat), while investment in road networks will have a greater impact on the construction sector [31].

What separates transport infrastructure from other forms of public infrastructure and capital investment is that it has the unique ability to potentially impact productivity via time savings [33]. This can be through time savings to market for commodities and manufactured goods, decreases in congestion, or in a public transportation context, through reductions in commuter journey times. To this point, Rice et al. [42] found on a metropolitan level that the labour productivity of cities is dependent upon the size of the local workforce and the size of the potentially available workforces within a radius of 80 min transit time. When applied on a United Kingdom (UK) basis, their study suggested that if a level of government investment in public transport infrastructure were enacted that resulted in the attainment of a 10% reduction in workforce travel times across the country, then a 1.2% increase in labour productivity would be realized [42].

Grice [36] reinforced this point by suggesting that a lack of public investment in transport infrastructure over the past forty years is one of the primary reasons why productivity in the UK is approximately a third lower than that of other advanced economies in the region, such as Germany and France when measured by output per labour hour. These results are a clear indication that congestion and other forms of transit delay have a negative impact on overall productivity. Accordingly, it can be seen how public investment in transport infrastructure increases productivity. Nevertheless, there is empirical evidence that reveals minor transit time savings will not lead to an adjustment in consumer travel behaviour nor a change in freight arrangements and logistics scheduling for transport firms [39]. If this is not taken into account, then from a project evaluation perspective it can often lead to a considerable overestimation of potential time-saving benefits, which in turn results in suboptimal projects being greenlit and benefits not being realized [39].

3.4. Endogenous Growth Theory

An alternative to the classical welfare economic approach is that of endogenous growth theory. In short, the endogenous growth theory suggests that permanent adjustments in public investment policies, such as a decision to either increase or decrease public infrastructure investment, can have a sustained effect on the long-term rate of growth of aggregate output via an increase in the capacity of public capital stock (infrastructure) and thus total productivity [43]. Endogenous growth models (for example [44]), insinuate that explicit factors such as highly educated human capital act as internal drivers of innovation via technical progress, leading to higher rates of productivity through increasing returns to scale. Additionally, the theory proposes that this investment will have additional positive spill-over effects which further increase economic growth through the facilitation of a knowledge-based economy [44]. The relationship between a knowledge economy (in the form of highly educated human capital) and transport infrastructure is supported by the empirically proven theory that highly educated consumers display an increased demand for accessibility, and consequently are attracted to spatial areas with greater connectivity to rapid transport systems [39].

From an econometric modelling perspective, this is incorporated into the supply side and incorporates the Keynesian assumption that demand-side factors such as employment are fluid, hence equilibria in this model are not identical to that of the classical welfare equilibrium [39,43]. Barro [45], however, noted that government investment (in this instance, infrastructure projects) will only increase the returns to firms through private investment if the positive effect of the project's investment is higher than the adverse impact of the rate of taxation required to finance the project [33,45]. This hypothesis was supported by empirical evidence from Japan, which showed that large-scale investment in public infrastructure boosted productivity when the rate of taxation used to finance it was low—but is counterproductive when financed at a high tax rate [46]. Utilizing the above theories, Crafts [33] and McMillan [47] provided explanatory equations for this theoretical premise. The first component factor relates to the concept of a production function, which incorporates the returns to scale of stabilized growth of government and firm's investment [33], as shown in Equation (2).

$$Y_W = (k^{\alpha}, k^{\gamma}{}_{PUB}) \tag{2}$$

Y_w is output per worker, k and k_{PUB} are capital and public capital per worker respectively and $\alpha + \gamma = 1$ [33]. The second factor is the Ramsey equation, which theoretically seeks to determine how much society (in Ramsey's theory, a nation-state) should consume or conserve [48]. This is viewed through the hypothetical prism of a representative agent faced with a constraint on resources, determining how to optimally apportion expenditure while factoring in time preference for consumption [47,48]. The Ramsey equation (see Equation (3)) is an important concept to understand, as it forms the intellectual basis of attempts to select the social discount rate to measure the direct impacts and total economic costs of climate change [49]. This will ultimately influence transport infrastructure project evaluation, as approximately a quarter of all global carbon emissions stem from transportation [50].

$$R = \delta + \eta g \tag{3}$$

R is the interest rate (social discount rate), δ is the pure rate of time preference, η is the coefficient of relative risk aversion and g is the per capita growth in consumption [47]. Crafts [33] indicated that the input of government investment in transport infrastructure (public capital stock) would spur economic growth (impact aggregate productivity) via its positive effects on output (the marginal product of capital). While able to demonstrate a model of economic growth, the primary criticism of the Endogenous Growth Theory is that it is hard to prove with empirical evidence [51]. Additionally, from the perspective of transport infrastructure, Crafts [33] noted that it does not incorporate the beneficial impacts of the dynamic economic effects unique to transport infrastructure investment.

3.5. Broader Dynamic Effects of Infrastructure Investment

Taking transport infrastructure as an example, the broader benefits of public investment in infrastructure derive from the dynamic effects of an implemented transport project's indirect impact on the economy. Relative to other types of public infrastructure investment, transport projects generally have greater socioeconomic (and environmental) effects owing to their unique ability to induce dynamic adjustments in the economy [33,40]. In contrast to the previously discussed static effects, which are in essence the direct impacts of a completed project, dynamic effects are the adjustments in the behaviour of both consumers and firms due to an induced spatial change in the structure of a localized economy [40]. By way of illustration, the construction of an intermodal terminal or port may result in firms relocating to the area where it is situated. This in turn will lead to a change in (increased) economic activity in this location, which should result in additional productivity gains outside of those already identified in the direct effects of the project.

The theoretical premise for the dynamic effects of transport infrastructure is commonly regarded as being Paul Krugman's theory of the New Economic Geography (NEG) [10]. However, it can be traced further back to Jules Dupuit's pioneering work on transport economics, in particular his measurements of the 'relative utility' of transport infrastructure, which introduced concepts of positive effects outside of the traditional consumer surplus model [39]. Krugman himself also accredits the work of Staffan Burenstam Linder on the economics of Trade Theory for shaping his underlying thinking in the field of economic geography [52].

The NEG emphasizes that public works improvements in transport infrastructure impact the spatial location of firms and consumers, by enabling greater access to economic markets, which will ultimately result in agglomerations of both industry and consumers at the location [53]. Krugman contended that transportation costs are a dominant factor in the development of 'core–periphery' patterns in nations, as they are a significant incentive for firms and consumers to move close to, or relocate within, large marketplaces [52,54]. Within this theory, the components of transportation costs are defined as the length of a journey, its duration, its total economic cost and the amount of energy expanded during its duration [55,56]. As the cost of transportation therefore theoretically dictates the location of economic activity, investment in transport infrastructure will make an area more enticing for labour and firms, by enabling a reduction in total transport cost. This will ultimately result in a centralized concentration of economic activity leading to the development of an economic (and subsequently social) core [39,56,57]. Conversely, the periphery areas that were not the beneficiary of transport infrastructure investment will in theory have higher costs of transportation and thus be less enticing to firms [39,54]. When examined longitudinally, the development of core–periphery patterns in a province or country are what lead to regional wealth disparity and consequently income inequality [35,56,58].

With regards to the NEG, the assumption of accessibility reinforces the notion that an overall reduction in transportation costs will encourage a significant change in the location of economic activities [54,59]. In the context of transportation itself, accessibility refers to the concept of gauging the relative ease of access to (and thus the relative ease of commercial engagement with) a particular location [10,59]. It therefore also enables the quantification of market access for consumers and firms from an economic standpoint [60]. Hansen and Johansen [61] stated that increased accessibility achieved through the construction of quality transport infrastructure coerces change in commuting behavioural patterns, which influences the activities and location of labour markets in a particular region. This demonstrates the dynamic effects of transport infrastructure, as this induced behavioural effect in the labour market is not accounted for in the traditional consumer surplus economic model for transport. Accessibility can further increase localized productivity outputs via the importation of knowledge from skilled workers through the aforementioned labour market adjustment [59].

A final benefit of accessibility is the potential for increases in socioeconomic equity upon project completion. Principle 5 of the G20 Principles for Quality Infrastructure Investment emphasizes the need for both social and economic impacts to be contemplated when planning decisions on public infrastructure investment are being decided [62]. While the literature itself tends to focus on the overall economic growth benefits of accessibility from either the macroeconomic viewpoint or that of the firm (such as an enlargement of the potential regional labour force or an increase in aggregate productivity), the socioeconomic benefits to the individual should not be overlooked. Increased accessibility through public investment in transport infrastructure enhances the welfare of the individual by enabling greater access to health services, education and the labour market [63,64]. Although perhaps harder to quantify than the component factors that contribute to economic growth via an increase in productivity, the indirect socioeconomic effects from an increase in accessibility should also be considered by policymakers when contemplating the concept of quality public transport infrastructure.

3.6. Infrastructure and the Environment

Environmental consequences should not be ignored. Approximately a quarter of all global energy-related greenhouse gas emissions emanate from transportation activities, with this percentage forecasted to grow exponentially over time [50,65]. Unlike other industry segments, the transport sector remains reliant upon carbon-intensive energy sources such as fossil fuels, particularly in the shipment of freight via road transport [65]. As such, the importance of achieving emissions reduction in both public and private transportation has been recognized, prioritized and enshrined in the United Nations (UN) Framework Convention on Climate Change more commonly referred to as the 'Paris Agreement' [50]. Emissions reduction in transport infrastructure has also been identified as a key component of the Sustainable Development Goals for the UN 2030 Agenda for Sustainable Development. Specifically, *Goal 9–Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation*, and *Goal 11–Make cities and human settlements inclusive, safe, resilient and sustainable*, cite 'sustainable transport' as a mechanism for achieving these objectives [66].

To this end, the IMF has identified COVID-19 fiscal stimulus packages as an opportunity to address this issue via investment in sustainable public transport infrastructure [67]. Speaking at the Rome Investment Forum in December 2020, Deputy Managing Director Antoinette Sayeh [22] declared that public investment in 'efficient mass transit systems' is a vital tool to tackle climate change. Sayeh's statement was supported by the IMF's official policy document on tackling climate change through COVID-19 economic stimulus packages entitled 'Greening the Recovery', which proposes that in order to combat the adverse economic effects of the COVID-19 induced recession, government spending should focus on 'boosting climate smart infrastructure' [67]. Kristalina Georgieva further endorsed this policy position in the preface of the IMF's recent publication on recommended guidelines for infrastructure governance, in which she put forward the proposition that considering the economic fallout from the spread of COVID-19, investment in effective public infrastructure was key for building a strong recovery [13]. One of the ways she proposed governments can do this is through a policy of investment in transport infrastructure that aligns with the UN Sustainable Development Goals (SDGs) and ensures carbon emission reductions [13].

Moving beyond the overarching macroeconomic perspective, the G20 addressed the issue of the environmental impact of public infrastructure at the project level in their 'Principles for Quality Infrastructure Investment' [62]. Principle 3 (Integrating Environmental Considerations in Infrastructure Investments) specifically highlighted the predominant environmental issues that arise throughout the design, construction and operational phases of public infrastructure projects [62].

These issues can be categorized into one of two sections. The first could be defined as 'land-use' issues, while the second involves the wider environmental impacts of the project from a life-cycle perspective. Land-use considerations comprise the direct spatial ecological impact of the transport project on its immediate surroundings, while life-cycle effects consist of not only the ongoing impact of operations and maintenance but also on the project's capacity to either increase or reduce carbon emissions [68]. The primary method for evaluating these impacts on a project basis is an environmental impact assessment (EIA), although other methods such as strategic environmental assessments (SEA) are often utilized in conjunction with an EIA when conducting a multi-criteria decision-making (MCDM) approach to environmental impact evaluation [68,69].

Most countries (and all advanced economies) have legislated the usage of EIAs during the planning phase for public infrastructure projects [70]. Within Australia, for example, EIAs are a mandatory component procedure within the broader project approval process for transport infrastructure projects [71]. The procedure for conducting an EIA includes forecasting activities, assessing their impacts, providing mitigation and treatment processes, monitoring works, and handling the effects of recognized issues [69]. In theory, the EIA process should be conducted and finalized at the outset of the project evaluation phase and well ahead of project commencement [70]. Morgan [72] noted, however, that EIAs are often conducted or revised post-project evaluation in the latter stages of the project planning phase.

As the essential point of an EIA is the provision of informative documentation outlining a project's impact on its surrounding environment so as to assist the approval process, late delivery could potentially nullify the assessment. This calls into question the governance of the EIA process and would suggest that greater transparency is required. A reason for this could be adjustments in the political decision-making process, and there are examples of this occurring on major transport infrastructure projects in the UK [8]. Harris et al. [71] stated that EIA decisions should be considered as sitting within a broader complex political decision-making exercise, and this might explain some of the equivocations and delays regarding their completion.

Finally, most policies on the environmental impact of public transport infrastructure have focused on achieving meaningful reductions in the collective carbon footprint of the transportation sector. It is not by mistake that most EIAs for transport infrastructure projects focus principally on CO_2 emissions [65]. This exercise is undertaken by calculating the forecasted emission per transport unit (e.g., a truck, or locomotive and carriage) and multiplying it by freight mass and transit distance [65]. These findings are often used as a justification to promote certain forms of transportation over others in both segments of transportation—freight and commuting [73,74]. Nonetheless, this fails to consider the systems nature of infrastructure.

As Helm and Mayer [75] pointed out, national approaches to public investment in infrastructure need to recognize the 'interrelationships' between infrastructure stock.

While a transition from certain forms of transportation to another (e.g., a transition in passenger commuting from automotive to light rail) will achieve a comparative reduction in carbon emissions, the overall effect can be diminished depending upon the power generating source of the alternate means of transportation [76].

4. Materials and Methods

4.1. Knowledge Gap

The need for fiscal stimulus is not necessarily aligned with fiscal success. There are many examples of projects, especially large-scale public infrastructure projects (or megaprojects) that can be considered failures. According to Flyvbjerg [77], over the last few decades a majority of megaprojects have demonstrated poor track records: 70% to 90% of megaprojects experience cost overruns. These problems are described as the iron law of megaprojects: '*over budget, over time, under benefits, over and over again*' [77] (p. 12). Project management, therefore, lies at the heart of fiscal success implementation.

The G20 Principles for Quality Infrastructure Investment [62] is a concerted international attempt to define what successful procurement of infrastructure looks like. However, while the objectives may be articulated, the method of compliance remains opaque. The previous literature, given extra significance due to the need for greater fiscal stimulus to support the economy during the COVID-19 recovery, summarizes the complexity of the challenges involved. A current knowledge gap that is identified is how to resolve the fragmentation of tools and techniques available in practice. In particular, the inability to easily combine tangible (largely financial) and intangible (largely social, ethical and environmental) evidence of performance is the main barrier to widespread adoption of a transparent and simplified model for making quality infrastructure decisions. The latter is often referred to as ESG (environmental, social and governance) criteria.

4.2. Evaluation of Infrastructure Projects

The Centre for Comparative Construction Research (CCCR) at Bond University, Australia, has developed an evaluation model for measuring project success called *i3d3*. It comprises a collection of Microsoft Excel worksheets that produce a matrix of performance scores and an overall index of success/failure. The matrix has three columns representing the phases of pre-implementation (project initiate), implementation (project implement) and post-implementation (project influence) and four rows representing performance expressed as financial, social, ethical and environmental consequences.

Ghanbaripour [78] explored 23 different models for the evaluation of project success published over a thirty-year period. He found that most models fail to offer a set of success criteria that can be quantitatively measured. Furthermore, he found that most models do not consider diverse stakeholder perspectives, particularly those of intended end-users. Few ESG considerations were formally integrated into the measurement of success, while financial values tended to dominate the decision-making process. Models were generally specific to project type and sector, making economy-wide comparisons problematic. Benefits realization was often ignored, enabling optimism bias to occur to meet political ends.

The *i3d3* model is an example of modern MCDM [79]. It calculates a single index that can be used to compare/rank completed project performance, as opposed to anticipated performance. This model overcomes the common disadvantages of earlier approaches and, given it builds on this previous work, is considered a leading example of project success evaluation suitable for this study.

Full information about the model and how it works is available from both CCCR (https://bond.edu.au/cccr, accessed on 10 November 2021) and i3d3.net (https://www.i3d3.net, accessed on 10 November 2021). The *i3d3* model is endorsed by the Global Alliance for the Project Professions (GAPPS) and can also be downloaded from their website (https://globalpmstandards.org/, accessed on 10 November 2021).

Figure 1 summarizes the model's logic and structure. It is based on a framework created by Dick [80] from research undertaken by Wes Snyder that tracks backwards from ideals to determine targets, immediate effects, activities and resources necessary to deliver the specified ideal(s). In the case of *i3d3*, there is one ideal (a 'successful project'), four targets, (namely, 'contributed to UN SDGs', 'progressive design', 'met delivery baselines' and 'satisfied end-users') and twenty immediate effects. A successful project is measured using a scale from +100 to −100, where 0 is the breakeven point between success and failure. The ideal is nominated as a value of 50 on this scale.

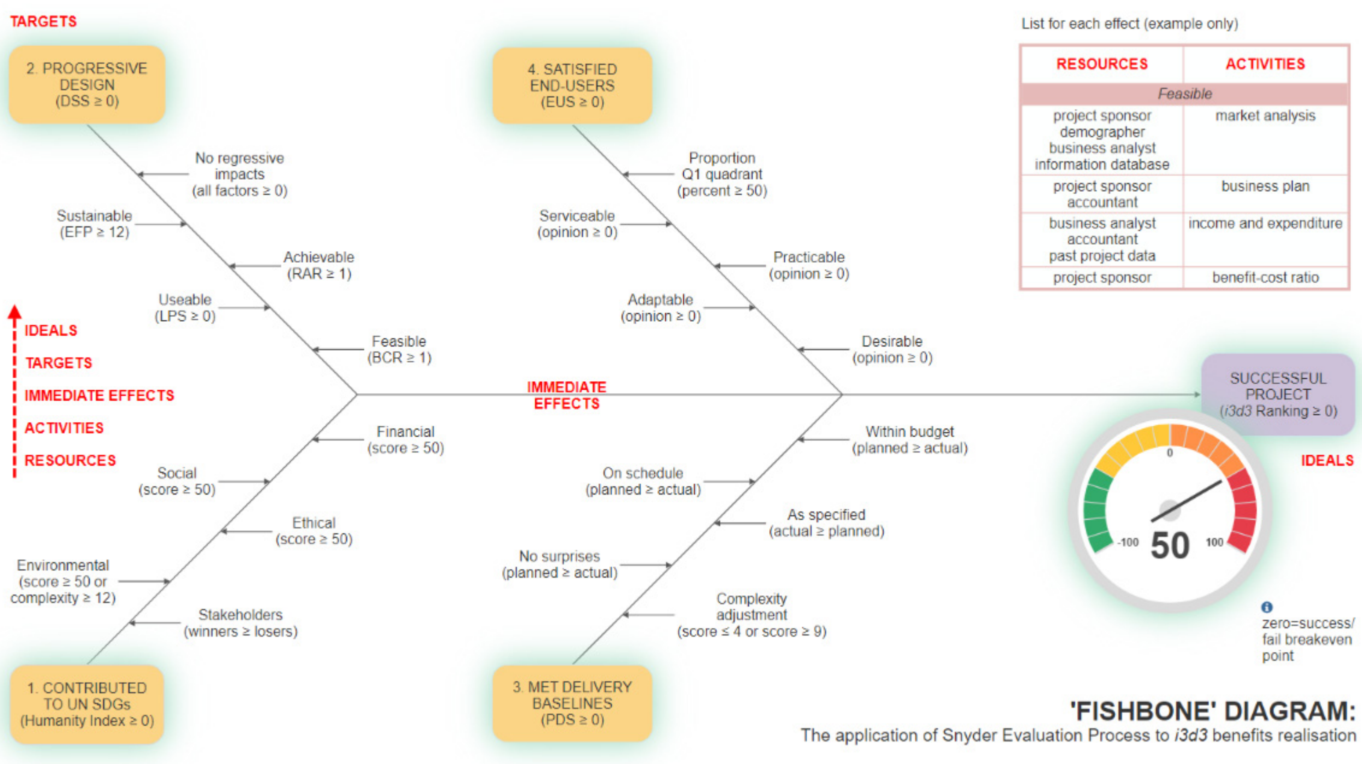

Figure 1. The logic and structure of the *i3d3* model (graphic provided courtesy of i3d3.net).

4.3. Method

Qualitative content analysis [81] of the G20 policy framework and the *i3d3* evaluation model is used to test the extent of alignment between 'theory' and 'practice'. Qualitative content analysis has been defined as '*a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns*' [82] (p. 1278). This approach involves a systematic understanding of the various components of both artefacts as evidenced by a pairwise comparison of G20 principles and *i3d3* model characteristics. Presentation of the results and their critique are undertaken objectively. The purpose of this approach is not to prove that the G20 principles are appropriate or that *i3d3* works, but rather the extent of content alignment between them. Overall alignment is assessed via a nominal scale of 'none', 'low', 'moderate' or 'high' based on an unweighted scoring algorithm (0 = none, 1 = low, 2 = moderate, 3 = high).

All information used in this analysis was accessed online. The results can be triangulated by interviewing practitioners who have purposively adopted and used both artefacts, but this was not part of the scope of this study since the identification of relevant practitioners was not possible. However, members of CCCR were consulted to ensure that the interpretation of their work was not misunderstood. This consultation was facilitated by i3d3.net, and their cooperation is gratefully acknowledged.

5. Results and Discussion

The G20 principles begin by describing infrastructure as a driver of economic prosperity that provides a solid basis for strong, sustainable, balanced and inclusive growth and sustainable development. These are key goals of the G20 policy and critical for promoting global, national and local development priorities. The preamble to the G20 principles states that '*a renewed emphasis on quality infrastructure investment will build on the past G20 presidencies' efforts to mobilize financing from various sources, particularly the private sector and institutional sources including multilateral development banks, thereby contribute to closing the infrastructure gap, develop infrastructure as an asset class, and maximizing the positive impacts of infrastructure investment according to country conditions*' [62] (p. 1). They believe that quantity and quality can be complementary.

In contrast, the *i3d3* model is not confined to infrastructure but claims to potentially measure success for '*projects of any type, size, location or date*' [83] (p. 17). Quality investment and success have some commonalities. The *i3d3* model defines success as doing the 'right project right' and incorporates the three phases of initiate (design), implement (deliver) and influence (delight) in the context of the passage of time and the different objectives of project stakeholders. It judges success as benefits realization (collective utility)—a key construct of social cost–benefit analysis. The *i3d3* model can use hindsight to audit performance as a means of ranking a portfolio of projects by success or be applied during project delivery to ensure that progress is on time, within budget, as specified and with no surprises.

There are six principles in the G20 framework that are specific to promoting quality infrastructure investment [62]:

- Sustainable growth and development.
- Economic efficiency.
- Environmental impact.
- Resilience.
- Social benefits.
- Governance and transparency.

Principle 1 focuses on sustainable growth and development (see Table 1). A key attribute of this principle is that infrastructure investments are progressive, not regressive and hence improve prosperity to the local community or region. The 17 United Nations SDGs are relevant here [66].

Table 1. Sustainable growth and development.

G20 Principles	*i3d3* Model Characteristics
Principle 1: Maximizing the positive impact of infrastructure to achieve sustainable growth and development	The premise of the *i3d3* model is to measure project success. Maximizing positive impacts is essentially the definition of success. The *i3d3* model largely converts these high-level principles into an objective and measurable index (−100 to +100). Large projects should address United Nations SDGs and ensure their performance is compatible with these important global priorities.
1.1 Setting off a virtuous circle of economic activities	A successful project is built on the philosophy of long life, loose fit, low energy and least pain. They serve as a language that aids communication between designers and end-users, and where absent, is often the underlying cause of dissatisfaction and an unsuccessful project. Four virtuous circles are created. For example, if a design is feasible, then end-users are more likely to see the project as desirable. This implies they will keep it longer. If end-users stay engaged with projects longer, then these projects become even more feasible.

1.2 Promoting sustainable development and connectivity	In the *i3d3* model, benefits realization is assessed as the sum of financial, social, ethical and environmental performance across each of the three phases of the project's life cycle. Time is obviously a key factor in realizing these benefits.

Principle 2 focuses on economic efficiency (see Table 2). A key attribute of this principle is that infrastructure assets have long lives and contribute to economic prosperity over time. The concept of life-cycle performance, often termed whole-of-life costs, is critical here.

Table 2. Economic efficiency.

G20 Principles	*i3d3* Model Characteristics
Principle 2: Raising economic efficiency in view of life-cycle cost	Economic efficiency is essentially a financial consideration. It is defined in the *i3d3* model as being feasible (initiate phase), within budget (implement phase) and desirable (influence phase), virtuously predicated on the ability to realize a project that has 'long life' characteristics. Financial performance in the *i3d3* model is not restricted to initial capital requirements, but rather considers costs and benefits over the economic life of the project, including disposal or reuse where relevant. The *i3d3* model does not compare options before commencement, but it does rank project success after completion.
2.1 The life-cycle costs and benefits of infrastructure investments should be taken into consideration in ensuring efficiency	Cost–benefit analysis is interpreted by benefit–cost ratio (BCR), which is the measurable outcome used in *i3d3* for financial consequences.
2.2 Infrastructure projects should include strategies to mitigate the risks of delays and cost overrun, and those in post-delivery phases	In the implement phase of *i3d3*, project delivery success (PDS) is defined as the combination of being within budget (cost), on schedule (time), as specified (scope) and no surprises (risk). It is computed as the per cent difference between the planned and actual performance.
2.3 Innovative technologies should be leveraged through the life cycle of infrastructure projects, where appropriate, to raise economic efficiency for existing and new infrastructure	Cultural innovation (or betterment) is the focus of comparing risk and reward (RAR) as part of the politics subsystem in the DSS.

Principle 3 focuses on the environmental impact (collateral damage) that can arise from infrastructure project development and operation (see Table 3). A key attribute of this principle is that natural resources matter and must be used sustainably, appropriately valued and respected.

Table 3. Environmental impact.

G20 Principles	*i3d3* Model Characteristics
Principle 3: Integrating environmental considerations in infrastructure investments	Environmental considerations are defined in the *i3d3* model as being sustainable (initiate phase), no surprises (implement phase) and serviceable (influence phase), virtuously predicated on the ability to realize a project that has 'low energy' characteristics.
3.1 These environmental considerations should be entrenched in the entire lifecycle of infrastructure projects	Ecological footprint (EFP) in the planet subsystem in the DSS pertains to non-renewable energy demand (embodied carbon), water quality impacts, air pollution, natural resource depletion, biodiversity loss, and non-degradable or non-recyclable waste to land-

	fills. Each factor comprises positive and negative effects as measured using a 5-star rating scale. However, unlike the G20 principle, in *i3d3* environmental criteria do not vary by country circumstances.
3.2 The environmental impact of infrastructure investment should be made transparent to all stakeholders	The DSS maps the decision-making process for the initiate phase and provides a transparent flowchart for all design decisions, including those related to environmental impact.

Principle 4 focuses on resilience (see Table 4). A key attribute of this principle is asset security in the face of natural disasters or related risks.

Table 4. Resilience.

G20 Principles	*i3d3* Model Characteristics
Principle 4: Building resilience against natural disasters and other risks	Adaptability (and hence resilience) is one of four success factors in the influence phase, although not specifically confined to disaster recovery.
4.1 Sound disaster risk management should be factored in when designing infrastructure	Disaster mitigation, where appropriate, is best embedded in the calculation of RAR as part of the political subsystem in the DSS.
4.2 Well-designed disaster risk finance and insurance mechanisms may also help incentivize resilient infrastructure through the financing of preventive measures	The inclusion of a Humanity Index within *i3d3* links project impacts with the 17 United Nations SDGs. Rather than provide insurance, this approach provides 'assurance' that goals designed to protect against degradation of financial, social, ethical and environmental loss are valued.

Principle 5 focuses on the social benefits that infrastructure provides (see Table 5). A key attribute of this principle is the utility that projects provide to human health and well-being. Social benefits are often intangible and hard to measure.

Table 5. Social benefits.

G20 Principles	*i3d3* Model Characteristics
Principle 5: Integrating social considerations in infrastructure investment	Social considerations are defined in the *i3d3* model as being useable (initiate phase), on schedule (implement phase) and adaptable (influence phase), virtuously predicated on the ability to realize a project that has 'loose fit' characteristics.
5.1 Open access to infrastructure services should be secured in a non-discriminatory manner for society	The people subsystem in the DSS uses local project support (LPS) as a measurable outcome of success.
5.2 Practices of inclusiveness should be mainstreamed throughout the project life cycle	This is part of the concept of overall satisfaction in the 'delight' phase assessment, although it also includes the concept of winners and losers, and in the latter case, mechanisms for compensation (respect) may become part of the design brief.
5.3. All workers should have equal opportunity to access jobs created by infrastructure investments, develop skills, be able to work in safe and healthy conditions, be compensated and treated fairly, with dignity and without discrimination	Equity is another part of collective utility. Raising living standards through new projects is often founded on more and better-paid jobs for local communities and is a reason why initial support would likely be positive. Equity is part of ethical practice, which stands alongside financial, social and environmental consequences in *i3d3*.
5.4 Safe and healthy occupational conditions should be put in place, both at the infrastructure site and in the surrounding communities	Health and safety during delivery is part of risk identification, analysis and treatment, but is also assessed as part of end-user satisfaction (EUS), i.e., being practicable (fit for purpose). Having said that, basic human safety is not a tradable success criterion

	but rather a fundamental and non-negotiable requirement during all project phases.

Principle 6 focuses on governance and transparency (see Table 6). A key attribute of this principle is ethical behaviour and ensuring that investments are deployed wisely and not diverted from their intended use.

Table 6. Governance and transparency.

G20 Principles	*i3d3* Model Characteristics
Principle 6: Strengthening infrastructure governance	Infrastructure governance is essentially an ethical consideration. It is defined in the *i3d3* model as being achievable (initiate phase), as specified (implement phase) and practicable (influence phase), virtuously predicated on the ability to realize a project that has 'least pain' characteristics. Governance can also be a key determinant of the outcomes that are measured in *i3d3*, and as such, is measured indirectly. Also, regulatory compliance is a part of the politics subsystem in the DSS and includes ethical (including anti-corruption) behaviour.
6.1 Openness and transparency of procurement should be secured to ensure that infrastructure projects are value for money, safe and effective and so that in-vestment is not diverted from its intended use	The *i3d3* model, at its most fundamental level, assumes that project success is judged by different stakeholder groups for each phase. Owner/sponsor and shareholders judge design, project team and regulatory authorities judge delivery, and client/end-user and local community judge delight. A power-interest chart is part of the *i3d3* assessment of net benefits.
6.2 Well-designed and well-functioning governance in-stitutions should be in place to assess financial sus-tainability of individual projects and prioritize among potential infrastructure projects subject to available overall financing	Across the phases of initiate (design), implement (deliver) and influence (delight), individual success factors embedded in the DSS, PDS and EUS respectively are integrated into a single transparent evaluation framework. Contingent liabilities are not formally considered.
6.3 Anti-corruption efforts combined with enhanced transparency should continue to safeguard the integrity of infrastructure investments	The *i3d3* model is intended to apply generically to any project, and so is not limited to infrastructure. A 'project' is essentially just a vehicle for change. Success is a measure of the fulfilment (or realization) of this change as judged by a representative group of stakeholders affected during the period of intervention. The *i3d3* model supports all 17 United Nations SDGs, and in this respect assesses the integrity of public investments.
6.4 Access to adequate information and data is an enabling factor to support investment decision-making, project management and evaluation	Investment decision-making is the basis of 'doing the right project', project management is the basis of 'doing the project right' and evaluation is the basis of 'doing the right project right'.

Generally, the *i3d3* model characteristics seem to closely align with the G20 framework. Principle 1 maps against the net benefit calculations within *i3d3*, Principle 2 maps against 'financial' consequences across initiate, implement and influence phases, Principle 3 similarly maps against 'environmental' consequences, Principle 4 maps against the humanity index and the United Nations SDGs, Principle 5 maps against 'social' consequences across initiate, implement and influence phases, and Principle 6 similarly maps against 'ethical' consequences, although there is no specific attention paid to evaluating corruption should it occur. Yet, in the same way that optimism bias is called out in hindsight as part of the evaluation of design, corruption can be identified through an audit of benefits realization in practice.

There were 23 numbered G20 principles. Using the three-level scoring algorithm discussed earlier, the total thematic match with *i3d3* was computed as 66. Principle 6.2 was scored as moderate (2) and Principle 6.3 was scored as low (1), while all other principles were scored as high (3). This translates to a synergy of 96%.

Two features of the *i3d3* model that are obvious and arguably advantageous comprise transparency and simplicity. Transparency is important but not always welcomed. It implies that decisions are traceable and their rationale can be comprehended even though not everyone will agree. The multidisciplinary nature of project management suggests that consensus can be demonstrated, and this is useful even where that consensus is not unanimous. Political imperatives are well understood to override rational independent recommendations, and in such cases, transparency might be challenged. On the other hand, simplicity enables evaluation to take place without significant time and cost impost and hence encourages the use of *i3d3* in practice. Likewise, this provides an opportunity for recommendations to be overridden on the grounds that there are other issues that should have been considered. A more comprehensive and rigorous evaluation could be adopted at the expense of both transparency and simplicity, which is probably what happens now on large-scale public infrastructure projects (for example, Infrastructure Australia [84]).

Nevertheless, *i3d3* is a useful tool in the broader context of project comparison. Although its design could be debated, at least it applies a consistent lens for evaluation and ranking of project success. It remains to be seen if *i3d3* truly is agnostic to project type, size, location or date. However, there are shared case studies available online [85–87] that suggest it can assess large public infrastructure projects for the purposes of comparison. Positive scores indicate success; negative scores suggest failure. The ability to trade-off good and bad performance typifies what generally happens in practice—there are no perfect solutions even though we strive to find them.

A key difference between *i3d3* and many other evaluation models is that the latter are focused on forecasting future performance. Decisions are taken to 'go' or 'no go' based on this information. Such approaches require a robust benefits realization mechanism to ensure that envisaged outcomes indeed eventuate. Without that, quality infrastructure investment cannot be validated. These models aim to compare design options and assess the risks and rewards of each proposal. The *i3d3* model also does this, but since the final score cannot be determined until at least one year after handover, the forecasts embedded in the initiation phase can be updated should some assumptions prove false. Optimism bias is removed. Quality investments cannot be known until after project completion. Forecasts of quality and proof of quality are two very different things.

Infrastructure projects, like any new initiative, are vehicles of change. Building situation awareness, as embedded in models such as ADKAR [88] and DALI [89], is fundamental to any change control plan. Therefore identifying, analyzing and managing negative risks and positive rewards will help make better decisions. Change also leads to process improvement so that project managers continually learn from their actions and pass this new knowledge to future projects in a systematic way. Quality infrastructure investments do not happen in isolation but arise from experience and organizational maturity over many years.

This research has assumed quality infrastructure investments are validated through project success evaluation. The G20 policy [62] sets out a theoretical definition of the former, while the *i3d3* model [83] sets out a solution to operationalize the theory into practice. While both were developed independently, albeit simultaneously, they have been shown in this study to have remarkable synergy. Of course, there are many principles that can be formulated, and many solutions invented to implement them, but the ones chosen are considered leading and recent examples that can support each other to improve fiscal success via process improvement.

There are several limitations that should be noted. First, the use of qualitative content analysis implies that findings are subjective based on the opinion of the researchers. Further studies could try and validate these opinions by surveying practitioners (who have experience in using both artefacts) using statistical means. This is still founded on subjectivity, but with greater numerical quantification than the simple 4-point scoring method employed in this study. It is too early to do this since both artefacts are new and not in widespread use. Second, evidence of collective utility from a range of infrastructure projects would provide more confidence in the efficacy of both artefacts. The case studies provided [85–87] are useful beginnings, but a much larger dataset of successful projects, and failed ones, needs to be developed. Future research should aim to resolve these limitations. This study is therefore a first step along this journey.

COVID-19 is the reason quality infrastructure investments are needed. It is easy to throw money at new projects to keep the economy moving, but if these investments do not contribute to improvements in productive capacity, then the benefits that flow from them are diminished. The OECD has forecast that the effects of COVID-19 are likely to continue for some time, and given concurrent supply chain problems, rising interest rates and higher levels of inflation, an even more challenging environment in which to operate is created [90]. The need to make better decisions and achieve fiscal success is now more important than ever. Project managers are well placed to routinely evaluate project success and such work should be considered as evidence of best practice.

6. Conclusions

The COVID-19 pandemic has engendered the worst economic recession since the Great Depression, triggering the largest global downturn in economic activity since 1720. Socioeconomically, this has resulted in a catastrophic labour market disruption, with 81% of the world's workforce being impacted by lockdown measures causing a global reduction in working hours four times greater than that suffered during the GFC. In this context, public investment in infrastructure projects as a component of a broader fiscal stimulus package is put forward as an economic policy measure to combat the protracted ill-effects of this downturn. Transport infrastructure investment is of great interest, as it will deliver jobs and inject money that will circulate through local communities in the short-term while enabling an increase in aggregate productivity and delivering indirect economic benefits in line with Krugman's NEG theory in the long term.

In order to ensure that the anticipated benefits of such a stimulus package would be realized upon project completion, the G20 Principles for Quality Infrastructure Investment were matched against the practical outcomes of the *i3d3* project success evaluation method. Studies of this nature have not been undertaken before despite a broad range of economic tools available in the marketplace. It was found that *i3d3* offers a 'high' thematic match (96%) against G20 policy principles and therefore provides an opportunity for project management practice to objectively validate strong, sustainable, balanced and inclusive growth and sustainable development that underpins the need for quality infrastructure investments. In this research, project success is seen as equivalent to fiscal success for public infrastructure projects. This directly enables project managers to contribute to outcomes that are progressive and take into consideration financial, social, ethical and environmental consequences. Further research is needed to extend this study through field validation and refinement.

It is thus recommended that project managers engage with the concept of quality infrastructure investment as the connection to project success is undeniable. Nevertheless, it is evident that project management success is not the same as project success, and hence the activities involved in successful implementation must be considered alongside the merits of initial design decisions and their acceptance by those whom the project intends to serve. This is difficult to do at a single point in time, such as when undertaking front-end planning and evaluating options, so the assessment of quality infrastructure is best completed in hindsight at least one year after project completion.

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Abbreviations

AUD	Australian Dollars
BCR	Benefit–Cost Ratio
CCCR	Centre for Comparative Construction Research
COVID-19	A disease caused by the SARS-CoV-2 virus
DSS	Decision Support System
EFP	Ecological Footprint
EIA	Environmental Impact Assessment
ESG	Environmental, Social and Governance
EUS	End-User Satisfaction
FY	Financial Year
G20	Group of 20
GAPPS	Global Alliance for the Project Professions
GDP	Gross Domestic Product
GFC	Global Financial Crisis
IMF	International Monetary Fund
LPS	Local Project Support
MCDM	Multi-Criteria Decision-Making
NEG	New Economic Geography
OECD	Organization for Economic Co-operation and Development
PDS	Project Delivery Success
RAR	Risk and Reward
SDGs	Sustainable Development Goals
SEA	Strategic Environmental Assessments
TFP	Total Factor Productivity
WEB	Wider Economic Benefits
WEI	Wider Economic Impacts
UK	United Kingdom
UN	United Nations
US	United States
USD	United States Dollars

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