



Review

Adopting International Learnings to Improve the Performance of New Zealand's Infrastructure Supply Chain

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Abstract: Growing interest in the productivity of the infrastructure sector has increased due to cost and time overruns in major projects. In this regard, many developed countries have failed to implement a framework to ensure that project success is met through newly available technologies and business initiatives to ensure the user is the most important beneficiary. This review paper provides a review of international research relating to the life cycle, firm-level operations, and collaborative business models of infrastructure projects. The review initially identified the importance that understanding key phases and procurement models has on the efficiency of a project's life cycle. A key indicator of the likelihood of good performance across a supply chain lies with the ability to understand the efficiencies of the firm-level operations. The literature has noted that successful projects are able to perform well across an organizations end-to-end involvement and be able to share risks among mature organizations. This paper provides a review of how a collaborative business model can benefit a project lifecycle and firm-level operations. The global research currently has identified the need for a collaborative approach that reduces the risk within all organizations through common goals, effective end-to-end project systems and consideration of the entire project lifecycle. The paper provides a detailed review of international practices in an infrastructure supply chain that have the potential to address New Zealand's infrastructure project failures.

Keywords: productivity; risk management; collaborative framework; infrastructure; supply chain; construction



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1. Introduction

Construction-related spending accounts for 13% of the world's GDP (gross domestic product) and has grown 1% annually over the past 20 years [1]. Annual growth in infrastructure is of concern as it has fallen well below the 2.8% growth for the world economy and 3.6% growth for manufacturing [1]. The sector as a whole has lost a degree of conviction among the public due to delayed, non-cost-effective, and poor-quality projects [2]. Current infrastructure projects neglect operational issues during design, and are lack several key elements: creative competition during contractor selection [3], risk sharing throughout project lifecycle [4], labor productivity [5], transparency [6] and collaboration [7].

Such issues have a direct impact on productivity, although that is not the only measure of a project's success; the ability to improve the productivity of individuals increases the overall livability factor of a country. New Zealand's overall annual multifactor productivity growth has decreased over the past 20 years. Between 2010 and 2017, a decrease in the annual growth rate was even observed [8].

Studies on a global scale have found that adapting to a changing business environment requires innovation. For instance, Polman [9] identified sustainable business created through value-driven practices as critical for resolving the decline in infrastructure productivity. Maximizing the economic and social impacts of projects is achieved through broader public policy objectives, prioritizing higher-quality projects and developing effective procurement strategies to include more than just the lowest bidder during

contractor selection [6]. The delivery of a project must ensure that it can sustain social and environmental impacts through its lifecycle [10].

From a national perspective, current infrastructure systems in New Zealand lack integrated links among clients, consultants, and contractors in addition to having little consideration for business maturity and risk management. Social business maturity takes advantage of opportunities to ensure that there are rewards for strong business values [11]. Alternatively, risk management requires an integrated approach to avoid risk trickling down the supply chain [12]. Effective risk management allows clients to have confidence in the maturity of an organization, thus allowing for more secure contractor selection [13]. The sharing of risk management is incorporated in similar frameworks worldwide to achieve industry-wide collaboration. In this regard, a collaborative approach allows for system-level changes to be carried out without a specific organization missing out on potential profits [9].

New Zealand is currently operating under an outdated framework that enables contractors to be selected based on price estimates at the beginning of a project. As such, the selection process has little consideration for project risk or collaboration between the client and contractor. The current system results in tenders that prioritise profit as opposed to a purpose in line with the projects goals and contracting for shared values. The lack of research around current methodology in New Zealand's infrastructure projects and its outdated framework must be addressed to adapt to a changing way of doing business.

Therefore, this paper aims to investigate the lessons that can be learnt from initiatives in other countries that have resulted in a more productive industry. The research will involve a review of the effectiveness of the overall infrastructure lifecycle, developing an understanding of key firm-level operations, and appreciating the principles involved in a collaborative business approach. Together, these sections will form the basis of understanding how international models across the supply chain can be applied to specific New Zealand circumstances.

2. Infrastructure Project Life Cycle

A project lifecycle defines all stages of a project from start to finish to give it order and structure [14]. A lifecycle analysis enables engineers, designers, and policy makers to generate a sustainable design and achieve environmental and spending goals to reduce environmental and economic impacts [15]. Traditional methods of lifecycle management separate the planning, design, construction, and organization phases; however, these can be redeveloped into a modern phase to develop a more profitable and sustainable business through a circular approach [16]. Procurement models vary depending on the type of project; however, understanding these models will enable more efficient contractor selection at the outset of the lifecycle. This section develops an understanding of the key phases of a project and how different procurement strategies can be used to improve the overall design feasibility of a project.

2.1. Key Project Phases

This sub-section is to consider the key phases within projects on an international scale. Howes and Robinson [17] define four key phases: phase 1 (the planning phase) involves identifying the main purposes, work locations and endorsements in the project; phase 2 (the design phase) incorporates the detailed design ideation and concept development to meet the specifications set by contractors and clients; phase 3 (the construction phase) covers all aspects of project delivery, activities, resources, equipment, and materials; phase 4 (the operation and maintenance phase) details project care during both the design life and recycling/deposition at the end of its life [17].

Similarly, the Project Management Institute [6] believe that effectively planned projects are produced utilizing five phases: project conception and ideation, project definition and planning, project launch and execution, project performance and control, and project close. Both [6] and Howes and Robinson [17] follow similar beliefs of the staging required in

achieving project success. A thesis generated analysing the beneficial effects that extending the design phase to include operation and maintenance components have on infrastructure projects [18] found that maintenance-related issues were the most critical technical processes within projects that significantly impact a project's success. Currently, the primary issue that requires addressing is the divide and un-integrated approach between the planning and design phase and the construction, operation and maintenance of projects as outlined in the thesis [18] and supported by Sultana et al. [4]. The integration of these units would enable optimal competitiveness between firms during different phase levels of the project life cycle, creating the ability for saving and an overall better value for money.

Sultana et al. [4] expands on the current issue of the negative effect a design-bid-build process has on the delivery of projects. It was found that the method encourages projects to originally be priced on tight budget constraints and award contracts with little consideration of exceeding the performance criteria and targets in order to reduce future maintenance costs [4,19]. To improve on such performance, the procurement strategies used globally to enable greater success over the entire project life cycle are to be addressed.

2.2. Procurement Models

The procurement process in civil projects is fundamental in achieving a project life cycle that benefits all involved, specifically the client and contractor organizations. This sub-section identifies how international procurement models have enabled improvement in the design phase of projects. Value in infrastructure projects does not come from the best tender or lowest cost to the client but rather from the most appropriate for the risk and value for money of that price. Often, value is incorrectly idealized to be how 'cheap' a project is, a view that needs to be resolved [20]. Early contractor involvement is an important model in infrastructure projects due to its attractiveness to contracting organizations resulting from the development of relationships and an overall collaborative approach to a project [21].

Incorporation of contractor involvement at the beginning of a project enables the design and decision-making processes to develop a higher level of buildability in the design. Designers tend to look at the buildability of a project with a systematic design thought process, whereas contractors are interested in flexibility in design during construction [22]. The attraction to such framework and involvement enables relationships between the different organizations to be developed at the front-end phase of a project, demanding frequent contact and interaction [23,24]. Song et al. [24] identified that, globally, countries employ different frameworks around contractor involvement in design. One such technique identified is to integrate design and construction into a design then build phase where the contractor selection occurs prior to the design phase. This goes against traditional methods of clients producing a design, followed by the bid for the contract and then construction of the design.

Scheepbouwer and Humphries [25] found that during a study of both contractors and designers, although the parties agreed that a framework of early contractor involvement can positively affect the delivery of a project, there remained potential for these positive effects to be neglected. This is resulting from the increase in collaboration and negotiation between the respective parties and, as such, potentially causing disagreements during the design phase. For the effective implementation of such a framework, the benefits to both parties should be identified and included in the initial negotiations between the designer and contractor.

A study of two major infrastructure projects at an international scale found that removing the cost aspect of a contractor's application can benefit a project's success [3]. This can be achieved by having a primary evaluation of the quality to price relationship rather than a bidding contest between contractors. A suggested framework involves the designers formulating specific performance requirements and close consideration of the health, safety, and environmental aspects of the project that contractors must identify the mitigating measures for in the proposal [3].

The previous research specific to procurement strategies on an international scale follow common focuses. A collaborative focus on project delivery is achieved through a front-end procurement focus. Early contractor involvement procurement models have been shown to be effective on an international scale and similar principles can be adopted to New Zealand conditions to benefit New Zealand's infrastructure life cycle. When designing a framework to represent this in New Zealand, considerations need to be taken into the efficiency of the designs generated to ensure the benefits of contractor involvement does not hinder a designer's ability to complete the project plans. The overall benefit of a well-performing infrastructure life cycle somewhat relies heavily on the ability to achieve success and the accountability of those involved at a firm-level operation phase. Effective operation within organizations enables an effective link between the key project phases discussed; however, it relies heavily on the incorporation of correct procurement models.

3. Firm-Level Operations

Firm-level operations embody the performance of the functioning of an organization post the design and decision-making phase. A critical analysis of organizational performance regarding their labor productivity, organization end-to-end processes, risk management, and business maturity allows for accountability of their practices in the delivery of projects. Project success is a joint process between designers and construction; hence, this section investigates how these contributors can be measured in terms of various categories to ensure that firms are being held accountable for their participation in a project. The learnings developed in the literature on an international scale may provide learnings relevant to New Zealand projects. Initially, internal end-to-end processes of delivery models within organizations are to be reviewed to identify any significant learnings within firm-level operation.

3.1. End-to-End Processes of Project Organizations

This sub-section provides a review of internal processes used on an international scale. The research on these processes internationally will enable the identification of areas where New Zealand can implement specific strategies to allow for a better performing supply chain. Effectiveness in the everyday operations of a firm's end-to-end process allows insight into relationships and struggles from all levels of the industry. A study of the Korean Train Express project identified five key issues in the end-to-end process of the operations that resulted in cost and time delays [26]. These included:

- The owner's ability and experience to manage projects of this scale was insufficient.
- Environmental concerns were raised by members of the public causing conflict and resulted in changes to the routes of the express train.
- The project delivery system was insufficient.
- Project scheduling failed to be tailored for projects of such size.
- Design changes of main components of all networks.

The economic impact of such challenges, as seen in the Korean Express Train study, is considered by Flyvbjerg et al. [27] to be an effect of the original cost estimates and tendered price having no consideration for overruns in the project. It was found that often in projects, contingencies are set too low and, although changes are foreseen in projects, failure to account for the impacts is not considered. Other factors often mislead in the budgeting of projects include a change in exchange rates, quantity and process changes, the cost of sustainable health and safety practices, and the environmental demand [27]. Furthermore, another study has identified that alterations to plans, restricted information on geotechnical data in the field, incompetent project management and design-related problems also result in delays in the end-to-end process [4]. The issues identified to allow for initial considerations to be carried out around similar aspects of the infrastructure supply chain in New Zealand.

The research shares similar perspectives hence one can be confident that these international issues may be relevant to other parts of the world, including New Zealand.

Alterations in plans and deviation from the original design have impacts on the timeframe and budget requirements in projects. Similarly, project scheduling and management within projects have negative impacts on the end-to-end efficiency within firms. Within a firm, there is an element of risk when undertaking a new project; however, the identification of exactly where the risks fall within the participating organizations of a project can be difficult. Risk management is often related to the maturity of an organization in terms of both its management and values. Risk management and business maturity are arguably two of the most important terms that impact the collaboration and success of projects. Hence, research into risk management and business maturity will support the learnings within the end-to-end processes to develop a more resilient framework for the improvement in New Zealand's infrastructure supply chain performance.

3.2. Risk Management and Business Maturity

This sub-section supports the international learnings to producing better firm-level operation practices relevant to a New Zealand context. The research classifies how risks are managed and the benefit that mature organizations have when reducing the risk at a firm level. Risk management principles are important to manage as it allows for the planning of unforeseen events and generated strategies to identify project strengths, weaknesses, opportunities, and threats [28]. Duggan [28] identified that successful projects realize the risks early in the project life cycle and are thus better prepared to reduce the potential effects they may have on the project goals.

Risk to a specific supply chain can be derived dependent on the line of the supply chain [12]. Gurtu and Johny [12] uses effective communication methods to demonstrate this in various ways. A supply chain can be classified into different areas according to the sources of risk and management [12,29]: as organizational risks, environmental risks [12,30], demand and supply risks [12,31], industry and organizational risks [12,32], and network risks [12,33]. The different risks identified often result in conflict between organizations as to who is responsible for the risk.

A risk management maturity study out of Nigeria revealed that organizations have, in the past, struggled to comprehend and address effective risk management processes. A systematic rollout of maturity analysis of organizations can be used to assist owners to assess and manage the relative strengths and weaknesses of the risk. The maturity analysis data can proceed to assist clients during the selection process for contracts, effectively increasing the standard of how risk is dealt with, thus improving business maturity results in increased productivity [13]. Maturity analysis and assessing risk management techniques allow for risks to be shared across clients and contractors, improving the quality of construction and maintenance whilst reducing a client's risk for cost overrun and production of poor quality work [4]. A collaborative business approach rather than a traditional method further emphasizes a greater understanding of some of the risks over all organizations as opposed to merely the client. This enables a collaborative approach for risk mitigation through all organizations to be utilized rather than passing the risk on to the next organization [34].

Heravi and Gholami [35] identified an important discussion point: while the risk management maturity of an organization may result in greater cost and quality aspects, supporting previous arguments, the project duration is constant and will not reduce. A collaborative approach to business [34] suggests that the integration of organizations to uphold maturity will reduce the likelihood of a project exceeding the timeframe. Consequently, the direct increase in productivity related to cost and quality improvements results in the satisfaction of timeframe targets.

MacDonald [34] has produced a model to assess business maturity in five key areas of focus: owner capability, governance, organization, integration and digital transformation. In such projects, the maturity matrix will rate the organization into three categories based on these key areas: simple collaboration, integrated functions and relationships, and high-performing enterprises. Such a model in a collaborative industry enables organizations to

account for the different principles and ensures high-performing enterprises are a point of difference when applying for contracts.

The current research identifies relevant risk management categories and addresses that through assessment of these, the owner of each can be identified. Risk ownership has been identified as a complex issue; hence, a framework to provide clarity of risk ownership is a focal point in the development of New Zealand's infrastructure supply chain. Research indicates that maturity within organizations enables greater overall project success. Organizational maturity was also found to be a contributing factor in risk reduction as mature, well-performing firm-level organizations are supported by a delivery team that are capable to achieve project outcomes. To produce a more holistic view of the firm-level operations, consideration as to the impact that labour has on productivity is required.

3.3. Labour Impact on Productivity

A review of productivity created through skilled labour, specifically at a firm-level phase, is essential such that an improved delivery model can be achieved, particularly if the motivating factors within the front-line delivery team are considered throughout the entire supply chain.

Skilled labour has a direct link to an increase in a business's reputation and ongoing success due to increased productivity and work quality, and decreased potential for rework [36]. Labourers with higher skill levels and expertise have a greater impact on the efficiency and effectiveness of projects and thus must be considered in more detail when analysing the effectiveness of project execution [37].

The effect of skilled and productive labour is dependent on a variety of factors. Halkos and Bousinakis [38] found that when analysing the effect of stress and satisfaction on productivity, there were clear factors that can impact the productivity of labour. It was found that increased stress within the workplace results in a decrease in productivity, whereas those who find satisfaction in their work will be more productive. The introduction of a framework to enhance positive traits in organizational policies to improve employee performance has the potential to lead to an increase in optimism, well-being, and personal strength; therefore, employees will have increased focused and are happier and more satisfied [5].

Barbosa et al. [1] found that one of the four core causes of low productivity in construction was due to insufficiently skilled labour at the frontline and supervisory levels. This is particularly concerning given that employees trust that organizations have the ability to ensure they are comfortable and satisfied within their role [38]. Trust and satisfaction in roles enable employees to achieve increase their productivity as it allows individuals to take pride in everyday tasks.

The research highlights key areas from which New Zealand can learn from. The research indicates that productivity improvements are achieved through skilled labour. The documentation identifies multiple contributing factors and methodologies to increase skill within workforces. Finding purpose and reducing stress in the workplace are two common factors that improve productivity within employees. Studies from firm-level operation suggest that a collaborative supply chain will improve the end-to-end processes, better manage risks, improve business maturity, and help improve labour productivity through a more purpose-focused workforce. Analysing international collaborative business models to refine the method New Zealand uses would enable the current supply chain relationships to improve.

4. Collaborative Business

The effectiveness of both the project life cycle and the firm-level operation phases can be positively impacted by the collaborative business. Collaborative business is becoming increasingly popular globally to ensure project deliverables are satisfied, reducing unnecessary cost and time overruns and improve the overall project success. Collaborative business requires organizations within the project to work together from an early stage, thus having

a common focus that will not only benefit the overall project outcomes but enhance the economic prospect for individual organizations. Collaborative business is underlined by the ability to generate a strong set of values that all participating organizations will accommodate in their phase of the project. This section identifies the key principle of collaborative business, a value-driven approach, and looks at models used overseas that have relevance to New Zealand's infrastructure supply chain.

4.1. Effect of Value Driven Business

Value-driven business underpins the collaborative business concept. The incorporation of key performance indicators specific to project needs enables all organizations and personal to work to a common set of values. Value-driven business enables a company to not only define their scope of works but also assists in defining intangible attributes such as business culture. A strong business culture created through values has the ability to create a positive, productive organization which entices customers and employees to contribute to the long term goals of the business [39].

The demand for developing organizations that create 'value through values' and 'profit through purpose' has a dramatic impact on overall business effect [9]. Polman [9] found that since the COVID-19 pandemic, companies in the United States of America who hold purpose at their core achieved 30% more profit than others. Business sustainability and a zero-carbon initiative creates purpose within a business's practices. Creating business models that uphold values close to them in both business and innovation creates purpose-driven leaders who will create more motivation and develop better relationships within industry through common value and initiatives [9]. A well-performing, integrated team can incorporate values such as social capital to improve the relationship between employees but also between different organizations. This will include the relationships in different levels of business and between business groups within the infrastructure sector [40].

A leading advocate for value-driven business is in the UK, known as Project 13. Project 13 is an industry-led response to infrastructure delivery models that are currently not just failing clients and their supplies, but also the operations and uses of the infrastructure systems and networks. Project 13 defines a high-performing enterprise as the development of contracts based on trust and relationships driven by well-defined value [34]. Additional studies out of the UK have found that lead contractors hold value and interest in a collaborative approach to construction. The frustration within contractors supports the vision that, although traditional methods of contractor selection are corrupt, these practices are still used. Collaboration between clients, consultants, and contractors is outlined in the study, which can be achieved through common values and industry practices. Customer-driven projects have the ability to create a more collaborative user, with consideration not only to the design and construction processes, but also the needs of the customer and end user [7].

Research has identified the benefit that value creation has on organizations and across the supply chain. These international examples of value-driven business emphasize the importance to broadly review the entire life cycle of projects when scoping a project, particularly analysing internally the positive effects that driven principles can have on firm-level operations. In addition to the value creation principle that underpins a collaborative approach, research of real-world collaborative business approaches worldwide can provide learnings that are applicable to New Zealand.

4.2. Collaborative Business Approaches Worldwide

Collaborative business approaches have been created in other countries with a positive effect on infrastructure project success. This sub-section provides real-world examples of where a collaborative approach has been successful and provides concepts that can benefit New Zealand's approach to a more collaborative supply chain.

Collaboration can be used to create real value through organizational competence, providing an advantage over other organizations [41,42]. Humphries and Wilding [41]

produced a framework that analyses a 3C network of co-operation, co-ordination, and the application of trust within a business. 3C behavior encourages organizations working jointly to achieve mutual benefits due to the implementation of operation processes in harmony with the strategies and objectives of the parties involved [43]. The framework identifies trust to be an attribute that promotes improved relationships in business, strengthening the willingness of organizations to rely on one other in project delivery, long-term [43]. This involves either party to be equally considerate of economic, social, and environmental implications [44,45].

IMAGINE, an enterprise set up to allow for system changes in the business industry, work with CEOs in different industries, worldwide, to enable purpose to be at the heart of the business. Deep and collective leadership is considered to have the ability to create a deeper social and environmental impact to improve sustainability [46]. This is a particularly pressing issue considering over 99% of CEOs believe that sustainability will be important for future business success [44]. Currently, IMAGINE has over 30 leading food companies working in collaboration to develop a global system to move towards one consumer labelling system and reduce confusion. Similarly, IMAGINE has approximately 30% of the fashion industry working in partnership to increase the speed and scale of system changes required in the fashion industry [9]. To develop conversations, a specific framework is required such that one can identify the maturity of different organizations. The UK currently has a large-scale project, Project 13, that is developing research ideas into this.

Project 13 engage utilizing a slightly different approach, where a common analysis of different organizations within industry is used to create understanding around different levels of the supply chain and how one's maturity can impact another's productivity. Through the implementation of five 'pillars', Project 13 enables for smarter, improved and higher performing outcomes in infrastructure. The project identifies that a more collaborative industry allows advisors, key suppliers, and owners to work cohesively whilst also allowing a contractor to have increased input on the clients decisions for the overall benefit of the project [34].

A key principle identified in the research was the benefit that growing inter-organizational relationships has on projects. Such inter-organizational relationships have the ability to create industry-wide changes to benefit the entire supply chain. Similar methods of business are yet to be identified in New Zealand; however, there are benefits, provided the entirety of high-powered people are involved in the approach. Such an approach has been identified as being beneficial to the infrastructure life cycle and enabling more success at firm-level operations. The literature provides strong evidence that a collaborative industry approach will be beneficial to both the productivity of organizations and the overall sustainability of business.

5. Discussion

This review outlined some key learnings from international research that has to potential to be adapted to New Zealand conditions to improve the infrastructure supply chain. The initial review of the infrastructure life cycle demonstrated the need to understand how the key phases within the life cycle interact and how these phases change dependent on the project requirements. It was found that incorporating organizations in multiple phases of a project can result in varying procurement models. Additionally, early contractor involvement was identified in the literature as having major success on improving the buildability of projects.

A major challenge identified in the industry when looking at the firm-level operations of projects in the supply chain is risk management. The current system results in the client bearing the majority of the project risk, enabling contractors to better the outcome for their organization rather than considering the overall project sustainability and success on the end user. It was found that risk management can be achieved through organizations analysing their internal maturity. A project involving mature organizations has better project risk management.

The literature presented the effectiveness of an industry to manage the life cycle and firm-level operation issues using a collaborative approach. Value-driven business is the most effective way to ensure collaboration and common goal achievement through a project. Collaborative business models require organizations in project to work together on a project from an early stage to meet all requirements during design, construction, and maintenance.

The likelihood of New Zealand's current infrastructure supply chain adopting the literature and implementing it to produce a framework relies on the relevance to New Zealand's applications. Much of the literature is project specific and is founded on several overseas case studies that have used similar principles to be successful. The lack of New Zealand research in this field proves the biggest challenge in cementing the findings of this review.

New Zealand requires infrastructure to be the backbone of the COVID-19 recovery; hence, a framework must be developed to overturn the current decline in production within the industry. To ensure success in all ready projects, New Zealand can learn and adapt from the literature, where relevant, on a project by project-based system. To be successful, the industry must be conservative in using these learnings in a New Zealand context, to avoid an unwilling initial response from industry leading organizations.

6. Future Directions

The lack of research specific to the New Zealand Infrastructure industry requires consideration. Although framework into different aspects of the supply chain shown above demonstrates that studies on similar topics have been considered previously, New Zealand conditions and government structures may affect these practices. In particular, the internal process between different organizations within the supply chain of infrastructure project delivery have not been considered, nor has the collaborative business approach, which has the potential to prevent time and cost consequences on infrastructure projects.

The research has followed a broad view of contracting organizations; therefore, there remain gaps in the daily process performance of contraction organizations. Collaboration as a link between clients, consultants, and contractors has been identified in the study; however, research into the internal processes within a contracting organization is lacking. To effectively develop a framework for monitoring the productivity of the industry, labourers and operations must be consulted to better understand daily frustrations that may arise.

The improvement in infrastructure quality and productivity resulting in the likelihood for government investment in more infrastructure projects has been identified as an area of further research. Studies have identified the benefits of improved productivity on project outcomes; however, identification into how this can create industry-wide investment will likely promote more interaction from organizations to apply a new level of thinking. Studies into this have yet to be carried out, but are expected to be a point of difference in the research.

Current business models are changing to adapt with the effect of COVID-19. Much of the research was conducted in a pre-COVID-19 status. Understanding how New Zealand can incorporate and apply the discussed research, along with the new challenges that have arisen from the pandemic, is one of the challenges found in the research area. Although this challenge will not have a significant impact on the operation of businesses as organizations and within industry-wide processes, a new approach to work in an unpredictable environment may force industry-wide changes where information is limited, thus requiring research.

It is recommended that moving forward, New Zealand's infrastructure sector begin to implement the findings from international successes into their projects. The review has identified that, internationally, the industry is changing; hence, New Zealand needs to maintain its status and move towards the latest principles. Additionally, to ensure that the issues identified in this review are relevant to New Zealand conditions, it is recommended that additional studies aim to involve industry leaders in New Zealand are carried out.

7. Concluding Remarks

This review was able to provide learnings for New Zealand's infrastructure supply chain that benefit the ability to achieve greater success in projects. The current infrastructure supply chain in New Zealand results in negative impacts on the overall productivity, quality, duration, and cost of projects. The literature identifies several key issues surrounding project delivery success. This review identifies ways in which infrastructure project life cycles are viewed internationally, specifically looking at key project phases and procurement models. The different phases of a project often are separated, and the maintenance costs of a project commonly become a burden for the client; hence, construction contractors look for cost-saving measures to maximize their profit. Early contractor involvement was found to increase the likelihood of project success as the buildability of design results in less frustration and shortcutting of construction due to flaws in the design. At a firm-level operation phase, it was found that the implementation of a framework to improve an employer's productivity will result in improvement in the end-to-end performance within an organization. Risk management and business maturity were found to have dramatic effects on project success and the selfish nature of organizations is a direct representation of immature business and the lack of risk sharing. Contrarily, collaborative business approaches worldwide have shown the positive effect that value and purpose-driven businesses can have on resolving the design, decision making and firm-level operation implications of a project. The research enables New Zealand's infrastructure to be reviewed according to successful implementation of techniques utilized internationally, enabling the development of a comprehensive framework to improve the processes used within the supply chain.

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