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Project Risk Management in Public-Private Partnerships: An Equitable Risk Allocation Decision Model based on Psychometrics

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An Equitable Risk Allocation Decision Model based on Psychometrics

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An Equitable Risk Allocation Decision Model based on Psychometrics

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ABSTRACT

Public-private partnership (P3) procurement has grown into an internationally acclaimed means of achieving value for money while procuring public infrastructure projects. Unlike conventional infrastructure procurement models, P3s transfer a considerable amount of project risk away from the public sector to the private sector. During a long, methodical procurement phase, public and private partners reach a final risk allocation agreement over forecasted risks regarding a project's potential design, build, finance, operation, and maintenance.

This thesis begins with exploring the P3 procurement phase, highlighting relevant project actors and stages leading up to the signing of a final contract. The concepts of risk and project risk management are studied under the assumption that P3 project partners operate under a principal-agent relationship, where public authorities are tasked with aligning private partner motivations with their own motivations through contractual incentives.

A core literature database provides 54 identified P3 project risks along with their suggested sectorial allocations. Exactly half – 27 – of these risks are deemed contentious because they are not unanimously allocated to a given sector within the database. These 27 contentious P3 project risks were subjected to an expert questionnaire asking Canadian practitioners to allocate them to a preferred sector based on a five-point semantic differential scale. The respondent pool was equally comprised of public and private sector practitioners from an array of specialized occupations relevant to P3 project risk management.

Expert input was subjected to various quantitative methods that measured: (i) levels of agreement within sectors over risk allocation preferences, (ii) levels of agreement between sectors over risk allocation preferences, and (iii) overall risk allocation preferences based on the five-point semantic differential scale. It is found that: (i) both sectors enjoy strong levels of agreement over risk allocation preferences, (ii) 6 of 27 risks show statistically significant levels of disagreement between sectors over their allocation preferences, and (iii) there are risks that should generally be borne by either the public or private sector pending individual P3 project circumstances.

The research findings should enable scholars and practitioners alike to establish more concrete conceptions of where P3 project risks should generally be allocated pending circumstantial conditions unique to different P3 projects. Where risks cannot be broadly allocated due to circumstantial conditions, a review of the study's final risk allocation model provides contextual considerations that influence their allocation. Concluding sections acknowledge this study's methodological and theoretical limitations. Recommendations for future studies to consider, both methodological and theoretical, are provided.

DEDICATION

In memory of Vito Badalamenti. Our time spent together was brief, but you've left an everlasting impact on me through your granddaughter and family. I promise to cherish all the good you have brought into this world.

ACKNOWLEDGEMENTS

Back in September 2015, my brother introduced me to a critically acclaimed sitcom, *Rick and Morty*. By October, I was hooked; I had finished watching both the first and second seasons. To my dismay, the closing comments of the second season were: 'tune in to *Rick and Morty* Season 3 in like, a year and a half, or longer, to see how we unravel this mess!' Since that time, I've experienced a mess of my own, albeit glittered in positive moments. As is the saying, 'give me the bad news first': for the past two-plus years, up until very recently, I have spent – on average – about half my days in bed.

When I was granted waking hours of the day, they were conditional on me being perpetually exhausted. Balancing my academic, social, and work life seemed like an insurmountable process. Another saying comes to mind: I was a shadow of my former self (if you can't tell already, it's been hard refraining from idioms while writing this thesis)! Fast-forward to fall 2016, and I find out that my sinuses and tonsils were causing obstructive sleep apnea (I instinctually bracketed off text to write 'OSA' there; it appears grad school has gotten to me). The good news, I have been recently rescued by my CPAP machine (trying hard to ignore the ironically placed colloquial acronym). The better news, I underwent a tonsillectomy that fixed the problem before my 'oral' defense (it's also been difficult to refrain from incorporating dad jokes into my writing, or bracketed run-on comments as it seems).

Until very recently, my energy levels could not keep up with the personal and professional expectations I've grown accustomed to meeting. I cannot make up for the lost hours spent working in vein over the course of my M.A. journey. I can, however, view the past for what it is and the future for what it can be; if I may paraphrase Friedrich Nietzsche, 'the future influences the present just as much as the past.' Luckily, my present is continually influenced by an overwhelmingly loving circle of friends and family that have been supportive in their own respective ways throughout this entire process.

To my Zia Franca and Nonna Rosa, who have provided me with Maslow's first four needs for the past ten months, I could never repay you for the timely support when I needed it most. Between Nonna's pasta and Zia's words of encouragement, I found the strength to spend long days behind my computer screen – you are both my second and third mothers, and I wouldn't trade you for the world.

To the final piece of that tripartite, thank you mom for constantly reminding me to push myself and be proud of my work in all facets of life. I attribute this thesis and my Board of Governors Medal to the work ethic you've instilled in me from a young age. To my dad, for playing an important role in helping me find my work ethic again through the aid of a Green Shield-procured CPAP machine, thank you… I'd like to say this is a joke, but I wouldn't have completed this project without my CPAP, and it's not a cheap device!

To the person who has impacted my life the most since I began this project, thank you Lauren for your love and support. You have been both selfless and compassionate throughout the trying times and I am so privileged to call you my girlfriend. A big, big shout out also goes out to Rita and John Miceli for ensuring my study got off the ground. It is hard to be unabashed in the face of the support your family has offered during this journey.

To Jason, our co-efforts have recently shifted from the weights to the books, and you have allowed me to enjoy both experiences substantially more than if I were working on my own. Thank you for constantly being up for prolonged study sessions and keeping your apartment free as if it were my own – you're truly a brother to me. To my blood brother, Matthew, start visiting Nonna more often – she misses you!

A special thank you goes out to Dr. Bob Arnold at the University of Windsor. Few at this institution rival your knowledge of quantitative methods – even fewer rival your benevolence. Thank you for your many responses to my many inquiries. Your guidance was invaluable to me. On this note, I must also thank the always-capable Aaron Bondy for taking the time to elucidate foreign mathematical concepts to me. I owe you dearly old friend.

Thank you Dr. Jeff Berryman for taking the time out of your busy days to evaluate this work. Thank you Dr. John Sutcliffe for being an ever-present mentor during my six years under this wonderful department. There have been a handful of times where I sought your assistance and you never wavered in your support. Your treatment of subordinates reminds me of what true leadership means. In light of the political climate of our bordering neighbours, it is integral to our social fabric that people like you continue to lead with dignity and respect. You are a true role model for your students and staff.

Speaking of role models, I am happy to say that my M.A. has brought me under the very large wings of Dr. Bill Anderson at the Cross-Border Institute. I can count the funding I have received from the University of Windsor and the CBI over the years, but I can't put a price on having people like yourself and Dr. Sutcliffe in my corner. In the 'early days,' I was happy to establish a rapport with my supervisor; light-hearted, off-topic conversations were frequent and enjoyable. As my defence deadline became more imminent, talks about Deflategate and fishing turned into talks about entropy and assumptions of equidistance between ordinal variables. I must say that I am appreciative of both types of meetings. Your coalescence of character and ability is something I admire and wish to emulate – thank you for being a fantastic mentor and friend.

A final thanks goes out to Dan Harmon, co-creator of *Rick and Morty*. Back in 2016, I watched a short interview that influenced the remaining entirety of my research. To paraphrase Dan, he said that you end up making 'good stuff' by making 'a bunch of bad stuff.' Dan reminded me it is a 'cardinal sin' to assume your job is to make something good without error.

Whether you're writing an M.A. thesis or writing a universally acclaimed sitcom viewed by millions of people, 'your definition of good will change as you get better.' The only way you can get better is by throwing out the terror of suboptimal work and being prepared to 'make something that sucks. Then criticize it and fix it.' No one is 'going to make all the right choices' from the onset. You need to be prepared to 'make something that sucks' in order to expand your capabilities to make 'good stuff.' With Dan's imparted wisdom, I began my journey into P3 literature in 2016 without fear of the monumental task in front of me and without fear of how little I knew.

It has been over a year and a half since I watched the Season 2 finale of *Rick and Morty*. Since then, I have come to terms with unfortunate medical conditions, met my girlfriend of a year, and completed an M.A. thesis. Despite 2016's roadblocks, I've been able to produce something I am proud of by taking Dan's advice and running with it. When things slowed down to a jog, I remembered that the path to good work is not flatly paved; you're going to trip and fall sometimes on the way to success – and that's *OK*. Thank you, Dan.

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LIST OF ABBREVIATIONS

ACEC – Association of Consulting Engineering Companies

AFP – alternative financing and procurement

BOO – build-operate-own

BOOT – build-operate-own-transfer

BOT – build-operate-transfer

CAPR – common area payment reduction

CCPPP – Canadian Council for Public-Private Partnerships

CI – Confidence Interval

DB – design-build

DBF – design-build-finance

DBFO – design-build-finance-operate

DBFOM – design-build-finance-operate-maintain

DBOM – design-build-operate-maintain

DOF – degrees of freedom

EC – European Commission

EU – European Union

HR – human resources

IERC – Independent Expert Review Committee

IISD – International Institute for Sustainable Development

JV – joint venture

KDLD – Hong Kong Disneyland

LCL – Lower Confidence Level

MAE – material adverse effect

MCL – Melbourne City Link

MTO – Ministry of Transportation Ontario

NPM – new public management

NSR – New Southern Railway

NTSA – National Treasury of South Africa

OAG – Office of the Auditor General of Canada

OECD – Organization for Economic Cooperation and Development

P3/PPP – public-private partnership

P3 NCOE – P3 National Center of Expertise

PFI – private finance initiative

PRM – project risk management

PSC – public sector comparator

PUMC – Philips Utilities Management Corporation

PWGSC – Public Works and Government Services Canada

RFP – request for proposals

RFQ – request for qualifications

RMA – risk mitigation alternative

ROD – record of decision

SPSS – Statistical Package for Social Sciences

SPV – special purpose vehicle

TBS – Treasury Board Secretariat

UCL – Upper Confidence Level

UFR – usage fee reduction

USA – United States of America

VDTF – Victoria's Department of Treasury and Finance

VFM – value for money

WDBA – Windsor-Detroit Bridge Authority

WEMG – Windsor Essex Mobility Group

LIST OF SYMBOLS

m_{Spub} – solely public membership function

m_{Mpub} – mostly public membership function

m_{ES} – equally shared membership function

m_{Mpri} – mostly private membership function

m_{Spri} – solely private membership function

σ – population's standard deviation

U – population's mean value

Z – Z value taken from normal curve table

$X_{10\%}$ – range of data encompassing ten percent of an assumed normal distribution curve, equally split between each side of the mean

CHAPTER 1

A NATIONAL CONTEXT FOR P3s

1.1 Introduction

Public-Private Partnerships (P3s) are rapidly emerging as a predominant form of public infrastructure procurement in Canada in lieu of conventional methods due to their capacity for accessing alternative financing sources and transferring multiple project risks away from the public sector. The emergence of P3s in Canada originates from the public sector's "new public management" (NPM) approach to governance in response to globalization pressures and increasing levels of both infrastructural necessities and public debt.[1] Under NPM, P3s are used to procure public infrastructure more efficiently by drawing private actor investment and involvement into the public sphere.

On an international level, governments are globally embracing P3s as a means to procure new infrastructure – and services – to address an "infrastructure deficit."[2] The European Union (EU), World Bank, and Organization for Economic Cooperation and Development (OECD) have all developed regulations, guidelines, and promotional campaigns for the global use of P3s,[3] while the European Commission (EC) publicly

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[1] Darrin Grimsey and Mervyn Lewis, *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance* (Edward Elgar Publishing, 2007).; Biljana Rakić and Tamara Rađenović, "Public-Private Partnerships as an Instrument of New Public Management," *Facta Universitatis-Series: Economics and Organization* 8, no. 2 (2011): 207–20, http://scindeks.ceon.rs/article.aspx?artid=0354-46991102207R.

[2] Anthony E Boardman, Matti Siemiatycki, and Aidan R Vining, "Public-Private Partnerships in Canada and Elsewhere" 9, no. 12 (2016), 1.; Eoin Reeves, "Public—Private Partnerships in Ireland: Policy and Practice," *Public Money & Management* 23, no. 3 (July 1, 2003): 163, doi:10.1111/1467-9302.00364.; Geethanjali Nataraj, *Infrastructure Challenges in South Asia: The Role of Public-Private Partnerships*, *ADB Institute Discussion Papers*, vol. 80, 2007, 5. http://www.adbi.org/discussion-paper/2007/09/27/2364.infrastructure.challenges.south.asia/.

[3] European Commission, "Guidelines for Successful Public Private Partnerships," *DG Regional Policy Http://ec. Europa. Eu/regional_policy/sources/docgener/guides/ppp_en. Pdf* (Brussels:

termed the "Investment Plan for Europe" – a monolithic investment program premised on procuring public infrastructure through large-scale financing from the private sector[4] – its number one initiative in the EC's new "roadmap for getting Europe back to work, based on clear priorities… to boost [its] economy."[5] In North America alone, cumulative P3 investments reached over 200 billion dollars in either planned or realized monies by 2010.[6] In the United States, the Obama administration heavily considered policies to attract private financing and investment of large infrastructure projects.[7]

North of the American border, Canadian governments have embraced P3s even more than their neighbouring state; scholars note that "there has been much more P3 activity in Canada than in the USA."[8] The 2011 Canadian federal budget introduced measures to ensure the national use of P3 projects increased, making it mandatory for government departments and agencies to assess and evaluate the feasibility of procuring large pieces of public infrastructure – or megaprojects – through P3 contracts:

European Union, 2003); Banco Asiático de Desarrollo, Banco Asiático de Desenvolvimento, and others, "Public Private Partnerships Reference Guide Version 2.0" (Washington, D.C.: World Bank, 2014); OECD, "Recommendation of the Council on Principles for Public Governance of Public-Private Partnerships," *Oecd* (Paris: OECD, 2012), https://www.oecd.org/governance/budgeting/PPP-Recommendation.pdf.

4 European Commission, "European Commission Investment Plan," 2015, http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52015DC0012&from=EN.

5 European Commission, "A New Start: European Commission Work Plan to Deliver Jobs, Growth and Investment" (Strasbourg, 2015), par. 4. http://europa.eu/rapid/press-release_IP-15-6308_en.htm.

6 In American dollars. See Public Works Financing, "Public Works Financing Major Project Database" (Peterborough, NH, 2016), http://pwfinance.net/projects-database/.

7 White House Press Secretary Office, "Increasing Investment in U.S. Roads, Ports and Drinking Water Systems through Innovative Financing," 2015, http://www.nawc.org/uploads/documents-and-publications/documents/2015 BUILD AMERICAN INVESTMENT THROUGH INNOVATIVE FINANCING FACT SHEET.pdf.

8 Anthony E. Boardman and Aidan R. Vining, "P3s in North America: Renting the Money (in Canada), Selling the Roads (in the USA)," in *International Handbook on Public-Private Partnerships*, ed. Graeme A. Hodge, Carsten Greve, and Anthony E. Boardman (Cheltenham: Edward Elgar Publishing, 2010), 355.

> Going forward, federal departments and agencies will be required to evaluate the potential for using a P3 for large federal capital projects. All infrastructure projects creating an asset with a lifespan of at least 20 years and having a capital cost of $100 million or more will be subjected to a P3 Screen to determine whether a P3 may be a suitable procurement option. Should the assessment conclude that there is P3 potential, the procuring department will be required to develop a P3 proposal among possible procurement options.[9]

Canada now boasts what is widely considered to be one of the most successful state models of P3s in the world.[10] At the end of 2016, a total of 247 P3 projects have been either approved for commission, under construction, or completed in Canada[11] across multiple public sectors[12] resulting in an estimated capital value of over 116 billion dollars.[13] As a global leader in P3 infrastructure procurement, Canadian federal,

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[9] Department of Finance Canada, "Budget 2011, The Next Phase of Canada's Economic Plan: A Low-Tax Plan for Jobs and Growth," 2011, http://www.budget.gc.ca/march-mars-2011/plan/chap4a-eng.html., 102.

[10] Mark Hellowell, "Public-Private Partnerships: What the World Can Learn from Canada" (The Canadian Council for Public-Private Partnerships, 2014.), http://www.constructcanada.com/wp-content/uploads/2014/08/canada_p3_white_paper_swg.pdf.

[11] I.e. from initial stages done post-project approval and pre-project construction – such as request for qualifications, request for proposals, or commercial close – to stages done post-project construction, such as the operations and maintenance phases of a P3 facility or complete expiration of the P3 contract entirely. See The Canadian Council for Public-Private Partnerships, "Canadian PPP Project Database" (Toronto: CCPPP, 2016), http://projects.pppcouncil.ca/ccppp/src/public/search-project.

[12] I.e. Transportation, health, energy, justice, education, accommodations, recreation, water treatment, and information technology. Supra note 9.

[13] In Canadian dollars. See Stephen Thorne, "The World Learns About P3s from Canada" (Toronto: The Canadian Council for Public-Private Partnerships, 2016), http://www.pppcouncil.ca/web/News_Media/2016/The_World_Learns_About_P3s_from_Canada.aspx.

provincial, and municipal governments are highly committed to incorporating private investment in their infrastructure projects, especially in the transportation sector.[14]

1.2 Defining Optimal Risk Allocation

P3 megaprojects are having a profound influence on Canada's infrastructural landscape, albeit the large majority of P3 projects in Canada are contracted primarily through provincial governments and in primarily urban areas.[15] As P3s continue to grow in national popularity, the need for a clear and cohesive dialogue between Canadian practitioners, from both public and private sectors, increases. One of the main factors considered in structuring P3s is risk allocation and transfer.

More specifically, the success of P3s is dependent on agreement between project actors over which parties will bear potential benefits or losses incurred from risks that may arise over a project's timeline. Factors like costs associated with mitigating a risk, the likelihood of a risk's occurrence, and a risk's potential severity to a project all play pivotal roles in deciding which parties should bear which risks, and how much they should be compensated for bearing them.

All notable project risks have the potential to directly affect a project and/or its actors adversely in two general ways: (i) a project's provision of responsibilities[16] or (ii) a project's financial capacity.[17] Since P3 advocates characterize the procurement process as an innovative way to meet service-based and finance-based objectives, mitigating risks

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[14] Charles Lammam, Hugh MacIntyre, and Joseph Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," no. May (2013): 1–78, papers3://publication/uuid/35113246-01FE-4BB2-8E7E-41064EFAA36D.
[15] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 1.
[16] For example, when a facility's construction is behind schedule.
[17] For example, when a facility's construction incurs unanticipated cost overruns.

that affect project responsibilities and financing is crucial. Where P3s deliver public services efficiently and economically, they create value for money (VFM), which is broadly defined as "the optimum combination of lifecycle costs and quality to meet user requirements."[18]

VFM will be elaborated on in the next chapter. For now, it is important to know that P3s are premised on obtaining VFM, and – of the factors that influence a P3's VFM – the allocation of project risk is one of the most critical. Risk transfer is "at the heart" of P3 procurement.[19] Indeed, the "core of a P[3] arrangement… is the transfer of appropriate risks from the public to the private partner."[20] The comprehensiveness with which risk is treated in P3 projects separates this highly innovative infrastructure procurement model from conventional procurement models. P3 contracts tend to be much more complex than conventional public-private contracts, as risk transfer and risk management are integral contractual components to the design, build, finance, operation, and management (DBFOM) of P3-procured public infrastructure.

While Chapter 2 explicates the major players and steps involved in P3 procurement processes, a general conception of risk allocation can be portrayed here. Risk transfer occurs on many levels in P3s. First, there is a primary transfer of risk from the public sector to the private sector – i.e. the P3 contract – followed by a secondary

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[18] A Roumboutsos et al., "Risks and Risk Allocation in Transport PPP Projects: A Literature Review," in *COST Action TU1001 Public Private Partnerships: Trends & Theory*, ed. Athena Roumboutsos and Nunzia Carbonara (COST European Cooperation in Science and Technology, 2011), 17-18, http://www.ppptransport.eu/docs/2011_12_Discussion_Papers.pdf.
[19] E R Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 2nd ed., Elsevier Finance (London: Butterworth-Heinemann, 2011), https://books.google.ca/books?id=fyHWtz7OepsC.
[20] Roumboutsos et al., "Risks and Risk Allocation in Transport PPP Projects: A Literature Review," 18.

transfer of risk delineated between private sector parties – i.e. subcontracts – leaving many potential opportunities for suboptimal risk transfer to take place. Of course, P3 actors do not possess clairvoyant capabilities; there will be parties that experience a more desirable project outcome than others pending which risks arise and which players they adversely affect.

However, through the educated input of public and private practitioners – whose opinions are supported by both theoretical knowledge of, and practical experience with, P3 risk management – the primary transfer of risk in P3 contracts can reach equitable levels to achieve what is referred to as optimal risk allocation. Optimal risk allocation is achieved when a P3 contract, which is signed at the end of the P3 procurement phase, transfers risks to the parties best able to manage them and at the most efficient cost.[21]

Figure 1.1 provides a broad summary of the theoretical advantages of using P3 procurement models in lieu of conventional procurement models. The following chapters expound on these concepts. For now, it is important to know that P3 benefits can only be realized through sound contracts premised on optimal risk allocation between both public

[21] Jennifer Firmenich and Marcus Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," in *New Forms of Procurement: PPP and Relational Contracting in the 21st Century*, ed. Marcus Jefferies and Steve Rowlinson (New York: Routledge, 2016), 71–94; Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada"; Bon Gang Hwang, Xianbo Zhao, and Mindy Jiang Shu Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," *International Journal of Project Management* 31, no. 3 (2013): 424–33, doi:10.1016/j.ijproman.2012.08.003; US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," no. December (2012): 44, http://www.fhwa.dot.gov/ipd/pdfs/p3/p3_risk_assessment_primer_122612.pdf; Mario Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," no. January (2010): 83; Yongjian Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," *International Journal of Project Management* 28, no. 5 (2010): 482–92, doi:10.1016/j.ijproman.2009.08.007.

and private actors. The remainder of this thesis delineates the P3 process, illuminates factors that affect risk allocation, and offers solutions based on original research premised on extensive literature reviews.

Figure 1. 1: Key features Distinguishing P3s from Conventional Procurement[22]

P3 Procurement Model	**Conventional Procurement Model**	**Comparative Advantage of P3 Model**
Output-based contracts	Input-based contracts	Promotes private sector *innovation* in building public infrastructure
Mostly or fully private financing	Mostly or fully public financing	Transfers *investment risks* from taxpayers to private sector
Conditional payments based on delivery	Regular payments in intervals	Gives *Incentives* to the private sector to work both on time and on budget
Integration of two or more project phases (i.e. design, build, operation, and/or maintenance)	Project phases contracted separately (i.e. design, build, operation, and maintenance)	Transfers project risks from taxpayers to private sector; this ensures *accountability*
Project management by private sector	Project management by public sector	Utilizes private sector's *expertise* in specialized fields

The goal of this thesis is to develop a clearer understanding of risk allocation in P3s, followed by developing further insight into what is required to arrive at sound risk allocation models between public and private actors at the P3 procurement stage. The assessment, allocation, and management of P3 project risks involve a plethora of players from public and private sectors alike. Thus, insights into the competing perspectives of

[22] This is a summative adaptation of Mario Iacobacci's original table; see Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," 3. The third section of the table concerning the comparative advantage of P3 models over conventional models is an original addition.

P3 actors – both public and private – based in Canada have been sought out and analyzed for empirical review.

1.3 Thesis Structure

The remaining structure of this thesis is as follows. Chapter 2 introduces the core lexicon of the P3 procurement process and its administration. A detailed overview of the general P3 procurement process, from its inception as a considered possibility to its completion at financial close, will provide readers with a comprehensive understanding of the many actors and stages involved in the signing of an official P3 contract. Once fundamental P3 concepts are explained, modern research trends and academic studies of focus are underlined in literature reviews of forthcoming chapters.

Chapter 3 provides a theoretical overview of how P3s can be examined and assessed. Theory frameworks and methodologies used to analyze P3 risk allocation and risk management are considered. Agency theory is then adopted to conceive of the relationship between public and private parties as a principal-agent relationship premised on self-motivation and a progressive separation between power and control. The theoretical concept of risk is examined and demarcated from uncertainty before assessing P3 project risk management (PRM) in the following chapter.

Chapter 4 outlines the PRM process in detail based on an extensive literature review. Concepts like pre-contractual PRM and post-contractual PRM, first-step risk transfer and second-step risk transfer, and risk identification, assessment, classification, and mitigation are explained to provide an overview of the PRM process for both public and private actors.

Chapter 5 presents a literature review of articles from which this thesis' original research is premised. This core literature database is comprised of a dozen articles that directly reference risk allocation preferences between public and private sectors. A cross-comparative analysis of the core literature database is conducted to arrive at sound risk preferences and contentious risk preferences. Sound risk preferences are defined as those given the same allocation preferences amongst the dozen pieces of literature that comprise the study's core database. Contentious risk preferences are defined as those that have been allocated to different preferential sectors at least once amongst the articles in the core literature database.

Chapter 6 presents an original psychometric study premised on the allocation preferences of contentious risks outlined in the previous chapter. Sound risks are not included in the study because it is assumed that their conclusive allocation preferences within the core literature database signifies a lessened need to conduct original research over their allocation preferences. An expert questionnaire is used to obtain risk allocation preferences of contentious P3 project risks from both public and private sector practitioners. Respondent views are measured using a semantic differential scale. The data is aggregated and analyzed through various quantitative methods to find patterns of risk allocation preferences for P3s both within and between the public and private sector. After a data analysis of the questionnaire's preliminary findings, explanations are proposed to describe identifiable patterns of reasoning within and between respondent groups. This chapter proposes an equitable risk allocation decision model premised on the study's respondent preferences.

Chapter 7 concludes with an acknowledgement of the study's limitations – both methodological and theoretical – and suggestions for future research, highlighting further recommendations for risk management and risk transfer in P3 literature.

Keyword searches include commonly used phrases and abbreviations associated with P3s, such as: public-private partnership (P3 or PPP), private financing initiative (PFI), alternative financing and procurement (AFP), design-build-finance-operate-maintain (DBFOM), build-operate-transfer (BOT), build-operate-own (BOO), build-operate-own-transfer (BOOT), project risk management (PRM), risk mitigation, risk transfer, and risk allocation, among others.[23] References retrieved from keyword searches were subject to content analysis to confirm their thematic relation to optimal risk allocation in P3s.

[23] PFI and AFP procurement methods "are essentially an outgrowth of the public-private partnership." These terms have been used interchangeably in literature to denote P3-esque projects. The use of different acronyms is often a matter of politicized rhetoric – contingent on geopolitical trends of different regions or politically-charged motives of public organizations. Plainly, "any arrangement which involves a government player and a [risk-bearing] private sector player may be described as a kind of public-private partnership." See Kevin McGuinness and Steve Bauld, "P3, PFI, and AFP: De-Cluttering the Terms Used Regarding Capital Asset Procurement," *Summit: Canada's Magazine on Public Sector Purchasing* 13, no. 4 (2010): 2, http://www.summitconnects.com/Articles_Columns/PDF_Documents/20100601/jun10_vol13_i4_07.pdf.

CHAPTER 2

THE P3 PROCUREMENT PROCESS

2.1 Introduction

Chapter 2 aims to both clarify P3 nomenclature and elucidate the P3 procurement process. Before conducting a literature review of contemporary P3 research on project risk management and risk allocation, it is necessary to develop an understanding and appreciation of the wide array of influential actors and project phases involved in P3 procurement. Because P3 contracts contain sensitive, privileged information, data on project bidding, project negotiation, and project implementation is scarce. A large amount of contractual data on the intricacies of P3 projects is inaccessible because private biding firms "are often reluctant to share information about their strategies."[24] Thus, an empirical assessment of primary data pertaining to specific policies between public and private parties is unfeasible.

However, theoretical models that explain the P3 procurement process, P3 project decision-making, and P3 risk management – especially from the public sector's perspective – are plentiful.[25] Such resources are used to conduct a literature review explaining the chronological P3 procurement process and the major actors involved. Concepts such as project risk, P3 player relationships, obtaining value for money, and the feasibility of conducting P3s in lieu of conventional models are explained largely from the perspective of the public sector.

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[24] Dennis De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," *Ku Leuven Faculty of Economics and Business*, no. 490 (2015): 13, https://lirias.kuleuven.be/bitstream/123456789/500596/1/PhD+dissertation+Dennis+De+Clerck.pdf.

[25] Ibid, 12.

Due to their situational nature, a consensus on the exact definition of P3s does not exist. P3 literature invites a multidisciplinary study of multiple industries, scopes, and sectors of focus.[26] Across the globe, different countries have their own varying experiences with P3 projects – so much so that scholars have argued in favour of assessing P3 projects on a country-specific basis in lieu of extrapolating results to develop global models.[27] There are, however, general characteristics of P3s that consistently arise in the literature examined: (i) P3s are a partnership agreement between public and private sectors for delivering infrastructure and/or services; (ii) the tasks and responsibilities involved in delivering infrastructure – which may include service components as well – are shared between partners; and (iii) the risks and rewards involved with infrastructure delivery are also shared.[28]

Also, it is generally accepted that the private sector is responsible for two or more of the following infrastructure tasks in any P3: (i) design, (ii) build, (iii) finance, (iv)

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[26] Disciplines used to assess P3s include political science, legal science, and economics. Industries of study include transportation, health care, and education. Scopes of study include international, national, jurisdiction-based, and case-based. Sectors of focus include project risk management, operations management, and project cost-benefit analyses. These lists are not exhaustive; P3 literature is not limited to the aforementioned examples.

[27] Albert P. C. Chan et al., "Drivers for Adopting Public Private Partnerships—Empirical Comparison between China and Hong Kong Special Administrative Region," *Journal of Construction Engineering and Management* 135, no. 11 (2009): 1115–24, doi:10.1061/(ASCE)CO.1943-7862.0000088; Ronald W. McQuaid and Walter Scherrer, "Changing Reasons for Public–private Partnerships (PPPs)," *Public Money & Management* 30, no. 1 (2010): 27–34, doi:10.1080/09540960903492331; Ofer Zwikael and Mark Ahn, "The Effectiveness of Risk Management: An Analysis of Project Risk Planning Across Industries and Countries," *Risk Analysis* 31, no. 1 (2011): 25–37, doi:10.1111/j.1539-6924.2010.01470.x; K S Rebeiz, "Public-Private Partnership Risk Factors in Emerging Countries: BOOT Illustrative Case Study," *Journal of Management in Engineering* 28 (2012): 421–28, doi:10.1061/(ASCE)ME.1943-5479.0000079.

[28] Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments"; Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada."

operation, and/or (v) maintenance (DBFOM).[29] It is assumed that all carefully structured P3 contracts are created in the attempt to promote the benefits of: an optimal share of risk and reward between partners, an optimal method of financing between partners, and performance-based conditional payments by which the public sector sets goals and the private sector micromanages the means to achieve them.

Performance-based conditional payments are contingent on a P3 contract's stipulations (e.g. timelines of completion and materials that should be used) whereby private actors incur either rewards or penalties based on their performance exceeding, meeting, or falling short of the public sector's stipulations.[30] This relationship generally transpires between the public sector's specialized crown corporations and a consortium of specialized private firms that form a "special purpose vehicle" (SPV).

While the private actor in a P3 theoretically consists of a single company, it is generally a consortium of multiple joint venture companies (JVs) that form an SPV. A consortium is an association of several companies forming a coalition to adequately address the diverse levels of specialized industry experience required to produce public infrastructure. Because P3s delineate a diverse array of tasks to the private sector aside from simply building infrastructure – contra conventional procurement methods – private sector consortiums (i.e. SPVs) must address an array of fields: finance (e.g. insurance companies and banks), law (e.g. public-private mediation, land use permits, and

[29] Samuel Carpintero, "Public-Private Partnership Projects in Canada : A Case Study Approach" 9, no. 5 (2015): 1; Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," iv; Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," iii.
[30] Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," iv-v.

environmental policy), engineering, construction, operation, and maintenance, among others.[31]

Another key aspect of SPV consortiums is that – despite being their own distinct legal entities – SPVs limit risks and liabilities transferred to them from public authorities. Financial burdens and project responsibilities are spread throughout different JVs under SPVs.[32] Potential risks transferred from the government to SPVs may include: project delays and cost overruns, erratic functionality of the finished facility, or the potential risk that the user demand and revenue stream projections denoted with a future piece of infrastructure are not realized.

In exchange for taking on various risks, SPVs can be reimbursed through: (i) availability payments, where the government directly compensates the SPV through pre-agreed periodic dates "based on the facility being available for use when needed and meeting certain requirements with penalties levied otherwise" (e.g. where government funds are allocated under the stipulation of safety regulations being met);[33] (ii) milestone payments, where the government pays the SPV through the completion of pre-agreed project standards;[34] (iii) full tolls, where the SPV retains all profit from the P3 facility for

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[31] Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," 4.

[32] While at first blush it may appear to be a benefit that firms can absorb a shared risk under a SPV consortium, this shared risk can also harm the project, as it leaves firms susceptible to a complex allocation of tasks and responsibilities, which can be especially harmful if issues arise in projects and there is no clear actor or outlet to blame. This will be elaborated on in Chapter 4, Section 4.4.1 during a case study on the Right Honourable Herb Gray Parkway.

[33] Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," 17.

[34] For milestone payments, like availability payments before it, payments "may be subject to a holdback provision or liquidated damages (penalties) should the private partner not fully meet the obligations as outlined in the project agreement's predetermined performance specifications." See Public Works and Government Services Canada, "Policy and Guidelines Supply Manual"

an agreed period of time; or (iv) shadow tolls, where payments are issued "from the public sector authority based on the use of the facility. Wishing to receive payment, the private operator has an incentive to provide suitable customer service, thus enticing drivers to use a road."[35] Any combination of these methods may be used to compensate SPVs.

Together, SPVs and specialized crown corporations interact under a mutually agreed upon contract to procure public infrastructure in Canada. The SPV consortium is usually incentivized with some future revenue stream over the life of a long-term P3 contract, which typically lasts 20 to 35 years.[36] Generally, the communal goal of P3s is to incentivize the private sector – known for possessing a presumably higher level of expertise and innovation than the government – to invest in large-scale infrastructure projects while absorbing a large share of accountability and risk associated with these projects.[37]

In principle, the aforementioned revenue streams are supposed to cover the private consortium's portion of investment in the project's DBFOM while including a margin for profit to be realized over the course of the project's lifecycle. Upon the end of the project's lifecycle, contracts are either renegotiated or ownership of the facility

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(Government of Canada, 2016), 9.60.45, e., https://buyandsell.gc.ca/policy-and-guidelines/supply-manual/section/9/60#section-9.60.

[35] Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," 17.

[36] Elisabetta Iossa and David Martimort, "The Simple Microeconomics of Public-Private Partnerships," *Journal of Public Economic Theory* 17, no. 1 (2015): 4.; Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 2.

[37] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," viii; Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," 32.

reverts back to the government.[38] In the event that asset ownership reverts back to the government, the P3 process has been referred to as a "rent to own" transaction; "that is, the public sector pays the private sector an annual rental fee for a specified period and then owns the asset at the end of that period."[39]

2.2 P3 Project Types

The aforementioned situational nature and complexity of P3s also means that their structure, or delivery model, will vary between projects. The delivery model is contingent on the public sector's infrastructural needs, the project's available funding options, the urgency associated with the project's timeline, the expert agents available for the project, potential risks associated with the project, and other strategic considerations.[40]

The private sector's involvement in DBFOM phases of a P3 project signifies its delivery model. While a literature review revealed that scholars consider a P3 to involve the private sector in at least two phases of DBFOM,[41] progressive interpretations of P3s are widely adopting a consensus that major private sector involvement in the *financing* of projects are a prerequisite to be considered an authentic P3. By this standard, a P3 project provides "project financing and also engages in at least two of the other [DBOM] activities… ensur[ing] that the private sector has some [financial] 'skin in the game.'"[42]

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[38] David Parker and Keith Hartley, "Transaction Costs, Relational Contracting and Public Private Partnerships: A Case Study of UK Defence," *Journal of Purchasing and Supply Management* 9, no. 3 (2003): 97–108, doi:10.1016/S0969-7012(02)00035-7.
[39] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 2.
[40] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.5, a.
[41] Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," 3; Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada," 7.
[42] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 4.

The interpretation above runs parallel with the Federal Government of Canada's interpretation, which recognizes four distinct P3 infrastructure delivery models – all of which include a financing phase for SPVs: (i) DBF, (ii) DBFO, (iii) DBFM, and (iv) DBFOM.[43] Regardless of the delivery model used, P3 projects in Canada will always differ from conventional procurement options in that they are financed at least partially by the private sector under a single, performance-based contract rather than financed by the public sector under distinct, separate contracts to various firms for DBOM.[44]

It is important to note that the delivery models listed above all entail the design and construction of new public infrastructure, but – because P3s can be utilized to offer the public both critical infrastructure and/or *services*[45] – not all P3 projects entail the procurement of a major piece of infrastructure. Just as P3s can vary in project delivery models, they can also vary in project scopes. P3s can be used as an outlet for providing structural modifications, structural additions, operational services, and maintenance services to previously existing infrastructure. The phases required of a P3 project, as well as the extent to which the public sector transfers risk to the private sector, are contingent on project scope. The three general scopes of P3 projects are: brownfield, greenfield, and hybrid projects.

Previously existing infrastructure can be leased under P3 brownfield projects, where the public actor "generates a capital inflow or debt payoff by transferring the rights, responsibilities, and revenues attached to an existing asset to a private [actor]…

[43] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.5, b.
[44] Ibid., 9.60.5, e.
[45] Neither of which are necessarily mutually inclusive.

for a defined period."[46] Generally, brownfield projects present considerably less risk to private actors, because design and build phases (i.e. construction) are either minimal or non-existent, and service-related factors like toll revenue or traffic volume can be projected more accurately due to the already-existing facility's present or past patterns of use by the public.

In greenfield projects, public actors transfer either a portion or all of the project's DBFOM responsibilities – and the risks associated with them – to private actors. Because greenfield projects require infrastructure procurement and the operation and maintenance of new pieces of infrastructure, they "generally present higher risks to both [public and private] parties than do brownfield projects because of the greater uncertainty surrounding traffic forecasts, permitting, and construction."[47] The complexity of greenfield projects becomes increasingly apparent when issues of financing and future revenue allocation are addressed, as project management teams consider the options of using availability payment concessions or toll concessions to reimburse the private actor, for example.

Hybrid projects require the expansion or extension of existing pieces of infrastructure through capital improvement, whereby private actors provide financing options to improve,[48] operate, and/or maintain the facility. While risks associated with future revenue for hybrid projects are relatively lower than greenfield projects, both

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[46] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," no. December (2012): 9, http://www.fhwa.dot.gov/ipd/pdfs/p3/p3_risk_assessment_primer_122612.pdf.
[47] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 9.
[48] I.e. through design and build.

public and private actors may still have to contend with issues of uncertainty concerning estimations of the public's willingness to accept new or increased toll fees that are often used to finance the project.[49] Further unforeseen issues denoted with any construction project may also arise, such as latent defects within the facility's new extensions. PPP Canada Inc. notes that hybrid projects "offer less potential for risk transfer because it may not be possible to distinguish the defects in new construction from pre-existing or latent defects in the [pre-existing] infrastructure."[50]

The extent to which private firms engage in various DBFOM activities varies between P3 projects, including those with the same delivery model. For example, for hospitals, prisons, and schools procured through DBFOM P3s, private firms may provide 'soft' operation services, (e.g. cleaning, laundry, catering, etc.) while the public sector retains control of the primary operation services pertaining to the main functions of respective facilities (e.g. nursing, detainment, teaching, etc.). In rare instances, DBFOM P3s can transfer core operation services to the private sector as well. For example, there are P3s in the Spanish city of Valencia that require SPVs to provide medical services as part of their operation duties for hospitals procured under a DBFOM delivery model.[51] The delivery model used for P3 projects shares a generally positive relationship with the degree of risk transferred to the private sector, as shown in Figure 2.1.

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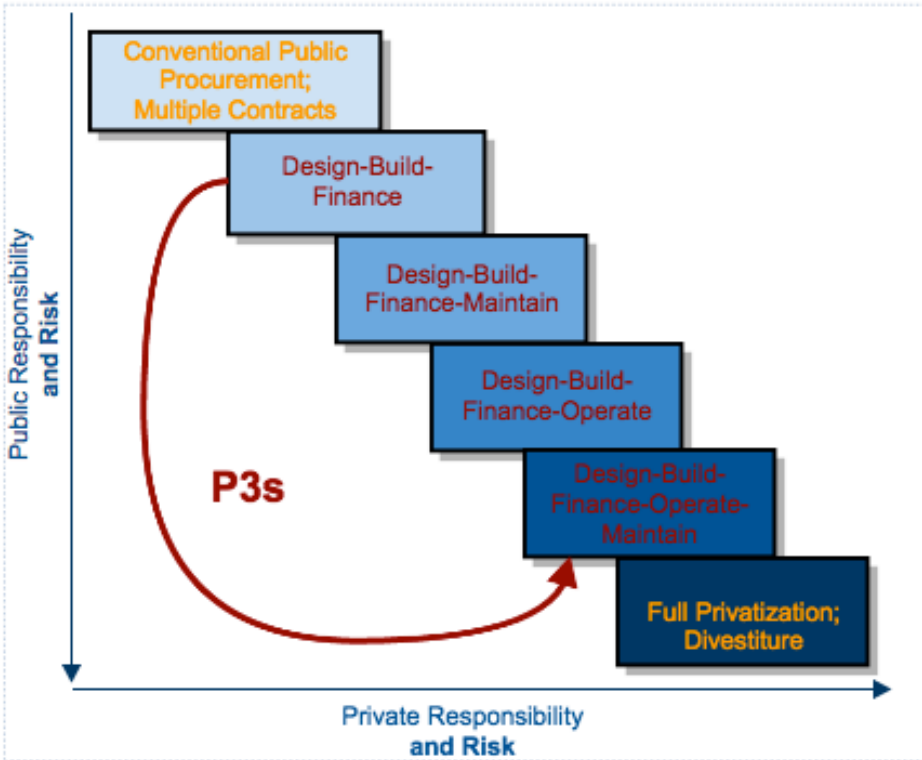
[49] Ibid, 6.; Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 2.
[50] PPP Canada, "Identifying P3 Potential: A Guide for Federal Departments & Agencies" (Ottawa, ON: PPP Canada, 2012), 15, http://www.p3canada.ca/~/media/english/resources-library/files/p3 a guide for federal departments agencies.pdf.
[51] Basilio Acerete, Anne Stafford, and Pamela Stapleton, "Spanish Healthcare Public Private Partnerships: The 'Alzira Model,'" *Critical Perspectives on Accounting* 22, no. 6 (2011): 533–49, doi:10.1016/j.cpa.2011.06.004.

Figure 2. 1: Scope of P3 Risk Transfer by Delivery Model[52]



2.3 Major P3 Players: Interests, Incentives, and Financial Relationships

To summarize, public authorities use P3s to procure, operate, and maintain infrastructure efficiently – achieving VFM – through long-term, lifecycle-driven contracts. The public sector utilizes the private sector's capacity to bear project risks and provide alternative financing options. SPVs are financially reimbursed through the public sector via one or more of the aforementioned methods (e.g. directly through payments and/or indirectly through tolls) and, in some P3 projects, public authorities will provide public subsidies via government bonds (with budgetary authority).[53] Generally, the more

[52] This is a simplified adaptation of a P3 involvement spectrum. See Figure 2 in Infrastructure Canada, "Infrastructure Spotlight: Improving Canada's Infrastructure Through Public-Private Partnerships" (Ottawa, ON, 2012), http://www.infrastructure.gc.ca/pub/infra/p3/p3-eng.html.
[53] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 10.

risks a private partner bears, the more compensation it receives from governments.[54] SPVs are also privately financed through lenders and equity investors. In turn, private SPV financiers encourage SPVs to bear minimal project risks so that they are more likely to receive subsequent repayment for their capital contributions.[55]

Lenders provide bonds and loans to SPVs to cover the large majority of a P3 project's required initial investment. In return for providing original private capital, lenders require SPV repayment through amortization agreements and associated interest fees. Their interest rates for capital bonds and loans are contingent on SPVs' risk-bearing capacities, which are assessed before contractual agreements (i.e. through due diligence). Generally speaking, SPVs with higher risk-bearing capacities pay lenders back with lower risk premiums and interest.[56] Lenders prioritize: (i) the dependability of SPVs to deliver on future dues owed, (ii) the capacity of SPVs to bear risks, and (iii) the soundness of project contracts to ensure relevant parties are contractually liable for financial risks associated with a project's DBFOM.[57]

Equity Investors also contribute to the initial investment of P3 projects. They provide private equity to the project, which is an essential component to ensure risk-bearing agents are held accountable for future project risks. Their share of equity is

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[54] Stephen Gruneberg, Will Hughes, and Debbie Ancell, "Risk under Performance-Based Contracting in the UK Construction Sector," *Construction Management and Economics* 25, no. 7 (2007): 694, http://journals2.scholarsportal.info.ezproxy.uwindsor.ca/pdf/01446193/v25i0007/691_rupcitucs.xml.

[55] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 72.

[56] Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," 37.

[57] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 72.

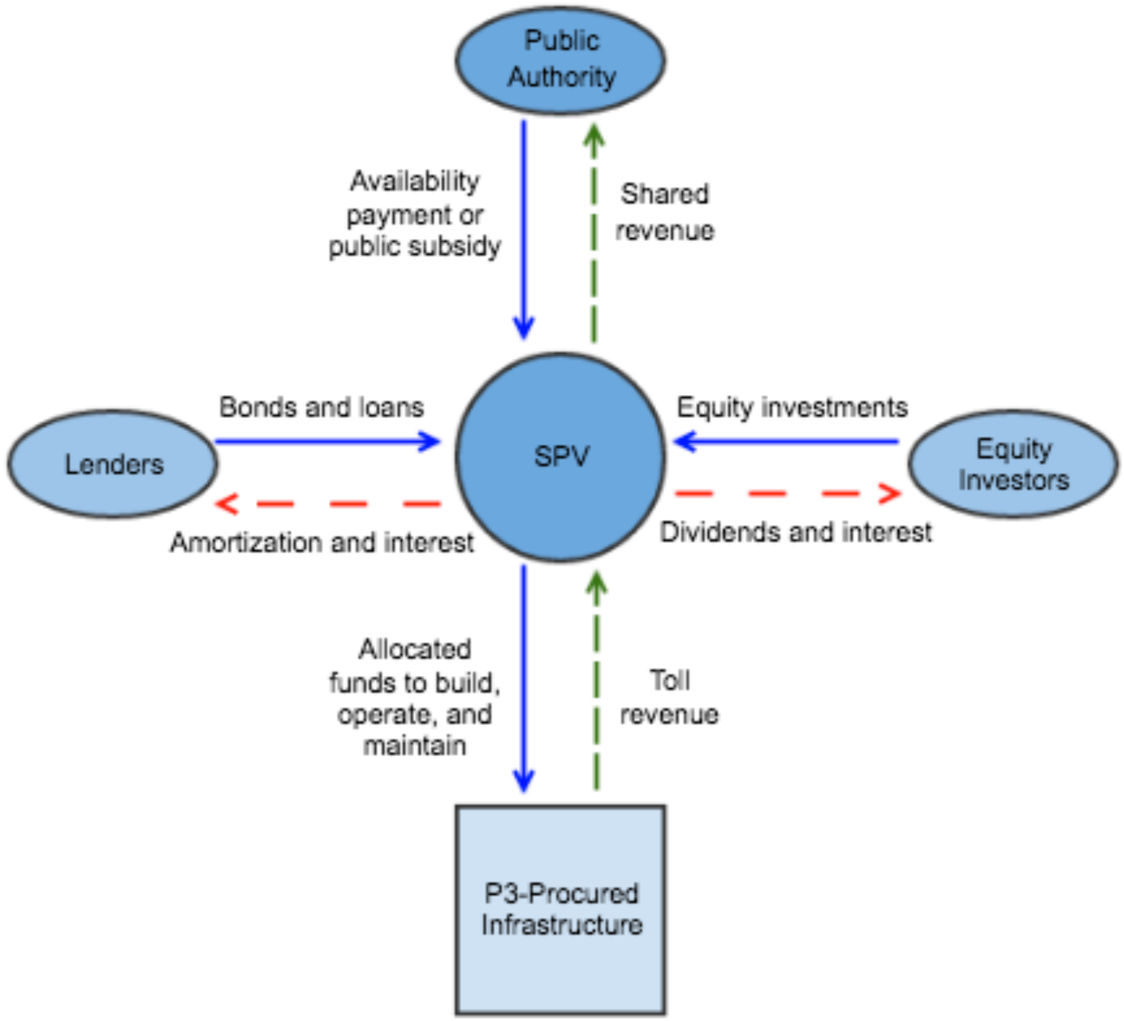
contingent on macroeconomic factors, and – like the interest rates of lenders – their required dividends and subsequent interest fees become more expensive as SPVs bear more risks.[58] Both project lenders and equity investors require due diligence to ensure that SPVs are dependable in issuing repayments and accurately gauging their respective risk-bearing capacities.[59]

The relationship between public authorities, SPVs, lenders, and equity investors for DBFOM P3s is depicted in Figure 2.2. SPVs – and their accompanying JVs – are at the focal point of all DBFOM monetary relations, as they bear most of the project's risk and, often, capital financing. The relationship between individual JVs – within SPV consortiums – and other P3 players is described more in depth in Chapter 4. For now, it suffices to conceptualize P3 projects as a set of interdependent relations between public and private agents premised on sound project financing and optimal risk allocation.

In particular, the remainder of this paper focuses on the features of DBFOM P3 projects, as these project models encapsulate all relevant broad phases related to risk allocation between public and private actors during P3 procurement. Figure 2.2 is a summative adaptation of various sources in P3 literature, particularly taken from primers and general P3 guides.

[58] In finance literature, dividends are regular payments made at pre-agreed intervals (e.g. quarterly payments) throughout a project's lifecycle.
[59] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 17.

Figure 2. 2: Structural Relationships of Major P3 Players in DBFOM Projects[60]



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[60] This figure broadly summarizes the relationships between project actors in DBFOM P3s. Due to its generality, Figure 2.2 includes the possibility of availability payments *and* fixed payments (i.e. an availability-based P3 model or a P3 concession model) to show all possible broad cash flow relations. For the original figures from which Figure 2.2 is adapted, see:
NTSA, "National Treasury PPP Manual - Module 4 : Ppp Feasibility Study National Treasury Ppp Practice Note" (Pretoria, 2004), 29, http://www.ppp.gov.za/Legal Aspects/PPP Manual/Module 01.pdf. OECD, "Public-Private Partnerships in the Middle East and North Africa: A Handbook for Policy Makers" (Paris, 2014), 21, https://www.oecd.org/mena/competitiveness/PPP Handbook_EN_with_covers.pdf; US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 11; and VDTF, "Risk Allocation and Contractual Issues: A Guide" (Melbourne, 2001), 11, http://www.dtf.vic.gov.au/Publications/Infrastructure-Delivery-publications/Partnerships-Victoria/Partnerships-Victoria-Risk-allocation-and-contractual-issues.

2.4 Advisory Units

In order for a P3 to be successful, the public sector requires specialized legal and technical skills in writing and negotiating P3 contracts with private firms. Thus, governments create specialized public agencies – or crown corporations – to handle P3s (e.g. PPP Canada Inc., Partnerships BC, and Infrastructure Ontario). In some instances, projects can be so specialized that they require their own crown corporation altogether to handle the construction and continued operation of infrastructure projects (e.g. the Windsor-Detroit Bridge Authority for the Gordie Howe Bridge). Often, specialized public agents consult with private sector experts in an array of fields while overseeing a given project.

Private advisory units to the public sector may include: financial, legal, technical, procurement, fairness, and integrity advisors.[61] Together, public and private agents form a dedicated project team – called a P3 project team – to coordinate different activities, including: planning, procurement, design, and construction phases. They also develop performance specifications for the project and provide oversight to public-private communications throughout project phases.[62] Third party advisors can come from both the public and private sector.

For an example of a third party advisor from the public sector, the P3 National Center of Expertise (P3 NCOE) assists the federal government in obtaining support for

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[61] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.40, a.

[62] Ibid., 9.60.40, b.

Real Property Branch projects,[63] facilitating informed decision making through drafting and submitting reports to federal bodies like the Treasury Board Secretariat and Public Works and Government Services Canada. The P3 NCOE can have a role in both the assessment and development of P3 projects.[64]

Another large vanguard for P3s in Canada, albeit not an official public entity, is the Canadian Council of Public-Private Partnerships (CCPPP). Established in 1993, the CCPPP is a member-based organization comprised of – and sponsored by – both public and private representatives. Together, these public and private sponsors form the CCPPP's Board of Directors along with its various committees.[65] While the Council is considered a nonpartisan third party organization, its research studies, published findings, forums, and annual conference on P3s suggest biased reporting for P3s in lieu of alternative infrastructural procurement methods. As a pro-P3 lobby group, it "is difficult to see them as impartial or unbiased, although they… have a role in helping the public sector negotiate with potential private partners once the decision to go the P[3] route has been made."[66] The CCPPP also provides a project database that summarizes the status of

[63] The Real Property Branch of government deals with procurement services involving real property contracting. Real property services include the architecture, engineering, construction, operation, and maintenance of public facilities. See Ibid., 9.10, b.
[64] Toren Barnes, "Toren Barnes: Real Property Branch of Public Works and Government Services Canada," *Simon Fraser University*, 2012, http://www.sfu.ca/olc/blog/co-op/toren-barnes-real-property-branch-public-works-and-government-services-canada.
[65] I.e. its Executive Committee, Communications and Government Relations Committee, Awards Committee (which selects award recipients for its annual conference), Research Committee, and Nominating Committee (which reviews and proposes Board of Director members annually).
[66] John Loxley, "Public-Private Partnerships after the Global Financial Crisis: Ideology Trumping Economic Reality," *Studies in Political Economy*, no. 89 (2012): 22, doi:10.1080/19187033.2012.11674999.

all P3 projects – planned, active, or completed – in Canada. This database is accessible to the public.[67]

For an example of a third party advisor from the private sector, Deloitte LLP – a finance, law, auditing, consulting, and risk management firm – has developed a global network of P3 teams that provide assistance to both public and private sector clients in the selection, negotiation, procurement, and financing of P3 projects. Both federal and provincial governments have hired Deloitte LLP for advisory roles. The former generally use the private advisor to help develop P3 frameworks and policies while the latter generally use the private advisor to help assess, structure, and procure individual P3 projects. Deloitte LLP also aids private actors, both financiers and SPVs alike, with P3 projects. For financiers, Deloitte LLP provides both financial advisor services (e.g. debt structuring) and financial transaction services. For SPVs, Deloitte LLP assists in developing project bids, structuring deals, and negotiating contracts.[68]

When private sector experts comprise part of a P3 project team, they must sign confidentiality agreements to ensure that due diligence is applied to the commercially confidential meetings P3 project teams hold. For example, during pre-contractual planning stages of a project, private third party advisors to the public sector may possess information that has yet to be released to SPV bidders. If any private advisors to the public sector have possible ties with a bidding private firm, they must not collude with this firm because P3 fairness and integrity rules dictate that SPV bidders must receive

[67] The Canadian Council for Public-Private Partnerships, "Canadian PPP Project Database."
[68] Nick Prior, "Public-Private Partnerships: Leveraging Global Best Practice," *Deloitte LLP*, 2016, https://www2.deloitte.com/uk/en/pages/infrastructure-and-capital-projects/solutions/public-private-partnerships.html#.

project information simultaneously in the Request for Proposal (RFP) stage before the public sector awards a contract to its 'preferred proponent' – the winning SPV.[69]

The RFP stage, coupled with the Request for Qualifications (RFQ) stage, deals with SPV bids for a project that the government evaluates. This integral step to the P3 process is explained towards the conclusion of this chapter. Before SPVs can bid for a P3 project, however, the government must first evaluate if a P3 model is the optimal procurement method (i.e. in lieu of conventional procurement). Ergo, planned public infrastructure projects that are large enough to warrant the consideration of a P3 go through a screening process consisting of P3 Screening, risk analysis, and Value for Money (VFM) analysis.[70]

2.5 P3 Screening

While P3s are issued on a federal, provincial, and municipal level in Canada, the federal government plays a large role in advancing potential P3 projects during early screening stages. Major branches and departments in the federal government, like the Treasury Board Secretariat (TBS) and Public Works and Government Services Canada (PWGSC), play advisory roles in documenting and evaluating early stage P3 screenings and assessments to ensure that a potential P3 procurement method is advisable in lieu of conventional procurement methods.

The TBS is in charge of awarding various P3 approvals, "including project approval, expenditure authority, contract approval, and the authority to enter into a real

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[69] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.30, f. and 9.60.40, d.
[70] Ibid., 9.60.10, a.

property transaction."[71] PWGSC holds ultimate accountability for recommending the most suitable delivery model for P3 projects under the DBFOM spectrum.[72] There are various departments within PWGSC that contribute to both risk and financial analysis of prospective P3 projects. An exhaustive list of these departments is, however, outside of the scope of this research.[73]

In 2008, the federal government established PPP Canada Inc. as an overarching federal crown corporation to act as an advisory unit for various departments and agencies involved in P3s and prospective P3 projects. PPP Canada Inc. – along with the TBS and PWGSC – consider various contributing factors to potential P3 procurement. These factors include, but are not limited to: (i) private sector interest and capacity; (ii) asset characteristics and size; (iii) time horizon; (iv) public acceptance or interest; (v) opportunity to transfer risk; (vi) performance specifications; (vii) potential for innovation; (viii) organizational capacity; and (ix) financial or funding considerations.[74]

When considering the viability of a potential P3 project, relevant departments and agencies must use and abide by PPP Canada Inc.'s P3 Screening Matrix and supporting guide. The P3 Screening Matrix is a tool used in conjunction with a department's assessment of capital projects for P3 potential. Users are faced with fourteen distinct questions that individually assess specific criteria pertaining to a potential P3 project. Each of the fourteen questions are answered with a score between one to five. These

[71] Ibid., 9.60.35, a.
[72] External advice from expert consultants is often considered before the Federal Government of Canada chooses to use a P3 and an accompanying delivery model. Ibid., 9.60.10, c.
[73] PWGSC's Real Property Branch and Acquisitions Program are large contributors to PWGSC assessment. For more information on P3 development and advisory services, visit PWGSC's official government website.
[74] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.15, b.

corresponding response indicators are meant to be objective in nature, with specific information demarcating the number values between one and five.[75]

For example, one of the fourteen criteria questions concerns the anticipated service life of the asset in question. Because "longer-lived assets tend to be better suited to a P3," five points are given if an asset's "life is greater than 25 years," and one point is given if an asset's "life is less than 10 years." In another example, for a criteria question concerning the potential for contract integration, five points are given if – under the DBFOM model – "all elements… could be integrated into one contract" while, conversely, one point is given if "only two elements could be integrated into one contract." This rationale is given because "P3s generate value… [through] the integration of various elements of the potential P3. The greater the potential for integration, the more likely a P3 will be viable."[76] Together, the values given for each of the fourteen questions accumulate to give a total score out of seventy to predict the feasibility of a P3 project. The higher the score, the more likely it is suitable for some form of P3 procurement model.

The Federal Government of Canada provides the screening matrix described above. While it serves as a simple and clear template for risk assessment, there are more intricate and exhaustive matrices used when assessing the viability of P3s and the monetary risks associated with allocating risks throughout a P3 project. Often, these in-

[75] PPP Canada, "Federal Screening Matrix" (Ottawa, ON: PPP Canada, 2016), http://www.p3canada.ca/en/about-p3s/p3-resource-library/federal-screening-matrix/.
[76] Infrastructure Canada, "P3 Suitability Assessment Questionnaire" (Government of Canada, 2016), http://www.infrastructure.gc.ca/plan/nic-vin/bc-ar09-eng.html., Criteria 1 and 14.

depth matrices are held as private property to be used between SPV consortiums and public authorities during P3 contract negotiations.

The World Bank provides an example of a more complex screening matrix that can be used to deeply assess the following areas of risk in using P3s to procure transportation infrastructure, all of which will be elaborated on in upcoming chapters: design risks, site risks, construction risks, force majeure risks, revenue risks, operation and maintenance risks, performance risks, external risks, other market risks, political risks, default risks, and strategic risks.[77]

2.6 Value for Money

If a P3 has been selected as a conceivable outlet for a project's procurement after it goes through P3 screening, a value for money (VFM) analysis becomes the determining factor for deciding to use a P3 and, more specifically, deciding which P3 delivery model is the optimal method for procuring and managing the given project.[78] VFM compares the costs and benefits of investment options pertaining to P3 projects through a risk-adjusted, iterative process that occurs throughout the project planning process. The VFM "is based on significant input from the project team and client who are most familiar with Government of Canada and project-specific requirements."[79] To mitigate evaluative subjectivity, data retrieved from internal (i.e. public) and external (i.e. private) experts is continually reassessed and aggregated throughout project phases.

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[77] See Robert Phillips, "Matrix of Risks Distribution - Roads," *Infrastructure Resource Center for Contracts, Laws, and Regulations* (World Bank, 2008), http://ppp.worldbank.org/public-private-partnership/sites/ppp.worldbank.org/files/documents/roadriskmatrix_1.pdf.
[78] I.e. from the aforementioned DBFOM spectrum.
[79] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.20, d.

VFM aids government officials with their recommendations to either proceed with a project or not by providing critical information concerning "project-specific qualitative, quantitative, and risk factors."[80] Literature on VFM analysis for proposed P3 projects outlines: (i) the creation of a "Public Sector Comparator" (PSC), a tool charged with estimating the whole-life cost of a proposed project through conventional means of infrastructure procurement;[81] (ii) using hypothetical "shadow bids" from a public authority (e.g. Windsor-Detroit Bridge Authority) to estimate the whole-life cost of a proposed project through a P3;[82] and (iii) comparing the values of the two aforesaid methods in an "apples-to-apples" manner.[83]

A typical PSC includes: base costs, financing costs, ancillary costs, retained and transferable risk, and competitive neutrality. Base costs refer to all relevant costs involved in both building and owning a piece of public infrastructure – including the delivery of services associated with it – for a pre-determined amount of time (e.g. a DBFOM project's lifecycle).

Ancillary costs refer to other costs, such as project monitoring costs and project procurement costs (e.g. easement costs for using privately owned land to build public

[80] Ibid., 9.60.20, e-f.
[81] US Department of Transportation, "Value for Money Analysis for Public–Private Partnerships (P3s)," *Program Areas of the Office of Innovative Program Delivery*, 2013, 1, https://www.fhwa.dot.gov/ipd/pdfs/p3/factsheet_03_vfm.pdf.
[82] Pre-contractual bids from private project bidders are also used as tools for cost estimation in lieu of – or in coordination with – shadow bids. They are typically used in lieu of a shadow bid at the end of the RFP stage, when a single bidder is chosen as the government's preferred proponent. Ibid., 1; European Investment Bank, "How to Prepare, Procure and Deliver PPP Projects" (Luxembourg, 2015), http://www.eib.org/epec/g2g/ii-detailed-preparation/22/222/index.htm.
[83] US Department of Transportation, "P3-Value: Shadow Bid Tool User Manual," *Program Areas of the Office of Innovative Program Delivery*, 2013, 6, https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_value_shadowbid_manual_v1.pdf.; US Department of Transportation, "Value for Money Analysis for Public–Private Partnerships (P3s)," 1.

infrastructure, like right-of-way fees).[84] Financing costs refer to both project issuance fees (e.g. attorney and accountant fees) and interests costs shared amongst taxpayers (i.e. public debt). The premiums of both retainable risks (i.e. public risk) and transferrable risks (i.e. private risk) refer to an assigned monetary value placed on bearing various project risks, derived from complex quantitative measures. These will be covered in more detail in Chapter 4. Lastly, competitive neutrality refers to mathematical adjustments made when assessing procurement options that account for competitive advantages and disadvantages accrued by virtue of a public authority's public ownership of infrastructure and services (e.g. a public agent's advantage of tax exemptions over private agents).[85]

In response to a PSC, a shadow bid is developed to estimate potential future bids from the private sector. These hypothetical estimations, contrasted with the PSC-estimated conventional procurement costs, consider: the net amount of expected payments to be given to the private agents involved (this includes base costs, financing costs, and premiums for transferred risks), the estimated value of the public sector's retained risks, and the value of the public sector's ancillary costs.[86]

With a PSC and shadow bid in place, the public authority of a P3 project conducts a financial assessment of a proposed project that compares the different costs for procuring the infrastructure and assesses the financial subsidies required when using either a conventional or P3 procurement model. Figure 2.3 broadly depicts the

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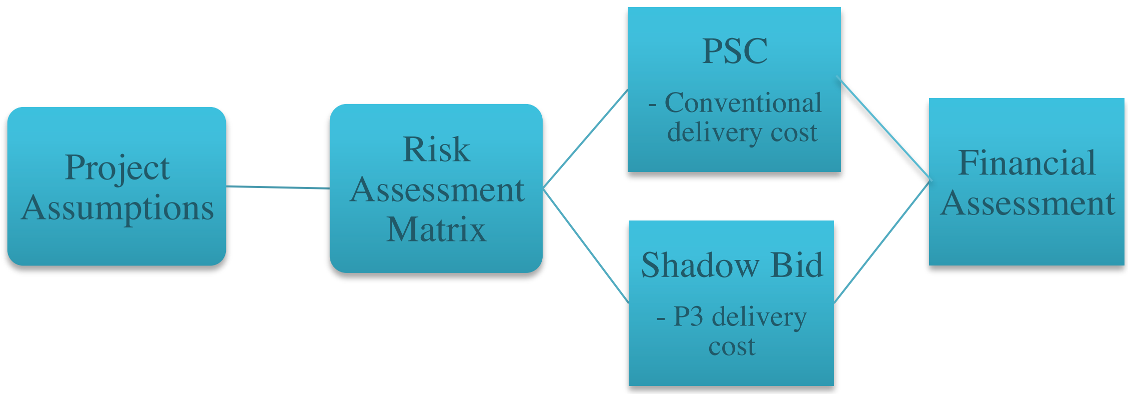
[84] "An easement is a right… created by grant or its equivalent, to do certain acts on another's land" for a specified purpose (e.g. to build part of a highway). See Wesley Newcomb Hohfeld, "Faulty Analysis in Easement and License Cases," *The Yale Law Journal* 27, no. 1 (1917): 70, doi:10.2307/786730.
[85] US Department of Transportation, "Value for Money Analysis for Public–Private Partnerships (P3s)."
[86] Ibid.

preliminary risk analysis phase of a potential P3 project – i.e. VFM phase – before it is granted public consent to follow through with the project. This figure adopts a public sector stakeholder perspective.

Figure 2. 3: Preliminary Value for Money Methodology for P3s



During the final phase of calculating preliminary VFM, referred to above as 'financial assessment,' the PSC's predicted project costs of conventional procurement and the shadow bid's predicted project costs of P3 procurement are compared on a risk-adjusted basis. If a shadow bid's projected estimation costs less than a PSC, the project is likely to be contracted out through a P3. When a P3 presents net savings over conventional procurement options, it provides VFM.

VFM is expressed as the difference by which either the PSC (i.e. conventional model) or shadow bid (i.e. P3 model) exceeds the other in cost. Because even incremental changes in underlying assumptions used in a complex VFM analysis can drastically change results, "it is important to undertake a sensitivity analysis to understand the [project's] critical assumptions" during preliminary VFM assessment measures.[87]

[87] Ibid., 2.

Thorough government-issued user manuals and reports on PSCs, shadow bids, and general VFM processes are publicly accessible for those who wish to understand the subtle complexities involved in these stages of P3 screening.[88] For an independent evaluation of VFM procedures, there are scholarly articles – albeit limited in number – that highlight strengths and weaknesses of current VFM methodology along with further suggestions for public agencies to adopt when conducting VFM assessments for prospective P3 projects.[89]

Government VFM projections are also regularly scrutinized by the Office of the Auditor General of Canada (OAG) through ex post project reports and audits. The OAG is an independent government watchdog that audits federal government departments, agencies, and crown corporations, reporting publicly to the House of Commons on matters on the allocation and management of public resources. The OAG increases transparency between public authorities and Canadian taxpayers by highlighting the consistency of government statements and projections for P3 projects.[90]

The accuracy of government-issued PSCs, shadow bids, and VFM statements are inspected through public reports, which often include recommendations for government

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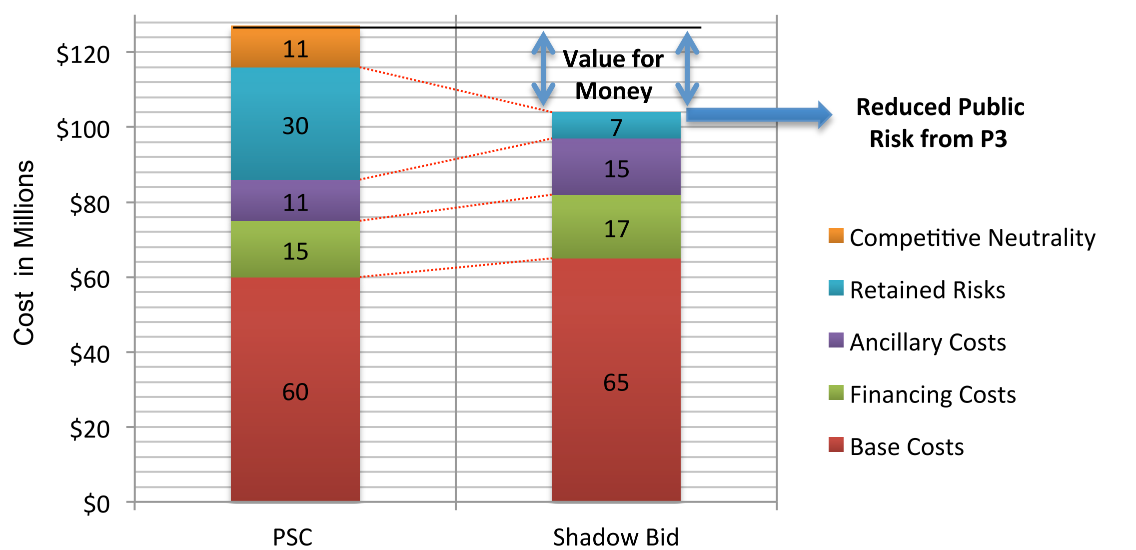
[88] See US Department of Transportation, "P3-Value: Shadow Bid Tool User Manual."; See also City of Saskatoon, "Business Case to PPP Canada: North Commuter Parkway Project and the Traffic Bridge Replacement Project" (Saskatoon, 2013), https://www.saskatoon.ca/sites/default/files/documents/transportation-utilities/transportation/planning/NorthCommuterParkwayPPPCanadaBusinessCase.pdf.
[89] See David Heald, "Value for Money Tests and Accounting Treatment in PFI Schemes," *Accounting, Auditing & Accountability Journal* 16, no. 3 (2003): 342–71, doi:10.1108/09513570310482291. See also Joaquim M. Sarmento, "Do Public-Private Partnerships Create Value for Money for the Public Sector? The Portuguese Experience," *OECD Journal on Budgeting* 10, no. 1 (2010): 93–119, http://search.proquest.com.ezproxy.lancs.ac.uk/docview/1030082620?OpenUrlRefId=info:xri/sid:primo&accountid=11979.
[90] Geert Bouckaert and John Halligan, *Managing Performance: International Comparisons*, *Public Management* (New York: Routledge, 2008), 260-261, doi:10.1108/09604529210029272.

on how to proceed with either current or future projects based on the OAG's findings.[91] One particular criticism of VFM assessments globally, including in Canada, is that governments are often guilty of overestimating "their own capacity to manage such large, complex, and long-term projects aside from what the final value [of their predictions] might say."[92] Figure 2.4 depicts a conceptual illustration of a preliminary VFM calculation comparing a PSC with a shadow bid for a prospective P3 project.

Figure 2. 4: Conceptual Value for Money Illustration



[91] In some instances, the OAG has questioned public authorities over the very use of the term P3, highlighting it as a potential rhetorical tool and not reflective of supposed P3-proclaimed projects. In a 2011 report on the Northwest Territories Deh Cho Bridge Project, advertised as a P3 by the provincial government, the OAG declared that "the project was not a public-private partnership… and did not shift any significant risk to the private sector; risk sharing was anticipated when a P3 procurement strategy was selected." See Office of the Auditor General of Canada, "Northwest Territories Deh Cho Bridge Project — Department of Transportation" (Ottawa, ON, 2011), http://www.oag-bvg.gc.ca/internet/English/nwt_201103_e_34999.html.

[92] Dorothy Morallos and Adjo Amekudzi, "The State of the Practice of Value for Money Analysis in Comparing Public Private Partnerships to Traditional Procurements," *Public Works Management and Policy* 13, no. 2 (2008): 114–25, http://journals2.scholarsportal.info.ezproxy.uwindsor.ca/pdf/1087724x/v13i0002/114_tsotpoppptt p.xml.

Although the shadow bid estimates an increased amount of \$5 million for base costs, \$2 million for financing costs, and \$4 for ancillary costs over the PSC, a projected \$23 million reduction in costs from privately transferred risks and \$11 million in adjustments for competitive neutrality result in a projected \$23 million in savings overall. The shadow bid's projected net cost of \$104 million divided by the PSC's projected net cost of \$127 million equals 0.82,[93] meaning the same project procured through a P3 is estimated to be 18 percent cheaper than if it were procured through conventional methods.

Thus, Figure 2.4 represents an estimated 18 percent VFM for a P3. This hypothetical example of VFM illuminates the general trade-offs that encourage the use of P3s both in Canada and around the world – the public sector trades large risks to the private sector in exchange for relatively higher project base costs, financing costs, and ancillary costs. In other words, while P3s may generally be more expensive than conventional procurement options, they have the potential to mitigate and transfer conventional project risks away from the public sector, securing more VFM, and thus making large infrastructure projects cheaper and safer for governments in the long term.

2.7 Competitive Selection

Once a P3 is selected as the optimal procurement model for an infrastructure project via VFM analysis, the public sector generally conducts a Request for Qualifications (RFQ) followed by a Request for Proposal (RFP). Together, the RFQ and RFP stages aid public authorities in choosing what they believe to be the best SPV

[93] Rounded to two decimal places.

consortium for a P3 project through a competitive bidding process where public agencies invite private actors to submit proposals for their services.

SPV proposals are assessed by public authorities, the public sector's third party advisors, and fairness monitors. Fairness monitors, like P1 Consulting Inc., are appointed by the government to ensure its selection of a preferred proponent is as objective and unbiased as possible. Fairness monitors are provided full access to documentation concerning the competitive selection process.[94] RFQ and RFP invitations extend to private firms on an international, national, and local representation level.

In the RFQ stage, prospective SPVs submit a detailed portfolio of their consortiums' abilities to handle all relevant parameters of a P3 project. Prospective SPVs express their interest in, and qualifications for, a project by outlining their ability to handle specified phases – either all or some – of a project's DBFOM. SPVs are supposed to show how they can provide the government with VFM and reduce the project's burden on taxpayers. RFQs provide a broad synopsis of project backgrounds, overviews, expectations, instructions, evaluation criteria, deadlines, and any other pertinent information for SPVs considering a submission. The main purpose of RFQs is to establish a shortlist of qualified consortiums – often the three most qualified from the pool of submissions – to invite to the following RFP stage, which is more specific, exhaustive, complex, and demanding.[95]

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[94] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge" (Windsor, 2015), 26, https://www.wdbridge.com/u/files/Spotlight/en/WDBA RFQ.pdf.
[95] Brian Watkinson, "Understanding Public Private Partnerships in Canada," *Association of Consulting Engineering Companies Canada*, 2015, 15, http://www.acec.ca/files/resources/acec_P3_report_v3.pdf.

The reason for RFQs being less comprehensive than RFPs is twofold: firstly, RFQs do not require the inclusion of project specifities to fulfill their purpose as a broad tool to "weed out" unqualified consortiums; second, RFQs are conducted considerably earlier – sometimes years earlier – than RFPs, and thus the monolithic list of pre-contractual project requirements is likely to be incomplete during the RFQ stage.[96] For example, the Windsor-Detroit Bridge Authority's (WDBA) RFQ for the Gordie Howe International Bridge left several significant sections open to further deliberation pending its RFP. In the 113-page document, the WDBA's RFQ informs Project Co that its role is still uncertain with respect to parts of the bridge's design and build:[97]

> Project Co's role with respect to the design of buildings and structures and such matters as site drainage, site servicing, location and size of storm water management ponds, and requirements for transformer sub-stations, will be provided in the RFP Process.[98]

The WDBA warns Project Co that, due to incomplete land acquisitions, Project Co's role and accompanying expenses are subject to change:

> The project requires the acquisition of properties in both Ontario and Michigan… Acquisition of the required properties has yet to be fully completed. The properties to be acquired will be described in the RFP Process. To the extent that property acquisition has not been completed prior to Financial Close, it is currently anticipated that the Project

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[96] The Windsor-Detroit Bridge Authority posted an RFQ for the Gordie Howe International Bridge on July 20, 2015. The project's RFP was released almost sixteen months later on November 10, 2016. However, according to the Conference Board of Canada, the P3 procurement phase is generally shorter, typically lasting "16 to 18 months." See Vijay Gill and Sarah Dimick, "Canada as a Global Leader: Delivering Value through Public-Private Partnerships at Home and Abroad," *The Conference Board of Canada* (Ottawa, ON, 2013), 27, http://www.infrastructure.alberta.ca/documents/14-004_P3Leader_RPT_-_08_21_13.pdf.

[97] Project Co is the tentative name given during the RFQ and RFP stages to a hypothetical SPV that wins a P3 contract with the government before it actually chooses a private partner.

[98] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge," 15.

> Agreement will provide relief to Project Co in the event that the status of acquisition of specific parcels materially and unavoidably impacts the Project schedule. The RFP will provide further details regarding the acquisition process and responsibilities of Project Co in connection with that process.[99]

The WDBA informs Project Co that its planned method of payment for the project is still uncertain:

> A toll systems study is currently being finalized and the current indications are that the tolling system will be a mixed manual and electronic system with details to be confirmed at the RFP stage. Further details on the setting of toll rates, the collection and administration of tolls, and toll revenues will be provided in the RFP... The RFP will contain details of any payments during the construction phase and after construction following the commencement of services.[100]

Finally, the WDBA reminds Project Co that its initiation of a Competitive Selection Process by no means presents an obligation to proceed with the project prior to Financial Close:

> This RFQ does not commit WDBA in any way to proceed to an RFP Process, award a contract or proceed with the Project and WDBA is entitled at any time to exercise the rights… to terminate the Competitive Selection Process and proceed with the Project, in whole or in part, in… some other manner…[101]

Once three consortiums are selected from the RFQ stage, the project's public governing body issues an RFP to qualified bidders. RFPs include draft project agreements, which constitute the planned contractual outlines and duties Project Co is expected to follow. These drafts delineate project output specifications in full, setting out

[99] Ibid., 18.
[100] Ibid., 19 and 21.
[101] Ibid., 41.

detailed technical requirements for an infrastructure's design, construction, operation, and maintenance. While output specifications and further project agreements set out in the RFP are issued by the public sector, they are often the result of rigorous consultation with third party advisors, both public and private (e.g. legal and financial advisors).[102]

During the procurement process, RFP specifications are open to modification via collaborative meetings with the qualified bidders. Over the span of months, or years, qualified bidders are given separate, confidential audiences with public authorities to discuss their requests for amendments to the draft project agreements on an individual basis. Input from the private sector helps refine disputable areas of the RFP before the government selects a preferred proponent to sign the project agreement.[103] The governing authority issues a final draft to the qualified bidders after negotiations have taken place, and this draft is used as the common basis for the proponents' final RFP proposals.

Final RFP proposals generally entail both technical and financial submissions for the project. Proponents' technical submissions include a submission of their official approach to relevant project phases (e.g. design plans, construction management, quality assurance, asset operation and maintenance, among others.). Proponents' financial submissions include confirmation from their funding sources that the project's financial terms have been agreed to – otherwise referred to as "fully committed financing."[104] Typically, public authorities prioritize *contractor quality* when selecting bidders at the RFQ stage (e.g. brand, history, and reputation) and *bid quality* when selecting a preferred

[102] Watkinson, "Understanding Public Private Partnerships in Canada," 15.
[103] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual," 9.60.30, h.
[104] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge," 27-28.

proponent at the RFP stage (e.g. cheaper bids and greater risk-taking capabilities).[105] Thus, RFPs must be exhaustive and specific in nature.

Following the selection of a winning bidder, the finalization of required documentation between the government and its preferred proponent takes place before the project can reach financial close. This includes “final limited discussions to customize the Project Agreement and other Project Documents… and… to clarify any ambiguous terms, so that it can be finalized for execution.”[106] Should the government and its preferred proponent come to an impasse during final discussions, the next preferred proponent may be chosen for the project. Or, in extreme circumstances, it is important to remember that the government retains the right to terminate P3 projects during competitive selection stages altogether.

Qualified firms that have made it to the RFP stage but are not awarded contracts receive honorariums of a pre-agreed amount for their participatory efforts in the project (e.g. for the Gordie Howe International Bridge, the amount is currently \$5 million).[107] In theory, the government purchases the right to own the intellectual property of unsuccessful proponents’ RFP proposals.[108] The main purpose of this practice, however, is to encourage the continued participation of potential proponents in future P3 projects

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[105] Osama Abudayyeh et al., “Hybrid Prequalification-Based, Innovative Contracting Model Using AHP,” *Journal of Management in Engineering* 23, no. 2 (2007): 88–96, doi:10.1061/(ASCE)0742-597X(2007)23:2(88).
[106] Windsor-Detroit Bridge Authority, “Request For Qualifications: Gordie Howe International Bridge,” 28.
[107] Ibid.
[108] If a P3 is terminated before the project reaches financial close, governments are more likely to use the intellectual property purchased from unsuccessful proponents via honorariums because they are not using the RFP proposal by any winning firm. Thus, if a P3 project is terminated during the RFP stage, it is possible for governments to take methodologies proposed from unsuccessful RFP bids and apply them to future projects.

by alleviating the significant costs of preparing RFP bids. RFQ bids, conversely, are not eligible for government-issued honorariums. Private firms are fully liable for all expenses incurred during the RFQ stage of the competitive selection process. This ensures that only ‘serious’ bidders participate in the competitive selection process.

2.8 Conclusion

The end of the competitive selection process marks the end of the project procurement phase, which is officially completed when the preferred proponent reaches financial close with the public authority and subsequently signs the final project agreement. In theory, once the final project agreement is signed, the negotiable terms of a P3 contract should be settled. In practice, this is generally not the case. The duration of most P3 projects post financial close – i.e. during respective DBFOM phases – are mired in contractual disputes between public and private partners, as well as disputes between private partners themselves.

Scholars note that P3s have “characteristics propitious to recurrent renegotiations; they represent long term, complex commercial and financial arrangements, in heavily regulated sectors, subject to significant political sensitivities, vulnerable to changes in circumstances and often grounded in uncertainty.”[109] In an updated, oft-cited study in P3 literature, recent data suggests that 78 percent of transportation P3 projects and 87 percent of wastewater management projects face major renegotiation at some point after

[109] Jeffrey Delmon, *Private Sector Investment in Infrastructure: Project Finance, PPP Projects and Risks*, 2nd ed. (Kluwer Law International, 2009), 44.

financial close. Further, the average time spent renegotiating project disputes for transportation and wastewater P3 projects is 0.9 years and 0.8 years, respectively.[110]

Post-contractual renegotiation and legal mediation are common elements of P3s and disputes can arise due to a plethora of factors. From a post-contractual perspective, disputes between P3 actors arise due to the limitations of incomplete contracts, which often experience variance between ex ante risks and ex post risks. From a pre-contractual perspective, disputes between P3 actors arise due to the drawbacks of subjective assessment during risk allocation at the procurement stage.

When optimal risk allocation is achieved at pre-contractual stages, variance between ex ante and ex post risk becomes minimal, and project risk management (PRM) under the incomplete P3 contract becomes easier. Thus, pre-contractual PRM directly affects post-contractual PRM and, accordingly, attention must be focused on achieving optimal risk allocation before the P3 contract is signed.

Chapter 2 emphasizes the structures and processes involved in creating a P3 project agreement, where risks and duties are officially transferred in a finalized contract. While open to renegotiation, risk transfer in P3 contracts has profound effects on the rest of a project's DBFOM and PRM practices. Thus, it is integral for P3s to achieve optimal risk allocation during the procurement phase in order to be successful in subsequent post-contractual project phases. Figure 2.5 presents a template timeline that delineates the general procurement process of P3s.

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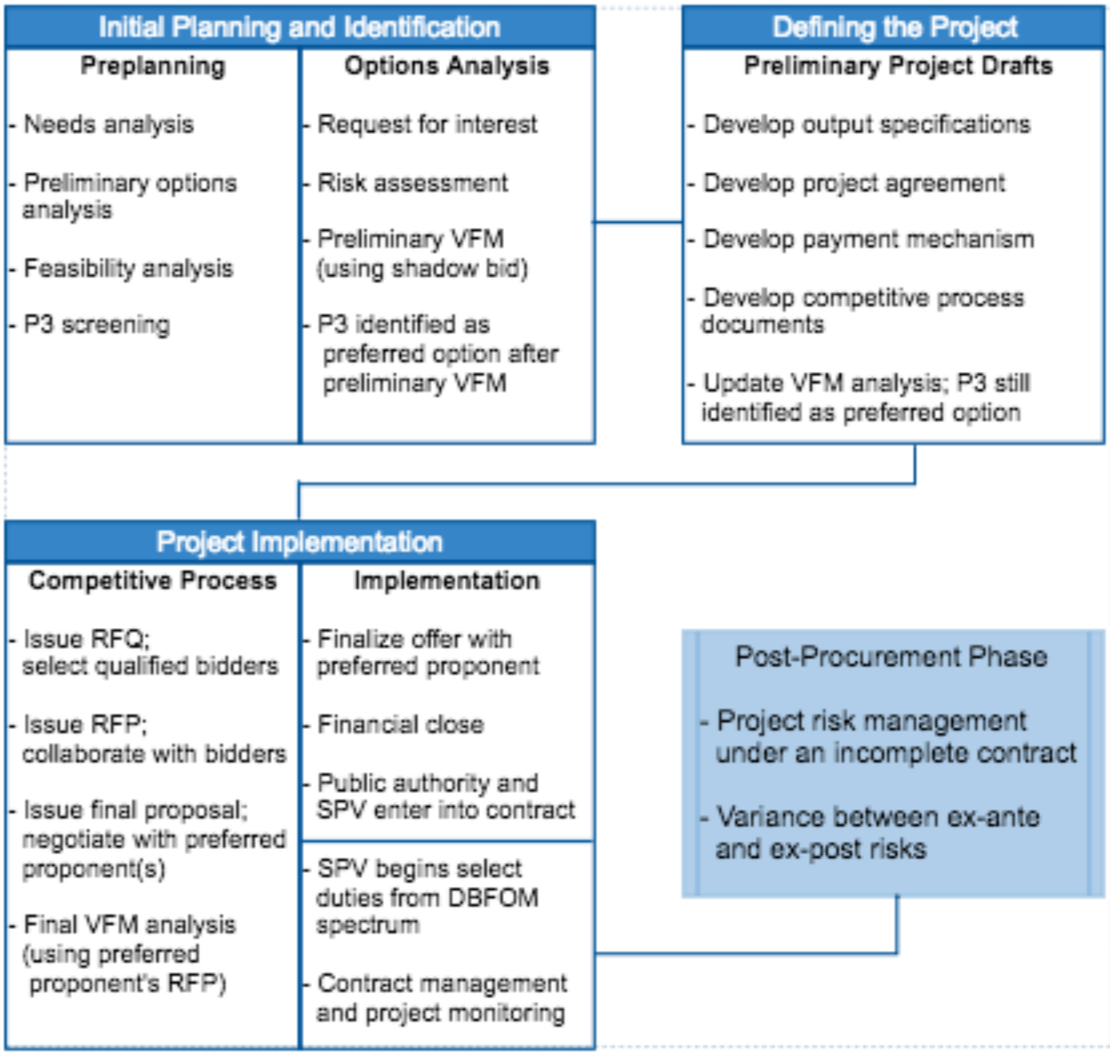
[110] José Luis Guasch et al., "The Renegotiation of PPP Contracts: An Overview of Its Recent Evolution in Latin America," *International Transport Forum Discussion Paper*, 2014, 13, https://www.econstor.eu/bitstream/10419/109159/1/818313609.pdf.

Figure 2. 5: Stages of the P3 Procurement[111]



Ideally, optimal risk allocation is achieved from mutually agreed upon risk transfer at financial close between public and private agents. More often than not, however, actors disagree on what constitutes optimal risk allocation – making cooperative project risk management between public authorities and SPVs crucial to a

[111] This is flowchart synthesizes information derived from the Federal Government of Canada. See Public Works and Government Services Canada, "Policy and Guidelines Supply Manual." The section on post-procurement phase considerations is an original addition. Its concepts will be elucidated in Chapters 3 and 4.

P3's success. A final outlying factor – not considered in Chapter 2 – that spurs suboptimal PRM, and subsequent contractual disputes, is moral risk.

Scholar Olufemi Vincent Tolani states that "the real success of P[3] projects depends on the degree to which risk is *genuinely* transferred from the public to the private sector and optimally shared."[112] His adverbs are not arbitrarily placed; while managing risks "optimally" can be understood from a cost-efficient perspective as risk transfer to the agents best equipped to handle them, managing risks 'genuinely' denotes the moral concerns of strategic and opportunistic behaviour that can affect P3 projects. Moral risks can erode a project's potential VFM. Thus, its potential affects on P3s cannot be overlooked. This behaviour can be explained via agency theory, where the principal-agent relationship public authorities and SPVs share is premised on self-motivated efforts from public authorities and their private partners.

Chapter 3 establishes a theoretical dimension to its literature review of the P3 process – specifically pertaining to P3 PRM under principal-agent relationships. Chapter 4, while explicative in nature, draws from these insights to illuminate the theoretical factors driving the behaviour of respective P3 players during PRM.

[112] Emphasis added. See Olufemi Vincent Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," *Afe Babalola University: Journal of Sustainable Development Law and Policy* 2, no. 1 (2013): 207.

CHAPTER 3

RISK AND PRINCIPAL-AGENT RELATIONSHIPS

3.1 Introduction

P3 PRM can be analyzed under many different theoretical frameworks, methodological approaches, disciplines of study, and agents of focus. Scholarly assessment of risk in P3 projects has roots in neoclassical political economics. Unlike traditional institutional economics, neoclassical political economy extends economic activity to social and legal models, treating them as separate institutions that intersect with, and affect, economic decision-making.

Modern political economy perspectives that work within a neoclassical framework – like new institutional economics, behavioural economics, and public-choice theory – account for social and legal complexities in political economics like bounded rationality, asymmetric information acquisition and sharing, opportunism, strategic behaviour, incomplete contracts, adverse selection, optimism bias, and asset specification.[113]

P3 literature can be categorized in relation to its: sector of focus,[114] adopted stakeholder perspective,[115] type of research,[116] data sources used,[117] subject of research,[118]

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[113] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Rui Sousa Monteiro, "Risk Management," in *International Handbook on Public-Private Partnerships*, ed. Graeme A. Hodge, Carsten Greve, and Anthony E Boardman (Cheltenham: Edward Elgar Publishing, 2010), 262–91.

[114] E.g. transportation, healthcare, water provision, education, housing, recreational facilities, defence and security, energy, and waste management.

[115] I.e. Solely public sector, solely private sector, public-private relations, and third parties that are subcontracted through JVs.

[116] I.e. quantitative, qualitative, and theoretical.

and methodologies used. It is of note that a large portion of P3 literature lacks explicit theoretical models and, in some instances, conclusive methodology.[119] However, popular theoretical frameworks used in the literature include: agency theory, transaction cost theory, public choice theory, and property rights theory.[120] Popular methodologies used in the literature include: simulation models (e.g. Monte Carlo), multiple regression, real options theory, game theory, data envelopment analysis, fuzzy methods, artificial neuronal networks, multi-attribute utility theory, network theory, cluster analysis, stochastic processes, analytical hierarchy process, and psychometrics.[121]

Recently, a large amount of literature on renegotiation issues in P3s has surged, suggesting private partners are employing strategic and opportunistic behaviour when bidding on projects. In other words, SPVs' *ex ante* pre-contractual agreements with public authorities are not in line with their *ex post* post-contractual actions.[122] Scholars

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[117] E.g. secondary data, interviews, and questionnaires.

[118] E.g. P3 procurement compared to conventional procurement, P3 governance structures, ex post evaluations of P3 projects, key success factors to P3 projects, pre-tender stages, competitive selection stages, risk identification and assessment, and risk allocation.

[119] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," vii.

[120] Ibid.; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure."

[121] Maryam Darvish, Mehrdad Yasaei, and Azita Saeedi, "Application of the Graph Theory and Matrix Methods to Contractor Ranking," *International Journal of Project Management* 27, no. 6 (2009): 610–19, doi:10.1016/j.ijproman.2008.10.004; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure."

[122] Chen Yu Chang, "Understanding the Hold-up Problem in the Management of Megaprojects: The Case of the Channel Tunnel Rail Link Project," *International Journal of Project Management* 31, no. 4 (2013): 628–37, doi:10.1016/j.ijproman.2012.10.012; Carlos Oliveira Cruz and Rui Cunha Marques, "Exogenous Determinants for Renegotiating Public Infrastructure Concessions: Evidence from Portugal," *Journal of Construction Engineering and Management* 139, no. September (2013): 1082–90, doi:10.1061/(ASCE)CO.1943-7862.0000710; Arshad Ali Javed, Patrick T I Lam, and Albert P C Chan, "Change Negotiation in Public-Private Partnership Projects through Output Specifications: An Experimental Approach Based on Game Theory," *Construction Management and Economics* 32, no. 4 (2014): 323–48, doi:10.1080/01446193.2014.895846; Wei Xiong and Xueqing Zhang, "Concession Renegotiation

note that private contractors can employ opportunistic, strategic behaviour – like asymmetric information sharing – to receive excessive compensation for bearing risks.[123] Chapter 3 adopts agency theory as an explicative tool for explaining public-private issues during P3 risk management. Once the parameters of public authorities and SPVs are explained as a principal-agent relationship, the concept of risk is expounded on. Chapter 3 concludes with an introduction to PRM, which is the centered focus of Chapter 4.

3.2 Agency Theory

Like P3s, agency theory is an interdisciplinary venture. Stephen Ross describes agency theory as "a relationship… between two… parties when one, designated as the agent, acts… on behalf of… the other, designated [as] the principal, in a particular domain of decision problems."[124] It is used to describe and prescribe outlets for principal-agent relations that involve delegated authority, "resulting in problems of control, which has been applied to a broad range of substantive contexts across different disciplines."[125] These 'problems of control' stem from the distinctive – and sometimes divergent – interests of principals and agents.

Principals, or owners, cooperate with their agents, or managers, in the oversight of projects. Typically, P3 literature denotes public authorities with a principal role and SPVs

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Models for Projects Developed through Public-Private Partnerships," *Journal of Construction Engineering and Management* 140, no. 5 (2014): 1–9, doi:10.1061/(ASCE)CO.1943-7862.0000843.

[123] Knut Sandberg Eriksen and Svenn Jensen, "The Cost of Second Best Pricing and the Value of Risk Premium," *Elsevier* Research i, no. 30 (2010): 29–37, http://journals2.scholarsportal.info.ezproxy.uwindsor.ca/pdf/07398859/v30i0001/29_tcosbpatvorp.xml.

[124] Stephen A. Ross, "The Economic Theory of Agency: The Principal's Problem," *The American Economic Review* 63, no. 2 (1973): 134, doi:10.2307/1817064.

[125] Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 208.

with an agent role, though multiple principal-agent perspectives can be found.[126] While principals hire agents and retain eventual ownership of the asset in question (i.e. public infrastructure), they depend on agents to manage projects, thus leading to a progressive separation of power.[127] Because P3s generally revolve around output-based contracts, agents retain some input-based autonomy. As agents become more autonomous in how they conduct business for principals, they attain more control over a project's input.

Agency theory frameworks adopt the realist perspective that both principals and agents are self-interested actors seeking to maximize their utility. Thus, as maximal utility agents, they may have diverse objectives that can compromise project cooperation. From the perspective of a principal owner – i.e. the government – the main problem of cooperation in agency theory is ensuring that the interests of managers fall into alignment with the interests of owners.[128]

When applied to P3s, agency theory investigates the tasks and responsibilities of self-interested actors in the presence of potential moral hazard issues. P3s create environments conducive to moral hazards and, through research premised on agency theory, scholars find that P3 agents are inclined towards strategic behaviour when

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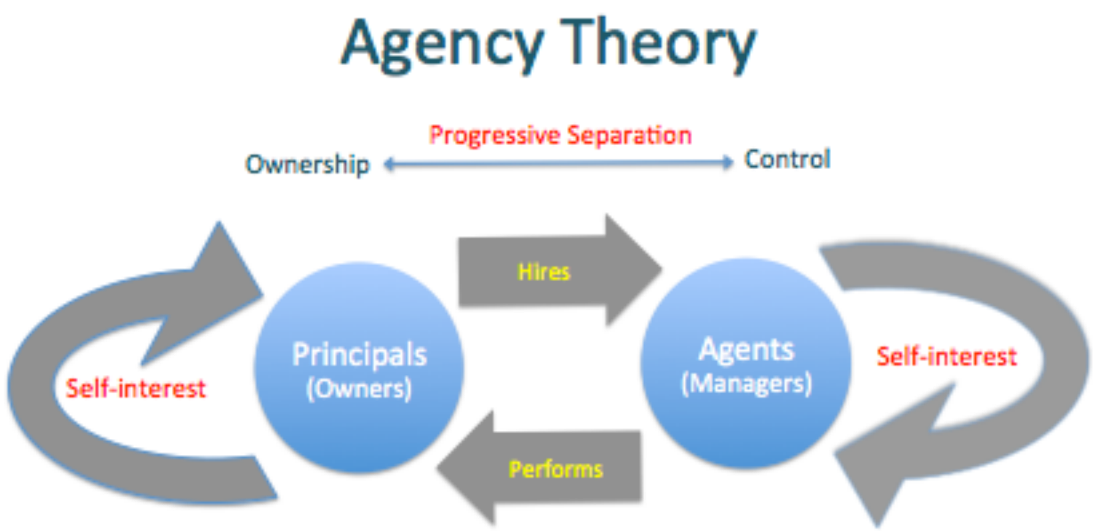
[126] For instance, in the case of SPVs managing JV relations, the SPV is the principal authoritative figure, delegating tasks to its agents, the JVs. In another example, public authorities can be viewed as an agent held accountable by the general public. For the purpose of this chapter, however, the principal-agent relationship of focus is between public authority principals and SPV-JV agents.

[127] Depending on the nature of the P3 contract, the private sector may retain legal ownership of the public infrastructure until its contract with the government runs out (see Chapter 2). However, private partners are still held accountable during their contractual ownership periods by the public sector via P3 contract stipulations.

[128] Lawrence. Freedman, *Strategy: A History*, 2nd ed. (New York: Oxford University Press, 2015), 527.

confronted with: (i) opposite objectives from their partners[129] and/or (ii) negative production externalities.[130] Figure 3.1 presents a typical principal-agent relationship.

Figure 3. 1: Traditional Principles of Principal-Agent Relationships



3.2.1 The Principal-Agent Issue of Adverse Selection

Chapter 2 delineates many procurement steps of the P3 process. In particular, it explains the tender process, where public authorities issue RFQs and RFPs to private bidders in an attempt to select a preferred proponent through competitive selection. Public authorities (i.e. principals) provide malleable – or at least negotiable – risk allocation frameworks in conjunction with RFPs. Then they invite qualified bidders to

[129] Francesca Medda, "A Game Theory Approach for the Allocation of Risks in Transport Public Private Partnerships," *International Journal of Project Management* 25, no. 3 (2007): 213–18, doi:10.1016/j.ijproman.2006.06.003; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria."

[130] Negative production externalities occur when "moral hazard environments… [show] that incentives in one task may destroy incentives in another when tasks are substitutes in the agent's cost function." Thus, where negative production externalities may occur, project tasks should be allocated to separate actors. See David Martimort and Jerome Pouyet, "To Build or Not to Build: Normative and Positive Theories of Public-Private Partnerships," *International Journal of Industrial Organization* 26, no. 2 (2008): 393–411, doi:10.1016/j.ijindorg.2006.10.004.

conduct their own assessments of the project risks involved. Through their own PRM processes – which are explained in detail in Chapter 4 – private bidders provide public authorities with their respective takes on: (i) risk probabilities, (ii) potential risk impacts, (iii) risk mitigation proposals, and (iv) associated risk premiums.[131]

Competition within the P3 tender process is critically contingent on opportunistic possibilities of *contract renegotiation*. For example, if strategic private bidders expect to renegotiate their contract after financial close, they could renegotiate for higher risk premium rates or decreased project input – this leaves public authorities with less efficient bidders than they initially perceive at financial close.[132] Consider, during the RFP stage, each SPV's bid should be based on an authentic estimate of what will be the net cost of the project including adequate risk premiums to account for potential alterations in a project's future environment.

The preferred proponent selected after the RFP stage should be relatively efficient and economical compared to its competitors. However, due to the aforementioned issues of agency theory, bidders may provide public authorities with unsolicited bids. Two types of competitors present a deceptive advantage at the RFP stage: (i) subjective SPV bidders that evaluate future costs and risks poorly and (ii) immoral SPV bidders that assign lower probabilities of risk towards expensive scenarios, because these bidders are prepared to enact strategic methods to protect themselves from paying from such scenarios. These

[131] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure."
[132] Monteiro, "Risk Management," 274-277; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 210.

types of private bidding agents are referred to as “the fools” and “the corrupt” in P3 literature.[133]

These two seemingly efficient yet deceptive SPV bidders present an apparent advantage to public authorities during the tender process because they are able to compensate for underproduction with lower risk assessments. Thus, they are able to produce deceptively lower RFP bids than that of their competitors, who may have been more efficient.[134] In this case, governments “may succumb particularly where… [they do not] have a clear framework for dealing with unsolicited bids or where… [they are] fully ‘sold out’ based on the optimism bias of the private sector.”[135]

While preliminary project assessments (e.g. P3 screening) and competitive selection procedures (e.g. RFPs) are used as means of circumventing the likelihood of adverse selection of project partners and risk bearers, scholars advise public authorities to be more prudent and judicious towards contractual negotiations with private partners.[136]

3.2.2 The Principal-Agent Issue of Project Risk Management

Once a P3 contract is signed, the public authority’s control of the project transfers to its SPV partner, creating issues like asymmetrical information sharing over the project’s DBFOM. From the SPV’s perspective, post-contractual PRM is premised on maximizing profits, even at the expense of a project’s DBOM (e.g. utilizing sub-standard resources to save money). From the public authority’s perspective, post-contractual PRM

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[133] Monteiro, “Risk Management,” 269.
[134] Ibid.
[135] Tolani, “An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria,” 210.
[136] De Clerck, “Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process,” 29; Monteiro, “Risk Management,” 289-290.

is premised on identifying conflicting goals between a government and its agents and implementing measures to limit the self-interested behaviour of private agents (e.g. through project oversight, control mechanisms, and incentive schemes). By enforcing contractual clauses and providing incentive schemes, public authorities inhibit strategically malicious conduct from private partners.[137]

Unlike transaction cost theory models, agency theory places heavy emphasis on private agents being risk averse opposed to risk neutral.[138] Thus, economic scholars note that contractual *ex post* principal-agent issues entail not only progressive separation of control, but risk-sharing too.[139] Post-contractually, public authorities must be prudent about the aforementioned issues of (i) conflicting motives between public-private partners and (ii) managing private partner behaviour. Pre-contractually, public authorities must also be prudent about private agent attitudes towards risk identification and assessment, as their evaluations affect contractual negotiation over risk transfer before reaching financial close.

In essence, differing perceptions of risk result in different recommendations over proposed risk mitigation tactics for a project's DBFOM. Thus, information asymmetry between public authorities and SPVs may arise strategically from 'corrupt' agents or authentically from 'fools.'[140] This is why P3s benefit largely from pre-contractual PRM –

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[137] Monteiro, "Risk Management," 270.
[138] Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 209.
[139] Edgar Kiser, "Comparing Varieties of Agency Theory in Economics, Political Science, and Sociology: An Illustration from State Policy Implementation," *Sociological Theory* 17, no. 2 (1999): 146–70, doi:10.1111/0735-2751.00073.
[140] When applied to strategic behaviour, asymmetric information sharing occurs when one party withholds "private information" from another party willingly. When viewing contract management from a principal-agent model, actors "sometimes fail to obtain essential information

which entails negotiation between public authorities and SPVs – to arrive at "final" risk transfer.[141]

3.3 Defining Risk

Before explaining the pre-contractual PRM process in detail, it is important to develop a sound definition of risk. P3 PRM literature contains varying definitions of risk, some of which reference risk as a function of uncertainty. Al-Bahar and Crandall define risk as "the exposure to the chance of occurrences of events adversely or favorably affecting the project objectives as a consequence of *uncertainty*."[142] Dennis De Clerck defines risk as "a function of the *uncertainty* of an event and the potential loss or gain resulting from the event."[143] From a theoretical level, however, there are fundamental differences between uncertainty and risk. It is important to demarcate risk from uncertainty, as the two separate concepts have different applications to P3 PRM.

3.3.1 The Problem of Uncertainty

Uncertainty lies at the heart of managing risk in P3 infrastructure procurement projects, as it affects projects in a plethora of ways. There is uncertainty concerning adverse selection of project partners, uncertainty concerning contemporary and future project conditions, and uncertainty concerning asymmetric information sharing between

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when they choose strategies." See Fang Deng, "Information Gaps and Unintended Outcomes of Social Movements: The 1989 Chinese Student Movement," *American Journal of Sociology* 102, no. 4 (1997): 1087-1088, doi:10.1086/231040.

[141] Akintola Akintoye et al., "Achieving Best Value in Private Finance Initiative Project Procurement," *Construction Management and Economics* 21, no. 5 (2003): 461–70, doi:10.1080/0144619032000087285.

[142] Emphasis added. See Jamal F. Al-Bahar and Keith C. Crandall, "Systematic Risk Management Approach for Construction Projects," Journal of Construction Engineering and Management 116, no. 3 (1990): 534, doi:10.1061/(ASCE)0733-9364(1990)116:3(533).

[143] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 28.

project partners. This includes uncertainty – both during the procurement phase and throughout each interim period of a contract's lifespan – of an actor's efficiency and efforts to deliver on contractually agreed upon responsibilities.[144]

This risk of uncertainty concerns "hidden" actions, features, or characteristics of actors regarding their potential to garner maximum project benefits at minimal costs. As mentioned at the beginning of Chapter 3, when features of uncertainty are coalesced with asymmetric information sharing, they can culminate into problems of adverse selection during a P3 project's procurement phase. Uncertainty creates concern over an agent's proclivity towards moral hazards and strategic conduct or optimism bias and subjective projections or estimations.[145]

3.3.2 Distinguishing between Risk and Uncertainty

While the aforementioned examples of uncertainty may be considered in conjunction with project risks, they differ in an important respect – uncertainties are much more difficult to forecast with respect to both their probability of occurrence and potential cost or impact on a project. An uncertainty's capacity to be empirically assessed and quantifiably forecasted is considerably lower than a risk's. Unlike uncertainties, risks can be measured and forecasted to a degree based on past empirical observations. Accordingly, risks can be more appropriately mitigated through PRM strategies than uncertainties.

[144] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere."; Monteiro, "Risk Management."
[145] Monteiro, "Risk Management," 268-270, 274.

A key component of PRM deals with the attempt to objectively quantify varied levels of chance. Objective quantification is computed by noting the empirical frequencies of variables and, in turn, developing a probability of occurrence for a risk. “Uncertainty” – conversely – has traditionally dealt with degrees of randomness.[146] This traditional demarcation between risk and uncertainty has advanced towards a modern definition of risk premised on subjective distributive probabilities: “each person is able to represent his [or her] beliefs as to the likelihood of the different states of the world… by a ‘subjective’ probability distribution.”[147] Thus, by definition, “all probabilistic situations [objective or subjective] are a matter of risk.”[148]

In the context of procuring infrastructure with P3s, risk is associated with distributive probabilities. In short, distributive probabilities link possible project risks with various probabilities via ‘ranges’ based on past empirical events. The main probabilities assessed are: (i) probability of occurrence and (ii) probability that the value of a variable falls within a certain range (e.g. regarding its potential cost for risk bearers or project impact). This is an important component of P3 PRM, which is looked at more specifically in Chapter 4. For now, it suffices to say that risks are broadly defined by their probability of occurrence and their potential to impact a project, both of which can be forecasted significantly more accurately for risks than for uncertainties. Accordingly, the potential consequences of risks can be better projected – and mitigated – through PRM.

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[146] Frank H Knight, *Risk, Uncertainty and Profit*, 3rd ed. (Mineola, New York: Dover Publications Inc., 2012), 46-48.
[147] Sushil Bikhchandani, Jack Hirshleifer, and John G Riley, *The Analytics of Uncertainty and Information*, 2nd ed. (New York: Cambridge University Press, 2013), 9.
[148] Richard N. Langlois and Metin M. Cosgel, “Frank Knight on Risk, Uncertainty, and the Firm: A New Interpretation,” *Economic Inquiry* 31, no. 3 (1993): 457, doi:10.1111/j.1465-7295.1993.tb01305.x.

For context, consider a sports betting simulation. Assume that a renowned professional soccer team – Team 1 – and its academy squad of youth reserves – Team 2 – are to play a forthcoming match against each other. Obviously, the outcome of this match cannot be certainly known until the final whistle blows. However, by assessing the reputation of each squad (i.e. their past performances and the efficacy of their players) through empirical observation and statistical analysis, an estimated result of the match can be made to propose a favoured team and an underdog team through betting odds.

Team 1 may be given 3/17 odds, where every seventeen dollars bet for their victory yields a three-dollar return. Conversely, Team 2 may be given 17/3 odds, where every three dollars bet for their victory yields a seventeen-dollar return. Clearly, a successful bet on Team 2 winning yields a higher rate of return than a successful bet on Team 1 winning, but Team 2's probability of winning the game is significantly lower than Team 1's. From a cost-benefit perspective, a bet placed on either team will consider the bet's estimated probability in conjunction with its associated payoff – this is a calculated risk for which distributive probabilities can be assigned based on the past performances of each team.

Now consider if this soccer team decides to play a charity match comprised of an amalgamation of both its senior squad and academy youth reserves. Assume that the charity match's two highest-contributing donors – both being fans of the team – are rewarded for their patronage by playing the role of manager for the charity match. Tasked with 'drafting' their own half of the team, and subsequently managing it during the match, Donor A and Donor B will take turns selecting players one at a time until every player on the squad is assigned to one of the two temporary teams.

If bets are placed before this draft, they will lack rationale based on empirical data because the teams have not been selected yet and, thus, no probabilities for a winner or loser can be assigned. Donor A and Donor B could select any combination of senior and youth squad players for their temporary charity match team. Without knowledge of which players are playing for which side, bets will be grounded in uncertainty. Only after the teams are selected will bets be grounded in risk.

3.3.3 Assessing and Affecting Risk

There is, however, one factor that can theoretically influence the charity match's probabilities before team selections take place – the aptitude of Donor A and Donor B to select and manage his or her half of the squad. If Donor A has extensive knowledge of the team's players – including its youth academy – and Donor B is merely a casual soccer fan, than Donor A will be able to make optimal selections that take into consideration team chemistry, player capabilities, strategic formations, and managerial tactics. Donor A will be able to directly influence Team A's odds of winning the game. Thus, the probability of Team A's victory becomes more tangible and accessible to betters.

By the same vein, when public and private actors forecast and manage a risk, they must also consider expectations of: (i) their *own* potential to influence future situations and (ii) the behaviour of *other* influential actors. Thus, risk is assessed not only with reference to empirical data, but also to the capacities and proclivities of project actors themselves. This is important to consider, as probabilities of occurrence and potential costs of risks can be influenced by principals and agents over a project's lifecycle. This means that P3 principals and agents have an active role in influencing the risk probabilities they forecast. Public authorities and private partners are *actively* assessing probabilities while simultaneously protecting themselves against extreme events and pernicious strategic moves from other actors.[149]

Risk probabilities change as policies or contracts change (e.g. if the capacity of an actor to deliver its contractual services increases or decreases). When actors assume risk, their assumptions are limited to the range of consequences calculated from their projections. All project stakeholders develop their own individual interpretations and measurements of risk due to the aforementioned issues of subjectivity and asymmetric information acquisition.[150] Because of this, the assessment and allocation of subjectively quantified risks – along with associated risk premiums – is regularly contested in P3 negotiations.

Consider, for example, that a project's risk is calculated through taking its estimated probability of occurrence multiplied by its estimated project impact. Suppose an impartial advisory unit undertakes a geological survey of a project's site and claims the site has a 1/1000 chance of requiring additional geotechnical engineering before construction due to poor soil. Suppose the cost of mitigating this risk, if it occurs, is 1000 units. With a cost of 1000 units and a 1/1000 chance of occurrence, the baseline assessment for this risk is 1.[151]

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[149] Medda, "A Game Theory Approach for the Allocation of Risks in Transport Public Private Partnerships."

[150] Athena Roumboutsos and Konstantinos P. Anagnostopoulos, "Public–private Partnership Projects in Greece: Risk Ranking and Preferred Risk Allocation," *Construction Management and Economics* 26, no. 7 (2008): 751–63, doi:10.1080/01446190802140086; Andreas Wibowo and Sherif Mohamed, "Risk Criticality and Allocation in Privatised Water Supply Projects in Indonesia," *International Journal of Project Management* 28, no. 5 (2010): 504–13, doi:10.1016/j.ijproman.2009.08.003.

[151] For simplicity's sake, a universal unit of measurement is used to measure both the risk's probability of occurrence and its potential impact. This example is returned to in Chapter 4.

However, risk probabilities are assessed from multiple project angles and multiple project actors. Depending on which actor is transferring a risk and which party is receiving a risk, judgments over their probabilities may be swayed due to a plethora of variables (e.g. different parameters of measure, different calculations, subjective biases, strategic behaviour, etc.). Often potential risk receivers will evaluate risks with higher associated premium costs than risk senders.[152] So, in the case of the simplified example provided above, the risk's receiver may assess the risk with a greater score than one, indicating a higher premium for bearing it, and the risk's sender may assess the risk with a smaller score than one, indicating a lower premium for bearing it.

3.4 Conclusion

It is important to know that if "the probability of occurrence as well as the impact can be quantified, this event is called a risk."[153] Conversely, uncertainties are not quantifiable, only foreseeable. Thus, it is difficult to transfer uncertainties, and their associated premiums, to private clients – public authorities will often 'bear the brunt' of most project uncertainties.[154] Where risks can be transferred, public authorities attempt to establish well-organized contracts to regulate their principal-agent relationship with SPVs, acknowledging that private agents are self-interested, risk averse, and susceptible to bounded rationality.

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[152] Eriksen and Jensen, "The Cost of Second Best Pricing and the Value of Risk Premium," 36.
[153] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 80.
[154] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere †"; André De Palma, Luc Leruth, and Guillaume Prunier, "Towards a Principal-Agent Based Typology of Risks in Public-Private Partnerships," *Reflets et Perspectives de La Vie {é}conomique* 51, no. 2 (2012): 57–73; Monteiro, "Risk Management."

The uncertainties of subjective assessment (e.g. optimism bias) and moral hazards (e.g. asymmetric information sharing) can lead to adverse selection of risk bearers and, in turn, suboptimal risk allocation. It is important to understand PRM as a dynamic, ongoing P3 process that can be viewed from many different, and often conflicting, perspectives between principals and agents.

CHAPTER 4

PROJECT RISK MANAGEMENT

4.1 Introduction

Risk allocation is typically a more complex endeavor for P3s than for conventional public infrastructure procurement projects because risks formerly borne by the government are transferred to the private sector. Thus, identifying, assessing, classifying, allocating, mitigating, and monitoring risk becomes a crucial component to a P3 project's success. To avoid suboptimal risk treatment, scholars suggest PRM should invoke transparent and systematic procedures, many of which are delineated throughout this chapter. Chapter 4 expands on the PRM process, introducing key features in PRM such as the cost-oriented considerations that drive risk allocation in P3s. The two main factors that drive risk allocation strategies are agents': (i) risk-bearing capacities and (ii) cost-effectiveness measures.[155]

These "strategies" – or the specific measures adopted to manage project risks – are referred to as risk mitigation alternatives (RMAs), of which risk transfer is only one of many RMAs used to arrive at optimal risk allocation (albeit a largely significant one).[156] Because risk management in P3s is a complex, multidimensional issue, its intricacies can be divided into specific sub problems, which are often propelled by different perspectives. PRM literature primarily focuses on the perspective of public

[155] Lucky Bryce Jatto, "A Review of the Impact of Canadian Law, Policy and P3 Practice on the Case for Procuring Capital-Intensive Infrastructure Services via P3s" (The University of Manitoba, 2011), 71-72, https://mspace.lib.umanitoba.ca/bitstream/handle/1993/4830/Jatto_Lucky.pdf?sequence=1.
[156] Jennifer Firmenich, "Risk Allocation Decision-Making Concept for PPP Projects" (Zurich, Switzerland: Institute of Construction and Infrastructure Management, 2013), 4, doi:10.3929/ethz-a-010127060.

authorities. Significantly less research focuses on private stakeholders. Scholars who explicitly acknowledge this fact attribute it to the scarcity of empirical data on contractual P3 agreements, which is itself a consequence of the competitive nature of P3s: "SPVs are often reluctant to share information about their strategies."[157]

Empirical research on P3s often attempts to provide descriptive models of the broad contexts of project risk management, demarcated project stages, and the many actors involved, with special focus on the conflicting motivations of agents within the private sector working alongside a public authority. These descriptive models can include decision models, where possible options and decisions for P3 actors are outlined between different project stages.[158] Chapter 4 focuses on explaining P3 PRM through the lens of agency theory, which is geared towards the goal of achieving optimal risk allocation during a principal-agent relationship between a public authority and SPV consortium.

4.2 The State of Research for P3 Project Risk Management

Due to the unique nature of P3 projects – i.e. long-term, multi-agent, public-private relations providing public infrastructure and services – their "resulting complexity can only be managed with an appropriate project risk management."[159] The literature review of PRM in P3 projects assumes that PRM can be analyzed by assessing public and private documents that – in conjunction – provide interdisciplinary, peer-reviewed,

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[157] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 13.
[158] G Girmscheid and T Pohle, "PPP-Risk Identification and Allocation Model – The Crucial Success Factor for PPPs," *Challenges, Opportunities and Solutions in Structural Engineering and Construction* (London: Taylor & Francis Group, 2010), http://ebooks.narotama.ac.id/files/Challenges, Opportunities and Solutions in Structural Engineering and Construction/11.15 PPP-risk identification and allocation model; The crucial success factor for PPPs.pdf.
[159] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 71.

scientific input pertaining to various takes on P3 PRM. In Canada, a central role for various public committees (e.g. TBS), crown corporations (e.g. PPP Canada), and non-partisan organizations (e.g. CCPPP) is to develop common, consistent methods to approach risk allocation for P3s.

The key objective for optimizing risk allocation between the public and private sector is, as mentioned previously, to achieve VFM with P3 projects.[160] Because risk transfer to the private sector is among the greatest arguments in favour of P3-induced VFM, suboptimal allocation of risk has great potential to deteriorate a P3's value. This is evident especially during risk devolution (i.e. attempts to default risk back to the government), and subsequent contract renegotiations or legal disputes.[161]

The most commonly cited risk criterion in P3 PRM literature is the ability and capacity of a potential risk-bearer to manage project risks. Other significant criteria include: minimizing foreseeable project costs, assessing the potential impact of risks, ensuring proper incentive standards are in place for bearing risks, lowering risk premiums, and awareness of the government's role as the residual risk holder of P3 projects – often being held ultimately accountable when hidden liabilities arise.[162] Some

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[160] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 29; Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments," 41.

[161] Chang, "Understanding the Hold-up Problem in the Management of Megaprojects: The Case of the Channel Tunnel Rail Link Project"; Cruz and Marques, "Exogenous Determinants for Renegotiating Public Infrastructure Concessions: Evidence from Portugal"; Rui Cunha Marques and Sanford Berg, "Risks, Contracts and Private-Sector Participation in Infrastructure," *Journal of Construction Engineering and Management* 137, no. NOVEMBER (2011): 925–32, doi:10.1061/(ASCE)CO.1943-7862.0000347.

[162] Grimsey and Lewis, *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance*; Graeme Hodge, Carsten Greve, and Anthony E. Boardman, *International Handbook on Public–Private Partnerships*, *International Handbook on Public–Private Partnerships*, 1st ed. (Cheltenham: Edward Elgar Publishing, 2010),

scholars argue that broad standards and methodologies for optimal risk allocation have extended application to P3s in general,[163] while others argue against universally applicable PRM recommendations, citing that optimal risk allocation is too project and agent specific to develop generalized standard methodologies for PRM.[164]

Scholars consider the main contributors to P3 project risk to be the long-term commitment of project lifecycles[165] and the complex nature of contractual relationships.[166] The literature presents an overarching criticism against a lack of public transparency, as well as avoidable project costs associated with both excessive risk transfer and long, bureaucratic tender developments.[167] These issues are often cited in literature aimed at making recommendations to improve Canada's longstanding P3 procurement framework.

P3 literature on project risk cites the importance of effective PRM and optimal risk allocation as preemptive tools against opportunistic behaviour.[168] Academics have observed that risks are allocated for maximal efficiency in theory, but – in practice – risks

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doi:10.4337/9781849804691; Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*.

163 Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Bing Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," *International Journal of Project Management* 23, no. 1 (2005): 25–35, doi:10.1016/j.ijproman.2004.04.006; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria."

164 De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process."

165 Gruneberg, Hughes, and Ancell, "Risk under Performance-Based Contracting in the UK Construction Sector."

166 Darrin Grimsey and Mervyn K. Lewis, "Evaluating the Risks of Public Private Partnerships for Infrastructure Projects," *International Journal of Project Management* 20, no. 2 (2002): 107–18, doi:10.1016/S0263-7863(00)00040-5.

167 Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere"; Kwak, Chih, and Ibbs, "Towards a Comprehensive Understanding of Public Private Partnerships for Infrastructure Development."; Monteiro, "Risk Management."

168 Medda, "A Game Theory Approach for the Allocation of Risks in Transport Public Private Partnerships"; Monteiro, "Risk Management"; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria."

allocation is often premised on variables contributing to the bargaining strength of P3 actors, which is often uneven during contract negotiations.[169] Bargaining asymmetries arise due to multiple factors and, accordingly, they can negatively affect both public and private actors depending on their context.[170] Further suggestions from the literature contend that all P3 risks that are not quantifiable – e.g. uncertainties – should be shared or solely retained by the public sector. Also, contracts should be malleable enough to allow risk to be assessed – and possibly modified – throughout different stages of a project's timeline.[171]

4.3 Pre-Contractual and Post-Contractual Project Risk Management

The resulting complexities that can ensue within a P3 arrangement – be it DBF, DBFO, DBFM, or DBFOM – necessitate appropriate levels of PRM. As stated in Chapters 2 and 3, PRM can be defined by two distinct stages: pre-contractual and post-contractual. In essence, pre-contractual PRM produces optimal risk management schemes from which public and private partners are in mutual agreeance (i.e. financial close and final contract), and post-contractual PRM produces managerial oversight to ensure that the contractual allocation of responsibilities is executed efficiently and viably.[172]

For the public sector, pre-contractual PRM begins from the moment a P3 is considered as a potential procurement option (e.g. P3 screening). For the private sector,

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169 Delmon, *Private Sector Investment in Infrastructure: Project Finance, PPP Projects and Risks*.

170 Monteiro, "Risk Management."; Delmon, *Private Sector Investment in Infrastructure: Project Finance, PPP Projects and Risks*.

171 Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; OECD, "Recommendation of the Council on Principles for Public Governance of Public-Private Partnerships."

172 De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure."

pre-contractual PRM begins during the public sector's preliminary development of a potentially forthcoming P3's competitive selection process (e.g. RFQ). For both sectors, pre-contractual PRM ends once a P3 contract is signed. A signed final contract marks the inception of post-contractual PRM, which covers the management of both foreseen and unforeseen risks during a P3's entire lifecycle, from the design of a project's infrastructure to the end of the private sector's operational responsibilities (see Figure 2.5).[173]

For post-contractual PRM, scholars conduct *ex post* studies of P3 PRM efficacy, typically focusing on the governing schemes public authorities used that contributed to either the success or failure of completed P3s. This includes: (i) the management of a project itself (i.e. the execution of DBFOM phases) and (ii) the public management of a project's stakeholder relations (i.e. ensuring responsibilities of SPVs, lenders, and equity investors are upheld). P3 literature on the former is scarce, which suggests that P3 PRM literature adopts theoretical frameworks from general project management literature, extending theories to P3 projects as necessary.[174] Scholars provide summaries of public sector management schemes that are conducive to successful projects.

Public authorities are advised to: (i) provide clear output specifications during pre-contractual PRM (i.e. to avoid agent subjectivity), (ii) implement symmetrically transparent performance-monitoring checks to avoid strategic behaviour from the private

[173] That is, for P3 projects that include post-construction phases for the private partner via infrastructure operation and/or management (e.g. DBFOM).
[174] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 33-34.

partner (e.g. asymmetric information sharing),[175] and (iii) provide equitable payment schemes to incentivize private partners, establishing united project agendas between public and private sectors.[176]

While pre-contractual PRM typically lasts only a few years, post-contractual PRM can potentially span decades. Despite this temporal disparity, the efforts invested in the former largely influence the proficiency of the latter. To achieve VFM, pre-contractual PRM entails rigorous risk analyses to avoid consequential issues that may arise during post-contractual PRM. P3 practitioners adopt a cost-benefit approach to optimally allocate project risks, which – in theory – "allow[s] for the management of risks by the party best able to handle them."[177] However, scholars note that, in practice, past P3 projects have developed a precedent to suboptimally manage risks during pre-contractual PRM due to the short-term pressures of project financing and timelines. Thus, the remainder of a project's post-contractual phases suffers.[178]

Chapters 2 and 3 elucidate broad pre-contractual arrangements between relevant P3 actors. Chapter 4 operates in the same vein, though with a specific focus on pre-contractual PRM. From a holistic perspective, optimally executed P3s require proactive risk management during the pre-contractual phase. Because pre-contractual PRM can 'make or break' a P3 project, the steps involved in achieving optimal risk allocation

[175] Herbert S. Robinson and Jon Scott, "Service Delivery and Performance Monitoring in PFI/PPP Projects," *Construction Management and Economics* 27, no. 2 (2009): 181–97, doi:10.1080/01446190802614163.
[176] Ibid.; H Smyth, "The Credibility Gap in Stakeholder Management: Ethics and Evidence of Relationship Management," *Construction Management and Economics* 26, no. 6 (2008): 633–43, doi:10.1080/01446190801905414.
[177] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 6.
[178] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Monteiro, "Risk Management."

before financial close are critical. Risk allocation entails the transfer of risk, which undergoes two main levels in P3s: first-step and second-step risk transfer.

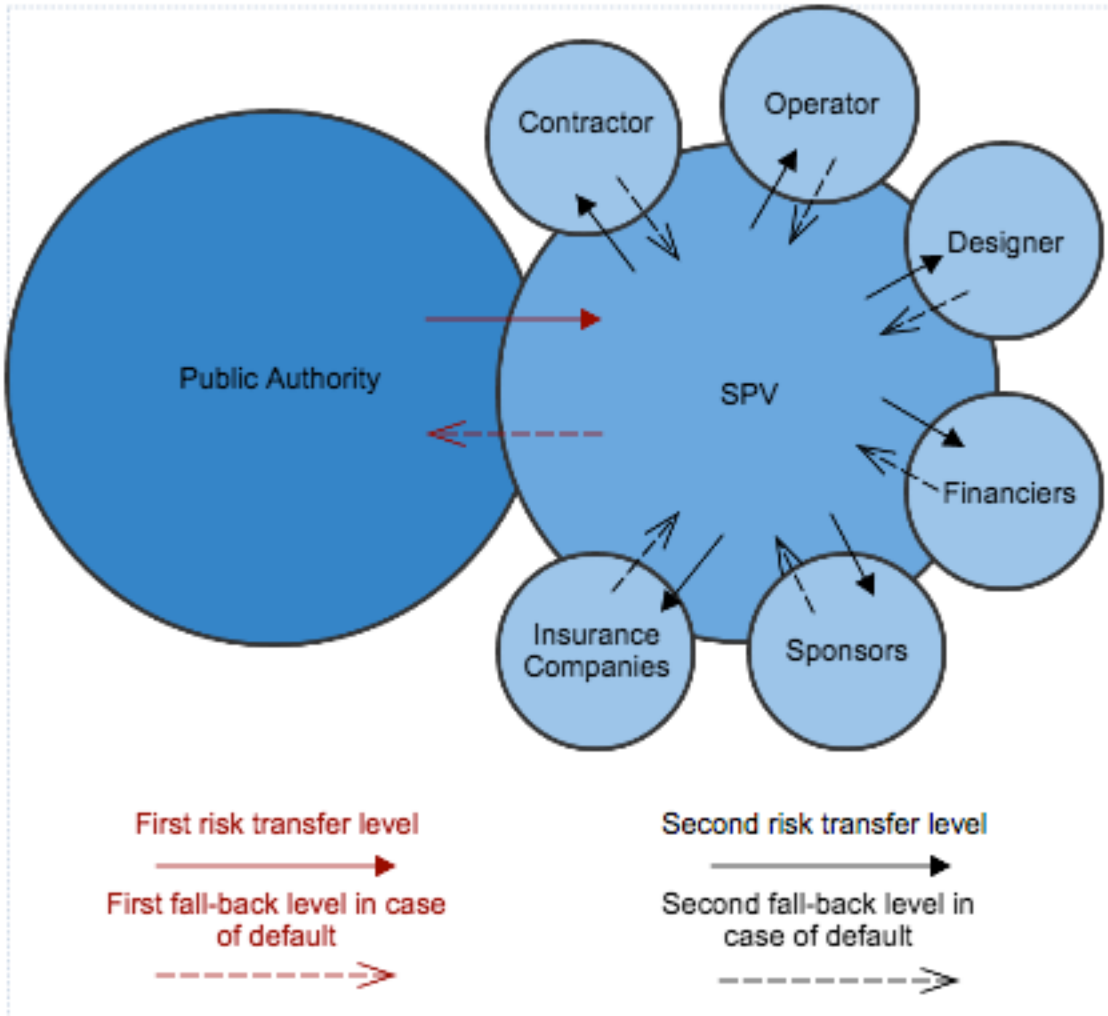
4.4 First-Step and Second-Step Risk Transfer

Chapter 2 heavily revolves around the broad relationship between public authorities and SPV consortiums – i.e. the main 'partnership' in P3s. More specifically, Chapter 2 explains that public authorities utilize P3s to transfer many project risks to SPV consortiums. This broad transfer of risk, from the public sector to the private sector, is known as first-step risk transfer. However, P3s are monolithic, complex arrangements; they entail too many risks and responsibilities to hold only two main actors accountable for the management of various risks associated with the DBFOM of large-scale infrastructure projects.

While SPVs are technically liable for risks transferred from public authorities during first-step risk transfer (and liable to be punished accordingly through pre-agreed contract stipulations), it is important to remember what an SPV is – a consortium of multiple joint venture (JV) companies that offer distinct expertise under an array of fields required to complete P3 projects (i.e. DBFOM responsibilities). While SPVs represent one distinct firm – in the form of a consortium – their DBFOM responsibilities, alongside the various risks associated with them, are allocated to various JVs on a multidimensional level through second-step risk transfer.

To ensure that distinct P3 project tasks – and the risks associated with them – are accounted for, SPVs must transfer project risks *alongside* tasks. Thus, SPVs experience two risk transfer levels: (i) on a macro level, the initial risk transfer comes from a public authority to a private SPV consortium and (ii) on a micro level, the secondary risk transfer comes from an SPV consortium to multiple JVs.[179] Figure 4.1 represents first-step and second-step risk transfer between a public authority, SPV, and multiple JVs.

Figure 4. 1: Model of First-Step and Second-Step Risk Transfer[180]



A benefit of second-step risk transfer for SPVs is that it makes it more difficult for private JV partners to default risks back to the SPV (i.e. second fall-back level). This

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[179] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 72-73.
[180] Adapted from Ibid., 73.

is also meant to aid in preventing risk devolution from the SPV to the public authority (i.e. first fall-back level). However, private parties – both SPVs and JVs – frequently attempt to renegotiate risk allocation post-contractually, and thus risk devolution frequently takes place, at least partially, in P3 projects.[181] Therefore, second-step risk transfer necessitates careful monitoring and oversight from risk senders during post-contractual PRM.

After the government transfers risks and responsibilities to the SPV, the SPV will allocate as many risks amongst its JVs as possible (i.e. specific risks dealing with design, construction, financing, and – if the P3 contract permits – the continued operation and maintenance of the infrastructure). This protects the SPV, making JVs liable for potential mishaps or suboptimal performances that fall under their specific responsibilities.[182] However, even after transferring risks, primary risk senders are still primary risk holders.[183] As Jennifer Firmenich and Marcus Jefferies note, even "after risk transfer, the risk sender bears the ultimate responsibility."[184]

While concerted efforts are put into pre-contractual PRM to achieve optimal risk allocation,[185] risk recipients may still default risks back onto risk senders. This creates the potential for legal conflicts between JVs, SPVs, and public authorities. These issues can last for years – well after the completion of a project's construction phase – and they can

[181] Monteiro, "Risk Management"; Patrick X.W. Zou, Shouqing Wang, and Dongping Fang, "A Life-cycle Risk Management Framework for PPP Infrastructure Projects," *Journal of Financial Management of Property and Construction* 13, no. 2 (2008): 123–42, doi:10.1108/13664380810898131.
[182] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure.", 72.
[183] I.e. public authorities during first-step risk transfer and SPVs during second-step risk transfer.
[184] Ibid., 87.
[185] E.g. insurable risks are insured, appropriate risk mitigation strategies for risks are adopted, and risk senders and risk recipients consider the risk-bearing capacities of agents.

be very expensive, costing millions of dollars. Consider, for example, an SPV needing to replace constructed girders for a highway because one of its JVs fails to meet the public sector's quality regulations. This issue arose during the construction of a P3 project in Windsor, Ontario – the Right Honourable Herb Gray Parkway.

4.4.1 Case Study: The Right Honourable Herb Gray Parkway

During the construction of the Right Honourable Herb Gray Parkway, the engineering and construction firm Freyssinet Canada Ltd. – a JV under the project's SPV consortium, the Windsor Essex Mobility Group (WEMG) – produced 500 girders for the project that were deemed unacceptable by the government's Independent Expert Review Committee (IERC).[186] The IERC cited "serious financial implications, time delays, and impacts associated with the [girder] issues."[187] There were also issues with connector bearings not meeting the Ontario Ministry of Transportation's (MTO) standards.[188]

These construction mishaps led to larger financial problems down the line for the WEMG. Because construction controversies threw the parkway's schedule "out of kilter," the WEMG failed to meet its deadlines with the government, putting the SPV "in a penalty situation and paying in the order of $100 000 plus per day to Infrastructure Ontario."[189] Unfortunately, due to the respective levels of bureaucracy and transparency in P3 contracts – that is, the extensive amount of the former and the general lack of the

[186] CTV Windsor, "Province Wants to Salvage Parkway Girders after Report Says Hundreds Don't Meet Standards," *CTV News*, 2013, http://windsor.ctvnews.ca/province-wants-to-salvage-parkway-girders-after-report-says-hundreds-don-t-meet-standards-1.1479902.
[187] Ibid., par. 9.
[188] Adelle Loiselle, "Parkway Allegations Met With Anger," *Blackburn News*, 2014, http://blackburnnews.com/windsor/windsor-news/2014/04/30/parkway-allegations-met-with-anger/.
[189] Dave Battagello, "Herb Gray Parkway Contractor Facing Penalty of $100K per Day for Missing Deadline," *Windsor Star*, 2015, par. 17 and 4, http://windsorstar.com/news/local-news/parkway-contractor-facing-penalty-of-100k-per-day-for-missing-deadline.

latter – this project is presently still in dispute with little knowledge divulged to the general public regarding the status of these heavy fines.

A WEMG spokesperson responded to this incident with secrecy, stating that the SPV's "construction team does not discuss internal contractual matters."[190] That being said, if "Infrastructure Ontario lets the penalty slide, it would set a dangerous precedent for other… [P3] projects should they also not be completed on time."[191] Freysinet, the WEMG's JV company responsible for the parkway's faulty girders, "may be targeted legally by [the] WEMG to take some financial responsibility for the penalties owed to the government."[192]

Because of second-step risk transfer between the WEMG and Freysinet, the WEMG is not immediately responsible for paying the government fines associated with the project. However, ultimate accountability for the project's mishaps must be settled in court proceedings, which have been ongoing for roughly half a decade. This short case study outlines the potential for dispute between public authorities, SPVs, and JVs by adverse risk threats being realized during post-contractual PRM. Due to discrepancies between parties over pre-contractual agreements and post-contractual occurrences (i.e. ex ante risk allocation and ex post risk treatment), legal disputes like this are common during P3 project lifecycles.[193]

[190] Ibid., par. 10.
[191] Ibid., par. 21.
[192] Ibid., par. 18.
[193] Guasch et al., "The Renegotiation of PPP Contracts: An Overview of Its Recent Evolution in Latin America."; Khaled A. Mohamed, Shafik S. Khoury, and Sherif M. Hafez, "Contractor's Decision for Bid Profit Reduction within Opportunistic Bidding Behavior of Claims Recovery," *International Journal of Project Management* 29, no. 1 (2011): 93–107, doi:10.1016/j.ijproman.2009.12.003.

Thus, pre-contractual PRM does not preclude post-contractual renegotiation, mediation, or – in this case – legal dispute. Further, this case study highlights the importance of optimally mitigating risks early on by transferring responsibilities *only* to actors that have the capacity to manage them.[194] Often, it is safer for SPVs to pay appropriate insurance and risk premium fees than it is to take chances transferring risks to JVs that may default on them due to insufficient risk-bearing capacities.[195]

4.5 Risk Identification, Assessment, Classification, and Mitigation

The oversight of P3 infrastructure projects that necessitate lifecycle PRM must constantly consider various project actors, phases, and assignments. Foreseeable risks, which are assigned distributive probabilities of occurrence, will have generally known causes and measurable impacts. Hypothetically, if a P3 project's planned phases and assignments carry out ideally without risk-induced deviation, this project would mirror its "reference scenario."[196] Practically all P3 projects experience some form of deviation from their original reference scenario, however, so reference scenarios are used as benchmarks to calculate the degree to which certain risks have impacted a project.

Potential deviations may be positive (i.e. opportunities) or negative (i.e. threats). While 'risk' is often connoted with adversity in P3 literature, it can also present *opportunities* to increase project profitability beyond original reference scenario

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[194] 'Manage,' in this case, does not denote an accident-free operation. Rather, it implies that, should a JV run into project mishaps, it is equipped to handle those mishaps without defaulting risk back onto other JVs, its SPV, or public authorities.
[195] Robinson and Scott, "Service Delivery and Performance Monitoring in PFI/PPP Projects."
[196] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 80.

estimations.[197] This double-sided nature of risk provides potential for P3 actors to experience a higher rate of returns than original reference scenarios predict due to, for example, higher-than-expected efficiency gains (e.g. through innovation or entrepreneurship). To comprehend a risk – and its potential to present an opportunity or threat – its cause and impact must be assessed in relation to the project's different actors, phases, and assignments. More specifically, a risk must be measured in relation to which actors, phases, and assignments are likely to affect, or be affected by, it.

Once risks are identified in infrastructure projects, they are assessed either qualitatively or quantitatively.[198] Literature on P3 project trends suggests that the latter is used in most risk assessments.[199] For quantitative risk assessment, a P3's reference scenario and its various levels of risk analyses are combined to facilitate optimal risk allocation. Different levels of risk analyses between the public and private sector include PSCs or shadow bids. The deterministic method is a simplified means of quantitatively assessing risk, where the probability of event A occurring ($0 < A < 1$) and its potential cost or impact (C) are multiplied to determine the risk's value (V). Thus, $V = A \times C$. This deterministic methodology can be applied to the hypothetical site from Chapter 3, where poor ground conditions may require extra geotechnical engineering. The risk value of 1 is

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[197] E.g. if project deadlines are met significantly earlier than expected, or if infrastructure is procured significantly cheaper than expected. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 22.

[198] Qualitative risk assessment generally depends on quasi-quantitative spectrums indicating a risk's probability of occurrence and/or potential for impact on a project as 'low, medium, or high.' See US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer" 23-25.

[199] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; K. C. Lam et al., "Modelling Risk Allocation Decision in Construction Contracts," *International Journal of Project Management* 25, no. 5 (2007): 485–93, doi:10.1016/j.ijproman.2006.11.005; Medda, "A Game Theory Approach for the Allocation of Risks in Transport Public Private Partnerships."

derived from a risk assessment where the probability of the risk occurring is 1/1000 and its cost, or impact on the project, is 1000. Thus, V = 0.001 x 1000 = 1.[200]

The probabilistic method of assessing risk – which is both more complex and accurate than the deterministic method – is the prevailing means of risk assessment in P3s. First, P3 practitioners determine a risk's probability of occurrence akin to that of the deterministic method (e.g. the probability of a site's soil being poor is 1/1000). Second, the risk's potential cost, or impact, on the project is assessed by expert estimates using three separate values – opposed to just one value in the deterministic method – pertaining to the potential impact's: minimal value, modal value, and maximal value. Third, practitioners utilize computational software by inputting the three separate risk impact values and turning them into aggregated distributive probability functions. The aggregated values associated with each individual risk, a combination of risks, or the whole project itself can then be derived via computational simulations (e.g. Monte Carlo).[201]

Both scholars and practitioners use computational simulations like Monte Carlo to assess the plethora of probabilities associated with P3 risks. They require advanced expertise as well as advanced software and are conducted throughout a project's lifecycle to account for the constantly malleable landscape of P3 PRM. During risk assessment –

[200] This is a simplified mathematical procedure using a universal unit of measurement to indicate the tripartite of a risk's: probability of occurrence, potential for impact, and associated premium value. The monetary impact of a risk has already been calculated into quantifiable units of measure that are comparable with units used to designate the probability of the risk occurring.
[201] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 72; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 81.;US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 26-30.

or, more broadly, PRM in general – misconceptions often arise due to humanity's cognitive, error-prone limitations.[202] The principal-agent relationship between public authorities and SPVs faces many limiting impediments against optimal risk allocation, especially pertaining to subjective assessment (e.g. optimism bias) and strategic behaviour (e.g. asymmetric information sharing).

Thus, to achieve optimal risk allocation, P3 PRM requires the interdisciplinary input of both public and private sector practitioners to develop systematic, standard procedures for risk assessment and, accordingly, risk allocation.[203] Of course, risk allocation must still consider the self-interest of principals and agents. For risk assessment and allocation specifically, finding middle ground can be a timely and costly endeavor mired in conflicting motives. Opportunism – be it through willful ignorance or intentionally pernicious strategy – remains a genuine concern for both public and private actors. Figure 4.2 demonstrates the pre-contractual PRM process, which mitigates the potential for suboptimal risk treatment in P3 projects.

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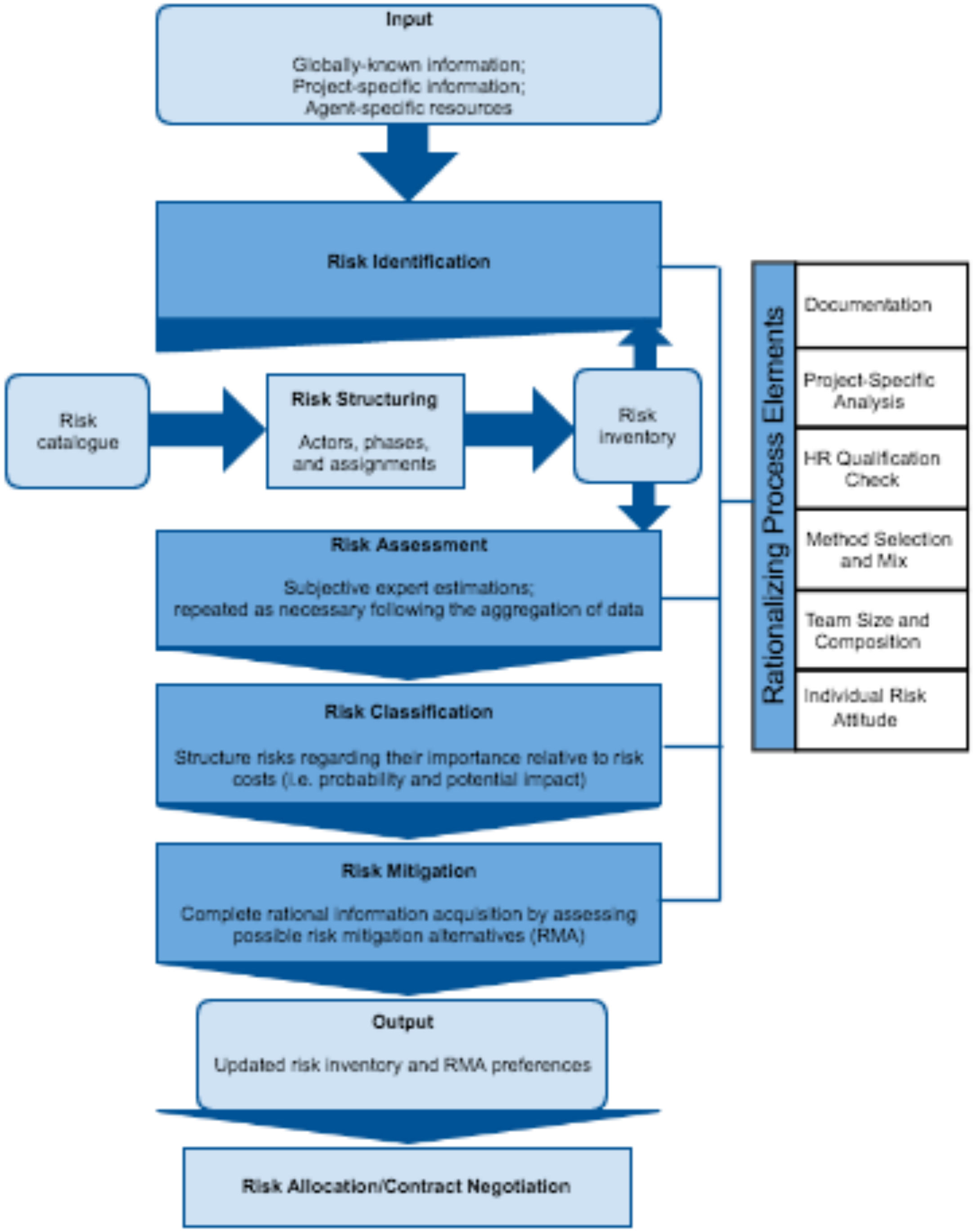
[202] David Vose, *Quantitative Risk Analysis: A Guide to Monte Carlo Simulation Modelling* (Chichester: John Wiley & Sons, 1996).
[203] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 88.

Figure 4. 2: Pre-Contractual Project Risk Management Cycle[204]



[204] Summative adaptation of Ibid., 82 and VDTF, "Risk Allocation and Contractual Issues: A Guide," 16.

Figure 4.2 illustrates the typical processes taken by public and private sector actors in identifying, assessing, classifying, and mitigating risks so that they can be properly accounted for before a P3 contract is signed. Because only identified risks can be assessed and managed, PRM typically begins with identifying risks. Following the identification of risks is risk assessment. As mentioned above, risk assessment can be complex and multifarious, especially when developing aggregated probabilities and appropriate premiums for risks. Final risk assessment proposals to project partners should be "as detailed, as necessary and as simple as possible."[205] Because P3s generally require long lifecycles and complex agreements, they benefit from early risk assessments using refined quantitative methods such as probabilistic assessment and Monte Carlo simulations.[206]

After risks are identified and assessed, they are classified. Risk classification associates risks with their respective probability of occurrence, potential for project impact, and – subsequently – a range of appropriate premiums for potential risk bearers. This process hastens risk transfer by providing the information necessary to begin considering risk mitigation alternatives and, accordingly, relevant parties that may bear respective risks. In summation, risk classification schemes alleviate public authorities from the potential of recurrent renegotiation and mediation pertaining to which parties are responsible for – and the degree to which parties are responsible for – specific risks.[207]

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[205] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 81.
[206] In lieu of deterministic assessment methods, for example.
[207] Kwak, Chih, and Ibbs, "Towards a Comprehensive Understanding of Public Private Partnerships for Infrastructure Development."; Monteiro, "Risk Management."

Together, risk identification, assessment, classification, and mitigation proposals represent the pre-contractual risk management cycle, which deals with a party's ability to assess risks based on their current knowledge of the project's landscape. In practice, many of these steps do not occur in isolation.[208] Nonetheless, Figure 4.2 serves as a useful framework in providing a template for pre-contractual P3 PRM steps. These steps occur repeatedly throughout a project's phases well before contract negotiation and financial close (e.g. during preliminary testing, PSCs, and shadow bids). The aforementioned principal-agent issues of moral risks and optimism bias are common threats during the pre-contractual risk management cycle.

Figure 4.3 presents more in-depth explanations for the pre-contractual PRM cycle's stages. As a P3 project gets closer to financial close, these steps become more meticulous and detailed to ensure discrepancies between public and private parties over risk treatment can be mediated accordingly. Scholars vary in their identification and demarcation of PRM steps, but their alternative titles label the same general practices.[209] Ultimately, the pre-contractual PRM cycle's main goal is to elicit the appropriate treatment of risks. The official treatment option for a risk is referred to as its selected 'risk mitigation alternative' (RMA). After the contract is signed, proactive RMAs are implemented and reactive RMAs for future risks are prepared. Different RMA strategies are delineated in Figure 4.4.

[208] For example, "risk allocation does not simply take place on a 'risk by risk' basis detached from the output specifications, payment structure, government policies, and the contract itself." See VDTF, "Risk Allocation and Contractual Issues: A Guide," 16.
[209] For instance, Al-Bahar and Crandall summarize the PRM cycle for construction projects as risk: identification, analysis, evaluation, response management, and system administration. See Al-Bahar and Crandall, "Systematic Risk Management Approach for Construction Projects,"535. The VDTF summarizes the PRM cycle for P3s as risk: identification, assessment, allocation, mitigation, and monitoring. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 16.

Figure 4. 3: Pre-Contractual Project Risk Management Cycle – Clarified Steps[210]

STEP	Risk Identification	Risk Assessment	Risk Classification	Risk Mitigation
Objective	Consider all plausible risks and their costs	Evaluate identified risks	Structure risks relative to their cost	Develop optimal risk mitigation and allocation options
Input	Information (i.e. global, project's, and agent's)	Risk inventory	Assessed risk inventory	Assessed risk inventory (aggregated)
Output	An exhaustive risk catalogue/inventory	Risk impact and probability	Potential RMA derived from organized risks	Optional RMA
Process	RATIONALIZING PROCESS ELEMENTS i.e. documentation; project analysis; HR qualification check; selection of methods			
	Risk structuring; project-specific risk analysis; team composition	Identify risk factors; aggregate data; repeat	Methodical analyses of project risks (computation)	Methodically identify risk mitigation factors based on risk probability/impact
Methods	Contract analysis; Risk checklists	Subjective expert analysis	Analyses:* ABC; equi-risk-contour; impact; sensitivity	Methods:** decision table; decision-tree, utility analysis, simulations (e.g. Monte Carlo)
Threats	Unidentified risks	Inaccurate risk assessment	Misinterpretation of risk severity	Inappropriate risk assessment/allocation due to strategic behaviours or bounded rationality

* Various methodical analyses used in P3 projects. These processes are not made public; like most pre-contractual work in P3s, their distribution is tightly constrained under contractual agreements between and within government entities and private companies.
** Various methodical identification schemes used in P3 projects. This process is also mired in transparency issues, though scholars have applied such schemes to their publications on P3 risk assessment and allocation for hypothetical projects.

For pre-contractual PRM, risk assessment is not conducted with finite numbers and variables. While PRM benefits from repeated expert correspondence, which is continually aggregated and reappraised, it still ultimately relies on subjective judgments.

[210] Adapted from Jennifer Firmenich and Gerhard Girmscheid, "Rational Information Acquisition for Quantitative Holistic Risk Allocation of PPP Projects in an Entrepreneurial Context," in *PPP Conference* (Preston, UK, 2013), 233, http://clok.uclan.ac.uk/11996/1/FINAL PROCEEDINGS 19th of March 2013.pdf.

This requires the acquisition of qualitative information that, upon continual assessment and data aggregation, becomes progressively quantitative. Figure 4.3 presents a general outline of the methodologies utilized in pre-contractual PRM. These steps present their own unique objectives and processes, which are critical to developing optimal RMAs.

PRM requires RMAs for most risks, and a RMA should be developed for any relevant risk taker to ensure that risk is optimally allocated. More specifically, by providing RMAs for all potential risk bearers, the risk bearing capacity of competing risk takers – as well as their accompanying risk premium offers – can be compared. This is how optimal risk allocation is achieved; the actor best equipped to handle a risk is considered via its risk-bearing capabilities *and* its associated risk premium costs.[211] Thus, RMAs are considered in conjunction with: (i) a risk's probability of occurrence, (ii) a risk's potential to impact a project, (iii) the capacity of potential risk senders and bearers to influence a risk, and (iv) the risk premium associated with transferring a risk to potential bearers. The main strands of RMAs include risk avoidance, risk reduction, risk transfer, and risk acceptance.

The underlying assumption during pre-contractual PRM is that the government retains all risks by default until risks are transferred.[212] Though, in some instances, public authorities may make contractual clauses that stipulate that the private sector must bear

[211] VDTF, "Risk Allocation and Contractual Issues: A Guide," 20-22.
[212] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere"; De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; Monteiro, "Risk Management."

unforeseen or unspecified risks.[213] If the government transfers a risk to an SPV, the SPV transfers all risks it can amongst its various JVs under the consortium through second-step risk transfer. The processes involved in each main type of RMA are outlined in Figure 4.4.

Figure 4. 4: Risk Mitigation Alternatives for a P3[214]

Risk Mitigation Alternative	Risk Consequence	Net Risk	Risk Sender's Fees	Differen-tiation	Risk Type
Avoid Risk	Risk's probability of occurrence is zero	Eliminated	Cost of risk mitigation	Cause oriented	Active
Measures to Reduce Risk: • HR • Technical • Organizational	Risk's probability of occurrence is decreased	Gross risk reduced	Cost of risk mitigation + Net risk costs		
	Risk's cost/impact is decreased			Impact oriented	
Risk Transfer • Insurance	• Risk sender expunged of residual risk • Risk sender pays premium to risk receiver	Gross risk unchanged	Insurance risk premium		Passive
Risk Transfer • JV company 1 • JV company 2			Transfer risk premium		
Acceptance	Risk coverage is necessary		Gross risk costs		

Ultimately, some party must accept each project risk. If a risk has not undergone specific RMA treatment in the P3 contract – i.e. residual risk – the government typically assumes responsibility for bearing it.[215] If risk transfer is chosen to be the optimal RMA for a risk, its bearer will try to decrease its potential impact, or cost, and probability of occurrence, if possible. In theory, each RMA action – be it avoidance, transfer, reduction,

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213 For example, the VDTF stipulates, "the private party bears all risks which government does not expressly take back under the contract… This puts beyond doubt… the risk allocation implicit in the payment mechanism." See VDTF, "Risk Allocation and Contractual Issues: A Guide," 123.
214 Retrieved from Firmenich, "Risk Allocation Decision-Making Concept for PPP Projects," 4.
215 Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere."

or acceptance – should be less costly to the risk sender than the sum of gross risk cost subtracted by net risk cost.[216]

4.5.1 Risk Transfer

As shown in figure 4.4, risk transfer is just one of several RMA options under P3 PRM; avoidance, reduction, and acceptance are also feasible RMAs that are implemented aside from – or alongside – risk transfer. If risk transfer is selected as an optimal RMA, its sender – be it a public authority, SPV, or JV – should assume that the risk has been allocated optimally and at a fair cost.[217] The more risks a project transfers optimally, the more likely it will achieve VFM.

In theory, all plausible RMAs should be evaluated for every individual project risk so that: (i) all plausible RMAs for all potential risk recipients can be compared and (ii) the best RMA can be adopted to achieve optimal risk allocation. In practice, however, a thorough evaluation of plausible RMAs only transpires for risks that are: (i) quantifiable and (ii) able to be influenced by potential risk recipients.[218] The reason for this is because thorough pre-contractual PRM cycles – i.e. repeated risk identification, assessment, classification, and mitigation considerations – is expensive and time-consuming. The procedures outlined in Figures 4.2 And 4.3 require repeated data aggregation before optimal RMAs become apparent.

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[216] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 81.

[217] I.e. during first-step risk transfer from the government to SPV, second-step risk transfer from the SPV to JVs, and – through relatively smaller-scale subcontracting – a form of third-step risk transfer from JVs to third party contractors, respectively. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 31.

[218] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 27-31.

From a cost-benefit perspective, the resources required to select a preferred RMA should not outweigh that RMA's eventual payoff for being managed optimally. If a risk is not quantifiable and unable to be influenced by risk recipients, there is little point in investing the resources required to develop an optimal RMA strategy during pre-contractual PRM stages. In fact, if a risk is not quantifiable, it is considered an uncertainty and it is unlikely that it has a foreseeably optimal RMA strategy to begin with.[219] In Chapter 3, risk was distinguished from uncertainty because it could be quantified using distributive probabilities. More specifically, risk is quantified in relation to both its probability of occurrence and potential project costs or impact, both of which are measured between risk senders and risk bearers.

Uncertainties may be foreseeable (e.g. hypothetically conceiving that a natural disaster would damage a P3 infrastructure project during post-contractual PRM); these are referred to as *first-degree* uncertainties. If a first-degree uncertainty is identified as a potential threat to the project, it will still likely lack thorough RMA consideration because of its unpredictable probability of occurrence and impact on the project.[220] *Second-degree* uncertainties are uncertainties that remain unidentified and, accordingly, left out of a P3's contract altogether. Second-degree uncertainties leave projects susceptible to increased contract mediation and legal disputes depending on the severity of their impact.[221]

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[219] Monteiro, "Risk Management," 272-273.
[220] That is, in comparison to the RMAs provided for quantifiable risks.
[221] James Stone, "A Theory of Capacity and the Insurance of Catastrophe Risks," *The Journal of Risk and Insurance* 40, no. 2 (1973): 241, http://www.jstor.org.ezproxy.uwindsor.ca/stable/pdf/252115.pdf.

In theory, to reduce the potential impact of project uncertainties, P3 scholars advise the insurance of all insurable risks and first-degree uncertainties.[222] In practice, some insurable risks and first-degree uncertainties are overlooked due to cost-oriented strategies on behalf of public and private actors.[223] Public authorities pay risk premiums and insurance fees indirectly through their payment mechanisms with SPVs.[224] SPVs pay risk premiums and insurance fees directly through monetary agreements with project lenders and equity investors.[225]

If project risks or uncertainties are uninsurable, the next step is to assess if they are quantifiable.[226] As stated previously, uncertainties are unquantifiable and risks are quantifiable. The general principle in P3 PRM is that public authorities should retain the threats of all uncertainties to a degree – either the public authority solely bears the uncertainty or it shares this responsibility with the private SPV. If a project uncertainty is shared, it should contain a risk cap for the private actors involved.[227]

The last main consideration for risk transfer pertains to the ability of potential risk senders and receivers to influence the risk or uncertainty (i.e. measurable means of reducing their impact, cost, and/or probability of occurrence). With regard to uncertainties, as stated above, the public sector should bear an uncertainty's potential

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[222] VDTF, "Risk Allocation and Contractual Issues: A Guide," 158-159.
[223] Howard Kunreuther, "The Role of Insurance in Managing Extreme Events: Implications for Terrorism Coverage," *Risk Analysis*, 2002, 434-435, doi:10.1111/0272-4332.00054.
[224] For example, through availability payments, milestone payments, full tolls, or shadow tolls. See Chapter 2, Section 2.1.
[225] NTSA, "National Treasury Ppp Manual - Module 4 : PPP Feasibility Study National Treasury Ppp Practice Note," 29; VDTF, "Risk Allocation and Contractual Issues: A Guide," 11.
[226] With regard to its respective probability of occurrence and potential impact on – or cost towards – a P3 project.
[227] Peter E. D. Love et al., "Risk/Reward Compensation Model for Civil Engineering Infrastructure Alliance Projects," *Journal of Construction Engineering and Management* 137, no. 2 (2011): 134, doi:10.1061/(ASCE)CO.1943-7862.0000263.

‘opportunities’ or ‘threats’ in all instances, and the private partner should only share this responsibility with the public sector if it has the capacity to influence potential outcomes.[228] Risks that cannot be influenced by either party, which are generally taken by the public sector, are considered “exogenous risks.”[229] The aforementioned considerations for uninsurable risks and uncertainties – during first-step risk transfer – are expressed in Figure 4.5.

Figure 4. 5: Risk Transfer Principles for Uninsurable Risks and Uncertainties in P3s

Risk/Uncertainty	Risk	Risk	Risk	Risk	Uncertainty	Uncertainty
Insurable	✗	✗	✗	✗	✗	✗
Quantifiable	✔	✔	✔	✔	✗	✗
Public Influence*	✔	✗	✔	✗	---	---
Private Influence	✗	✔	✔	✗	✗	✔
Preferred Means of Allocation	Public authority	Private SPV/JV	Compare RMAs**	Shared; no cap	Public authority	Shared; private cap

* These general principles relate to first-step risk transfer between the public and private sector. To apply to second-step risk transfer, the figure’s considerations would have to be modified so that the default risk sender is an SPV in lieu of a public authority.
** Further assessment of potential RMAs is required. Potential RMAs are compared so that an optimal RMA is selected.

The treatment of risks and uncertainties expressed in Figure 4.5 can be visualized by a decision-tree, which is one of the RMA methodologies expressed in Figure 4.3. Decision-trees are commonly used during pre-contractual PRM for classifying multiple variables that must be considered before selecting an optimal RMA for P3 risks. Figure 4.6 provides a broad template for P3 decision-tree methodology in pre-contractual PRM for first-step risk transfer.

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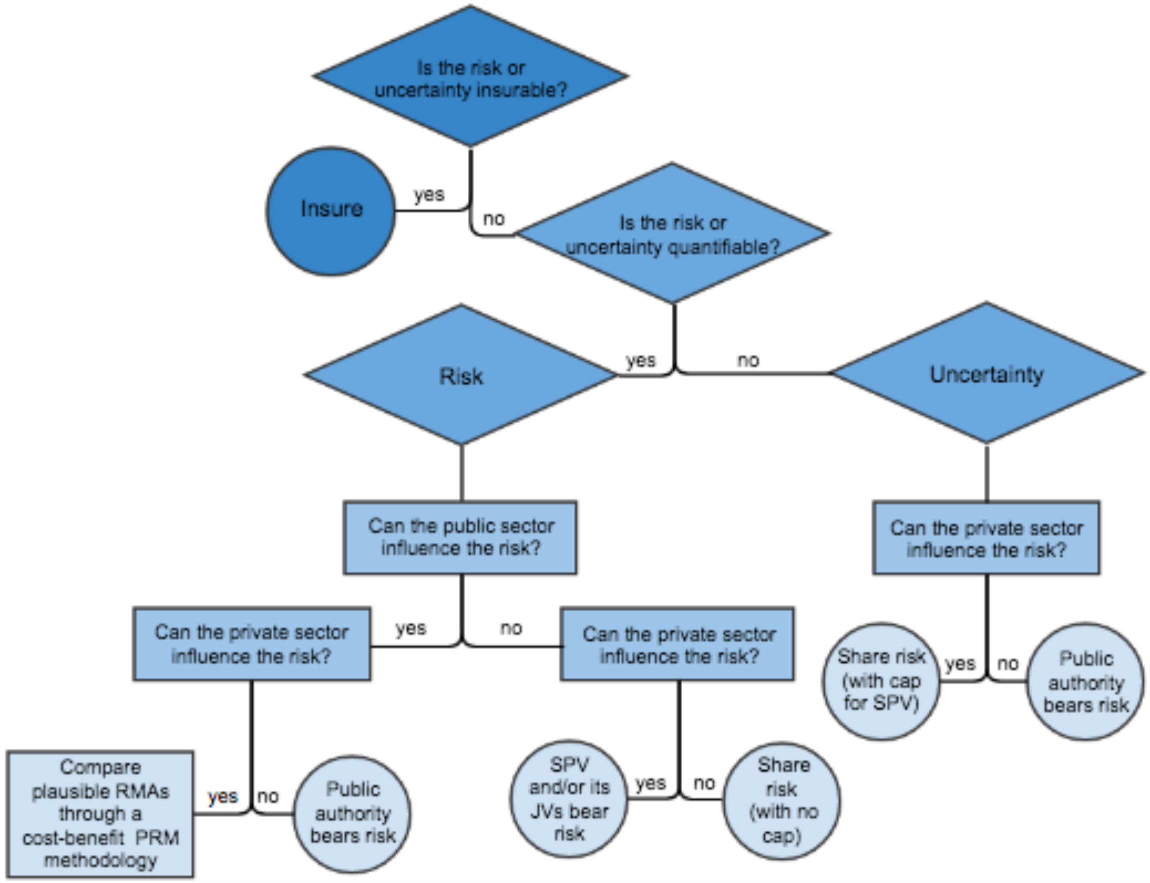
[228] Firmenich and Jefferies, “Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure,” 86.
[229] De Clerck, “Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process,” 30.

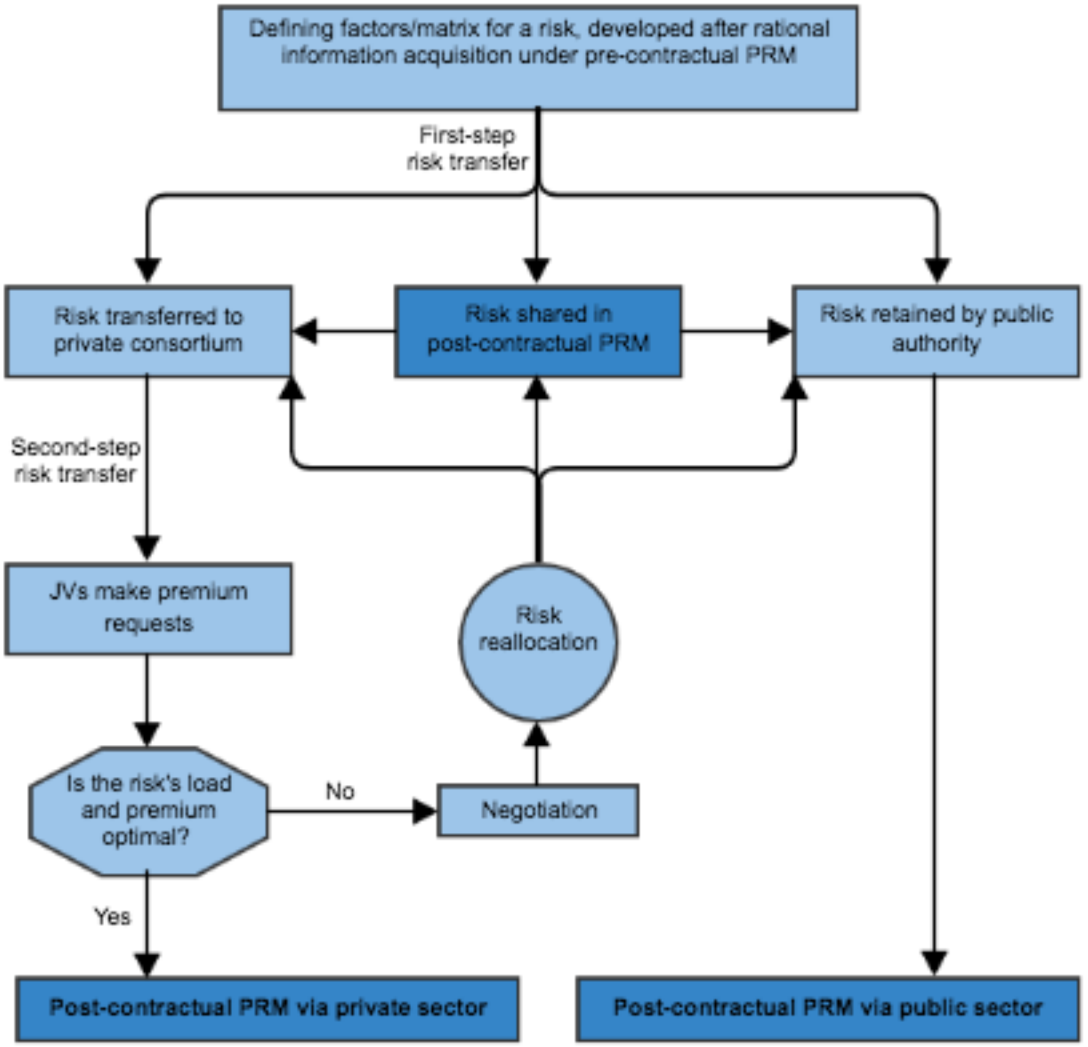
Figure 4. 6: P3 Decision-Tree for First-Step Risk Transfer



Risk decision-trees, along with a multitude of other PRM methodologies, are used to rationally choose RMAs after continuously aggregated quantitative expert input.[230] While Figure 4.6 deals with first-step risk transfer, this methodology applies to both: (i) first-step risk transfer, to decide which risks are allocated to which sector, and (ii) second-step risk transfer, to decide which risks are allocated to which JVs within an SPV consortium. Figure 4.7 represents the final steps taken before allocating P3 risks in pre-contractual PRM (i.e. first-step risk transfer).

[230] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance,* 68.

Figure 4. 7: Broad Risk Allocation Template for Pre-Contractual P3 PRM[231]



The consideration of actors' risk-bearing capacities is especially applicable during second-step risk transfer because the list of potential risk recipients increases from a mere public-private demarcation to an array of competing JVs. Remember, in second-step risk transfer, the default risk senders are SPVs instead of governments and potential risk recipients expand to include all applicable JVs under the SPV consortium. Thus, there are more potential risk bearers brought into consideration for risk transfer.

231 Adapted from Bing et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 27.

The respective capacities of potential risk recipients are contingent on their ability to handle risks and the risk premium fees they negotiate. As stated previously, a risk's associated premiums are generally contingent on the risk's probability of occurrence and its potential for impact. Save for deviations in the assessment of a risk's premium value between actors, these two factors have the largest effect on a risk's associated premiums. If a risk premium is too high, either: (i) the risk transfer should be increased or (ii) fees should be decreased. If a risk premium is too low, either: (i) the risk transfer should be decreased or (ii) fees should be increased.[232]

To avoid risk defaults, and subsequent legal disputes, risk senders should only transfer risks to recipients that can handle them 'best.'[233] While cost-optimization is a large consideration for arriving at the 'best' risk transfer, risk senders should not be parsimonious and merely allocate risks to agents willing to bear them at the lowest cost. Suitable risk premiums should be paid to suitable risk bearers who in turn will do a suitable job of post-contractual PRM.[234] Risk defaults have harmful impacts on P3 projects and should be avoided through appropriate payment and accountability mechanisms. Unfortunately, it is difficult to gain contextual insight into how

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232 Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 87.
233 Depending on the project's stage, risk senders could be public authorities (during first-step risk transfer), SPVs (during second-step risk transfer), or JVs (during third-step risk transfer, more commonly referred to as subcontracting).
234 De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 34; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure." 87; Robinson and Scott, "Service Delivery and Performance Monitoring in PFI/PPP Projects," 182-183.

governments create risk pricing and risk premium models, as "risk compensation calculations in the particular P[3] context are lacking."[235]

4.5.2 Insuring Risk

Typically, both public and private parties are required to maintain insurance policies with respect to a large portion of P3 project risks. P3 contracts stipulate required insurance coverage up to a minimum amount for both public and private parties, and sometimes a maximum amount for private parties (i.e. insurable risk caps). As noted in Section 4.5.1, not all P3 project risks are insurable; these risks are heavily borne by public authorities. For risks that are insurable, it is "common practice… [to include] minimum insurance package[s]" during early stages of P3 PRM.[236] In fact, public authorities request that SPVs include proposed insurance policies for transferrable risks as early as the RFQ stage. SPVs are typically asked to include cost estimations for their respective insurance partners on insurable risks that cover "physical damage during construction, loss of revenue due to delays… third-party liabilities, as well as performance guarantees required by the P[3] contract" in their RFP submissions.[237]

The involvement of insurance companies is not limited to a financier role; they are often included in the provision of RMAs as risk management consultants. Thus, insurance practitioners provide specialized insurance advice that transcends its field and permeates into the fields of risk delegation itself and PRM as a whole. During pre-contractual PRM, insurers may assume a consultant role over risk transfer and RMA

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[235] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 33.
[236] APMG International, "PPP Certification Program Guide" (Buckinghamshire, England: APM Group Ltd., 2016), Section 9.5, par. 14.
[237] Ibid., Section 6.2, par. 7.

selection. During post-contractual PRM, insurers will provide advice over the treatment of risks associated with insurance costs. Insurance risk "refers to the risk of the price for the insurance developing in a different way than anticipated, such that it is not compensated for by the indexation of the service payment."[238] When insurable coverage requirements deviate significantly from final contract projections, insurance policies present a risk threat or risk opportunity to public and private partners.[239]

Pending provisions in the final P3 contract, where insurance costs present a risk threat (i.e. insurance costs exceed projections by a stipulated amount), private partners are entitled to compensation equivalent to the amount insurance costs exceed initial projections with reference to a benchmark. Similarly, where insurance costs present a risk opportunity (i.e. insurance costs fall short of projections by a stipulated amount), public authorities are entitled to symmetrically equivalent compensation in the form of a credit paid back by private partners who received insurance premiums in excess of what was required.[240]

4.6 Conclusion

In theory, a P3 achieves optimal risk allocation through the selection of appropriate RMAs – derived from a thoroughly exhaustive pre-contractual PRM cycle – followed by post-contractual PRM, where each actor manages its project responsibilities and risks as expected. Under the principal-agent framework, the interdependency of a P3's execution between public principals and private agents requires trust and

[238] Ibid., Section 1.2.9, par. 14.
[239] This deviation is considered when the costs of insurance premiums exceed projections by a stipulated percentage, typically expressed in the range of 50 to 100 percent. See Ibid., Section 1.2.9, par. 16.
[240] Ibid.

cooperation. To be charitable to the P3 process, most public and private actors have the mutual incentive of creating optimal risk transfer under a "common destiny…[where] every player has an interest in the other players not failing."[241]

While a 'common destiny' – a reciprocal objective to create a sound project through the optimal treatment of risk – is a theoretical ideal, it is mired in obstructive constraints. During pre-contractual PRM, optimal risk allocation is threatened by issues like bounded rationality (e.g. asymmetric information acquisition), subjectivity (e.g. optimism bias), and moral hazards (e.g. strategic behaviour).[242] Together, these threats can spur opportunistic behaviour from private partners, whereby project bids and pre-contractual agreements do not align with post-contractual performance. In turn, premeditated contract renegotiations can occur.[243] To this end, governments must promote incentive schemes, aligning and uniting the strategic motivations of private partners and public authorities.

As mentioned earlier, it is important for governments to ensure that P3 projects are conducted with transparency. To this end, it is difficult to offer further insight on moral risk. Scholars regularly note that issues of this vein – for example, moral hazards and adverse selection – exist in P3s, but they are difficult to identify due to a general lack of contractual transparency.[244] Legal disputes and contractual renegotiations of P3s are

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[241] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 87.
[242] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere"; Eriksen and Jensen, "The Cost of Second Best Pricing and the Value of Risk Premium"; Monteiro, "Risk Management."
[243] Mohamed, Khoury, and Hafez, "Contractor's Decision for Bid Profit Reduction within Opportunistic Bidding Behavior of Claims Recovery"; Monteiro, "Risk Management."
[244] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 29.

tightly confined procedures. Major disputes eventually become publicly known (e.g. between the Canadian Government, WEMG, and multiple JVs over the Right Honourable Herb Gray Parkway's faulty girders). However, their legal intricacies and financial resolutions remain elusive to the general public.

Moral risks aside, the success of a P3 project is also threatened by subjectivity in PRM; decision-making modules for P3s necessitate the subjective, albeit expert, input of practitioners. Scholars offer various measures to combat practitioner subjectivities that hamper PRM procedures and RMA selection: (i) systematic decision-making modules; (ii) transparent documentation of decisions; (iii) exhaustive qualification measures to validate the status of experts that quantify risk and risk premiums; (iv) adequate size of expert teams; (v) the use of multiple methodologies during pre-contractual PRM; and, most relevant to the next chapters, (vi) a multidimensional, interdisciplinary approach to risk allocation.[245]

Ultimately, considering the treatment of risk over a P3 project's lifecycle, it is imperative that this interdisciplinary procurement method is studied through an interdisciplinary vein.[246] Successful P3s require the coalescence of multiple agents from diverse areas of expertise. Further, the development of P3 literature stands to benefit from a holistic approach that considers the expertise and concerns of practitioners and scholars

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[245] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; Nora M. El-Gohary, Hesham Osman, and Tamer E. El-Diraby, "Stakeholder Management for Public Private Partnerships," *International Journal of Project Management* 24, no. 7 (2006): 595–604, doi:10.1016/j.ijproman.2006.07.009; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Bent Flyvbjerg, "What You Should Know about Megaprojects and Why: An Overview," *Project Management Journal*, 2014, doi:10.1002/pmj.21409.
[246] El-Gohary, Osman, and El-Diraby, "Stakeholder Management for Public Private Partnerships," 604.

from a multitude of disciplines: political science, law, engineering, mathematics, finance, business, management science, geography, and economics, among others.[247]

PRM, as an applied science, must utilize cooperative efforts to present diverse expert input that can be readily transferred to the P3 industry itself. PRM literature should develop a systematic transfer of knowledge to real-life P3 infrastructure procurement – one that considers the input of all aforementioned fields. In light of this idea, the following chapters present research that revolves around original input from public and private P3 practitioners from a wide range of professional backgrounds. Their input specifically pertains to risk allocation preferences during first-step risk transfer.

[247] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 9; El-Gohary, Osman, and El-Diraby, "Stakeholder Management for Public Private Partnerships," 601; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 88.

CHAPTER 5

RISK ALLOCATION RECOMMENDATIONS IN P3 LITERATURE

5.1 Introduction

The centered focus of Chapter 5 deals with risk allocation during the P3 procurement phase. This entails either: (i) the public sector retaining risks or (ii) first-step risk transfer – either fully or partially – to SPVs. As noted in Chapters 2 and 4, the P3 procurement phase requires years of pre-contractual considerations from the public sector – i.e. P3 screening processes – and negotiations both within and between public and private sectors. Poor pre-contractual PRM, resulting in suboptimal risk allocation, has the potential to create irreparable opportunity costs in P3s. The significance of planning and managing risk allocation during this phase cannot be overestimated.[248]

Chapter 5 complements P3 literature on risk allocation by offering theoretical insight, and potential guidance, towards first-step risk transfer during the procurement phase. Research on the public-private relationship is steered by expert practitioner feedback in Chapter 6, drawing from an interdisciplinary research network of both public and private sector P3 practitioners. Thus, this research's strength lies in its multifaceted focus on risk allocation between public authorities and SPVs.

To recap, the literature reviews of Chapters 3 and 4 – which draw from scholarly insights and principal-agent considerations – provide broad guidelines for first-step risk transfer: (i) risks that are solely influenced by the public sector should be retained by the public client; (ii) risks that are solely influenced by the private sector should be

[248] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 40.

transferred to the private client; (iii) risks that are partially influenced by both clients can be shared; and (iv) regardless of the private sector's influence on uncertainties, the public client should bear them either in full or to a degree.[249] Further, when a risk is being allocated through an optimal RMA, risk bearers should be able to foresee the risk, gauge the risk's potential project impact or cost, mitigate the chances of the risk occurring, assess whether it can bear the risk if it arises, and receive a reasonable risk premium for bearing it.[250]

With gained insight on P3 procurement and PRM processes – supplemented by principal-agent risk allocation frameworks – Chapter 5 builds on previous chapters by presenting a core literature database comprised of a dozen articles that focus on risk allocation between public and private P3 partners. This core database is used to execute an original study premised on the allocation of contentious risks in P3 projects in Canada. A cross-comparative analysis of the core literature is conducted to arrive at sound risk preferences and contentious risk preferences.

In this study, 'sound' risk preferences are defined as those that were given the same allocation preferences across all articles where they are mentioned in the core literature database.[251] Sound risks are not assessed for further research; it is assumed that their conclusive allocation preferences within the literature signifies a lessened need to

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[249] I.e. if the private client has no influence, the public client should bear an uncertainty in full; if the private client has some influence, it may share the uncertainty with a pre-agreed risk cap. See Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 86.
[250] A.P.C. Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China.," *Journal of Management in Engineering* 27, no. July (2010): 143-144, doi:10.1061/(ASCE)ME.1943-5479.0000049.
[251] While the twelve pieces of literature that comprise the core database share similar thematic scopes, they do not all focus on identical risks. Thus, not every risk is mentioned in every piece of literature.

conduct original research on their allocation. Conversely, contentious risk preferences are defined as those risks that have been allocated to different preferential sectors at least once amongst the articles where they are mentioned in the core database.[252] The preferential sectors of allocation for risks in the P3 literature include a spectrum denoting: sole public allocation, different degrees of shared allocation, and sole private allocation.[253]

5.2 Literature Review

The dozen pieces of P3 literature in the core database – comprised of ten scholarly articles and two central government agency primers – were selected and cross-referenced to arrive at common risk allocation preference schemes and a common methodological framework for the study. The selected pieces of literature all evaluate P3 risk allocation schemes and were published between 1998 and 2013. Figure 5.1 presents a geographical depiction of the literature consulted.[254] Figure 5.2 classifies the core literature database according to the research's sector of interest, stakeholder perspective, type of research used, data sources used, subject of study, and methodologies used.

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[252] Content analysis of the literature was used to ensure identified risks could be compared across the literature. For example, if an identified risk is named 'legal/regulatory changes' in one article and named 'change in law' in another, both of these titles – albeit different – denote the same risk and are treated accordingly.

[253] Due to variance in methodologies, some pieces of literature in the core database employ different means of labeling risk allocation preferences. Specifically, not all pieces of literature demarcate the extent to which public or private parties should share risks (e.g. some articles suggest allocation preferences where a risk should be borne either solely by the public or private sector or simply 'shared,' while articles offer degrees of sharing preferences where one sector bears a larger fraction of a risk than the other).

[254] Some pieces of literature in the core database extrapolate their findings to make global P3 recommendations. Thus, the location where research was conducted is not always a relevant factor when assessing every author's recommended risk allocation scheme.

Figure 5. 1: Geographical Representation of Core Literature Database's Origins

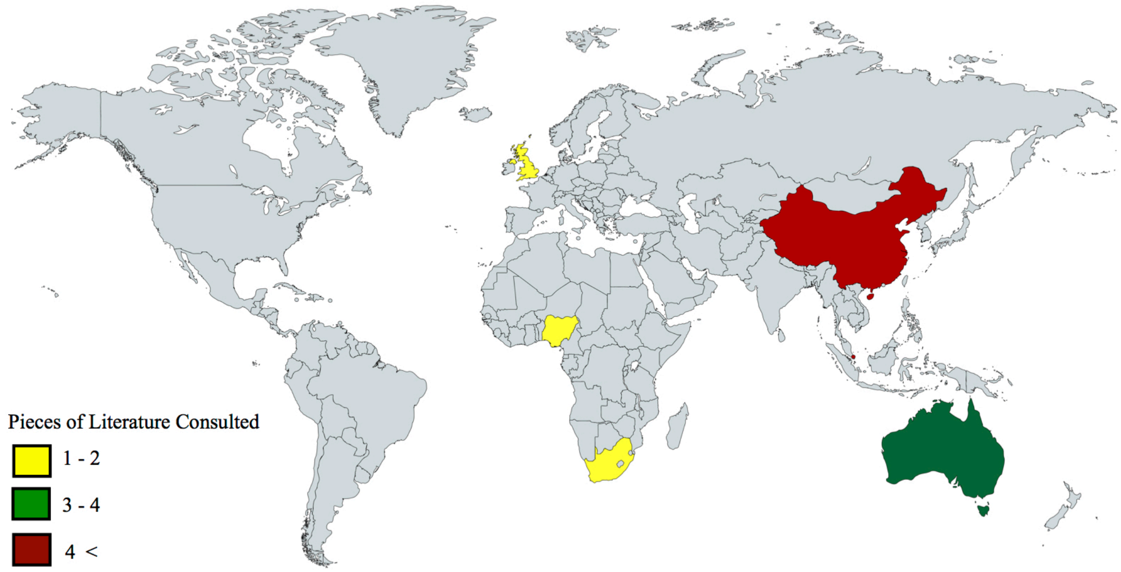

Figure 5. 2: Classification of Core Literature Database

Author	Classification					
	Sector of Interest	Stake-holder Persp-ective	Type of research	Data sources	Subject of study	Methodology
Arndt (1998)	Transportation	Public-Private	Qualitative	Secondary	Risk Allocation	Summative Content Analysis of Case Study
Wang & Tiong (2000)	Energy	Public-Private	Qualitative	Secondary	Risk Allocation	Factor analysis of Case Study
VDTF (2001)	n/a	Public-Private	Qualitative and Quantitative	Secondary	P3 Procurement (exhaustive)	n/a
NTSA (2004)	Health	Public-Private	Qualitative and Quantitative	Secondary	P3 Procurement (exhaustive)	n/a
Li et al. (2005)	n/a	Public-Private	Quantitative	Primary	Risk Allocation	Content Analysis of Expert Questionnaire
Shen et al. (2006)	Recreation	Public-Private	Qualitative	Secondary	Risk Allocation and Risk Assessment	Factor analysis of Case Study
Ng & Loosemore (2007)	Transportation	Public-Private	Qualitative	Secondary	Risk Allocation	Factor analysis of Case Study
Lam et al (2007)	Transportation	Public-Private	Quantitative	Primary	Risk Allocation	Fuzzy Logic applied to Expert Input
Ke et al (2010)	n/a	Public-Private	Quantitative	Primary	Risk Allocation	Content Analysis of Expert Questionnaire
Chan et al (2011)	n/a	Public-Private	Quantitative	Primary	Risk Allocation and Risk Assessment	Content Analysis of Expert Questionnaire
Hwang et al (2013)	n/a	Public-Private	Quantitative	Primary	Risk Allocation and Risk Assessment	Content Analysis of Expert Questionnaire
Tolani (2013)	n/a	Public-Private	Quantitative	Primary	Risk Allocation	Content Analysis of Expert Questionnaire

5.2.1 Risk Allocation in the Melbourne City Link Project

Ardnt analyzes a transportation P3 project – the Melbourne City Link (MCL), worth 1.8 billion dollars[255] – from a public-private stakeholder perspective. He assesses the MCL's risk allocation scheme using secondary sources under the widely-accepted principle that "the government intends to allocate risks to those parties it considers best positioned to assess and manage them."[256] Arndt adopts a qualitative methodological approach, assessing the project's risk allocation in light of the MCL's material adverse effect (MAE) regime, which "is a tool that helps allocate and share risks."[257]

By accessing reports on ministerial portfolios, Arndt notes that "a closer reading of the documents indicates a further shift of risk to the private sector" compared to previous P3 projects in Australia.[258] He develops an MCL risk matrix for the project's risks, noting where the public authority and private partner have: (i) accepted the majority of a risk, (ii) partially accepted a risk, or (iii) not taken a risk.

In line with the MCL's MAE clauses, Arndt identifies the following risk categories: design and construction risks (e.g. design, construction, site, approvals, and completion); operation risks (e.g. production, asset upgrades, maintenance, environmental, and insurance); market risks (e.g. demand, volume, and revenue); sponsor risks (e.g. consortium, commercial, finance, default, and condition at transfer); sovereign risks (e.g. legislation, policy, and residual value); network risks (e.g. access regime and linked infrastructure); and external risks (e.g. force majeure and financial). In total, 26

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[255] In American dollars.
[256] Raphael Henry Arndt, "Risk Allocation in the Melbourne City Link Project," *The Journal of Project Finance*, no. 2 (1998): par. 17, doi:10.1007/s13398-014-0173-7.2.
[257] Ibid., par. 28.
[258] Ibid., par. 90.

risks – along with their preferred allocation schemes – are identified under these categories.

5.2.2 Case Study of Government Initiatives for PRC's BOT Power Plant Projects

Wang and Tiong analyze an energy infrastructure project – the Laibin B Power Plant – from a public-private stakeholder perspective. While the cost of the project is not publicly available, the project was solely financed by the private sector.[259] It uses the power plant as a case study to conduct qualitative research on the risk allocation schemes of build-operate-transfer (BOT) concessions in China. The study adopts a factor analysis methodology to assess the Laibin B Power Plant's risk allocation scheme.[260] Wang and Tiong draw from the following data sources: (i) secondary sources (i.e. Laibin B's concession agreement, power purchase agreement, and fuel supply and transportation agreement); (ii) interviews with Laibin B project practitioners (i.e. public officials and private managers); (iii) literature reviews on BOT-esque procedures and regulations (e.g. BOT, BOO, and BOOT projects); and (iv) an expert questionnaire.[261]

After a case study on the Laibin B Power Plant, Wang and Tiong create a risk allocation matrix for the project. They identify the following risk categories: political risks, construction completion risks, operating risks, market and revenue risks, finance risks, legal risks, and competition risk (i.e. adverse selection during project tender). In

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[259] The World Bank, "Laibin B Power Plant Snapshots - Private Participation in Infrastructure (PPI) - World Bank Group," *Private Participation in Infrastructure Database*, 1997, http://ppi.worldbank.org/snapshots/project/laibin-b-power-plant-270.
[260] S. Q. Wang and L. K. Tiong, "Case Study of Government Initiatives for PRC's BOT Power Plant Project," *International Journal of Project Management* 18, no. 1 (2000): 69–78, doi:10.1016/S0263-7863(98)00072-6.
[261] Ibid., 70.

total, 53 risks – along with their preferred allocation schemes – are identified under these categories.

5.2.3 Partnerships Victoria: Risk allocation and Contractual Issues

The Government of Victoria's Department of Treasury and Finance (VDTF) provides an exhaustive three-part primer to guide practitioners in implementing P3s under the Partnerships Victoria policy framework. The primer's scope encompasses a wide range of P3 procurement matters relating to risk allocation and contractual practices.

Throughout the primer, multiple stakeholder perspectives are considered (i.e. public-private, public, private, and subcontracted third parties), multiple subjects of study are considered (e.g. P3 governance, ex post evaluations, key success factors, pre-tender and tender stages, risk identification and assessment, and risk transfer), multiple approaches to research are used (i.e. quantitative, qualitative, and theoretical), and multiple methodologies are adopted (e.g. financial analysis via usage fee reduction [UFR] formulas and common area payment reduction [CAPR] formulas). For the sake of brevity, only relevant sections of this primer are identified and classified in Figure 5.2.[262]

Part One establishes a policy framework with reference to guiding principles for providing public infrastructure via P3s. Part Two provides the foundations of risk identification, assessment, and allocation with reference to generic examples of past P3 projects. Part Three focuses on the main contractual concerns of P3 project risk

[262] Due to its relatively wide scope in comparison to the rest of the core literature database, only select chapters are focused on. If the primer were assessed in full, it would cover a considerably larger amount of factors than those identified in Figure 5.2.

allocation. Special attention is paid to Part One, Chapter 4, which develops a risk allocation framework, and Part Two, Chapters 8-17, which identify a plethora of P3-related project risks alongside their respective allocation preferences.

Part Two, Chapters 8-17 proves useful for identifying and defining various contentious risks for the forthcoming study. Part One, Chapter 4 summarizes much of what has already been covered in this thesis. Specifically, its covers risk allocation concepts such as: optimal risk allocation, risk-bearer influence, risk premiums, risk 'threats' and 'opportunities,' pre-contractual PRM, post-contractual PRM, and the factors influencing RMA selection.[263]

Part One, Chapter 4 concludes with reference to an appended standardized risk matrix that provides a framework for the Victorian Government's risk allocation preferences. The following risk categories are identified: site risks; design, construction, and commissioning risks; sponsor and financial risks; operating risks; market risks; network and interface risks; industrial relations risks; legislative and government policy risks; force majeure risks; and asset ownership risks.[264] In total, 42 risks – along with their preferred allocation schemes – are identified under these categories.

5.2.4 PPP Manual Module 4: PPP Feasibility Study, South Africa

In the same vein as the VDTF, the National Treasury of South Africa (NTSA) provides another comprehensive primer – *National Treasury's PPP Manual* – as a systematic guide to regulate the practices of both public and private P3 practitioners

[263] While these concepts are covered in the VDTF's primer, it uses different naming schemes (e.g. risk "threats" and "opportunities" are called "liabilities" and "upside benefits"; "PRM" is not explicitly mentioned as a concept). These discrepancies are merely rhetorical in nature. VDTF, "Risk Allocation and Contractual Issues: A Guide," 19-23.
[264] Ibid., 178-192.

during P3 project lifecycles. The manual contains nine modules in total. However, Module 4 is the focus of this literature review. Similar to the VDTF's primer – which models its risk allocation recommendations with reference to the Partnership Victory policy framework – Module 4 of the NTSA's primer models its risk allocation recommendations with reference to a national policy framework: Treasury Regulation 16 of the Public Finance Management Act of 1999.[265] Treasury Regulation 16 is the chief legislation governing national and provincial P3s in South Africa. It provides practitioners with meticulously crafted legal parameters and contains hundreds of provisions for public and private actors to follow during P3 project delivery.[266]

Thus, the NTSA's Module 4 is largely explicative in nature; it provides readers with precise, detailed instructions on P3 procurement with the goal of aiding in "the effective and efficient management and use of financial resources."[267] Module 4 summarizes much of what has already been covered in this thesis. It considers: preplanning and options analysis (e.g. needs analysis, feasibility analysis, P3 screening, PSCs, and preliminary VFM using shadow bids); preliminary project drafts (e.g. developing output specifications, a project reference scenario, and early competitive process documents); competitive selection processes (e.g. due diligence from the private sector, developed VFM tests, and RFPs); and, eventually, a final risk allocation scheme.

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[265] NTSA, "National Treasury PPP Manual - Module 4 : PPP Feasibility Study National Treasury Ppp Practice Note," iii.
[266] H.K. Yong, *Public-Private Partnerships Policy and Practice: A Reference Guide*, 2010, https://books.google.com/books?id=tnuFUUjP9f8C&pgis=1.
[267] Christopher McCrudden, *Buying Social Justice: Equality, Government Procurement, & Legal Change* (New York: Oxford University Press, 2007): 261, https://books.google.ca/books?hl=en&lr=&id=HKqL-ZyF1oAC&oi=fnd&pg=PP1&dq=The+Manipulation+of+Choice:+Ethics+and+Libertarian+Paternalism&ots=RvS-buK8qN&sig=0fK_ydEins-a_P8vGapytIAwuYs.

Like the VDTF's primer, the NTSA's Module 4 covers multiple stakeholder perspectives, subjects of study, approaches to research, and methodologies. While the module covers the P3 process broadly, it draws a specific sector of interest – the health sector – via a case study of a construction project for a hypothetical hospital.[268] Specific attention is paid to the module's matrix approach "to weigh up the evaluation of… option[s]… to assist in the choice of the best one[s]."[269] The module considers possible project impacts on both public and private stakeholders when constructing the matrix. The NTSA notes the value of risk matrices during all P3 procurement phases: "A comprehensive risk matrix is a fundamental component of P[3] procurement as it is used to identify and track risk allocation throughout the drafting of the P[3] agreement, the bidding process, P[3] agreement negotiation and financial closure."[270]

Its standardized P3 risk matrix for the hypothetical hospital identifies the following risks: availability risks, completion risks, cost overrun risks, design risks, environmental risks, exchange rate risks, force majeure risks, inflation risks, insolvency risks, insurance risks, interest rate risks, latent defect risks, maintenance risks, market demand and volume risks, operating risks, planning risks, political risks, regulatory risks, residual value risks, resource input risks, subcontractor risks, tax rate change risks, technology risks, and utilities risks. Unlike most pieces of literature in this study's core database, the NTSA does not classify project risks under broad categories. Thus, the

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[268] For example, Module 4 uses financial analysis to arrive at the net present value (NPV) of the hospital's projected cash flow during the PSC phase. Its PSC reference model of the case study adopts a discounted cash flow (DCF) analysis to arrive at an NPV calculation to determine the case study's project costs. See NTSA, "National Treasury PPP Manual - Module 4 : PPP Feasibility Study National Treasury PPP Practice Note," 55.
[269] Ibid., 13.
[270] Ibid., 27.

aforementioned 24 risks – along with their preferred allocation schemes – are identified independently.[271]

5.2.5 The Allocation of Risk in PPP/PFI Construction Projects in the UK

Li et al. take a generalized focus on P3s without a specific industry of interest. They develop a risk allocation framework for public authorities under the United Kingdom's private finance initiative (PFI), adopting a public-private stakeholder perspective. They use an expert questionnaire to arrive at risk allocation preferences for various P3 project risks (i.e. between public, private, and shared sectors of allocation). Their respondent pool comprises expert practitioners from both the public and private sector.[272] They adopt a meta-classification approach to risk identification, assorting risks by their respective levels: macro, meso, and micro.

Macro level risks are exogenous risks (i.e. external project risks that cannot be influenced). Meso level risks are project-related risks occurring within a P3's "system boundaries" (e.g. foreseen project risks during DBFOM implementation processes). Micro level risks are party-related risks that arise due to stakeholder relationships during PRM (e.g. moral hazards or optimism bias); these risks arise due to the aforementioned principal-agent relationship between public authorities and SPVs, where it is assumed that the public principal is driven by providing social services and the private agent is driven by maximizing profits.[273]

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[271] Wang and Tiong, for example, identify 53 risks under seven broad categories; the VDTF, for example, identifies 42 risks under ten broad categories. The NTSA, however, identifies and allocates 24 risks separately without categorizing them.
[272] Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 29.
[273] Ibid., 27.

The three meta-classification categories contain sub-categories that classify risks of a specific nature (i.e. akin to the previous literature from Arndt, Wang and Tiong, and the VDTF). Li et al. note that, by adopting these sub-categories to classify project risks, "it facilitates a strategic approach to risk management for public and private sector project stakeholders… [and] indicate[s] situations where common approaches to risk analysis, risk treatment, and subsequent risk monitoring and control, can be adopted in the risk management process."[274]

Li et al's risk catalogue classifies macro level risks as: political risks (e.g. unstable government), macroeconomic risks (e.g. inflation and interest rates), legal risks (e.g. legislation changes), social risks (e.g. public opposition to a project), and natural risks (e.g. force majeure). It classifies meso level risks as: project selection risks (e.g. land acquisition), project finance risks (e.g. potential investor attraction), residual risk,[275] design risks (e.g. delay in project approvals and permits), construction risks (e.g. construction cost overrun), and operation risks (e.g. operational revenues below project projections). It classifies micro level risks as: relationship risks (e.g. organization and coordination risk) and third party risks (e.g. third party tort liability). In total, 46 risks – along with their preferred allocation schemes – are identified under these categories.

5.2.6 Role of PPPs to Manage Risks in Public Sector Projects in Hong Kong

From the onset of their study, Shen et al. note how the complex, interdisciplinary nature of P3 megaprojects puts a premium on achieving optimal risk allocation for project success. Further, they note how potentially divisive principal-agent relationships

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[274] Ibid.
[275] Residual risk is both its own risk category and risk factor; there are no other risk factors associated with residual risk's category.

between public authorities and private partners compound the significance of optimal risk allocation:

> … construction activity is usually subject to more risk than other business activities because of its complexity particularly in coordinating a wide range of disparate and interrelated skills and activities. This complexity is further compounded in implementing public sector projects where multiple project objectives are expected by a wide range of stakeholders who have different interests associated with the projects.[276]

Shen et al. analyze the Hong Kong Disneyland (KDLD) P3 project from a public-private stakeholder perspective. They assess the KDLD's PRM scheme, with particular focus on its risk allocation framework, to "examin[e]… the ways that the application of P[3s] can effectively manage risks in project delivery."[277] They adopt a qualitative methodological approach, assessing the KDLD's risk allocation framework by means of semi-structured interviews with senior public officials, followed by factor analysis on the KDLD case study to provide recommendations on risk allocation preferences for P3 projects in the recreational sector in Hong Kong.

Akin to Chapter 4 of this thesis, Shen et al. review pre-contractual and post-contractual P3 PRM. They arrive at similar conclusions over the mutual incentive of collaboration between P3 actors, noting that P3 partners "have an incentive to work together at an early stage to decide the best way to deliver the required service over the contract life… This results in minimum lifecycle cost… and… less [project] changes… during the construction process."[278] Through their own literature review, Shen et al.

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[276] Li Yin Shen, Andrew Platten, and X. P. Deng, "Role of Public Private Partnerships to Manage Risks in Public Sector Projects in Hong Kong," *International Journal of Project Management* 24, no. 7 (2006): 587, doi:10.1016/j.ijproman.2006.07.006.
[277] Ibid., 588.
[278] Ibid., 591.

identify the following major risk categories: project-related risks, government-related risks, client-related risks, design-related risks, contractor-related risks, consultant-related risks, and market-related risks.[279] In total, 13 risks – along with their preferred allocation schemes for the KDLD – are identified under these categories.[280]

5.2.7 Risk Allocation in the Private Provision of Public Infrastructure

Ng and Loosemore conduct an ex post case study on a transportation P3 project – the New Southern Railway (NSR), worth 920 million dollars[281] – from a public-private stakeholder perspective. They analyze the rationale behind the NSR's risk allocation scheme, highlighting the project's "complexity and obscurity of risks… and the difficulties in distributing them appropriately."[282] They employ a qualitative factor analysis methodology by highlighting the main risks associated with the NSR project and critiquing the RMAs selected during PRM. Ng and Loosemore utilize a range of data sources, including: semi-structured interviews with senior public and private practitioners, primary analysis of publicly available contract documentation, secondary analysis of public and private sector reports and documents, conferences, newspaper reports, and P3 journal articles.[283]

This literature review focuses specifically on Ng and Loosemore's risk identification and allocation schemes. Instead of allocating project risks to a sector of preference (i.e. public or private), they recommended risk transfer to specific project

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[279] Ibid., 590.
[280] Ibid., 592-593.
[281] In American dollars.
[282] A. Ng and Martin Loosemore, "Risk Allocation in the Private Provision of Public Infrastructure," *International Journal of Project Management* 25, no. 1 (2007): 66, doi:10.1016/j.ijproman.2006.06.005.
[283] Ibid., 72.

actors (e.g. government, construction contractor, insurer, etc.). By demarcating JVs, equity investors, and lenders as separate actors under the private sector, Ng and Loosemore arrive at more specific risk allocation recommendations than their peers.

They adopt major risk categories from Grimsey and Lewis, who identify the following main types of risk categories: site risks, technical risks, construction risks, operating risks, revenue risks, financial risks, force majeure risks, political risks, project default risks, and asset risks.[284] In total, Ng and Loosemore identify 36 risks – along with their preferred allocation schemes for the NSR – under these categories.

5.2.8 Modeling Risk Allocation Decision in Construction Contracts

From the onset, Lam et al. recognize the unavoidable issue of subjective expert assessment – mentioned in Chapter 4[285] – in allocating P3 project risks: "allocation of risk among the contracting parties… requires qualitative judgment and experiential knowledge of construction experts. However, it is subjective and implicit."[286] To mitigate the widely recognized issue of expert subjectivity, Lam et al. deploy a systematic fuzzy logic analysis, converting private expert input into quantitatively based risk allocation preferences between the public and private sector. Thus, Lam et al. adopt a public-private stakeholder perspective, using private stakeholder input and fuzzy logic methodology to provide a template quantitative model for P3 project risk allocation.

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[284] Grimsey and Lewis, *Public Private Partnerships: The Worldwide Revolution in Infrastructure Provision and Project Finance*.

[285] To recap a major theme of Chapter 4, no matter how many quantitative PRM methodologies are adopted – and no matter how many times data is aggregated – risk allocation schemes are always subject to expert input and interpretation, which suffer from degrees of subjectivity. See Eriksen and Jensen, "The Cost of Second Best Pricing and the Value of Risk Premium," 36; Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure," 88; Monteiro, "Risk Management," 269.

[286] Lam et al., "Modelling Risk Allocation Decision in Construction Contracts," 485.

Lam et al. also note the significance of pre-contractual PRM in providing optimal RMAs, so that "litigation of contractual claims… [do not] come after… in court. The allocation of risks is thus one of the important decision-making processes leading to project success."[287] Expert input during pre-contractual PRM suffers from issues like linguistic vagueness, imprecision, and partiality.[288] Fuzzy logic tackles project complexities that arise from these issues by taking natural language and computing it quantitatively to arrive at precise, certain variables based on semantics.

Lam et al. take expert practitioner input – i.e. linguistic variables, which are imprecise qualitative values – and convert it to precise quantitative values by means of "membership functions." Membership functions denote "various degrees of membership" – from 0 to 1 – to a variable (e.g. inflation risk) and a member (e.g. public authority). Because membership functions are non-binary, Lam et al. are able to model risk allocation preferences by degrees.[289] For example, if fuzzy logic is applied to personal risk allocation preferences of expert practitioners for inflation risks, and inflation risk's membership function is calculated to be 0.20 for the private sector and 0.80 for the public sector, then it follows that the public sector should retain inflation risks either majorly or solely.

Lam et al. use a case study model of a railway P3 project issued by the Hong Kong Government. They assess a contract issued by a private railway company responsible for the project's DBFO. The authors obtain expert input for each risk

[287] This assertion signifies the importance of optimal risk allocation during pre-contractual PRM as a means of mitigating risks during post-contractual PRM. See Ibid., 485-486.
[288] As noted in Chapter 4, this is especially prevalent during the pre-contractual PRM cycle. Transparency issues like information asymmetry should also not be ignored. See Ibid., 486.
[289] Ibid.

stipulated under the contract before fuzzifying the data.[290] The contract identifies five main risk categories: capability risks, contractual and legal risks, economic risks, physical risks, and political and societal risks. In total, 16 risks – along with their preferred allocation schemes for the railway project – are identified under these categories.

5.2.9 Preferred Risk Allocation in China's PPP Projects

Ke et al. adopt a public-private stakeholder perspective to analyze risk allocation preferences in Chinese P3 projects. Similar to scholars before them, they note "each risk should be allocated to the party best able to manage it and at the least cost." Ke et al. conduct a comprehensive literature review to identify common P3 project risks. Their literature review is supplemented by telephone interviews with P3 practitioners to collect data on sixteen P3 projects in China.[291]

Based on the risks identified in their literature review and interviews, Ke et al. administered a two-round Delphi questionnaire survey to P3 practitioners in China. The first round asked participants to allocate risks between public and private sectors based on a five-point scale.[292] The second round asked first round respondents to reassess their original scores after being provided with feedback of the first round's results.[293]

Ke et al. apply various quantitative methods (e.g. mean score methodology) to the survey results to arrive at respective risk allocation preferences to aid public and private

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[290] This includes the degree to which a risk is foreseeable, assessable, controllable, manageable, and sustainable to a contractor. See Ibid., 490.
[291] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 483.
[292] Where 1 = "government takes sole responsibility," 2 = "government takes the majority of responsibility," 3 = "both parties take equal responsibility," 4 = "private sector takes the majority of responsibility," and 5 = "private sector takes sole responsibility." See Ibid., 484.
[293] This includes each risk item's: (i) mean score, (ii) frequency of selection between the five points, and (iii) the respondent's original selections from the first round. See Ibid.

sector partners in achieving "a balance of distribution of responsibilities and risks and thus reduce the time and cost of contract negotiation."[294] They identify seven risk categories: political risks, construction risks, operation risks, legal risks, market risks, economic risks, and "other" risks.[295] In total, 37 risks – along with their preferred allocation schemes – are identified under these categories.

5.2.10 Empirical Study of Risk Assessment and Allocation of PPP Projects in China

Chan et al. adopt a public-private stakeholder perspective to identify, assess, and allocate principle risks during P3 project delivery in China. They conduct a literature review of previous studies on P3 PRM, identifying two broad risk classifications: systematic/country risks and specific project risks. Systematic/country risks include macroeconomic variables that are beyond the scope of SPV influence. Specific project risks include microeconomic variables of a specific project that are within the scope of SPV influence.[296] Once all project risks are identified, Chan et al. administer an expert questionnaire to measure each risk's weighted significance to P3 projects and arrive at a preferred allocation scheme.

Each risk's weighted significance is calculated by multiplying its probability of occurrence with its potential impact on a project, both of which are measured using a five-point Likert scale.[297] Each risk's preferred allocation scheme is calculated via mean

[294] Ibid., 491.
[295] Ibid., 485.
[296] A.P.C. Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China.," *Journal of Management in Engineering* 27, no. July (2010): 139, doi:10.1061/(ASCE)ME.1943-5479.0000049.
[297] The probability of occurrence and potential project impact are both measured with the same scale: "1 = very low, 2 = low, 3 = average, 4 = high, and 5 = very high." See Ibid., 140.

score methodology from a three-point semantic differential scale.[298] Chan et al. note that the questionnaire's empirical results provided a "general consensus" among public and private sector practitioners, with slight deviations regarding the degree to which some risks should be allocated to their respective sectors.[299]

Chan et al. identify subcategories within the two broad classifications of systematic/country risks and specific project risks. Systematic/country risks deal with: political risks, economic risks, legal risks, social risks, and nature risks. Specific project risks deal with: construction risks, operation risks, market risks, relationship risks, and "other specific project risks."[300] In total, 34 risks – along with their preferred allocation schemes – are identified under these categories.

5.2.11 PPP Projects in Singapore: Critical Risks and Preferred Risk Allocation

The purpose of Hwang et al.'s research is twofold. First, they conduct ex post research on P3 projects in Singapore, identifying positive and negative risk factors that influence their national feasibility.[301] Second, they employ an expert questionnaire survey to identify both the degree of each identified risk's criticality and the preferred sector of allocation for each risk.[302] Thus, the research takes a public-private stakeholder perspective. Hwang et al. use quantitative methodology to conduct a content analysis, along with statistical hypothesis testing, on critical success factors and risk allocation preferences for P3 projects.

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[298] Where "1 = mainly to the public sector, 2 = equally shared between the public and private sectors, and 3 = mainly to the private sector." See Ibid., 144.
[299] Ibid., 136.
[300] Ibid.
[301] Based on ten completed P3 projects where facilities are under current operation. See Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 424.
[302] Ibid., 425.

Hwang et al. note that appropriate risk allocation and PRM is "critical for both public and private parties in P[3] projects to attain their objectives."[303] As is the case with most literature on P3 risk allocation, they explicitly note the widely accepted principle that a risk should be allocated "to the party best able to manage it at least cost."[304] They provide a literature review and subsequent research on: (i) the status of P3s in Singapore, (ii) the critical success factors of P3s, (iii) positive and negatives factors of using P3s to provide public infrastructure in lieu of conventional procurement models, (iv) risk identification, and (v) risk allocation.[305] Specific attention is paid to the latter two sections – i.e. risk identification and risk allocation – because they are directly relevant in scope to the forthcoming research.

After creating a catalogue of P3 project risks through their literature review, Hwang et al. administer their expert questionnaire. Their respondent pool consists of P3

[303] Note that risk allocation is merely one element of PRM, albeit a largely significant one. At times, Hwang et al. refer to risk allocation as a separate entity from the risk management process. This suggests that sometimes, when they refer to risk management, they refer to post-contractual PRM (i.e. after risks have already been allocated). At other times, however, they refer to risk management in the same vein as pre-contractual PRM: "Risk identification is a critical phase in a project risk management process." See Ibid., 424-425. Thus, Hwang et al. conflate 'project risk management' with both pre-contractual and post-contractual PRM without providing a contextual demarcation between the two separate stages of PRM.

[304] Ibid., 425.

[305] (i) On the status of P3s in Singapore, Hwang et al. present a generally favourable review. For instance, they note a "clear accountability" from the private sector when delivering services. However, they also note the "confidentiality of information" available from P3 projects; (ii) on critical success factors, they identify: a well-organized public agency, appropriate risk allocation and sharing, a strong private consortium, transparency in the procurement process, clearly defined responsibilities and roles, clarification of contract documents, favourable legal frameworks, and a shared authority between the public and private sector; (iii.a) on positive P3 factors, they note: better value for money, improved risk profile, cost-effective innovation, improved quality and services, tap on private sector expertise, and optimal resource allocation; (iii.b) on negative P3 factors, they note: lengthy delays in negotiation, high participation costs, confusion on government objectives and criteria evaluation, lack of experience or appropriate skills, high project costs, high risk relaying on the private sector, and excessive restriction on participation. See Ibid., 425, 427-428.

practitioners whose positions include: project directors, senior managers, junior managers, quantity surveyors, and "others."[306] The respondents evaluate each risk's criticality by means of a five-point Likert scale and select a sector of preference for each risk's allocation.[307] Hwang et al. identify four risk allocation categories: (i) public sector allocation, (ii) private sector allocation, (iii) shared sector allocation, and (iv) negotiable risks based on circumstantial project conditions.[308] In total, 42 risks are identified and allocated between these categories.

5.2.12 An Examination of Risk Allocation Preferences in PPPs in Nigeria

Tolani analyzes risk allocation preferences of P3 actors through a public-private stakeholder perspective.[309] Early on, he stresses that a P3's VFM hinges on optimal risk allocation, or "allocating risks to the party best able to manage them optimally."[310] He also notes agency theory's affects on risk allocation between public authorities and private partners. His principal-agent analysis, however, also considers the role of taxpaying citizens in addition to public authorities and SPVs.[311] This observation opens up a new theoretical framework for conceptualizing principle-agent relationships under P3s. Moreover, it presents an alternative means of assessing the forthcoming study. This observation is considered in detail in Chapter 7.

Tolani's quantitative study utilizes expert P3 practitioner feedback through a questionnaire. He employs a convenience sampling method to obtain suitable expert

[306] Ibid., 427.
[307] Where 1 = lowest; 2 = low; 3 = moderate; 4 = high; 5 = extreme. See Ibid., 427.
[308] Ibid., 430.
[309] Tolani demarcates private SPV-JV practitioners from private financiers in his research.
[310] Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 206.
[311] Ibid., 209.

participants ranging from the fields of banking, construction, and public sector agencies. Tolani notes that public and private practitioners have different perceptions of risk due to different "risk priorities and mitigation strategies."[312] Accordingly, Tolani demarcates public and private expert feedback on each risk's: allocation preference, probability of occurrence, and potential for impact.

Tolani uses an ordinal scale to measure each identified risk's preferred sector of allocation, probability of occurrence, and potential project impact.[313] Like Ng and Loosemore before him, Tolani distinguishes financiers from SPVs as separate potential risk bearers.[314] However, his study's risk allocation categories remain broad; Tolani's ordinal scale for measuring risk allocation preferences provides the selection options of: the public sector, the private sector, or "equally shared."[315] In total, 46 risks – along with their preferred allocation schemes – are identified and allocated between these categories.

5.3 Conclusion

After an extensive review of the core literature database, seven broad risk categories have been adopted: political risks, construction risks, operation risks, legal risks, market risks, macroeconomic risks, and 'other' risks. A content analysis of the core database presents 54 identified project risks under these broad categories. To fit the criterion of an identified risk, a risk must appear in at least two of the dozen pieces of literature examined.

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[312] Ibid., 208.
[313] Ibid., 211.
[314] Ng and Loosemore are even more specific in their demarcation of private sector actors by differentiating equity investors from lenders. Tolani does not do this; he denotes both actors under the broader cloak of general 'financiers.'
[315] Ibid., 214.

The average identified risk appears in half of the literature examined.[316] One identified risk appears in all twelve of the literature pieces examined.[317] Two identified risks appear in just two of the twelve literature pieces examined.[318] A comparative analysis of the literature shows that, of the 54 identified risks, exactly half – 27 – were found to be controversial. Controversial risks are described as risks that do not have conclusive allocation recommendations throughout the core database in which they appear. Figure 5.3 presents these results.

[316] I.e. The average risk is mentioned six times throughout the dozen pieces of literature comprising the core database. This statistic is rounded up from 5.98/12.
[317] I.e. 'change in law.'
[318] I.e. 'protection of geological/historical objects' and 'condition of facility.'

Figure 5. 3: Comparing Risk Allocation Preferences in Core Literature Database

Subgroup	Risk	A	B	C	D	E	F	G	H	I	J	K	L	Same	Total
Political	Termination of concession by government		Public		Public			Public			Public			√	4
	Expropriation and nationalization		Public		Public	Public		Private		Public	Public	Public	Public	x	8
	Political/public opposition				Public	Public				Share	Public	Public	Public	x	6
	Change in law	Share	Share	Public	Share	Share	Public	Private	Share	Public	Public	Public	Public	x	12
	Unstable government					Public	Public		Public	Public	Public	Public	Public	√	7
	Project approval and permit	Share		Private				Share	Private	Public	Public	Share	Public	x	8
	Land acquisition						Public			Public	Public		Share	x	4
	Influential economic events			Private		Private							Share	x	3
	Changes in industrial code of practices	Share		Private	Share	Private	Private						Share	x	6
Construction	Availability of finance	Private		Private		Private				Private	Private	Private	Private	√	7
	Improper design	Private	Private	Private	Private	Private	Private	Private	Private			Private	Private	√	10
	Insolvency of subcontractors	Private	Private		Private	Private			Private				Private	√	6
	Quality risk	Private	Private	Private	Private	Private		Private	Private			Private	Private	√	9
	Site safety	Private							Private			Private		√	3
	Availability of labour/materials		Public			Private			Private	Private	Private	Private	Private	x	7
	Ground conditions			Private		Private	Public	Private	Public	Share	Private	Private	Private	x	9
	Site availability	Share		Private		Public		Private	Public			Public		x	6
	Construction/design changes			Public	Public		Private	Public	Private	Private	Private		Private	x	8
	Environmental Protection						Private			Share	Share	Private	Share	x	5
	Labour disputes and strikes		Private	Private					Private					√	3
	Land use				Public	Public		Public						√	3
	Waste of materials	Private				Private		Private						√	3
	Construction cost overrun	Private	Private	Private	Private	Private	Private	Private				Private	Private	√	9
	Construction completion	Private	Private	Private	Private	Private	Private	Private		Private	Private	Private	Private	√	11
	Supporting utilities risk	Share	Share					Public		Public				x	4
	High financial cost	Private	Private			Private					Private	Private	Private	√	6
	Unproven engineering techniques	Private	Private	Private	Private	Private				Private	Private		Private	√	8
	Protection of geological/historical objects		Private	Private										√	2
Operation	Operation cost overrun	Private			Private	Private		Private		Private	Private	Private	Private	√	8
	Organization and coordination risk									Private	Private	Private	Private	√	4
	Operator default	Private	Private	Private				Private						√	4
	Quality of operation	Private	Private	Private	Private			Private						√	5
	High maintenance cost	Private		Private	Private	Private						Private	Private	√	6
	Frequency of maintenance	Private		Private	Private	Private						Private	Private	√	6
	Low operating productivity	Private	Private		Private	Private						Private	Private	√	6
	Residual value risk					Private		Public		Private	Private	Share	Private	x	6
	Residual assets risk	Private		Public	Private									x	3
	Condition of facility		Private	Private										√	2
Legal	Excessive contract variation		Share						Public	Share	Private	Share	Private	x	6
	Third party tort liability					Private			Public	Share			Private	x	4
	Asset ownership		Share	Share	Private			Private						x	4
	Insolvency of Concession company		Private		Private					Private	Private			√	4
Market	Income risk	Private	Private			Private	Private			Share			Private	x	6
	Public fluctuation of material costs		Public	Public	Public			Public						√	4
	Private fluctuation of material costs		Private	Private	Private		Private	Private			Private			√	6
	Tariff change		Private	Private	Private	Private	Private	Private		Share				x	7
	Tax Regulation Changes									Public	Public	Public	Public	√	4
	Market demand change	Share	Private		Share	Private	Private	Private		Share	Private			x	8
	Exclusive right/competition		Share	Private						Public	Public			x	4
Macroeconomic	Inflation risk		Share	Share	Share	Private		Share	Share	Share	Private	Share	Share	x	10
	Interest rate		Share		Private	Private		Share		Share	Private	Share		x	7
	Foreign currency risk		Public		Private					Share	Private			x	4
Other	Force majeure	Share		Share	Share	Share	Share	Share		Share	Public	Share	Share	x	10
	Weather conditions	Public			Public	Private			Share	Share	Private	Private	Private	x	8

A = Arndt (1998); B = Wang & Tiong (2000); C = VDTF (2001); D = NTSA (2004); E = Li et al. (2005); F = Shen et al. (2006); G = Ng & Loosemore (2007); H = Lam et al. (2007); I = Ke et al. (2010); J = Chan et al. (2011); K = Hwang et al. (2013); L = Tolani (2013).

CHAPTER 6

RISK ALLOCATION PREFERENCES OF P3 PRACTITIONERS

6.1 Introduction

The main purpose of Chapter 5 is twofold: firstly, through content analysis of the core literature database, it develops a risk identification catalogue of 54 project risks; second, through cross-referencing of the database, it evenly demarcates ‘sound’ and ‘contentious’ risks, where contentious risks are subject to further analysis. Figure 6.1 presents the list of contentious risks assessed for further study.

Figure 6. 1: Contentious Risks Definitions

Contentious Risk	Risk Definition
Expropriation and nationalization	Due to socioeconomic pressures, the government overtakes a project before the end of its lifecycle. The private consortium is subsequently not compensated in full.
Political/public opposition	Project experiences prejudicial backlash from factions in local community
Change in law	New laws and regulations result in their inconsistent application to project
Project approval and permit	Unanticipated delay or refusal of required project approvals and/or permits
Land acquisition	Unanticipated delay in, or refusal against, procuring land that is required for project
Influential economic events	Macroeconomic anomalies on a national or global scale adversely affect local market
Changes in industrial code of practices	Amendments or revisions to industrial code of practice affect project’s development
Availability of labour/materials	Subcontractors and/or suppliers are unable to supply staff and/or materials punctually
Ground conditions	Unforeseen poor ground conditions result in additional geotechnical engineering
Site availability	Unanticipated delay in accessing land and/or resources already procured for project
Construction/design changes	Changes to project terms due to poor preliminary investigation/improper design
Environmental protection	Project impinges on environmental regulations; legal ramifications ensue
Supporting utilities risk	Required local utilities (e.g. electricity and gas) are unavailable or unfairly priced
Residual value risk	After concession period, assets transferred from private to public hands are impaired
Residual assets risk	After concession period, some assets on project land remain undesignated in contract
Excessive contract variation	Inappropriate contract delegation at financial close, subsequently resulting in excessive contract mediation/arbitration during the project
Third party tort liability	A third party breaches project obligations; compensation for damages is required
Asset Ownership	Costs for owning, operating, and maintaining infrastructure during concession period
Income risk	Projected income for private sector (toll revenue or government payout) is not met
Tariff change	Insufficient project income due to improper and/or inflexible tariff design framework
Market demand change	Demand, and price, for a service transcends forecasted levels resulting in less revenue
Exclusive right/competition	Government revokes exclusivity rights from its selected private consortium, creating a new competitive project with open to other competitor firms
Inflation risk	Unanticipated rise in inflation rates under local economy
Interest rate	Unanticipated rise in interest rates under local economy
Foreign currency risk	Exchange rate fluctuations create unforeseen difficulties converting currencies
Force majeure	Severe events outside of a party’s control (e.g. natural disasters, terrorism, war, etc.)
Weather conditions	Unfavourable weather conditions result in project delay and/or impairment

The general principle driving risk allocation scholarship in P3 literature has been repeated throughout Chapter 5: every risk should be allocated to the party best able to manage it and at the least cost. In theory, this concept seems rational and simple. In practice, as previous chapters have indicated, it can be difficult to follow. Several reasons have been provided to explain why suboptimal risk allocation occurs (e.g. bounded rationality, asymmetric information sharing, opportunism, strategic behaviour, incomplete contracts, optimism bias, etc.), however none explicitly factor into the research reviewed in Chapter 5.

While these impediments to P3 PRM are frequently cited in the core literature database, they are not an explicit function of the database's actual research. The dozen pieces of literature reviewed do not replicate conditions conducive to – for example – moral hazards or asymmetric information sharing, because they are conducted in a low stakes environment with the impartial goal of obtaining scholarly insight into P3 risk allocation frameworks. In short, the scholars and P3 practitioners who contributed to the core database's findings were not operating under principal-agent relationships.

Thus, the bulk of optimal risk allocation impediments linked to agency theory do not apply to the research findings. Yet, exactly half of the 54 identified project risks are deemed contentious via cross-examination of the core literature database. This suggests another major influence is at hand – differing perceptions and, accordingly, differing preferences amongst P3 practitioners. The literature review from Chapter 5 provides a solid foundation for identifying contentious P3 risks. It both develops and validates the selection of the 27 risks included in the expert questionnaire so that their selection for assessment in Chapter 6 is non-arbitrary.

6.2 Research Design

Chapter 6's research adopts psychometric methodology to arrive at a proposed risk allocation decision model through a diverse research network of P3 practitioners via expert questionnaire. Insight gained on risk allocation preferences from the core literature database is supplemented by the interdisciplinary, multifaceted input of in-field public and private practitioners. Tolani notes, "Questionnaire survey is the most common research method used to obtain risk allocation scheme[s] in P[3]s."[319] However, this type of scholarly assessment has yet to take off in Canada.[320] The expert questionnaire was conducted from February 2017 to April 2017 with a sampling frame comprised of Canadian P3 practitioners equally divided between public and private sector positions.

6.2.1 Application of Expert Questionnaire

A non-probability purposive sampling method was used to develop the sampling frame of recognized expert practitioners qualified to take part in the study.[321] To fulfill the eligibility criterion, participants had to have in-field experience as a P3 practitioner from at least one of an array of applicable fields, many of which are identified in Chapter 4 (e.g. financial, legal, political, among others). Potential respondents were sought out through membership directories of P3 organizations,[322] P3 certification programs,[323] and

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[319] Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 211.
[320] This is to the author's knowledge based on an extensive literature review of studies providing P3 risk allocation decision models premised on expert questionnaire input.
[321] This is also known as convenience sampling technique, where the principal investigator knows the identity of his or her potential sampling frame. One of its benefits – compared to probability sampling – is that expert respondents can be recruited who are recognized as knowledgeable in specialized fields. Thus "purposive sampling… can… focus on quality over quantity" when developing a smaller sampling frame to extract data. See Lisa O'Halloran et al., "Doing Descriptive Phenomenological Data Collection in Sport Psychology Research," *Sport in Society*, 2016, 6, doi:10.1080/17430437.2016.1159199.
[322] For example, the CCPPP membership directory.

known partners under Canadian SPV consortiums or public authorities.[324] Practitioners all hold, or previously held, various roles dealing with P3 risk allocation from distinct stakeholder perspectives and from distinct industries of expertise.[325]

In total, 58 practitioners were invited to participate in the research and 24 completed the expert questionnaire. This represents a 41 percent response rate. While 24 samples do not cover a large respondent pool, the number is comparably sufficient when considering previous studies of a similar nature. For example, Li et al. collected 53 valid responses with an 11 percent response rate;[326] Ke et al. collected 47 responses with a 23 percent response rate; Hwang et al. collected 48 responses with a 40 percent response rate; and Tolani collected 45 responses with a 16 percent response rate.[327]

It is believed this study's high response rate is attributed to the personal method employed when reaching out to participants. Great care was taken to research the backgrounds of potential respondents before contacting them, and emails explaining the study's purpose and scope included personalized additions explaining why each practitioner was singled out as an eligible candidate for the project. To encourage a

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[323] For example, the list of program directors and faculty for the 'Osgoode Certificate in P3s.'

[324] For examples from the private sector – JV practitioners under the Gordie Howe Bridge's three SPV bidders: Bridging North America, CanAmGateway, and Legacy Link Partners. For examples from the public sector – statespersons under crown corporations like Infrastructure Ontario or the aforementioned WDBA.

[325] Respondents have direct experience with managing roles, consulting roles, or regulating roles – among others – for risk allocation in P3 projects from a variety of industries of expertise (e.g. legal, financial, political, etc.).

[326] Li et al. collected 61 completed questionnaires, but only "53 provided suitable data for the section of the[ir] questionnaire relating to risk allocation preferences." See Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 29.

[327] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 427; Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 484; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 210.

higher respondent rate, participants were given the option of remaining anonymous; 11 of the 24 respondents chose to remain unidentified.

For respondents who filled out personal identifiers, the sampling frame's practitioner positions include: a Certified Public Accountant, Chief Administration Officers, a Chief Executive Officer, a Chief Financial Officer, Chief Procurement Officers, a Contract Innovations Engineer, Executive Directors, Managing Directors, Project Directors, a Canadian Senator, and Vice Presidents of firms. To respect the privacy of participants who withheld their personal information, their specific occupations have been withheld from this study. The respective profiles of respondents, regarding their sectors of affiliation, years of experience, and general fields of specialization, are presented in Figure 6.2.

Figure 6. 2: Background Information of Sampling Frame

Respondent Profiles	Category	Number of Respondents	Percentage of Respondents
Sector of Employment	Public	12	50%
	Private	12	50%
Years of Experience	Withheld	4	16.67%
	1-5	4	16.67%
	6-10	4	16.67%
	11-15	9	37.50%
	16-20	2	8.33%
	20 <	1	4.16%
Private Experience	Advisory/consulting/legal	2	8.33%
	Design/build/operate/maintain	3	12.50%
	Financing/investing/insurance	7	29.17%
Public Experience	P3 Agency Employee	4	16.67%
	Public Servant	6	25%
	Other	2	8.33%

The questionnaire was divided into three main sections. The first section briefly explained the research's scope, purpose, and instructions. The second section obtained profiles of respondent backgrounds. Optional background questions included the respondent's name and years of P3 industry experience. Mandatory background questions included the respondent's sector of employment and general field of specialization. The third section asked respondents to allocate the 27 contentious P3 risks identified from the study's core literature database to a sector of preference according to a five-point public-private spectrum on a semantic differential scale.

Due to aforementioned issues related to risk allocation in Chapter 4 – namely, the subjectivity and potential vagueness of risk assessment – a psychometric methodology was employed to apply quantitative values to the otherwise qualitative linguistic terminology used to garner expert opinion.[328] Thus, the five-point semantic differential scale was adopted to evaluate the degree to which contentious risks should be allocated between public and private sectors (i.e. 1 = solely public; 2 = mostly public; 3 = equally shared; 4 = mostly private; and 5 = solely private).[329] Definitions for each project risk were provided alongside their respective five-point allocation scales to ensure uniformed comprehension of each risk amongst respondents (see Figure 6.1).

6.2.2 Assuming Equidistance of Semantic Differential Scales

Several methodologies – both parametric and nonparametric – were applied to the questionnaire's results, which were calculated via mean score analyses. Mean score

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[328] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Lam et al., "Modelling Risk Allocation Decision in Construction Contracts."

[329] There was also a sixth option offered for each question: 'not applicable' (n/a).

analysis on Likert scales and semantic differential scales necessitates an assumed equidistance between variables.[330] However, Likert and semantic differential scales use *ordinal* levels of measurement, which do allow variable values to be rank ordered, but not in a way that the "distances between the values of… variable[s] are equal and mathematically meaningful." Equidistant variables include *interval* levels of measurement, where each point on a scale represents a quantifiably equal numerical difference, contra ordinal variables.[331]

Dispute over the use of mean score analyses on ordinal data – i.e. the assumed equidistance of ordinal data – is longstanding between scholars. Because this issue continues to be "extensively debated among researchers," the use of mean score analyses on this study's ordinal respondent input is recognized as a methodological limitation in Chapter 7. However, psychometrician Stanley Smith Stevens himself – founder of the nominal, ordinal, interval, and ratio levels of measurement taxonomy – deemed the interval treatment ordinal data as permissible, stating that "in numerous instances it leads

[330] Almost all P3 literature employing point scale methods to assess risk allocation claim the use of a 'Likert scale' to gauge a risk's association with the public and private sector (e.g. on either a three-point or five-point scale where lower numbers indicate public allocation and higher numbers indicate private allocation). However, P3 scholars are using the term Likert scale incorrectly; Likert scales traditionally gauge "levels of agreement and disagreement" with a specific statement. While the public-private demarcation is bipolar, it does not reflect a direct "attitude statement… for agreement or disagreement." Thus, scales akin to this study's – and to those of Chan et al.'s, Hwang et al.'s, Ke et al.'s, Li et al.'s, and Tolani's – should be referred to as "semantic differential" scales, not Likert scales. See Jonathan E. Brill, "Likert Scale," *Encyclopedia of Survey Research Methods* (SAGE Publications, Inc., 2008), 427-429, doi:http://dx.doi.org/10.4135/9781412963947.
[331] For example, in a five-point Likert scale, the 'distance' between point 1 – strongly agree – and point 2 – partially agree – cannot be objectively quantified, because the scale adopts ordinal levels of measurement. See Amy R. Gershkoff, "Level of Measurement," *Encyclopedia of Survey Research Methods*, 421-423.

to fruitful results." Thus, this study affirms the use of mean score analyses on its ordinal data, recognizing the practice as a "pragmatic sanction," in the words of S.S. Stevens.[332]

6.2.3 Methodologies for Data Analyses

To calculate the mean scores and standard deviations for each risk according to public respondents and private respondents, an independent two-sample t-test was conducted. Before combining the total mean scores of both public and private respondents to arrive at a total mean score for each risk, the degrees of agreeance *within* the public and private sector sample groups had to be assessed to ensure the questionnaire's feedback was valid.

The degrees of agreement within both independent sample groups (i.e. public respondents and private respondents) were measured using nonparametric statistics. Kendall's Coefficient of Concordance (W) and Chi-square tests validated the hypothesis that both groups contained significant agreement patterns between their respective respondents over the allocation preferences of the 27 contentious P3 project risks. Statistically significant agreement within respondent groups is a necessary prerequisite to conducting further analysis using the group's total mean scores as valid data.[333]

Once the mean values within both public and private sector samples were verified, the degrees of agreement *between* these groups was also measured using nonparametric statistics to see which risks, if any, held statistically significant differences of perspective between public and private respondents. A Mann-Whitney U test showed

[332] S S Stevens, "Mathematics, Measurement, and Psychophysics," in *Handbook of Experimental Psychology*, 1951, 26.
[333] Gregory W Corder and Dale I Foreman, *Nonparametric Statistics: A Step-by-Step Approach*, 2nd ed. (New Jersey: John Wiley & Sons, 2014).

that 5 out of 27 contentious P3 risks held statistically significant differences between the public and private sector. The independent two-sample *t*-test identified a sixth risk with statistically significant sectorial disagreement. This suggests a future research opportunity in settling the preferred allocations of these six risks. The Kendall's W, Chi-square, and Mann-Whitney U, and *t*-tests were all performed at a 95 percent confidence level.

To arrive at a proposed risk allocation decision model, four types of analyses were considered: majority opinion analysis, half-adjusting principle analysis, a formula based on an assumed normal distribution curve, and an original hybrid adjusting principle model in conjunction with lower and upper confidence levels for each risk. Ultimately, the latter was adopted in lieu of the first three analyses, all of which are still included in this study to reflect the limitations they pose for future literature that may otherwise consider adopting these methods.

Of selected questionnaire-based articles within the core literature database, Li et al. and Hwang et al. employed a majority opinion analysis to arrive at a proposed risk allocation decision model for P3s in the United Kingdom and in Singapore, respectively. These studies recognize four possible risk allocation categories: (i) public sector risks, (ii) private sector risks, (iii) shared risks, and (iv) negotiable risks contingent on "project circumstances." Based on majority opinion analysis, if more than 50 percent of respondents choose to allocate a risk to either the public sector, private sector, or 'equally shared' categories, then the risk is put in that category. If none of a risk's percentages reach over 50 percent, then its proposed allocation preference is 'negotiable' based on specific project circumstances.[334]

Majority opinion analysis was one of several methodologies applied to this study. However, scholars question the reliability and accuracy of studies that use majority opinion analysis to identify risk preferences between sample groups. Both Chan et al. and Tolani criticize majority opinion analysis, which is premised on "preponderance of opinion,"[335] arguing that it is "hypothetical and does not [accurately] reflect the industry practice."[336]

Both Li et al. and Hwang et al. use a three-point semantic differential scale to conduct a majority opinion analysis – without 'mostly public' or 'mostly private' allocation options – because lower scales are more conducive to definitive selection preferences. While higher-point scales provide more information than lower-point scales, a higher percentage of respondents are inclined to "discriminate among categories" with lower-point scales because options are less dispersed.[337] Due to the aforementioned limitations of majority opinion analysis, its inclusion is not the focal point of this study.

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334 Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 430; Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK,"

335 Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 212.

336 Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China," 145; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 212.

337 Sara L McLafferty, "Conducting Questionnaire Surveys," in *Key Methods in Geography*, ed. Nicholas Clifford, Shaun French, and Gill Valentine, 2nd ed. (London: London: SAGE, 2010), 81, https://is.muni.cz/el/1431/jaro2015/Z0132/um/54979481/_Nicholas_Clifford__Gill_Valentine__Key_Methods_in_BookFi.org_.pdf#page=100.

Thus, while three-point scales are more suited for this type of analysis, this study's five-point scale was retained as the basis for all analysis methods, including majority opinion.

Ke et al. employed a half-adjusting principle to their five-point semantic differential scale questionnaire to arrive at a risk allocation framework for Chinese P3s. For their study, risks with total mean scores falling under 1.5, 2.5, 3.5, and 4.5 should be allocated solely to the public sector, mostly to the public sector, equally between sectors, and mostly to the private sector, respectively. Finally, risks with a total mean score above 4.5 should be allocated solely to the private sector.[338] Like majority opinion analysis, the half-adjusting principle relies on relatively rudimentary methodology and, ultimately, presents a lack of conclusive evidence for proposed risk allocation decision models.

The most glaring limitation of using the half-adjusting principle to propose a risk allocation decision model is that it only allots the 'solely public' and 'solely private' risk categories with half a point of space on the five-point scale's spectrum while allotting a full point of space to 'mostly public,' 'equally shared,' and 'mostly private' risk categories. This means that 'solely public' and 'solely private' each only account for 12.5 percent of the five-point scale's space while 'mostly public,' 'equally shared,' and 'mostly private' each account for 25 percent of the five-point scale's space.

This uneven distribution between risk categories becomes blatantly evident when reviewing Ke et al.'s results. Only one risk out of a possible 37 fell into the 'solely public' category and no risk fell into the 'solely private' category. The remaining 36 risks fell between the other three categories with a full point allotted on the spectrum. Ke et al.

[338] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects."

do not address this limitation. Firstly, they do not directly address the peculiarity of the 'solely public' category receiving only one project risk. Second, they suggest that the 'solely private' category potentially received zero risks because "respondents may still believe that private investors will encounter many problems caused by government or government officers and their actions… [or] due to the sample of survey respondents."[339]

To arrive at their risk allocation decision model, Chan et al. and Tolani adopt a formula based on the assumed distribution of a normal distribution curve:

$X_{10\%} = U \pm Z^*\sigma$

Under this formula, $X_{10\%}$ = the upper and lower limits within the range from which a risk should be allocated to either the public sector, private sector, or shared between sectors. U = the population's mean value. Z = the corresponding mean value taken from the normal curve table. Finally, σ = the prescribed standard deviation for the population.[340] Here, Chan et al. and Tolani both 'force' a normal distribution of their assessed P3 project risks, where a range for categorizing 'equally shared' risks is applied, demarcating an equal share of public and private sector risks to either side of the distribution curve.[341]

There are two issues with Chan et al.'s and Tolani's methodology. First, it necessitates an arbitrary range (i.e. $X_{10\%}$) of a selected percentage of risks – in this case 10 percent – to be categorized as 'equally shared.' Thus, while the means of risks deemed

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[339] Ibid., 487.
[340] Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China," 144; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 211-212.
[341] Unless, of course, an odd number of risks are being assessed. In this case, one sector – e.g. public – will contain exactly one more risk category than the other sector – e.g. private.

‘equally shared’ in both studies do gravitate towards the middle of both studies’ scales, the ‘cut-off’ point between an equally shared category and a public-private category is based on the personal selection of the researcher.

Second, this methodology requires the assumption that the data analyzed is *normal*; that is, the assumption that the combined scores of every risk’s mean equal their median, that 68 percent of the data falls under one standard deviation, and that the first and second half of the distribution, on either side of the median, are symmetrical. Neither Chan et al.’s nor Tolani’s study contain an authentic normal distribution of data. The fundamental issue with assuming a normal distribution on non-normally distributed mean values is that it ‘forces’ an equal share of risks to fall into either public or private categories.

To understand the implications of a forced distribution, consider an extreme instance where over three quarters of a study’s risks are given a value above 4. Clearly, over three quarters of the study’s risks should fall under categories denoting a major degree of private allocation. However, under a forced normal distribution, a third of these ‘private’ risks will be ‘pushed’ to the left of the curve, falling under either ‘shared’ or ‘public’ categories depending on the size of the study’s arbitrary selected range (e.g. $X_{10\%}$).

To account for the methodological flaws of works cited in the core literature database, this study employs a hybrid adjusting principle analysis on the upper and lower confidence levels for each risk. The methodological flaw of using majority opinion analysis – i.e. preponderance of opinion – is bypassed by analyzing mean scores in lieu of their modes. To account for the issue of variance when assessing means, each risk's range based on its lower confidence level (LCL) and upper confidence level (UCL) is analyzed opposed to using a crisp mean value on its own (e.g. for the risk of 'influential economic events,' its LCL/UCL range of 2.610 – 3.473 is applied to the proposed risk allocation decision model opposed to its mean value of 3.042).

To account for the methodological flaw of using the half-adjusting principle on a five-point scale – namely, that the 'extreme' risk categories of 1 and 5 are each allotted half the space allotted to their central counterparts, 2, 3, and 4 – this study's categorical demarcations are equally divided so that each point receives 20 percent of the space on the five-point scale. Accordingly, (i) < 1.8, (ii) 1.8 < 2.6, (iii) 2.6 < 3.4, (iv) 3.4 < 4.2, and (v) 4.2 < represent the categories of (i) 'solely public,' (ii) 'mostly public,' (iii) 'equally shared,' (iv) 'mostly private,' and (v) 'solely private,' respectively.

This hybrid adjusting principle, in conjunction with LCL/UCL ranges, also avoids the methodological limitations of employing a formula based on an assumed normal distribution of means. Firstly, there is no arbitrary range for which risks should be placed under an 'equally shared' category. Second, because each risk is assessed based on its own independent mean value and variance, the proposed risk allocation decision model represents an 'authentic' distribution of risks that does not 'force' an equal distribution between publicly and privately allocated risks.[342]

[342] Consider, for example, the aforementioned hypothetical situation where over three quarters of risks are given combined mean values over 4. By assessing each risk independently – opposed to a forced distribution where risk categorization is dependent on the mean values of other risks – the distribution of risks, based on expert respondent opinion, can be authentically displayed.

Despite their methodological flaws, the majority opinion analysis, half-adjusting principle, and forced normal distribution formula are all left in this study's analysis because of their potential contribution – namely, to start a precedent for future P3 risk allocation literature to eradicate such imprecise methods from their proposed risk allocation decision models. This study should catalyze the notion that such analyses are outdated means of arriving at proposed risk allocation decision models based on expert questionnaire input, despite the popularity of using such methods in P3 literature.[343] Stark comparisons of results derived between these three methods and this study's hybrid distribution model should illuminate the respective shortcomings of the former.

6.3 Assessment of Respondent Groups

Results presented throughout the remainder of this chapter have been calculated using the Statistical Package for Social Sciences (SPSS) and StatPlus software. Microsoft Excel was also used to: (i) calculate the total mean scores for each risk after calculating their independent mean scores for public sector respondents and private sector respondents and (ii) present figures for SPSS and StatPlus-derived results.

[343] Andi, "The Importance and Allocation of Risks in Indonesian Construction Projects," *Construction Management and Economics* 24, no. 1 (2006): 69–80, doi:10.1080/01446190500310338; Yosr Badran, "Risk Analysis and Contract Management for Public Private Partnership Projects in Egypt" (School of Sciences and Engineering, 2013), http://dar.aucegypt.edu/bitstream/handle/10526/3559/isA Compiled-28-05-13.pdf?sequence=1; N. Carbonara et al., "Risk Management in Motorway PPP Projects: Empirical-Based Guidelines," *Transport Reviews* 35, no. 2 (2015): 162–82, doi:10.1080/01441647.2015.1012696; Sameh Monir El-Sayegh, "Risk Assessment and Allocation in the UAE Construction Industry," *International Journal of Project Management* 26, no. 4 (2008): 431–38, doi:10.1016/j.ijproman.2007.07.004; Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors"; Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China."; Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK."

6.3.1 Mean Values within and between Sectors

The independent two-sample *t*-test does more than provide the 54 independent and 27 combined mean scores for the 27 contentious P3 risks between sample groups. It provides context into the degree to which: (i) mean value responses *within* public and private respondent groups are similar (i.e. through standard deviations for each mean score); and (ii) mean value responses *between* public and private respondent groups are significantly different (i.e. through the *t*-statistic and test significance levels). Performed at a 95 percent confidence level, the *t*-test shows 6 of 27 risks fall below the significance level of 0.05. This is shown on the last column of Figure 6.3.

Figure 6. 3: Independent Two-Sample *t*-Test for Risk Allocation Preferences [344]

Risk	Group	N	Mean	SD	Mean Dif.	Mean Total	*t* Statistic	Sig.
Expropriation and nationalization	Public	12	2.167	0.937	0.917	1.708	2.823	0.011
	Private	12	1.25	0.622				
Political/public opposition	Public	12	2	0.853	0.083	1.958	0.266	0.792
	Private	12	1.917	0.669				
Change in law	Public	12	2.333	0.888	0.583	2.042	1.629	0.117
	Private	12	1.75	0.866				
Project approval and permit	Public	12	2.917	0.996	0.333	2.75	0.784	0.441
	Private	12	2.583	1.084				
Land acquisition	Public	12	1.917	0.793	0.167	1.833	0.528	0.603
	Private	12	1.75	0.754				
Influential economic events	Public	12	3.416	0.996	0.75	3.042	1.533	0.139
	Private	12	2.667	1.371				
Changes in industrial code of practices	Public	12	3.5	1.087	1	3	2.253	0.035
	Private	12	2.5	1.087				
Availability of labour/materials	Public	12	4.083	1.084	0.5	4.333	-1.444	0.163
	Private	12	4.583	0.515				
Ground conditions	Public	12	2.917	0.515	0.167	2.833	0.437	0.666
	Private	12	2.75	1.215				
Site availability	Public	12	2.667	0.985	0.917	2.208	2.561	0.018
	Private	12	1.75	0.754				
Construction/design changes	Public	12	3.083	1.379	0.083	3.125	-0.15	0.882
	Private	12	3.167	1.337				
Environmental protection	Public	12	3.083	1.311	0.083	3.042	0.172	0.865
	Private	12	3	1.044				
Supporting utilities risk	Public	12	3.583	0.793	1.167	3	2.869	0.01
	Private	12	2.417	1.165				
Residual value risk	Public	12	3	1.128	0.25	2.875	0.506	0.618
	Private	12	2.75	1.288				
Residual assets risk	Public	12	2.833	0.577	0.583	2.542	1.432	0.166
	Private	12	2.25	1.288				
Excessive contract variation	Public	12	2.833	0.389	0.25	2.708	0.98	0.338
	Private	12	2.583	0.793				
Third party tort liability	Public	12	3.833	0.718	0.75	3.458	2.941	0.008
	Private	12	3.083	0.515				
Asset ownership	Public	12	4.083	0.793	0.25	4.208	-0.844	0.408
	Private	12	4.333	0.651				
Income risk	Public	12	4	0.853	0.083	3.958	0.248	0.807
	Private	12	3.917	0.793				
Tariff change	Public	12	3.583	0.996	0.167	3.5	0.392	0.699
	Private	12	3.417	1.084				
Market demand change	Public	12	3.417	0.9	0.333	3.583	-0.875	0.391
	Private	12	3.75	0.965				
Exclusive right/competition	Public	12	2.833	0.937	1.5	2.083	4.552	0
	Private	12	1.333	0.651				
Inflation risk	Public	12	3.833	1.03	0.25	3.708	0.503	0.62
	Private	12	3.583	1.379				
Interest rate	Public	12	3.917	1.084	0	3.917	0	1
	Private	12	3.917	1.379				
Foreign currency risk	Public	12	4	1.044	0.167	4.083	-0.411	0.685
	Private	12	4.167	0.937				
Force majeure	Public	12	2.5	0.674	0.167	2.417	0.484	0.633
	Private	12	2.333	0.985				
Weather conditions	Public	12	3.417	0.793	0.083	3.458	-0.196	0.847
	Private	12	3.5	1.243				

[344] Figures are presented up to three decimal places.

6.3.2 Agreement within Respondent Groups

Kendall's coefficient of concordance (W) was conducted to measure the internal agreement of both public and private respondent groups on their respective ratings of risk allocation. Kendall's W is a nonparametric test that evaluates the degree of association or agreement amongst mean values assigned by different respondents (e.g. P3 practitioners) over the same variables (e.g. P3 project risks). If the value for W exceeds its corresponding critical value, then there is significant agreement amongst the group in question over its risk allocation preferences. The critical value is found by connecting the value's degrees of freedom (DOF) and significance level. Critical values for Kendall's W are presented in Siegel and Castellan's textbook on page 365.[345]

At 26 DOF[346] and a 0.05 significance level,[347] the critical value for W is 0.280. Kendall's W for the public and private sector respondent groups is 0.365 and 0.527, respectively. Thus, while the private sector group of respondents shows more agreement, both results show significant agreement among respondents over risk allocation preferences at a 95 percent confidence level. Siegel and Castellan warn that, when the number of variables being assessed – in this case, risks – exceeds seven, Chi-square is a more accurate method of gauging the degree of agreement amongst respondent groups.[348]

Because 27 risks are being assessed, Chi-square analysis was also conducted to ensure both the public and private sector respondent groups showed significant

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[345] Sidney Siegel and N J Castellan, *Nonparametric Statistics for the Behavioral Sciences (2nd Ed.)*, *Nonparametric Statistics for the Behavioral Sciences*, 2nd ed. (New York: McGraw-Hill Book Company, 1988), 365.
[346] Found by subtracting the total number of controversial risks by one (i.e. 27 – 1 = 26).
[347] Because the test was conducted at a 95 percent confidence level, this translates to a 0.05 significance level.
[348] Ibid.

agreement at a 95 percent confidence level. If the Chi-square value for a respondent group is higher than its corresponding critical value, then there is significant agreement amongst the group in question over its risk allocation preferences. Like the critical value for Kendall's W, the critical value for Chi-square is also found with reference to a table of critical values connecting DOF with significance levels.

At 26 DOF and a 0.05 significance level, the critical value for Chi-square is 38.885.[349] The Chi-square value for the public and private sector respondent groups is 113.988 and 164.283, respectively. This reinforces the results from Kendall's W; there is statistically significant agreement within the public and private sector respondent groups. Accordingly, both sample groups can be assessed further under the assumption that they contain risk allocation preferences indicative of the views of their respective sectors.

6.3.3 Agreement between Respondent Groups

A Mann-Whitney U test was conduced to evaluate whether significant differences exist between the risk allocation preferences of this study's public sector respondents and private sector respondents. Mann-Whitney U is a nonparametric test that takes mean values assigned to ordinal data (e.g. P3 project risks) from two independent samples (e.g. public and private P3 practitioners) and tests whether the two independent samples represent two distinct populations with significantly different perceptions of the data. Referring back to Figure 6.3, 6 of 27 risks fell below the significance level of 0.05 based on the independent two-sample *t*-test. This means, according to the *t*-test, 6 risks show a significant statistical difference between public and private sector respondents at a 95 percent confidence level. These risks are: (i) expropriation and nationalization, (ii)

[349] Ibid.

changes in industrial code of practice, (iii) site availability, (iv) supporting utilities risk, (v) third party tort liability, and (vi) exclusive right/competition.

According to the Mann-Whitney U test, if the significance level (p-value) falls below the significance level of 0.05, then there is significant disagreement between the two independent groups over a risk's allocation preference at a confidence level of 95 percent. Figure 6.4 shows that, according to the Mann-Whitney U test, 5 of 27 risks show a statistically significant difference between the public and private sector over their allocation preferences based on the five-point semantic differential scale questionnaire (i.e. 5 risks have a p-value under 0.05). Every risk that was statistically significant according to the t-test – except 'changes in industrial code of practice' – was statistically significant for the Mann-Whitney U test. Figure 6.4 shows the mean ranks of risks according to the public sector respondents and private sector respondents alongside the results of the Mann-Whitney U test.[350]

[350] Regarding each risk's 'mean rank,' the closer a risk's rank leans towards 1, the more inclined respondents are to allocate it to the public sector; the closer a risk's mean rank leans towards 27, the more inclined respondents are to allocate it to the private sector.

Figure 6. 4: Mann-Whitney U Test for Risk Allocation Preferences

Risk	Public Sector Mean Rank	Private Sector Mean Rank	*Z* Statistic	*p*-value
Expropriation and nationalization	7.63	4.5	-2.674	0.014
Political/public opposition	5.33	8.5	-0.065	0.977
Change in law	8.75	7.04	-1.55	0.143
Project approval and permit	12.46	12.33	-0.78	0.478
Land acquisition	6.04	7.5	-0.527	0.63
Influential economic events	15.33	12.08	-1.393	0.178
Changes in industrial code of practices	15.88	12.54	-2.024	0.052*
Availability of labour/materials	19.96	24.08	1.023	0.378
Ground conditions	11.75	13.38	-0.507	0.671
Site availability	10.63	7.54	-2.348	0.024
Construction/design changes	12.46	16.42	0.119	0.932
Environmental protection	14.13	14.42	-0.12	0.932
Supporting utilities risk	16.96	11.54	-2.405	0.02
Residual value risk	12.25	13.88	-0.535	0.63
Residual assets risk	10.75	10.92	-1.735	0.101
Excessive contract variation	11.54	12.5	-0.974	0.443
Third party tort liability	18.46	15.58	-2.574	0.02
Asset ownership	20.29	22.79	0.784	0.478
Income risk	20.08	20.5	-0.334	0.799
Tariff change	16.54	16.75	-0.391	0.713
Market demand change	15.58	19.46	1.027	0.347
Exclusive right/competition	12.08	5.13	-3.403	0.001
Inflation risk	18.75	18.38	-0.329	0.755
Interest rate	19.29	19.83	0.215	0.843
Foreign currency risk	19.92	21.5	0.371	0.755
Force majeure	9.42	11	-0.439	0.713
Weather conditions	15.75	17.92	0.476	0.671

* This risk lies just above the 0.05 significance level for the Mann-Whitney U test, but below the 0.05 significance level for the independent two-sample *t*-test.

It is of note that the Mann-Whitney U test and independent two-sample *t*-test present slightly different results at a 95 percent confidence level. The *t*-test reveals 6 risks with contentious allocation preferences, all falling under the test's 0.05 significance level. The Mann-Whitney U test, however, recognizes only 5 of these 6 risks falling under its 0.05 significance level. The sixth 'would be' significantly different risk – 'changes in industrial code of practices' – just exceeds the Mann-Whitney U test's significance level of 0.05 by 0.002 with a *p*-value of 0.052. Previous studies that have yielded a *p*-value of 0.052 at a 95 percent confidence level have referred to that value as "approaching prognostic significance."[351] Because the *t*-test's results were more sensitive at a 95 percent confidence level, its results have been adopted for further analysis over the Mann-Whitney U test to account for the sixth risk that shows a relatively weak degree of agreement over its allocation between public and private sector respondents.

6.4 Previous Methodologies used to propose a Risk Allocation Decision Model

After the mean scores of risks were analyzed both within and between sample groups via *t*-test, Kendall's W, Chi-square, and Mann-Whitney U, the risks could be assessed further to prescribe a risk allocation decision model based on expert questionnaire input. Two important factors were learned in Section 6.3: (i) both the public and private sector respondent groups provided enough statistical significance to be assessed as ideologically unified, representative samples; and (ii) at least 6 of 27 risks should be assessed with caution when proposing a risk allocation model due to statistically significant disagreement between sectors over their allocation.

[351] Rajan Sarin et al., "Treatment Results and Prognostic Factors in 101 Men Treated for Squamous Carcinoma of the Penis," *International Journal of Radiation Oncology Biology Physics* 38, no. 4 (1997): 713, doi:10.1016/S0360-3016(97)00068-0.

6.4.1 Majority Opinion Analysis

As noted in Section 6.2, majority opinion analysis – when risks are allocated to categories where they have received more than 50 percent of sample votes – has been criticized by scholars. Further, it is usually deployed alongside a three-point ordinal scale in lieu of a five-point scale because lower-point scales are more conducive to definitive selection preferences.[352] When used in conjunction with higher-point scales, majority opinion analysis may be less effective due to sparser selection preferences. This appears to be the case with this study's majority opinion analysis, as only 8 out of 27 risks are given a definitive risk allocation preference, as shown in Figure 6.5.

Figure 6. 5: Majority Opinion Analysis for Risk Allocation Preferences

Contentious Risk	Public Sector Respondents					Private Sector Respondents					Total Respondents					Suggested
	SPu %	MPu %	ESh %	MPr %	SPr %	SPu %	MPu %	ESh %	MPr %	SPr %	SPu %	MPu %	ESh %	MPr %	SPr %	Risk Allocation
Expropriation and nationalization	25	41.66	25	8.33		83.33	8.33	8.33			54.16	25	16.66	4.16		Solely Public
Political/public opposition	25	58.33	8.33	8.33		25	58.33	16.66			25	58.33	12.5	4.16		Mostly Public
Change in law	16.66	41.66	33.33	8.33		50	25	25			33.33	33.33	29.16	4.16		Negotiable
Project approval and permit	8.33	25	33.33	33.33		16.66	33.33	25	25		12.5	29.16	29.16	29.16		Negotiable
Land acquisition	33.33	41.66	25			41.66	41.66	16.66			37.5	41.66	20.83			Negotiable
Influential economic events		16.66	41.66	25	16.66	25	25	16.66	25	8.33	12.5	20.83	29.16	25	12.5	Negotiable
Changes in industrial code of practices		16.66	41.66	16.66	25	16.66	41.66	16.66	25		8.33	29.16	29.16	20.83	12.5	Negotiable
Availability of labour/materials		8.33	25	16.66	50				41.66	58.33	4.16	12.5	29.16	54.16		Mostly Private
Ground conditions		16.66	75	8.33		16.66	25	33.33	16.66	8.33	8.33	20.83	54.16	12.5	4.16	Equally Shared
Site availability	8.33	33.33	50		8.33	41.66	41.66	16.66			25	37.5	33.33		4.16	Negotiable
Construction/design changes	8.33	33.33	25	8.33	25	8.33	33.33	8.33	33.33	16.66	8.33	33.33	16.66	20.83	20.83	Negotiable
Environmental protection	8.33	33.33	16.66	25	16.66	8.33	25	25	41.66		8.33	29.16	20.83	33.33	8.33	Negotiable
Supporting utilities risk		8.33	33.33	50	8.33	25	33.33	16.66	25		12.5	20.83	25	37.5	4.16	Negotiable
Residual value risk	8.33	25	33.33	25	8.33	16.66	33.33	16.66	25	8.33	12.5	29.16	25	25	8.33	Negotiable
Residual assets risk		25	66.66	8.33		33.33	33.33	16.66	8.33	8.33	16.66	29.16	41.66	8.33	4.16	Negotiable
Excessive contract variation		16.66	83.33			8.33	33.33	50	8.33			4.16	25	66.66	4.16	Mostly Private
Third party tort liability			33.33	50	16.66		8.33	75	16.66			4.16	54.16	33.33	8.33	Equally Shared
Asset ownership			25	41.66	33.33			8.33	50	41.66			16.66	45.83	37.5	Negotiable
Income risk		8.33	8.33	58.33	25		8.33	8.33	66.66	16.66		8.33	8.33	62.5	20.83	Mostly Private
Tariff change		16.66	25	41.66	16.66		25	25	33.33	16.66		20.83	25	37.5	16.66	Negotiable
Market demand change		16.66	33.33	41.66	8.33		16.66	8.33	58.33	16.66		16.66	20.83	50	12.5	Negotiable
Exclusive right/competition	8.33	25	41.66	25		75	16.66	8.33			41.66	20.83	25	12.5		Negotiable
Inflation risk		8.33	33.33	25	33.33	8.33	16.66	16.66	25	33.33	4.16	12.5	25	25	33.33	Negotiable
Interest rate		8.33	33.33	16.66	41.66	8.33	8.33	16.66	16.66	50	4.16	8.33	25	16.66	45.83	Negotiable
Foreign currency risk		8.33	25	25	41.66			33.33	16.66	50		4.16	29.16	20.83	45.83	Negotiable
Force majeure	8.33	33.33	58.33			25	25	41.66	8.33		16.66	29.16	50	4.16		Negotiable
Weather conditions			75	8.33	16.66	8.33	8.33	33.33	25	25	4.16	4.16	54.16	16.66	20.83	Equally Shared

[352] McLafferty, "Conducting Questionnaire Surveys," 81.

The risks with definitive selection preferences based on majority opinion analysis – i.e. those with over 50 percent of its respondents in favour of allocating the risk to a particular sectorial category – are as follows: 'expropriation and nationalization,' 'political/public opposition,' 'availability of labour/materials,' 'ground conditions,' 'excessive contract variation,' 'third party tort liability,' 'income risks,' and 'weather conditions.' Their suggested risk allocation preferences, based on majority opinion analysis, are: solely public, mostly public, mostly private, equally shared, mostly private, equally shared, mostly private, and equally shared, respectively.

6.4.2 Half-Adjusting Principle

As noted in Section 6.2, Ke et al.'s "half-adjusting principle" – like majority opinion analysis before it – rests on questionable methodology. This is made most apparent when perusing their proposed risk allocations. Based on a five-point semantic differential scale assessment of 37 P3 project risks, only one risk is allocated solely to the public sector and zero risks are allocated solely to the private sector; the remaining 36 risks are dispersed throughout the remaining three risk allocation categories: 'mostly public,' 'equally shared,' and 'mostly private.'[353]

Similar articles that employ the half-adjusting principle to develop risk allocation models also present comparably imbalanced results.[354] It is hypothesized that this is due in part to the aforementioned issue of uneven distribution between risk categories while

[353] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 487-488.

[354] Y Chen, "Pricing Mechanism and a Framework of Public-Private Partnership Financing Risk Allocation for Public Rental Project," *Applied Mechanics and Materials*, 2013, doi:10.4028/www.scientific.net/AMM.256-259.2989; Akintayo Opawole and Godwin Onajite Jagboro, "Benchmarking Parties' Obligations in the Execution of Concession-Based PPP Projects in Nigeria," *Journal of Place Management and Development* 9, no. 1 (2016): 27–46, doi:10.1108/JPMD-08-2015-0029.

employing the half-adjusting principle. For instance, 'solely public' and 'solely private' each make up 12.5 percent of a five-point scale's space, while the remaining three categories comprise 25 percent of a five-point scale's space. Thus, Figure 6.6, like Figure 6.5 before it, presents an alternative means of arriving at a proposed risk allocation decision model, but it rests on flawed methodology.

Figure 6. 6: Half-Adjusting Principle for Risk Allocation Preferences

Contentious Risk	Total Mean	Public Mean	Private Mean	Suggested Allocation
Expropriation and nationalization	1.708	2.167	1.25	Mostly Public
Political/public opposition	1.958	2	1.917	Mostly Public
Change in law	2.042	2.333	1.75	Mostly Public
Project approval and permit	2.75	2.917	2.583	Equally Shared
Land acquisition	1.833	1.917	1.75	Mostly Public
Influential economic events	3.042	3.417	2.667	Equally Shared
Changes in industrial code of practices	3	3.5	2.5	Equally Shared
Availability of labour/materials	4.333	4.083	4.583	Mostly Private
Ground conditions	2.833	2.917	2.75	Equally Shared
Site availability	2.208	2.667	1.75	Mostly Public
Construction/design changes	3.125	3.083	3.167	Equally Shared
Environmental protection	3.042	3.083	3	Equally Shared
Supporting utilities risk	3	3.583	2.417	Equally Shared
Residual value risk	2.875	3	2.75	Equally Shared
Residual assets risk	2.542	2.833	2.25	Equally Shared
Excessive contract variation	2.708	2.833	2.583	Equally Shared
Third party tort liability	3.458	3.833	3.083	Equally Shared
Asset ownership	4.208	4.083	4.333	Mostly Private
Income risk	3.958	4	3.917	Mostly Private
Tariff change	3.5	3.583	3.417	Mostly Private
Market demand change	3.583	3.417	3.75	Mostly Private
Exclusive right/competition	2.083	2.833	1.333	Mostly Public
Inflation risk	3.708	3.833	3.583	Mostly Private
Interest rate	3.917	3.917	3.917	Mostly Private
Foreign currency risk	4.083	4	4.167	Mostly Private
Force majeure	2.417	2.5	2.333	Mostly Public
Weather conditions	3.458	3.417	3.5	Equally Shared

Figure 6.6 (i.e. half-adjusting principle) does present more conclusive results than Figure 6.5 (i.e. majority opinion analysis) in that it does not categorize any risk as 'negotiable' based on specific project circumstances. 'Negotiable' risks aside, there is discrepancy between the majority opinion analysis' risk allocation scheme and the half-

adjusting principle's risk allocation scheme: (i) 'expropriation and nationalization' is given a 'mostly public' allocation preference according to the half-adjusting principle and a 'solely public' allocation preference according to majority opinion analysis and (ii) 'excessive contract variation' is given an 'equally shared' allocation preference according to the half-adjusting principle and a 'mostly private' allocation preference according to majority opinion analysis.

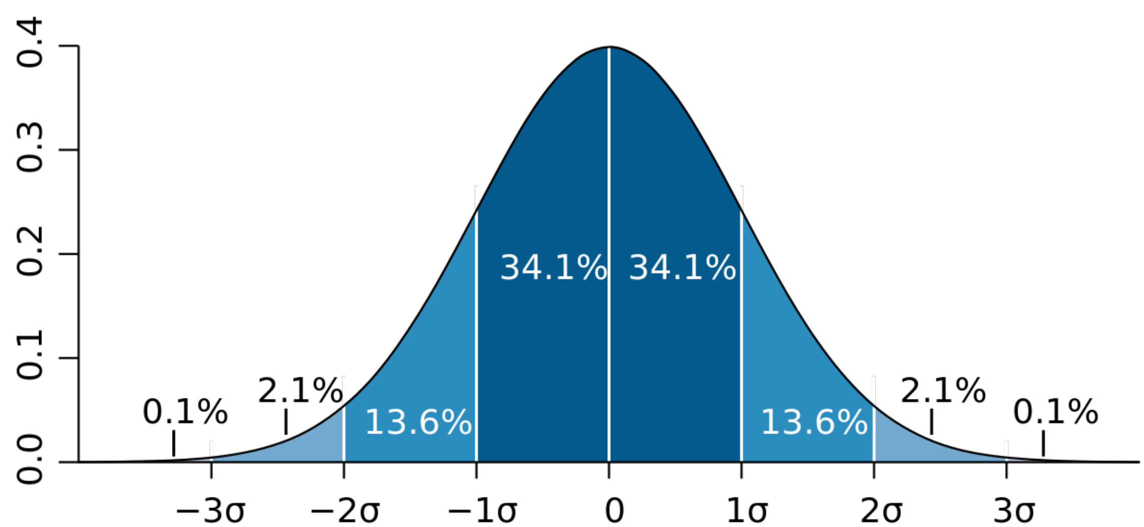
Figure 6.6's results, like other half-adjusting principle-derived results before it, present an imbalanced risk allocation decision model where 'solely public' and 'solely private' categories remain vacant as risk means congregate towards the 'middle' three categories of the five-point scale, each taking up double the allotted space over the 'solely public' and 'solely private' categories. As mentioned in Section 6.2, this study requires a more reliable and accurate means of developing a risk allocation model based on mean ratings from expert questionnaire input.

6.4.3 Hypothetical Normal Distribution Curve Formula

A formula based on an assumed normal distribution curve – presented in Section 6.2 – is applied to calculate a specified range that allocates contentious P3 risks under: (i) 'mostly public,' (ii) 'equally shared,' and (iii) 'mostly private.' Based on the formula's calculated range, risks falling under the range should be borne mostly by the public sector, risks falling within the range should be borne equally by both sectors, and risks falling over the range should be borne mostly by the private sector. It is important to relay that this methodology forces a normal distribution on non-normally distributed data, which does not reflect the true distribution of this study nor the true distributions of other questionnaire-based studies in the core literature database.

Figure 6.7 presents a normal distribution curve and its associated standard deviations (i.e. the ’68-95-99.7’ rule). A normal distribution is a continuous probability distribution that represents the distribution of variables through a symmetrical bell-shaped curve on a graph. In short, approximately 68 percent of observations fall within one standard deviation of the mean, 95 percent of observations fall within two standard deviations of the mean, and 99.7 percent of observations fall within three standard deviations of the mean under a normal distribution. Further, in an authentic normal distribution, both the mean and median are equal because data under and above the median are symmetrically opposed to one another under a continuous probability distribution.[355]

Figure 6. 7: Normal Distribution Curve



The formula used to arrive at Chan et al.’s and Tolani’s proposed risk allocation decision model is again as follows:

[355] S. Narayan Rao, *Educational Psychology* (New Delhi: New Age International (P) Limited, 2002), 399, https://books.google.ca/books?id=Huz5gasACqEC.

$X_{10\%} = U \pm Z^*\sigma$

With reference to Figure 6.7, this formula provides a specified range over an assumed normal distribution curve (i.e. finding $X_{10\%}$) where $X_{10\%}$ = the upper and lower values of the set range on the normal distribution curve, filling an area comprising 10 percent of the distribution near the centre of the curve as demonstrated in Figure 6.8.

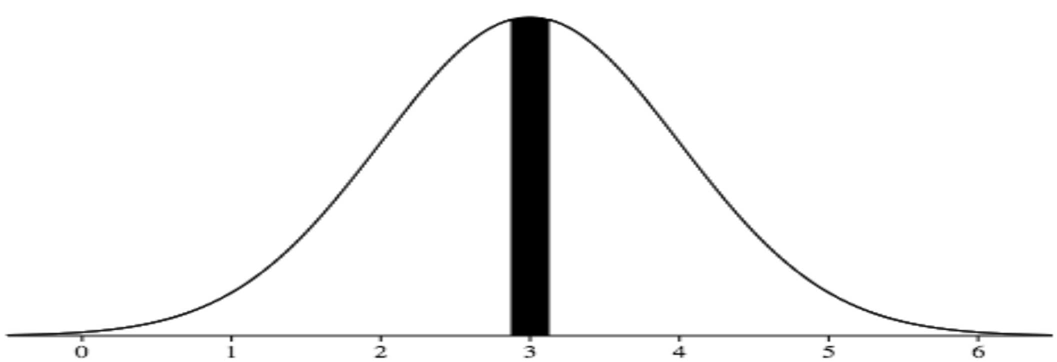
Figure 6.8's mean value (*U*) remains steady at 3 to reflect a five-point scale's median of 3 (i.e. 'equally shared' risks).[356] To find $X_{10\%}$, the range must occupy an area of the curve that covers 5 percent of the distribution below *U* and 5 percent of the distribution above *U*. In order to find this range, a table of normal distribution must be consulted to arrive at a corresponding Z value for 45 percent of a normal distribution curve (i.e. $X_{10\%}$'s lower limit) and 55 percent of a normal distribution curve (i.e. $X_{10\%}$'s upper limit) to arrive at a 10 percent range evenly distributed between the hypothetical normal distribution curve's mean. Because Chan et al. and Tolani both use one standard deviation to conduct their analyses, their corresponding Z value for the formula is 0.125.[357] Neither article provides reference to how they arrived at this Z value, but it is understood that they consulted a table of normal distribution to arrive at the corresponding 0.125 Z value for a standard deviation of one.

[356] Though they do not explicitly explain their justifications for using their respective *U* values, this point makes it clear that Chan et al. use a mean population value of three because their risk allocation scheme is premised on a five-point semantic differential scale and Tolani uses a mean population value of two because his risk allocation scheme is premised on a three-point semantic differential scale.
[357] Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China," 143; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 211-212.

After perusing the normal distribution table, however, it is found that a standard deviation of one actually presents a Z value of 0.1256613. Thus, Chan et al. and Tolani incorrectly used 0.125 for their formulae's Z values when they should have used a Z value of 0.126. Statisticians at the University of Windsor have verified this misstep, which has the potential to contaminate study results. Thus, while this thesis criticizes the use of forced distribution methodology, it still aims to bolster academic literature that employs forced distribution models by setting a precedent for rounding Z values correctly where previous studies by established authors with scholarly influence have rounded incorrectly.[358]

Figure 6.8 provides a standard normal distribution curve with a 10 percent range equally distributed between a mean of 3 over one standard deviation, thus providing a range of 2.874 – 3.126 on a five-point scale. Again, this range is found by adding and subtracting a 0.126 Z value – which has been multiplied by one to account for the standard deviation of one – to a mean of 3.

Figure 6. 8: $X_{10\%}$ over Normal Distribution Curve at One Standard Deviation



[358] For example, Tolani's study is based in large part on Chan et al.'s. Thus, his incorrect use of 0.125 as a corresponding Z value for one standard deviation under the normal distribution formula is not surprising, as Chan et al. set a precedent to copy this miscalculation. It is important to correct misshapes like this early, because scholars may continue to be influenced by the flawed methodologies of their established peers without questioning their peer's practices or results.

With reference to Figure 6.8, the assumed normal distribution formula mentioned in Section 6.2 is applied as follows:

$X_{10\%} = U \pm Z^{*}\sigma$

$X_{10\%} = 3 \pm 0.126^{*}1$

$X_{10\%} = 3 \pm 0.126$

$X_{10\%} = 2.874 - 3.126$

Because 3 is the value attributed to an 'equally shared' risk allocation on a five-point scale, by adopting a standard deviation of 1 and its corresponding Z value of 0.126, the mean range limits for this calculation are 2.874 to 3.126, as shown in Figure 6.9.

Figure 6. 9: $X_{10\%}$ over Forced Normal Distribution at One Standard Deviation

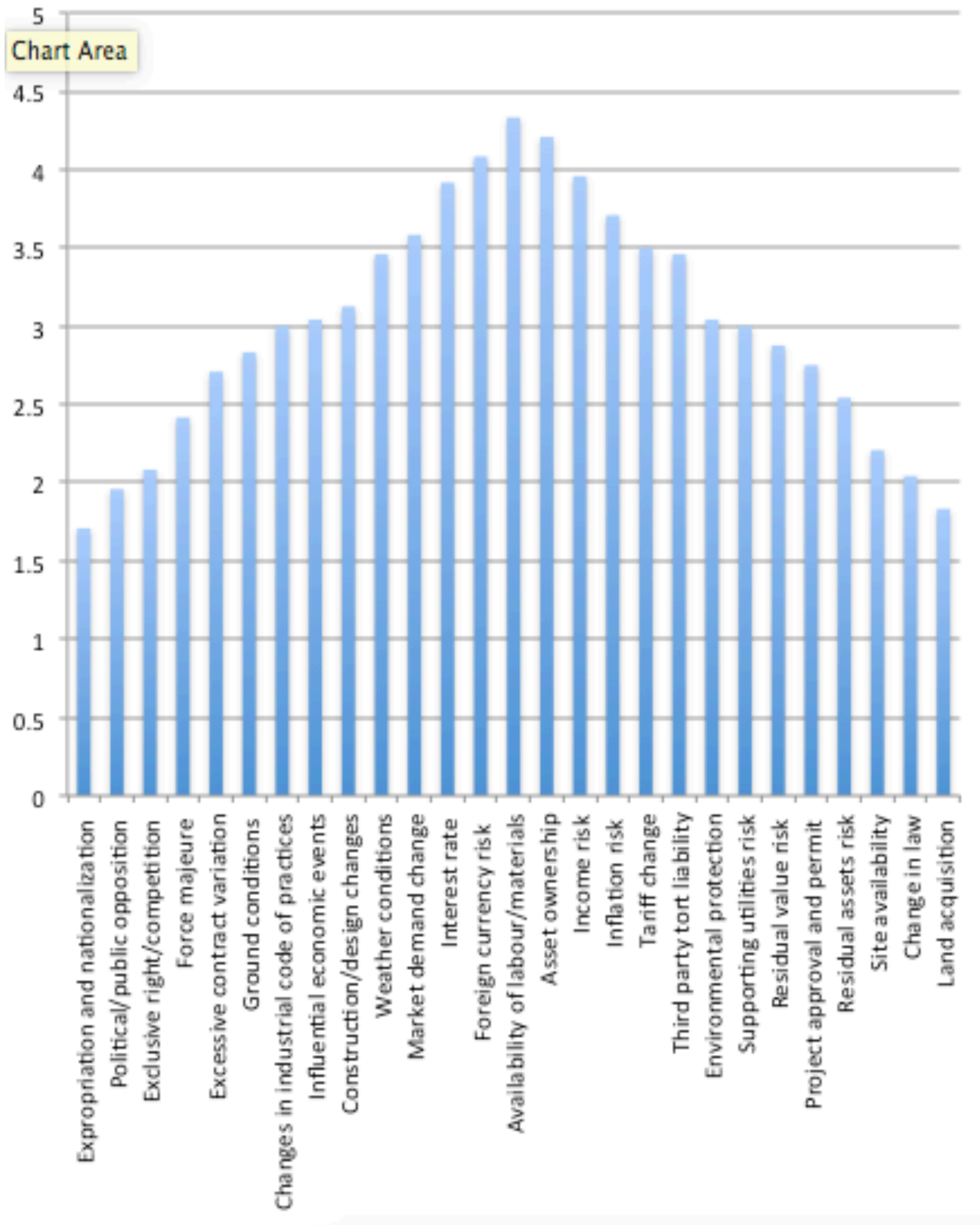
Risk Allocation Scheme		All Respondents		Public Sector		Private Sector	
Sector of Allocation	Contentious Risk	N	Mean	N	Mean	N	Mean
Public	Expropriation and nationalization	24	1.708	12	2.167	12	1.25
	Land acquisition	24	1.833	12	1.917	12	1.75
	Political/public opposition	24	1.958	12	2	12	1.917
	Change in law	24	2.042	12	2.333	12	1.75
	Exclusive right/competition	24	2.083	12	2.833	12	1.333
	Site availability	24	2.208	12	2.667	12	1.75
	Force majeure	24	2.417	12	2.5	12	2.333
	Residual assets risk	24	2.542	12	2.833	12	2.25
	Excessive contract variation	24	2.708	12	2.833	12	2.583
	Project approval and permit	24	2.75	12	2.917	12	2.583
	Ground conditions	24	2.833	12	2.917	12	2.75
Equal	Residual value risk	24	2.875	12	3	12	2.75
	Changes in industrial code of practices	24	3	12	3.5	12	2.5
	Supporting utilities risk	24	3	12	3.583	12	2.417
	Influential economic events	24	3.042	12	3.417	12	2.667
	Environmental protection	24	3.042	12	3.083	12	3
	Construction/design changes	24	3.125	12	3.083	12	3.167
Private	Third party tort liability	24	3.458	12	3.833	12	3.083
	Weather conditions	24	3.458	12	3.417	12	3.5
	Tariff change	24	3.5	12	3.583	12	3.417
	Market demand change	24	3.583	12	3.417	12	3.75
	Inflation risk	24	3.708	12	3.833	12	3.583
	Interest rate	24	3.917	12	3.917	12	3.917
	Income risk	24	3.958	12	4	12	3.917
	Foreign currency risk	24	4.083	12	4	12	4.167
	Asset ownership	24	4.208	12	4.083	12	4.333
	Availability of labour/materials	24	4.333	12	4.083	12	4.583

Due to the aforementioned limitations of forced distribution methodology – namely, the (i) arbitrary selection of a range to indicate ‘equally shared’ results and (ii) the assumed normal distribution of non-normally distributed data – Figure 6.9 does not represent an ‘authentic’ output of expert questionnaire input. It is worth noting that, for this particular study, the mean values of each risk do represent a quasi-normal distribution (see Figure 6.10): the mean value is 3.01 (opposed to 3), twelve risks fall below the mean and thirteen risks fall above the mean (opposed to an even split of thirteen risks falling both below and above the mean),[359] and 59 percent of variables fall within one standard deviation of the mean (opposed to 68 percent of variables). Thus, this particular distribution of risks passes the Shapiro-Wilk test of normality.

Nonetheless, a forced normal distribution still does not accurately reflect this study’s true respondent input and – more importantly – this methodology still suffers from the selection of an arbitrary range to demarcate public, private, and equally shared risk categories. Further, this method necessitates the use of only three risk allocation categories, which detracts from the level of sectorial allocation specificity offered by this study’s five-point scale. More specifically, this approach fails to account for the different degrees of preferred risk sharing offered by the five-point scale, where point two’s ‘mostly public’ allocation preference and point four’s ‘mostly private’ allocation preference allow respondents to differentiate between allocating risks solely and allocating risks partially. Thus, a forced normal distribution should not be adopted to assess this study’s questionnaire-based mean scores.

[359] The reason for this study’s uneven split of twelve risks falling below the mean and thirteen falling above the mean is because two risks – ‘changes in industrial code of practice’ and ‘supporting utilities risk’ – opposed to one risk, each share a mean of 3.

Figure 6. 10: Distribution of Total Mean Scores for Contentious P3 Risks[360]



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[360] The x-axis represents this study's selected P3 risks and the y-axis represents their total mean scores based on the expert questionnaire's respondent input. To represent the quasi-normal distribution intuitively, the risk mean scores have been organized as such: the lowest mean score is placed in the left-most column, the second lowest mean score is placed in the right-most column, the third lowest mean score is placed in the second left-most column, the fourth lowest mean score is placed in the second-right most column, and so on until the risk with the highest mean score – 'availability of labour/materials' – is placed directly in the middle.

6.5 Proposed Risk Allocation Decision Model: Hybrid Adjusting Principle with Ranges

In light of the aforementioned drawbacks to using majority opinion analysis, the half adjusting principle, and a forced normal distribution curve, this study adopts a hybrid adjusting principle in conjunction with risk ranges based on their LCLs and UCLs. As noted in Section 6.2, this preferred methodology bypasses the key limitations offered in previous questionnaire-based studies on P3 risk allocation, and it accounts for both the size and input variance of this study's respondent pool by offering a proposed risk allocation decision model based on confidence intervals for each risk's mean score.

By incorporating ranges based on confidence intervals, it is proposed that this study's risk allocation decision model reflects the potential views of the *population* of P3 practitioners more accurately than previous studies (i.e. rather than merely the views of the *sample* of P3 practitioners consulted). Confidence intervals are estimations of a population's parameters based samples. Thus, it is estimated that the population's mean score for every risk would fall above each LCL and below each UCL. Figure 6.11 shows the LCL and UCL of each risk at a 90 percent confidence level alongside the sectorial categories each risk's range falls into based on the adjusted scale where values falling under: < 1.8 = solely public allocation; 1.8 < 2.6 = mostly public allocation; 2.6 < 3.4 = equally shared allocation; 3.4 < 4.2 = mostly private allocation; and 4.2 < = solely private allocation.

Figure 6. 11: Lower and Upper Confidence Levels of Contentious P3 Risks

Contentious Risk	Mean	LCL-UCL	Sector of Allocation
Expropriation and nationalization*	1.708	1.391 - 2.026	Solely Public; Mostly Public
Land acquisition	1.833	1.567 - 2.100	Solely Public; Mostly Public
Political/public opposition	1.958	1.696 - 2.221	Solely Public; Mostly Public
Change in law	2.042	1.724 - 2.359	Solely Public; Mostly Public
Exclusive right/competition *	2.083	1.698 - 2.468	Solely Public; Mostly Public
Site availability*	2.208	1.867 - 2.550	Mostly Public
Force majeure	2.417	2.126 - 2.707	Mostly Public; Equally Shared
Residual assets risk	2.542	2.185 - 2.899	Mostly Public; Equally Shared
Excessive contract variation	2.708	2.490 - 2.927	Mostly Public; Equally Shared
Project approval and permit	2.75	2.389 - 3.111	Mostly Public; Equally Shared
Ground conditions	2.833	2.513 - 3.154	Mostly Public; Equally Shared
Residual value risk	2.875	2.458 - 3.292	Mostly Public; Equally Shared
Changes in industrial code of practices*	3	2.587 - 3.413	Mostly Public; Equally Shared; Mostly Private
Supporting utilities risk*	3	2.600 - 3.400	Equally Shared
Influential economic events	3.042	2.610 - 3.473	Equally Shared; Mostly Private
Environmental protection	3.042	2.636 - 3.448	Equally Shared; Mostly Private
Construction/design changes	3.125	2.660 - 3.590	Equally Shared; Mostly Private
Third party tort liability*	3.458	3.206 - 3.711	Equally Shared; Mostly Private
Weather conditions	3.458	3.101 - 3.815	Equally Shared; Mostly Private
Tariff change	3.5	3.143 - 3.857	Equally Shared; Mostly Private
Market demand change	3.583	3.258 - 3.908	Equally Shared; Mostly Private
Inflation risk	3.708	3.290 - 4.127	Equally Shared; Mostly Private
Interest rate	3.917	3.492 - 4.341	Mostly Private; Solely Private
Income risk	3.958	3.676 - 4.240	Mostly Private; Solely Private
Foreign currency risk	4.083	3.742 - 4.424	Mostly Private; Solely Private
Asset ownership	4.208	3.956 - 4.461	Mostly Private; Solely Private
Availability of labour/materials	4.333	4.030 - 4.637	Mostly Private; Solely Private

* Risks that showed significant sectorial disagreement between public and private practitioners based on the independent two-sample *t*-test and Mann-Whitney U test.

As previously stated, the proposed allocation of the six risks that showed significant sectorial disagreement should be viewed more skeptically than the risks that passed both the independent two sample *t*-test and Mann-Whitney U test at a 95 percent confidence level. To gauge sectorial disagreement over the allocation of these six risks, their LCLs and UCLs are computed independently between sectors. Figure 6.12 reveals the preferred sector of allocation between public and private respondents based on ranges derived from the LCLs and UCLs of public and private sector respondents separately at a 90 percent confidence level.

Figure 6. 12: Separate Ranges for Risks with Significant Sectorial Disagreement

Contentious Risk	Mean		LCL-UCL		Sector of Allocation	
	Public	Private	Public	Private	Public	Private
Expropriation and nationalization	2.167	1.25	1.681 - 2.653	1.000 - 1.572	Solely Public; Mostly Public; Equally Shared	Solely Public
Exclusive right/competition	2.833	1.333	2.347 - 3.319	1.000 - 1.671	Mostly Public; Equally Shared	Solely Public
Site availability	2.667	1.75	2.156 - 3.177	1.359 - 2.141	Mostly Public; Equally Shared	Solely Public; Mostly Public
Changes in industrial code of practices	3.5	2.5	2.936 - 4.064	1.936 - 3.064	Equally Shared; Mostly Private	Mostly Public; Equally Shared
Supporting utilities risk	3.583	2.417	3.172 - 3.994	1.813 - 3.020	Equally Shared; Mostly Private	Mostly Public; Equally Shared
Third party tort liability	3.833	3.083	3.461 - 4.205	2.816 - 3.350	Mostly Private; Solely Private	Equally Shared

At least one of the proposed sectors of allocation for every risk with significant sectorial disagreement in Figure 6.11 falls under the proposed sectors of allocation from both public and private respondents in Figure 6.12. For half these risks, all proposed sectors of allocation offered in Figure 6.11 fall under the proposed sectors of allocation offered by both public and private respondents in Figure 6.12 (i.e. site availability, changes in industrial code of practices, and supporting utilities risk).

To be charitable to the risk allocation decision model proposed in Figure 6.11, this partial congruity can be viewed as a redeeming sanction. While the risks assessed in Figure 6.12 may require additional negotiation between sectors to arrive at optimal – or at least agreeable – RMAs, the public-private divide over their preferred allocation is close enough to expect relatively straightforward sectorial compromise between public and private P3 practitioners. Like any partnership, compromise is at the heart of P3 agreements. Further, the 27 risks assessed in this study are deemed contentious based on the core literature review. Thus, it is unsurprising that sectorial compromise is necessary to arrive at a proposed risk allocation decision model; unanimous agreement between sectors over the treatment of all contentious P3 project risks should not be expected.

6.5.1 Membership Functions and Membership Degrees

Now that preferred sectors of allocation for each risk have been proposed, the *degree* to which P3 practitioners associate these risks with their preferred sectors of allocation should be analyzed. By doing so, this study recaptures information otherwise lost by merely proposing allocation categories for risks based on crisp mean values. Each risk allocation category can be viewed as a "membership function" (m) to which each risk carries an associated agreement level – or "membership degree" – between 0 to 1.[361] Thus, each risk's range – based on LCLs and UCLs at a 90 percent confidence level – can be assessed under pairs of values denoting five possible membership functions alongside their associated membership degrees. Let m_{Spub} = solely public, m_{Mpub} = mostly public, m_{ES} = equally shared, m_{Mpri} = mostly private, and m_{Spri} = solely private.

For example, land acquisition risk's range, at a 90 percent confidence level, is 1.567 to 2.1. Thus, it falls under both 'solely public' (< 1.8) and 'mostly public' (1.8 < 2.6) risk allocation categories. Land acquisition's LCL, 1.567, falls under m_{Spub} at 0.233 units (i.e. 1.8 – 1.567 = 0.233). Land acquisition's UCL, 2.1, falls above m_{Spub} at 0.3 units (i.e. 2.1 – 1.8 = 0.3). Because 0.3 + 0.233 = 0.533, and 0.233 divided by 0.533 = 0.437, 44 percent of land acquisition risk's range falls within the 'solely public' category, representing a membership degree of 0.44 to membership function m_{Spub}. Because 0.3 divided by 0.533 = 0.563, 56 percent of land acquisition risk's range falls within the 'mostly public' category, representing a membership degree of 0.56 to membership function m_{Mpub}. Because none of land acquisition risk's range of 0.533 falls within membership functions m_{ES}, m_{Mpri}, or m_{Spri}, its membership degree for all three is 0.

[361] Qing Li, "A Novel Likert Scale Based on Fuzzy Sets Theory," *Expert Systems with Applications* 40, no. 5 (2013): 1611, doi:10.1016/j.eswa.2012.09.015.

Where CI = the confidence interval – or range – based on each risk's LCL and UCL, land acquisition risk's membership degrees can be modeled as follows:

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.44$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.56$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; and $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

Here, land acquisition's range of 0.533 was found by: (i) subtracting land acquisition's LCL (1.567) from m_{Spub}'s limit (1.8) to arrive at 0.233; (ii) subtracting m_{Spub}'s limit (1.8) from land acquisition's UCL (2.026) to arrive at 0.3; and (iii) adding the results, 0.233 and 0.3, to arrive at a range – or confidence interval – of 0.533 at a 90 percent confidence level. Land acquisition risk's range can be verified by simply subtracting its LCL from its UCL: 2.1 – 1.567 = 0.533.

By demarcating land acquisition's range of 0.533 into two segments, that which falls under 1.8 and that which falls between 1.8 and 2.6, its membership degrees towards 'solely public' and 'solely private' membership functions are found. Note that these degrees are relative to the size of land acquisition's range of 0.533. This means, no matter how high a risk's range is, its combined membership degrees for all membership functions will always equal 1 (e.g. 0.44 + 0. 56 + 0.0 + 0.0 + 0.0 = 1).

Because all risks' combined membership degrees will equal 1 regardless of the size of their range, the size of their range must be noted when assigning them to risk allocation categories. The higher a risk's range between its LCL and UCL, the higher its variance will be. Respondent variance shares an inverse relationship with the conclusiveness and confidence of population predictions based on a sample's input. Thus, the higher a risk's range is, the less conclusive its results are for this study. Conversely, the lower a risk's range is, the more conclusive its results are for this study.

Because each risk's range is directly tied to its membership degrees for the five membership functions, the range of risks with high variance can encompass a *greater* portion of a risk allocation category (e.g. 'equally shared') under this study's adjusted scale while *simultaneously* holding a comparably *lower* or equal membership degree towards membership functions than risks with a lower variance.

For example, Figure 6.11 shows that site availability risk and supporting utilities risk both fall under one risk category, thus both hold a membership degree of 1.0 for their respective membership functions. However, because site availability risk's range and variance are lower than supporting utilities risk's range and variance, it encompasses less of its risk category's space on the adjusted five-point scale. Site availability risk's range falls within 85 percent of the 'mostly public' allocation category (i.e. 1.8 < 2.6) with an LCL of 1.867 and a UCL of 2.55. Supporting utilities risk's range perfectly falls within 100 percent of the 'equally shared' allocation category (i.e. 2.6 < 3.4) with an LCL of 2.6 and a UCL of 3.4.[362]

At first blush, it may appear counterintuitive to believe that, by encompassing a smaller portion of the adjusted scale's 'mostly public' section, site availability risk shares a stronger relationship with the membership function m_{Mpub} than supporting utilities risk does with m_{ES}. An observer may say that site availability risk and supporting utilities risk both share an equally strong relationship with their respective membership functions on account of both holding a sole membership degree of 1. However, site availability risk's lower range and variance provides more conclusivity over the confidence with which it is

[362] Site availability risk's range and variance are 0.683 and 0.955 respectively, while supporting utilities risk's range and variance are 0.8 and 1.304 respectively.

allocated to its respective membership function. If this concept does not seem readily apparent, it is because that – in this instance – membership degrees and functions do not provide this information on their own.[363] They do, however, in the following example.

The effect range and variance have on risk membership degrees is made blatantly apparent when comparing the risk of changes in industrial code of practices with supporting utilities risk and site availability risk. The risk of changes in industrial code of practices presents a unique situation where it holds three membership degrees above zero for three separate membership functions. Unsurprisingly, its range and variance are both higher than the range and variance of site availability risk and supporting utilities risk.[364] With an LCL of 2.587 and a UCL of 3.413, the risk of changes in industrial code of practice's range falls within 100 percent of the 'equally shared' allocation category and less than a percent of both 'mostly public' and 'mostly private' allocation categories.

Despite encompassing the entire 'equally shared' category, this risk's high range – due to a high variance – must be accounted for. Because a high range and variance is associated with lower conclusivity and confidence in a risk's proposed allocation on the adjusted scale, it shares a lower membership degree to the membership function m_{ES} than supporting utilities risk does, despite both risks' ranges encompassing the entire 'equally shared' portion of the adjusted scale.

Due to its high range and variance, the risk of changes in industrial code of practice actually shares a lower membership degree with m_{ES} (i.e. 0.96) than site

[363] Without reference to both risk's range and variance, their equal membership degrees of 1 incorrectly appear to denote an equally strong relationship with their respective sole membership functions.
[364] Changes in industrial code of practices risk's range and variance are 0.826 and 1.391 respectively.

availability risk does with m_{Mpub} (i.e. 1.0), despite the former falling within 100 percent of the 'equally shared' allocation category and the latter falling within 85 percent of the 'mostly public' allocation category. The respective membership degrees of the three aforementioned risks are expressed as follows.

For site availability risk,

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 1.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; and $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

For supporting utilities risk,

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 1.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; and $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

For changes in industrial code of practice,

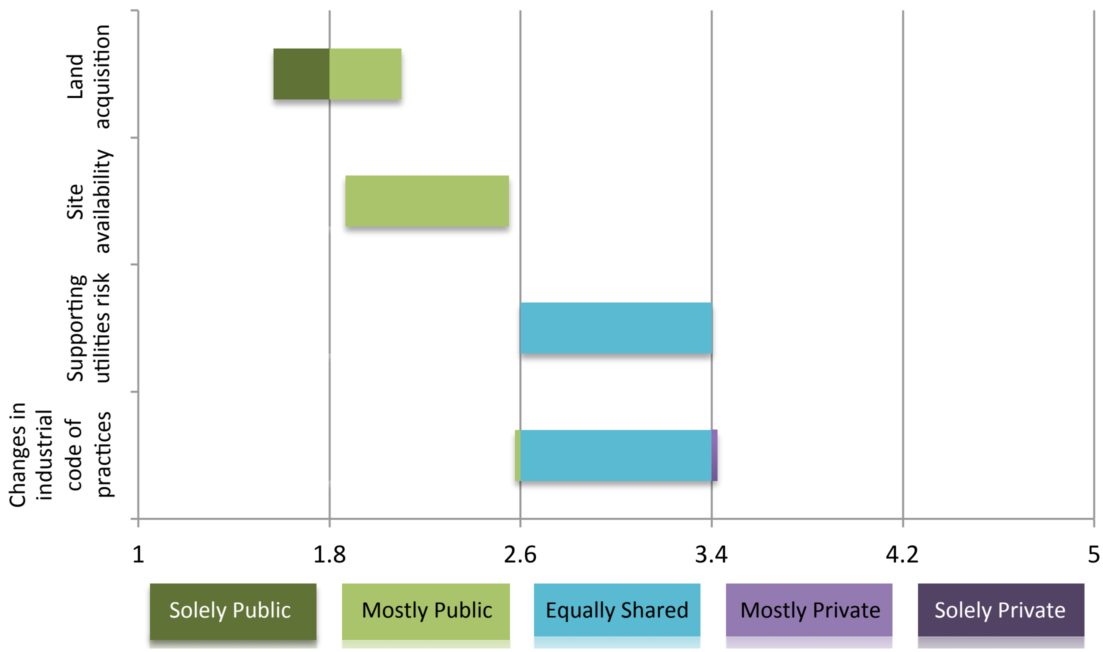
$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.02$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.96$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.02$; and $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

These three risks are unique in holding membership degrees above zero for either one or three membership functions – the remaining 24 risks in this study all hold membership degrees above zero for exactly two membership functions.[365] Figure 6.13 provides a conceptual illustration of the three aforementioned risks' unique dispersions

[365] Because of their unique dispersions over the adjusted scale, the membership degrees for these three risks were calculated differently than the other 24 risks. The beginning of Section 6.5.1 provides an example with land acquisition risk to denote the method used to arrive at membership degrees for 'typical' risk ranges that fall within two membership functions – by calculating the percentage of a risk's range that falls below and above its 'cut off' point of range demarcation (i.e. 1.8, 2.6, 3.4, or 4.2). For the two risks with one membership function, no calculations are necessary to find their membership degree – it is necessarily 1. For the risk with three membership functions, the differences between its: (i) lowest cut off point, 2.6, and its LCL, 2.587 as well as its (ii) highest cut off point, 3.4, and its UCL, 3.413, are calculated and divided by its range. Because both differences equal 0.013, this number is divided twice separately by 0.826 to arrive at its equal membership degrees for m_{Mpub} and m_{Mpri} – 0.02. Accordingly, 4 percent of changes in industrial code of practices' range falls evenly between the 'mostly public' and 'mostly private' allocation categories. Hence, 96 percent of this risk's range falls within the 'equally shared' allocation category, despite encompassing its entire section on the adjusted scale.

over this study's adjusted scale; for context into the 'typical' dispersion of the remaining 24 risks, land acquisition – mentioned earlier in this section – is also included.

Figure 6. 13: Ranges for Select Risks over Adjusted Scale



Note that, because of the aforementioned effects risk ranges, due to variance, have on their membership degrees, membership functions (e.g. m_{ES}) and risk allocation categories (e.g. 'equally shared,' or 2.6 < 3.4) are not synonymous. While membership degrees do provide readers with the distribution under which each risk's range is placed, understanding the size of each risk's range, and how these ranges fall under risk allocation categories, is also a significant factor in arriving at a proposed risk allocation decision model. In short, the shorter a risk's range is, the more confidently it can be placed under a proposed allocation category. Thus, it is important to view membership degrees and functions alongside the categorical placement of risk. Figure 6.14 provides each P3 risk's range and degrees towards their relevant membership functions.

Figure 6. 14: Proposed Risk Allocation Decision Model for Contentious P3 Risks[366]

Contentious Risk	LCL-UCL	Range	Membership Degrees Above Zero
Expropriation and nationalization	1.391 - 2.026	0.635	m_{Spub}(CI) = 0.64; m_{Mpub}(CI) = 0.36
Land acquisition	1.567 - 2.100	0.533	m_{Spub}(CI) = 0.44; m_{Mpub}(CI) = 0.56
Political/public opposition	1.696 - 2.221	0.525	m_{Spub}(CI) = 0.20; m_{Mpub}(CI) = 0.80
Change in law	1.724 - 2.359	0.635	m_{Spub}(CI) = 0.12; m_{Mpub}(CI) = 0.88
Exclusive right/competition	1.698 - 2.468	0.770	m_{Spub}(CI) = 0.13; m_{Mpub}(CI) = 0.87
Site availability	1.867 - 2.550	0.683	m_{Mpub}(CI) = 1.0
Force majeure	2.126 - 2.707	0.581	m_{Mpub}(CI) = 0.82; m_{ES}(CI) = 0.18
Residual assets risk	2.185 - 2.899	0.714	m_{Mpub}(CI) = 0.58; m_{ES}(CI) = 0.42
Excessive contract variation	2.490 - 2.927	0.437	m_{Mpub}(CI) = 0.25; m_{ES}(CI) = 0.75
Project approval and permit	2.389 - 3.111	0.722	m_{Mpub}(CI) = 0.29; m_{ES}(CI) = 0.71
Ground conditions	2.513 - 3.154	0.641	m_{Mpub}(CI) = 0.14; m_{ES}(CI) = 0.86
Residual value risk	2.458 - 3.292	0.834	m_{Mpub}(CI)=0.17; m_{ES}(CI)=0.83
Changes in industrial code of practices	2.587 - 3.413	0.826	m_{Mpub}(CI) = 0.02; m_{ES}(CI) = 0.96; m_{Mpri}(CI) = 0.02
Supporting utilities risk	2.600 - 3.400	0.800	m_{ES}(CI) = 1.0
Influential economic events	2.610 - 3.473	0.863	m_{ES}(CI) = 0.92; m_{Mpri}(CI) = 0.08
Environmental protection	2.636 - 3.448	0.812	m_{ES}(CI) = 0.94; m_{Mpri}(CI) = 0.06
Construction/design changes	2.660 - 3.590	0.930	m_{ES}(CI) = 0.80; m_{Mpri}(CI) = 0.20
Third party tort liability	3.206 - 3.711	0.505	m_{ES}(CI) = 0.38; m_{Mpri}(CI) = 0.62
Weather conditions	3.101 - 3.815	0.714	m_{ES}(CI) = 0.42; m_{Mpri}(CI) = 0.58
Tariff change	3.143 - 3.857	0.714	m_{ES}(CI) = 0.36; m_{Mpri}(CI) = 0.64
Market demand change	3.258 - 3.908	0.650	m_{ES}(CI) = 0.22; m_{Mpri}(CI) = 0.78
Inflation risk	3.290 - 4.127	0.837	m_{ES}(CI) = 0.13; m_{Mpri}(CI) = 0.87
Interest rate	3.492 - 4.341	0.849	m_{Mpri}(CI) = 0.83; m_{Spri}(CI) = 0.17
Income risk	3.676 - 4.240	0.564	m_{Mpri}(CI) = 0.93; m_{Spri}(CI) = 0.07
Foreign currency risk	3.742 - 4.424	0.682	m_{Mpri}(CI) = 0.67; m_{Spri}(CI) = 0.33
Asset ownership	3.956 - 4.461	0.505	m_{Mpri}(CI) = 0.48; m_{Spri}(CI) = 0.52
Availability of labour/materials	4.030 - 4.637	0.607	m_{Mpri}(CI) = 0.28; m_{Spri}(CI) = 0.72

As an educational resource, Figure 6.14's risk allocation decision model provides readers with an intuitive understanding of each risk's strength of association towards both the public and private sector – based on expert opinion – via colour accents. Where green, purple, and blue represent public, private, and shared allocations respectively, the darker the accent, the stronger a risk's association with the sector to which it has a majority membership function (i.e. m[CI] > 0.50).

[366] Risks are ordered in descending order from lowest total mean score to highest total mean score.

Again, because this study's respondents were confined to selecting variables on an ordinal semantic differentiation scale, the five-point scale "tells nothing about the intervals between responses." This type of scale leads to "information lost during measurement" because its discrete variables provide little means of association between each other (i.e. other than their clear orderly ranking from one to five). Further, the "closed response format" of semantic differential scales (i.e. truncated variables) force respondents to make choices that may otherwise "not match their exact responses."[367] In short, while this study's five-point scale allows respondents to gauge allocation preferences according to expert opinion, these opinions – on their own – come at an informational compromise due to the drawbacks of using ordinal, truncated measurement variables.

By treating the questionnaire's ordinal input as interval data, mean score methods can be applied to arrive at Figure 6.14's proposed risk allocation decision model based on risk ranges and their degrees of membership towards membership functions. These degrees of membership reduce the information loss denoted with ordinal point scales, allowing for a more fluid risk allocation decision model premised on 'grey' risk categorization – opposed to 'black and white' – that more thoroughly accounts for the relational *strength* between risks and their accompanying allocation categories.[368]

[367] Li, "A Novel Likert Scale Based on Fuzzy Sets Theory," 1610.

[368] Albeit, by treating the ordinal data as interval data, two major assumptions are required: (i) the aforementioned assumed equidistance between points on the semantic differential scale and (ii) the assumed universality with which a point's quality (i.e. the quality of being public, private, or equal) applies to each risk. The limitations of these assumptions are considered in Chapter 7.

6.6 Allocating Contentious P3 Risks

While this study's strength lies in its fluid allocation model, its 27 contentious P3 project risks can easily be compartmentalized under three broad categories: (i) risks leaning towards public sector allocation, (ii) risks leaning towards an evenly shared allocation, and (iii) risks leaning towards private sector allocation. These categories are premised on the membership function the majority of a risk's range falls under. Because of the 'situatedness' of P3s, risk allocation is a malleable process – it should never be assumed that certain P3 risks should always be borne by a public or private party in every circumstance. Thus, these broad categories should not be dogmatically followed, but rather used to conceptualize the general preferences of expert practitioners over the general treatment of contentious P3 risks.

Eight risks fall under the broad public sector allocation category. These risks follow a general trend where their strength of public sector association falls in descending order according to Figure 6.14. Two of these risks share membership degrees with the 'equally shared' membership function.

Nine risks fall under the broad evenly shared allocation category, where the strength of equal sharing between sectors gradually increases until it climaxes two thirds of the way down at 'supporting utilities risk.' The remainder of this category's strength of association towards an evenly shared membership stays relatively stagnant until its last risk, 'construction/design changes,' which shares a small – but significant – relationship with the 'mostly private' membership function. All of this broad category's risks except 'supporting utilities risk' share a membership degree above zero with either the 'mostly public' or 'mostly private' functions. This is because this category: (i) operates at the center of the spectrum and (ii) revolves around one risk membership function out of five opposed to two risk membership functions out of five.

Ten risks fall under the broad private sector allocation category. These risks follow a general trend where their strength of private sector association rises in ascending order according to Figure 6.14. Interestingly, five of these risks share membership degrees with the 'equally shared' membership function, representing half the broad private category. Compared to the broad public category, in which only a quarter of its risks share membership degrees with the 'equally shared' membership function, this trend may indicate that P3 practitioners have stronger confidence or conviction in allocating risks to the public sector in lieu of the private sector.

The remainder of Chapter 6 assesses this study's proposed risk allocation decision model reflected in Figure 6.14. P3 literature is consulted to justify, question, or comprehend this study's results. Original allocation preferences from the core literature database are commonly referenced. Note, however, that some risks appear more frequently in the database than others (see Figure 5.3).[369]

6.7 Risks Leaning Towards Public Sector Allocation

This study indicates that eleven risks should generally be allocated to the public sector either fully or to a significant degree. The following 'public' risks – in order of their strength of association to the public sector[370] – include: (i) expropriation and nationalization, (ii) land acquisition, (iii) political/public opposition, (iv) change in law,

[369] For example, the risk of 'change in law' appears in every article examined while the risk of 'influential economic events' appears in a quarter of the articles examined.
[370] According to their total mean scores.

(v) exclusive right/competition, (vi) site availability, (vii) force majeure, and (viii) residual assets risk.

6.7.1 Expropriation and Nationalization

$m_{\text{Spub}}(\text{CI}) = 0.64$; $m_{\text{Mpub}}(\text{CI}) = 0.36$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Expropriation and nationalization is the only risk in this study with the majority of its range falling under the 'solely private' membership function. Its strong ties to the public sector are likely due to expropriation traditionally being both a sole government power and, accordingly, a sole government responsibility. Governments often retain the right to acquire private projects or land through "compulsory acquisition" by means of expropriation.[371] By viewing expropriation as a 'risk,' questionnaire respondents – both public and private – believe that governments should bear the financial consequences of the compulsory acquisition of a project – this includes providing reasonable compensation to their private P3 partners.

Chan et al., Hwang et al., Ke et al., Li et al., and Tolani all recommend this risk be retained by the public sector. It should be noted, however, that public sector respondents present a total mean of 2.167 for this risk while private sector respondents present a total mean of 1.25. With a mean difference of 0.917, expropriation and nationalization remains one of the most contentious risks in this study; it has the tied fourth largest mean difference between public and private respondents (see Figure 6.3). Further, its independent public and private ranges – derived from its public and private LCLs and UCLs – do not overlap (see Figure 6.12). This high level of disagreement is echoed in P3

[371] S. Keith et al., "Compulsory Acquisition of Land and Compensation" 1, no. 3 (2008): 1, http://www.fao.org/docrep/011/i0506e/i0506e00.htm.

literature, and it may be tied to the perceived conditions public and private sector practitioners denote with expropriation risks.

Public practitioners may denote expropriation with first-step risk default where private partners breach contractual obligations (see Figure 4.1); in such situations, private partners should not be compensated for breaching contractual agreements. Private practitioners may denote expropriation with strategic behaviour from governments, where public authorities strategically adopt PRM techniques employed by their preferred proponents and use them to procure or manage the same facility through another contract with separate partners (see Chapter 2, Section 2.7).[372]

The concept of strategic behaviour has been largely denoted with private parties up to this point, though governments are capable of such practices too.[373] However, P3s take a wealth of resources and years of preliminary public input to initiate. Governments do not undertake exhaustive preliminary screenings and competitive selection processes (e.g. RFQs, RFPs, and due diligence) with the goal of expropriating land from their preferred proponent's concessionaire. This leaves two points to consider: (i) where expropriation risks occur, they are likely to be caused by extreme contractual breaches from the private sector; and (ii) according to this study's findings, governments should bear the risk of compensating the private parties affected by expropriation.

If these points appear contradictory, it is because they are. A commonly cited point of contention amongst P3 literature is the fact that governments are often the

[372] As noted in Chapter 2, governments can use the intellectual property of preferred proponents by 'purchasing' their respective PRM methods and applying them to future projects.
[373] Chapter 7 will elucidate this concept further.

residual risk holder should private parties majorly default on risks.[374] While this study's findings on expropriation risk may seem uncharitable towards the public sector, they parallel industry standards (albeit contentious industry standards). An example of a brownfield P3 project going awry – and eventually leading to expropriation – is the infamous battle between the government and its SPV partner over the mistreatment of a water treatment facility in Hamilton in 1994.

Under the operational oversight of the project's SPV, Philips Utilities Management Corporation (PUMC), approximately 180 million litres of raw sewage spilt into the city's harbour. This mishap required additional resources for cleanup, yet half of the PUMC's subcontracted workforce was cut down in 1995; they cited financial strain as the reason for the lay offs (at least two of the project's contractors are now bankrupt and both had dealings with the now infamous Enron corporation). The government reluctantly put the treatment of the plant back into the hands of the public sector, consequently accepting its large project losses.[375]

While it is clear that governments should reimburse private partners affected by expropriation when contractual obligations are met, this issue remains largely project-specific. Thus, this risk's strong ties towards public sector allocation, while reflecting

[374] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere †"; De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process"; De Palma, Leruth, and Prunier, "Towards a Principal-Agent Based Typology of Risks in Public-Private Partnerships"; Monteiro, "Risk Management."
[375] Salim Loxely, "An Analysis of a Public-Private Sector Partnership : The Hamilton - Wentworth - Philip Utilities Management Corporation PPP," *Canadian Union of Public Employees* (Manitoba, 1999), http://www.archives.gov.on.ca/en/e_records/walkerton/part2info/partieswithstanding/pdf/CUPEppp.pdf.

industry practices, are questionable from an ethical perspective. Degrees of sharing expropriation risks are necessary.

6.7.2 Land Acquisition

$m_{\text{Spub}}(\text{CI}) = 0.44$; $m_{\text{Mpub}}(\text{CI}) = 0.56$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

It is unsurprising that 'land acquisition' falls within a public range of allocation; internationally, governments have "shown a tendency to retain ownership of government land and to grant leases to private parties… so that the land and any improvement on it revert to government."[376] Curiously, however, the degree to which this study's experts denote land acquisition with public sector responsibility does not always correlate with allocation suggestions based in P3 literature. The VDTF notes that, "as the major project market has evolved, the need for government to retain a propriety interest has come increasingly into question… It should not be automatically assumed that the underlying land asset needs to be in government hands."[377]

Perhaps this is why there is discrepancy within the core literature database over its allocation. Chan et al., Ke et al., and Li et al. allocate land acquisition to the public sector while Tolani recommends a shared allocation. Li et al. provides conditions under which land acquisition should generally be borne solely by the public sector:

> i. Where the site is an existing government site, perhaps with existing defects or environmental liabilities;
> ii. Where the government wishes to retain ownership of the underlying land asset, or is to acquire it at the end of the contract term;
> iii. Where site approvals are likely to be particularly complex, as in the case of linear infrastructure projects involving an environmental impact assessment; or

[376] VDTF, "Risk Allocation and Contractual Issues: A Guide," 43.
[377] Ibid.

iv. Where indigenous title/ownership issues arise over the land proposed for the project.[378]

The VDTF provides additional conditions under which land acquisition should be borne solely by the public sector:

i. Sites which government clearly wants into the future, e.g. major roadways;
ii. Sites from which government *may* wish to receive or deliver future services; and
iii. Sites in which government has no special interest and from which it can, if need be, walk away.[379]

With these conditions in mind, risks associated with land acquisition (e.g. unanticipated delay in, or extra costs associated with, procuring land that is required for a P3 project) are still generally associated with the public sector – it appears this study's public allocation is sound. However, this trend may change in the future as traditional public responsibilities and risks increasingly shift towards to the private sector.[380]

6.7.3 Political/Public Opposition

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.20$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.80$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

This risk is similarly linked with land acquisition as well as other issues that may arise before and during the P3 tender process (e.g. environmental protection and project approval and permit). When a P3 project experiences prejudicial backlash from factions within its surrounding community, the general response from governments is to form a "community liaison," establishing a means of communication between the community

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[378] Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 32.
[379] VDTF, "Risk Allocation and Contractual Issues: A Guide," 43.
[380] J E Stiglitz and J K Rosengard, *Economics of the Public Sector: Fourth International Student Edition*, 4th ed. (New York: W.W. Norton & Company, 2015), https://books.google.ca/books?id=miPeCgAAQBAJ.

and the crown corporation responsible for the project during early site preparation stages.[381]

Of course, SPVs can form community liaisons too, especially in the name of transparency with the general public.[382] However, according to this study, the risk of mitigating potential public backlash against P3s should generally be borne by the government. This result runs parallel with findings from the core literature database: five studies recommend public sector allocation and one study recommends a private sector allocation. This study's 'mostly public' allocation appears sound.

6.7.4 Change in Law

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.12$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.88$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

The risk of legal change received six public, five 'shared,' and one private allocation recommendation according to the core literature database. It is the only risk out of 54 to appear in all twelve pieces of literature examined in the database.[383] The VDTF defines change in law risk as "the risk that the agreed legal, policy and regulatory framework will change during the contract term in a way not allowed for when the contract was signed and which disadvantages or has a negative financial impact on the project."[384]

Changes in law generally affect private partners adversely during DBO phases of a P3 project. One of this risk's most oft-cited consequences is the need for SPV partners

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[381] VDTF, "Risk Allocation and Contractual Issues: A Guide.", 34.
[382] Mahran Maher Zatar, "Public Private Partnership Pitfalls In Toll Roads" (Civil & Environmental Engineering, 2014), 17, https://uta-ir.tdl.org/uta-ir/bitstream/handle/10106/24447/Zatar_uta_2502M_12617.pdf?sequence=1.
[383] See Figure 5.3.
[384] VDTF, "Risk Allocation and Contractual Issues: A Guide," 90.

to undergo design modifications for the DB of infrastructure (e.g. a modification of ventilation stacks to minimize pollution caused by traffic in tunnels in accordance with new environmental standards). While private partners are often charged with mitigating change in law risk, this study indicates that governments should compensate them for doing so (pending final contract stipulations). For instance, public authorities could compensate private partners though payment measures like increased tariffs for adapting to project-adverse legal changes.[385] This study's public allocation appears sound.

6.7.5 Exclusive Right/Competition

$m_{\text{Spub}}(\text{CI}) = 0.13$; $m_{\text{Mpub}}(\text{CI}) = 0.87$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Similar to expropriation, public authorities are generally the only actors with the influence to revoke previously established exclusivity rights from their original project partners and potentially reopen competition to other private competitors. For this risk, a public allocation indicates some form of compensation to the private sector on behalf of public authorities, while a private allocation would indicate a lesser degree of compensation to no compensation at all. If a private party has its exclusive right agreements revoked or dishonoured, it should be fairly compensated according to this study. This result echoes the findings of the core literature database, where this risk received three public allocation recommendations and one 'shared' allocation recommendation.

Interestingly, this study's public and private respondents gave this risk an overall mean score of 2.833 and 1.333 respectively. This sectorial mean difference of 1.5 is the

[385] Ibid.90, 93-94.

highest in this study (see Figure 6.3). Further, this risk's public and private ranges do not overlap (see Figure 6.12). It is of no surprise that the risk of exclusive right/competition showed statistically significant difference between sectors through the independent two-sample *t*-test and Mann-Whitney U test at a 95 percent confidence level. This suggests sector-driven partiality; of all risks in this study, the proposed allocation of exclusive right/competition risk needs to be viewed with the most skepticism. Further research on sectorial agreement over its allocation is necessary. However, according to the literature, a 'mostly public' allocation – for which it received a 0.88 membership degree – appears sound.

6.7.6 Site Availability

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 1.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

Site availability is only one of two risks in this study with a range that falls within one category – 'mostly public.' Like exclusive right and expropriation risks before it, site availability is among the six risks that showed statistically significant sectorial disagreement over its allocation. The public sector's overall mean score of 2.667 and the private sector's overall mean score of 1.75 yields a significant mean difference of 0.917 (see Figure 6.3). Further, its public range and private range do not overlap; however, its public sector LCL and private sector UCL are only 0.015 units away from meeting on the adjusted five-point scale (see Figure 6.12). This suggests cooperative compromise over its preferred allocation is possible.

This risk differs from land acquisition because it deals with the risk of inaccessible land or resources *already* procured for a project, resulting in added delays and costs. This risk may intersect with availability of labour/materials, weather conditions, environmental protection, project permits, and ground conditions – among others – as it broadly encapsulates unanticipated delays in using resources that are otherwise available save for specific obstacles.

Both Hwang et al. and Li et al. suggest public allocation for site availability. Hwang et al. note that a corruption free public sector should be better able to manage this risk to "ensure that P[3] projects are in a favourable environment for private sectors." Further, they note that the "public sector should also retain the risk of site acquisition as it has higher authority to control the process of land acquisition."[386]

Again, results from the core literature database are echoed in this study's findings – land acquisition received a larger share of public allocation preferences both within the core literature database and within this study than site availability did. Land acquisition, with three public and one 'shared' allocation recommendation, received relevant membership functions $m_{\text{Spub}}(\text{CI}) = 0.44$ and $m_{\text{Mpub}}(\text{CI}) = 0.56$; site availability, with three public, two private, and one 'shared' allocation recommendation, received a relatively weaker public score with no m_{Spub} degree of membership above zero.

Site availability risk's weaker public sector allocation likely arose in both circumstances because such risks are connected to a wide array of different factors – many of which may arise under private sector influence. Ng and Loosemore note that "site risks" should be allocated to different actors from different sectors depending on what each risk entails. For instance, should site availability risks arise due to Native title

[386] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 430.

or cultural heritage issues, they recommend governments bear the risk; if site availability risks arise due to the failure of supporting structures or ground conditions, they recommend private construction contractors bear the risk; if site availability risks arise due to pollution and discharge, they recommend private operating companies bear the risk.[387] Thus, this risk remains highly contingent on specific project circumstances.

6.7.7 Force Majeure

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.82$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.18$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

As noted in Chapter 4, large-scale, uninsurable risks that can neither be quantified nor influenced by private actors should be borne by public authorities. Even if the private sector has influence over such risks, unquantifiable risks should still be borne largely by governments with a risk cap for the private sector (see Figure 4.5). The VDTF defines force majeure risk as "the risk that a specified event *entirely outside the control of either party* will occur and will result in a delay or default by the private party in… its contractual obligations."[388] Other force majeure definitions can be less optimistic; Yescombe defines force majeure risk as an event where, "though neither party is at fault, the effect of the event is so severe (*and cannot be mitigated by insurance…*) that the Project Contract has to be terminated."[389]

One pattern remains clear, however, and that is that force majeure risks are *exogenous* – they arise from external influences, and thus no party has control over their occurrence. In line with Chapter 4's findings, force majeure has appropriately garnered a

[387] Ng and Loosemore, "Risk Allocation in the Private Provision of Public Infrastructure," 6.
[388] Emphasis added. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 106.
[389] Emphasis added. See Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 245.

strong membership degree – 0.82 – towards 'mostly public' allocation on account of Figure 4.5's rule: risks that cannot be fully insured, quantified, or controlled to any degree by either party should be borne by governments. Its relatively weak membership degree – 0.12 – towards 'equally shared' allocation nicely accounts for the concept of risk sharing for force majeure events with a private sector risk cap.

Force majeure takes shape in two distinct forms: political and non-political. Non-political force majeure risks, often referred to as "acts of God," include natural disasters (e.g. earthquakes, landslides, and floods) and biological calamities (e.g. nuclear or chemical contamination to a site). Political force majeure risks include war, terrorism, and riots. It is generally accepted that no party has influence over these risks and, accordingly, they should be borne by the public sector if they cannot be covered by insurance.[390]

The reason events like force majeure risks – which cannot be affected by either sector – are solely borne by public authorities, or mostly borne by public authorities with a cap for the private sector, is twofold. Firstly, the main purpose of P3s for governments is to develop public infrastructure and services for citizens while the main purpose of P3s for SPVs is to make a profit. If SPVs were expected to bear a large portion of force majeure risks, they would be less likely to participate in P3s due to the exorbitant costs associated with bearing these risks. This would hamper the government's ability to attract P3 bidders and thus utilize P3 procurement to develop public infrastructure. Second, governments have "a much higher (almost infinite) ability to absorb risk, while… private

[390] VDTF, "Risk Allocation and Contractual Issues: A Guide," 106; Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 245.

partner[s] ha[ve] limited legal and financial responsibility."[391] Because of the government's virtually unrestrained ability to accrue continual resources via taxation, it will be less affected than private parties in the long-term from bearing major force majeure risks.[392]

6.7.8 Residual Assets Risk

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.58$; $m_{\text{ES}}(\text{CI}) = 0.42$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Residual assets risks concern the designation of unspecified assets on project land remaining at the end of a project's lifecycle. Residual assets risks, along with residual value risks, are considered a "handback risk" dealing with the ownership rights of either physical or intellectual property at a project's end.[393] As mentioned in Chapter 2, asset ownership can be temporarily transferred to the private sector over the course of a P3 project's lifecycle in a 'rent to own' transaction where public authorities pay their private partners annual fees over a specified period – generally between two to three decades – to own the infrastructure at the end of the period.[394]

The end of a P3 project's lifecycle presents two options to the government: (i) contracts are renegotiated with the original private partner or (ii) ownership of the facility reverts back to the government.[395] In the event that public authorities select the latter option, the terms and conditions associated with handback risks are typically covered

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[391] Monteiro, "Risk Management," 262.
[392] I.e. because of continual guaranteed income via taxation.
[393] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 21.
[394] This is the most common practice in P3 concessions that include an operation and/or maintenance phase (e.g. DBFOM).
[395] Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere," 2.

under P3 contracts. Governments typically structure incentives through awards and/or fees associated with facility upkeep to ensure that infrastructure is in suitable condition upon transfer of ownership.[396]

However, in the instance that an SPV utilizes undesignated assets during the operation and maintenance of a P3 project, this study suggests that private partners should be able to either: (i) retain the assets upon ownership transfer or (ii) negotiate to receive extra compensation for transferring the assets alongside ownership of the facility. Unsurprisingly, the total mean score for public respondents was 0.583 points higher than for private respondents (2.833 to 2.25).

6.8 Risks Leaning Towards an Evenly Shared Allocation

This study indicates that nine risks should generally be shared significantly between sectors. With reference to the five-point semantic differentiation scale, a literal interpretation of its third point – 'equally shared' – is an imprecise reflection of industry practices. P3 contracts are long, exhaustive, and complex documents; such agreements are not conducive to exactly equal risk sharing. The term 'equal sharing' comes from the rhetorical limitations of using ordinal scales to propose risk allocation decision models in lieu of real-life industry methods. The aforementioned studies provided by Li et al., Ke et al., Chan et al., Hwang et al., and Tolani do not make this admission when presenting risks they regard as 'equally shared.'

With this in mind, the following risks that fall under the broad evenly shared risk category include: (i) excessive contract variation, (ii) project approval and permit, (iii)

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[396] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 21.

ground conditions, (iv) residual value risk, (v) changes in industrial code of practices, (vi) supporting utilities risk, (vii) influential economic events, (viii) environmental protection, and (ix) construction/design changes.

6.8.1 Excessive Contract Variation

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.25$; $m_{\text{ES}}(\text{CI}) = 0.75$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Risks associated with excessive contract variation entail inappropriate contractual delegation at financial close (i.e. a poorly written final contract). This subsequently results in excessive mediation or arbitration procedures. Excessive contract variation was one of the most contentious risks recognized in the core literature database – it appeared in six of the database's twelve articles and received public, private, and 'shared' allocation suggestions. According to Ke et al., since "feasibility studies and contract negotiation are relative to both parties, it would be the best for the public and private sectors to share the responsibility for these risks."[397] Hwang et al. adopt a similar perspective for risks that arise due to the "inadequate distribution of responsibilities."[398]

Hwang et al. believe risks arising from suboptimal contractual delegation are "relationship risks… [that] can be caused by both parties in a P[3] project." Accordingly,

[397] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 490.
[398] The wording of risks found in the core literature database varies between articles. For example, the risk of 'excessive contract variation' appears as titled in Tolani's study, but it is referred to as "improper contracts" in Ke et al. and "conflicting or imperfect contract'" in Chan et al. Thus, content analysis was required to ensure synonymous risks could be assessed together across the database despite having different titles. See Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China," 146; Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 431; Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 488; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 214.

they justify their study's allocation for this risk being 'equally shared.'[399] This study's public and private respondents gave excessive contract variation risk a total mean value of 2.833 and 2.583, respectively (see Figure 6.3). While leaning towards an equal sharing of risk, it is hypothesized that a quarter of excessive contraction variation's range falls within 'mostly public' membership because ultimately, P3 contracts are written for *public* infrastructure projects where governments are principals and private parties are mere agents. Because governments are the project principals in a principal-agent relationship, they take on a supervisory role. Further, they are responsible for ensuring that their output specifications are both clear and coherent to their agents.

In certain instances, public authorities protect themselves from some excessive contract variation risks due to poorly written contracts. For example, Partnerships Victoria – a crown corporation under Victoria's Department of Treasury and Finance – has set a national precedent where public authorities are only liable for risks explicitly mentioned in P3 contracts; if risks are not identified and delegated by either sector due to suboptimal pre-contractual PRM, they are automatically borne by private partners. This is a risk private parties must accept upon entering any P3 contract with a Victorian public authority.[400] To cite protection methods against excessive contract variation risk, Canada's Association of Consulting Engineering Companies (ACEC) refers to one P3 model "called Project Alliance, [where] parties sign a contract that states they will not take legal action against each other." Should unspecified cost overruns or savings occur

[399] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 431.
[400] See VDTF, "Risk Allocation and Contractual Issues: A Guide," 20.

under 'Project Alliance,' parties also agree to share these drawbacks and/or benefits over specified ranges depending on which type of instances occur.[401]

In summation, excessive contract variation risks are treated differently on a project-to-project basis. This study recognizes their 'equal sharing' status while still acknowledging the principal role, and extra responsibilities, denoted with public authorities as project supervisors. This study's proposed allocation appears sound.

6.8.2 Project Approval and Permit

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.29$; $m_{\text{ES}}(\text{CI}) = 0.71$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Project approval and permit risks deal with unanticipated delays or refusals against acquiring official documents authorizing the use of land, labour, or other resources that require permits or some other means of official consent from an authority. In its most extreme form, mitigation against risks associated with project approvals may require public expropriation (e.g. for land rights). Most commonly, however, both public and private parties obtain project permits through relatively straightforward administrative processes, generally before financial close.[402]

Yescombe notes that public authorities often obtain "key planning permits before… bids take place" during the competitive selection process to hasten project progress while further permits pertaining to a project's DBOM are obtained between both sectors, varying from project to project (e.g. construction permits and environmental

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401 Watkinson, "Understanding Public Private Partnerships in Canada," 8.
402 Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 250-251.

clearances).[403] Yescombe's insights are mirrored in the WDBA's RFQ for the Gordie Howe Bridge:

> Project Co will be responsible for: obtaining all permits and approvals necessary for construction of the Facility, but excluding (i) those permits and approvals which have been obtained and (ii) those permits and approvals which are the responsibility of a WDBA Party… [which are] Canadian Government Approvals… to proceed [with the project]… and… zoning required to permit the Facility.[404]

Li et al. note that project approval and permit risks are "strongly dependent upon projects."[405] Chan et al., Ke et al., and Tolani all allocate project approval and permit risks to the public sector. This risk received relatively weak public mean scores from Chan et al. and Tolani: 2.45 out of 5 and 1.66 out of 3, respectively.[406] By adopting a fluid risk allocation model based on degrees of membership, this study recognizes project approval and permit risk's public association while simultaneously recognizing its generally shared nature. This type of insight is not offered in other questionnaire-based literature on P3 risk allocation. With a relatively weak 'mostly public' membership of 0.29 and a strong equal sharing membership of 0.71, this study's proposed allocation for project approval and permit risk remains consistent with previous studies and appears sound.

6.8.3 Ground Conditions

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.14$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.86$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

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[403] Ibid., 250.
[404] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge," 17-19.
[405] Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 31.
[406] Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China."; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria."

Ground conditions deal mainly with geotechnical engineering risks. Geotechnical engineering deals with the DB of infrastructure that is supported by, or constructed around, soil and/or rock.[407] In this study, ground condition risks pertain to unforeseen or poorly surveyed land that requires alternative geotechnical engineering post financial close. Thus, these risks create additional costs and delays. If given a public sector mean rank score, public authorities should compensate private partners for this mishap; if given a private sector mean rank score, SPVs should accept that extra costs and delays will be borne by select JVs under its consortium. Upon review of the core literature database, ground condition risk remains very contentious, receiving public, private, and shared allocation suggestions over the nine times it appears (see Figure 5.3).

Yescombe seconds this contention, noting that ground condition risks may be shared or allocated to either sector depending on project contexts:

> The risks that the geology of the site is not as expected… should preferably be passed from the Public Authority to the Project Company, and then to the Construction Subcontractor. Site surveys may be carried out in advance of Financial Close to reduce this risk… [and] one possibility is that the bidders collectively share the cost, another is that the Public Authority pays for them… this is a difficult area of risk transfer.[408]

Yescombe notes that public authorities should bear ground condition risks for brownfield projects, where "access for [site] surveys may be difficult because there are old buildings on the site." Greenfield projects, conversely, provide easier access for private parties to assess ground conditions before financial close (see Chapter 2, Section 2.2 for a summary of greenfield and brownfield projects). If ground condition risks are to be shared in the

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[407] Gordon A. Fenton and D. V. Griffiths, *Risk Assessment in Geotechnical Engineering*, *Risk Assessment in Geotechnical Engineering*, 2008, xv, doi:10.1002/9780470284704.
[408] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance,* 249.

final contract, private lenders and equity investors usually request a risk cap on the private sector to ensure that SPVs are only liable for a portion of potentially exuberant losses denoted with additional geotechnical engineering RMAs.[409]

While receiving a strong 'equally shared' membership function of 0.86, it is believed that ground conditions risks retain a slight public membership function of 0.14 because – in this study – such risks are specified as those which are unforeseen or undelegated post financial close. Thus, this reflects the general consensus amongst P3 practitioners that there is an expectation from public authorities to ensure contracts are tightly constrained to include foreseeable risks that may arise (i.e. because governments are project principals).[410] Just like the risk of excessive contract variation before it, this study's expert respondents appear to be charitable towards the private sector for mishaps involving undelegated responsibility, even when that responsibility may be shared with or delegated towards the private sector. This risk's recommended allocation appears sound, albeit malleable, pending unique project specificities.

6.8.4 Residual Value Risk

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.17$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.83$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

Another "handback risk," residual value risks deal with the transfer of ownership from private partners to public authorities at the end of a P3 project's lifecycle. These risks include provisions regarding the "terms, conditions, requirements and procedures governing *the condition* in which a private partner is to deliver an asset to the public

[409] Ibid., 249-250.
[410] This risk is a more specific example under the broad umbrella of 'excessive contract variation' risks.

sector… as set forth in… [a P3 project's] contract."[411] As noted in Chapter 2, public authorities provide incentive mechanisms – typically through awards and penalties – associated with the condition of public facilities to encourage the suitable maintenance of public infrastructure under temporary private control.[412]

Over the six times residual value risk appears in the core literature database, it is given one public sector allocation, one shared allocation, and four private sector allocations. Results from this study suggest a shared allocation for residual value, meaning both public and private authorities should bear potential losses associated with the transfer of a devalued facility from private partners. Hwang et al.'s study suggests a shared allocation "because the ability to operate the project transferred to the public sector at the end of the concession period is concerned with not only the operation responsibility of the private sector but also the work of the public sector."[413]

Even if a facility is not impaired, public authorities are still exposed to residual value risks when, upon transfer back to the government, a facility "does not have the value originally estimated by [the] government at which the private party agreed to transfer it to [the] government." This issue may arise if capital investments are used to upgrade a piece of infrastructure that has since depreciated or been removed, demolished, or not in use. Because private capital will likely be used for these investments, public authorities should compensate SPVs where these specific forms of residual value risks occur. Further, because governments commission regular inspections of P3 facilities

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[411] Emphasis added. See US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 21.
[412] As stated previously, this 'temporary' period can span decades.
[413] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 431.

during private operation, it is fair to assume that risks associated with discrepancies found between lifecycle inspections and final inspections upon transfer of ownership should not be borne solely or majorly by private partners. In this case, a public allocation is warranted.[414]

However, if private partners transfer an impaired facility to the public sector, they should be responsible for bearing costs associated with the facility's condition. Thus, depending on the context of a residual value risk, both the public and private sector may be the justified risk receiver. Accordingly, this study's 'shared' allocation preference is sound, while noting the risk may shift towards either sector depending which of the individual project circumstances mentioned above arise.

6.8.5 Changes in Industrial Code of Practices

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.02$; $m_{\text{ES}}(\text{CI}) = 0.96$; $m_{\text{Mpri}}(\text{CI}) = 0.02$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

As noted in Section 6.5.1, the risk of changes in industrial code of practices presents a unique scenario where it shares degrees of membership above zero towards three membership functions. Albeit, this risk's association with 'mostly public' and 'mostly private' membership functions is marginal; its membership degree for both is 0.02. It is hypothesized that this risk's unique association towards three membership functions is attributed to its relatively large range of 0.826. Section 6.5.1 also notes that range shares a positive relationship with variance; because a high variance means less conclusivity amongst respondents, the confidence with which a risk's range is predicted decreases.

[414] VDTF, "Risk Allocation and Contractual Issues: A Guide," 191.

Accordingly, risks with high respondent variances require higher ranges to confidently predict where they will fall under. Consider, at the most extreme level, respondents were asked to assign a number on the questionnaire's five-point scale to a 28th variable with no title or definition. Because this variable would be given arbitrary respondent input, it would likely yield an extremely high variance between respondents – so much so that its predicted range for a population could not be accurately predicted at all. In this hypothetical scenario, the variable's range may theoretically fall under *all* membership functions on the five-point adjusted scale (see Figure 6.13).

Because of its high range and association to three membership functions, it is unsurprising that the risk of changes in industrial code of practices was one of six project risks showing a statistically significant disagreement between public and private sector respondents over its allocation. With a public mean score of 3.5 and a private mean score of 2.5, its mean difference between sectors represents an entire point on the questionnaire's five-point semantic differentiation scale. A small sanction may be offered, however, in citing the intersection of this risk's public CI range and private CI range, which overlap at 0.128 units (see Figure 6.13).[415]

This risk is equally split between three private and three shared allocation preferences amongst its six appearances in the core literature database. While Li et al.'s study – based on majority opinion analysis – recommends private allocation for changes in industrial code of practices, they note that "risk[s] of industrial regulation change attracted [a significant] preference for shared allocation… This reflects the fact that…

[415] Because public sector respondents present an LCL of 2.936 and private sector respondents present a UCL of 3.064, the sectorial overlap of ranges is found from subtracting the private UCL from the public LCL to arrive at a difference of 0.128.

private contractors may endeavor to have the public client bear part of any extra costs due to regulation change."[416]

Industrial code change risks differ in scope from general law change risks in that they seldom involve regulation from political bodies tied to P3 projects (hence this study's more preferred public allocation of the latter and more equally shared allocation of the former). More specifically, risk associated with 'changes in law' deal with "strictly legal requirements… [or] policy requirements," which emanate from common law and statute law, both of which are within Parliament's – or a governmental department's – power to change or influence.

Conversely, changes in industrial code of practices refer to "regulatory requirements set by… independent" firms. While governments ultimately influence private practices through legislation, "their operation is otherwise self-sufficient" in this respect.[417] Thus, when commercial industries experience changes in their industrial codes, P3 crown corporations are seldom tied to these changes and, accordingly, "government generally does not accept the risk of change in… [these] regulatory requirements."[418]

The VDTF's primer, which was included in this study's core literature database, believes such risks should be borne solely by the private sector:

> A private party should not be shielded from changes in law which apply generally to the business environment or to which its particular industry sector would ordinarily be subject, merely because it has entered [into] a contract with [the] government. Accordingly, costs arising from any change in law which applies universally to the business environment… or

[416] Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 33.
[417] VDTF, "Risk Allocation and Contractual Issues: A Guide," 91.
[418] Ibid., 95-96.

> to the project's particular industry sector, should be borne by the private party.[419]

It is possible that this study's expert respondents prefer an equally shared allocation for this risk because they inflate the degree to which public authorities are responsible for changes in industrial practices and codes. While a shared allocation preference for this risk runs consistent with a large portion of P3 literature, its allocation scheme remains contentious even after this study.

However, to be charitable to this study's findings, a clear demarcation can now be made between the risk allocation of: (i) changes in law that emanate directly from common law and statute law, which should be borne mostly by the public sector, and (ii) changes in law that apply directly to regulatory practices of commercial industries, which should include private sector allocation to some degree.

6.8.6 Supporting Utilities Risk

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 1.0$; $m_{\text{Mpri}}(\text{CI}) = 0.0$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Like site availability risk before it, supporting utilities risk presents a special situation where it falls under only one membership function. However, the confidence for supporting utilities risk's strength of association with 'equally shared' is less than the confidence for site availability risk's strength of association with 'mostly public.' This is due to supporting utilities risk's higher range of 0.8 compared to site availability risk's range of 0.683. As mentioned above, a risk's degrees of membership for a function must be viewed alongside its range to account for variance between respondents. Higher ranges create a relatively lower strength of association towards a membership function.

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[419] Ibid., 96.

Section 6.5.1 uses the examples of site availability, changes in industrial code of practices, and supporting utilities risks to explain why degrees of membership alone do not provide a holistic conception of this study's results for this reason.[420]

Supporting utilities risk deals with the availability and/or price of a P3 project's required local utilities (e.g. electricity, gas, and water supply). This risk was among the six contentious risks that experienced a statistically significant difference in allocation preferences between public and private sector respondents. With a public mean score of 3.583 and a private mean score of 2.417, its mean difference between sectors is the second largest in the study at 1.167. Of the four times this risk appeared in the core literature database, its suggested allocation preference was split evenly between 'shared' and public allocation preferences.

For the Laibin B Power Project case study in Chapter 5, Ke et al. note that the public sector retained risks associated with supporting utilities to aid the project's SPV. The public sector was responsible for:

> …providing the Project Company with the transmission line and providing start-up electricity and steam and all fuel for testing… Government support would also be offered to ensure that no similar competitive project will be approved so that the market volume would not be undermined by the other projects.[421]

[420] Because this study's risk ranges are found at a 90 percent confidence level, and because supporting utilities risk's range fits perfectly in the 0.8 units of space allotted to m_{ES}, it can be inferred that any higher confidence level would have yielded a higher range, thus creating a situation akin to the risk of changes in industrial code of practices where the risk's range would have fallen into three membership functions. Site availability risk, however, would have retained its exclusive association with one membership function at a 95 percent confidence level.
[421] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 489.

This method is mirrored in the Gordie Howe Bridge project, where the WDBA's RFQ states that early works towards facilitating the availability and relocation of project utilities are "the responsibility of [the] WDBA and will be undertaken at the expense of [the] WDBA. [The] WDBA's expenses… will be recovered through tolls."[422]

There are instances in P3 literature where supporting utilities risks are given public sector allocation preferences,[423] private sector allocation preferences,[424] and shared allocation preferences.[425] Yescombe notes that supporting utilities risks – such as relocating gas, sewage, or water pipelines – may generally be transferred to JV private partners because they entail "relatively routine requirement[s] in construction, although [they] may be treated as… Relief Event[s]."[426]

'Relief events' are agreements created during pre-contractual PRM that specify events for which, if certain risks occur, SPVs are to be pardoned from otherwise breached responsibilities (e.g. if a water treatment plant's water supply becomes contaminated for reasons beyond an SPV's control, JV operators may be afforded extra time by the government to provide the public with suitable drinking water). While relief events provide no financial compensation, they allot private partners with extra time to complete project tasks affected by certain risks.[427] Thus, while Yescombe largely denotes supporting utilities risks with private sector allocation, he recognizes a form of 'shared'

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[422] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge," 18.
[423] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects," 489.
[424] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 252.
[425] US Department of Transportation and Federal Highway Administration, "Risk Assessment for Public-Private Partnerships: A Primer," 34.
[426] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 252.
[427] Ibid., 276.

allocation preference – to a degree – as well. Considering the combination of supporting utilities risks' (i) inconclusive allocation preferences within P3 literature, (ii) high degree of sectorial disagreement in this study, and (iii) the relative frequency with which its allocation is expressly designated under a 'project-to-project' basis, its 'shared' allocation preference from this study is subject to scrutiny. Further research is required.

6.8.7 Influential Economic Events

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.92$; $m_{\text{Mpri}}(\text{CI}) = 0.08$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

For this study, the broad risk of influential economic events is defined as 'macroeconomic anomalies on a national or global scale that greatly affect local market conditions.' It appears thrice under the core literature database with two private sector allocation preferences and one shared allocation preference. It passed both the independent two-sample *t*-test and Mann-Whitney U test at a confidence level of 95 percent. However, this risk presents a considerably higher mean score difference between sectors compared to the other 21 risks that showed statistically significant agreement between sectors over their allocation. Its public mean total is 3.416 and its private mean total is 2.667, creating a large – albeit not statistically significant – mean score difference of 0.75.[428]

Ibrahim et al.'s and Roumboutsos' and Anagnostopoulos' studies on P3 project risk allocation also suggest a 'shared' allocation preference for influential economic

[428] To provide context, the next highest mean score differences among the 21 risks that showed statistically significant agreement between sectors are 0.583, 0.333, 0.25, and 0.167, respectively.

events.[429] While neither article is included in the core literature database, their findings echo the opinions of this study's expert respondents. As mentioned in Chapter 4, uninsured large-scale risks that can be quantified – but not influenced by public or private actors – should be shared without a cap for the private sector (see Figure 4.5). Thus, this study's 'shared' allocation recommendation between public and private parties for influential economic events – such as 'booms' or recessions – is considered sound.[430]

6.8.8 Environmental Protection

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.94$; $m_{\text{Mpri}}(\text{CI}) = 0.06$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

Environmental protection risk concerns events where a P3 project impinges on environmental regulations and, subsequently, legal ramifications ensue. This risk boasts one of the highest levels of agreement between sectors over its allocation with a public mean score of 3.083 and a private mean score of 3. Ke et al. also denote environmental protection risk with a 'shared' allocation. However, they further note that, "if the invitation of bidding has stated the environment standards required for the project, additional measures undertaken to protect the environment by the private sector due to changes of the requirements should be rationally compensated."[431]

For the Gordie Howe Bridge, the WDBA worked alongside the state of Michigan to conduct a coordinated environmental assessment to determine the project's potential

[429] A.D. Ibrahim et al., "The Analysis and Allocation of Risks in Public Private Partnerships in Infrastructure Projects in Nigeria" 11, no. 3 (2006): 157; Roumboutsos and Anagnostopoulos, "Public–private Partnership Projects in Greece: Risk Ranking and Preferred Risk Allocation," 760.
[430] With reference to the mention of economic 'booms,' remember that not all risks exclusively pose the possibility of adverse outcomes. See Chapter 4, Section 4.5 for a short summary of risk 'opportunities' and risk 'threats.'
[431] Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects,"490.

environmental impact, potential RMAs to minimize this impact, and environmental commitments and regulatory approvals identified under the United States Environmental Protection Agency's Record of Decision (ROD) for the project.[432] Although the WDBA already obtained early project approvals concerning environmental regulations before issuing an RFP, it specifies in the project's RFQ that some "environmental commitments… and… regulatory approvals identified in the ROD… are to be obtained by Project Co."[433]

While the WDBA provides guideline resources for prospective private bidders (e.g. a link to the Gordie Howe Bridge's ROD), it states that prospective project bidders are ultimately "responsible for obtaining [their] own independent… environmental… advice, and making [their] own investigations with respect to the Project."[434] Thus, while environmental responsibilities for the Gordie Howe Bridge are generally 'shared,' its public authority puts a considerable onus on the private sector to ensure it comprehends environmental regulations pertaining to the project (for which it may receive potential awards for upholding or penalties for ignoring). Ultimately, this study's 'shared' allocation for environmental protection risks appears sound.

6.8.9 Construction/Design Changes

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.80$; $m_{\text{Mpri}}(\text{CI}) = 0.020$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

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[432] RODs are public documents that delineate project responsibilities pertaining to the environmental upkeep of a forthcoming construction site. See P. Tomlinson and S. F. Atkinson, "Environmental Audits: Proposed Terminology," *Environmental Monitoring and Assessment* 8, no. 8 (1987): 190-191, doi:10.1007/BF00404264.
[433] Windsor-Detroit Bridge Authority, "Request For Qualifications: Gordie Howe International Bridge," 17.
[434] Ibid. 43.

Project risks associated with construction and design changes are defined in this study as 'changes to project terms due to poor preliminary investigations resulting in improper design.' These risks may be linked to geological P3 project risks, such as environmental protection and ground conditions, or to general DB project phases that exclusively deal with the engineering and construction of infrastructure. For most projects, "[d]esign, construction and commissioning risk[s]… [are] implicitly allocated to the private party… provided that the ability of the government to interfere with the design, construction and commissioning processes is then extremely limited."[435]

Recall from Chapters 2 and 3 that P3s generally operate under 'output-based' contracts. Because private sectors may be given considerable leeway over the 'input' of the public infrastructure's design and build, it is universally understood that mishaps regarding the improper design or construction of infrastructure are 'private' risks. Consider, for example, Chapter 5's case study on the Right Honourable Herb Gray Parkway. The government issued fines on the project's SPV – the WEMG – for 500 faulty girders produced by one of its JVs, Freyssinet Canada Ltd. While the WEMG has mitigated economic consequences associated with this risk through second-step risk transfer, fines associated with this risk must be borne by the private sector.[436] This example presents a textbook DB risk that is justifiably allocated to the private sector.

[435] If governments impose post-contractual stipulations relating to a P3 project's DB phases, their original first-step risk transfer to the SPV is jeopardized. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 52.
[436] Personal correspondence with Dominic Amicone, President and CEO of Triamico Development Affiliates, revealed that the main question associated with this legal dispute is not *if*, but *which* private actors will pay for these losses and for how much. The government – along with other project JVs – will receive compensation regardless.

The risk in question, however, deals with 'poor preliminary investigations resulting in improper design.' While governments may provide private partners with considerable leeway over the DB of P3-procured infrastructure, they generally provide guidelines associated with preliminary investigations presented in project RFQs and RFPs. In cases where design and construction risks arise due to government-initiated mishaps, such as the inclusion or omission of a DB specifications that adversely affect a project, "it may be appropriate, using optimal risk allocation principles, for government[s] to bear the cost of such [DB] changes" that result from these mishaps.[437]

In summation, risk allocation preferences over a P3 project's DB changes are contingent on the sector responsible for requiring DB changes. If such risks arise due to poor post-contractual PRM (i.e. the 'output' of otherwise acceptable DB guidelines), then private parties should bear the risks. If such risks arise due to poor pre-contractual PRM (i.e. the 'input' of DB guidelines), then public parties should compensate private partners by bearing an agreed portion of the risks. This study's 'shared' allocation is relatively sound in that both sectors may bear risks associated with design and construction changes, but specific project conditions ultimately dictate which sector bears them.

6.9 Risks Leaning Towards Private Sector Allocation

This study indicates that ten risks should generally be allocated to the private sector either fully or to a significant degree. The following 'private' risks – in order of their strength of association to the private sector[438] – include: (i) availability of labour/materials, (ii) asset ownership, (iii) foreign currency risk, (iv) income risk, (v)

[437] VDTF, "Risk Allocation and Contractual Issues: A Guide," 52.
[438] According to their total mean scores.

interest rates, (vi) inflation risks, (vii) market demand change, (viii) tariff change, (ix) weather conditions, and (x) third party tort liability.

6.9.1 Availability of Labour/Materials

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.28$; $m_{\text{Spri}}(\text{CI}) = 0.72$.

While this risk is considered ‘contentious’ based on the core literature review, it almost registers as a ‘sound’ P3 risk. Availability of labour/materials is one allocation recommendation shy of unanimously holding a ‘private’ allocation – it appears seven times in the core database with six private allocation recommendations and one public allocation recommendation. It is no surprise that this risk garners the highest – and thus most private – mean score on the questionnaire’s five-point scale for both public and private sector respondents with a 4.083 and 4.583 rating, respectively.[439]

It is generally accepted in P3 literature that SPVs should be tasked with delegating responsibility over the provision of project resources – i.e. materials and staff – amongst its selected JVs through second-step risk transfer. Should project subcontractors and suppliers fail to produce the resources they are tasked with, they are generally liable to bear the financial penalties associated with such mishaps. If, for some reason, a subcontractor or supplier defaults this risk back to its sender (i.e. from a JV to an SPV through second-step risk transfer default), its associated penalties will still be levied against a private party. Thus, the private sector generally retains such risks during a P3 project’s potential DBFOM stages.

[439] Between private sector respondents, this risk conclusively received the highest mean score. Between public sector respondents, this risk received the joint highest mean score alongside asset ownership, which also received a 4.083 public mean score.

Ke et al. note that “most construction and operation risks are assigned to the private partner… [including] ‘Delay in Supply.’”[440] Li et al. note that “construction risk is assigned completely to contractors for all procurement methods.”[441] Hwang et al. note that “the private sector should be more familiar with design and construction risks, including… ‘material availability’…Hence, it is not surprising that [it was] preferably assigned to the private sector.”[442] The private allocation of material and labour availability for P3s is confirmed in several other studies.[443] This study’s private allocation of risks associated with the availability of labour/materials appears sound.

6.9.2 Asset Ownership

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.48$; $m_{\text{Spri}}(\text{CI}) = 0.52$.

Risks associated with the – temporary – ownership of public infrastructure through P3 concessions entail the costs of owning, operating, and maintaining infrastructure over a project’s lifecycle. Potentially, maintenance and upgrade requirements may entail additional design and build stages as well over the course of a DBFOM P3 contract. Asset ownership encompasses a broad spectrum of post-contractual PRM-related risks that may arise either during a P3 service contract (e.g. changes in industrial code of practice, construction/design changes, force majeure, and market

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[440] Ke et al., “Preferred Risk Allocation in China’s Public-Private Partnership (PPP) Projects,” 490-491.
[441] Li et al., “The Allocation of Risk in PPP/PFI Construction Projects in the UK,” 34.
[442] Hwang, Zhao, and Gay, “Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors,” 431.
[443] Chan et al., “Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China.”; Ibrahim et al., “The Analysis and Allocation of Risks in Public Private Partnerships in Infrastructure Projects in Nigeria”; Lam et al., “Modelling Risk Allocation Decision in Construction Contracts”; Roumboutsos and Anagnostopoulos, “Public–private Partnership Projects in Greece: Risk Ranking and Preferred Risk Allocation”; Tolani, “An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria.”

demand change) or upon termination of a contract (e.g. expropriation, exclusive rights revocation, and residual value risks). Asset ownership risks mainly arise for three broad reasons: (i) maintenance or upgrade costs of a facility are higher than anticipated, (ii) a facility's value falls below the initial projected value to which it was ascribed, or (iii) a project's lifecycle is shorter than anticipated.[444]

As noted in Chapter 2, conventional infrastructure procurement methods traditionally allocate asset ownership risks to the public sector. However, a key component of P3 projects concerns the transfer of 'whole life' costs to the private sector – especially for projects with longer lifecycles and heavy private partner involvement (i.e. DBFOM projects). Thus, it is no surprise that asset ownership risk received this study's second highest total mean score of 4.208 and its second highest 'solely private' membership degree of 0.52.

It should be noted that, for some of the risks associated with asset ownership mentioned above, mean score ratings differ greatly from asset ownership's mean rating. For example, expropriation, exclusive right, and force majeure risks received total mean scores of 1.708, 2.083, and 2.417, respectively. None of these risks fall under private sector membership functions. This stark contrast between allocation preferences for risks linked to asset ownership is a testament to the wide range of risks denoted with the operation and maintenance of P3s over project lifecycles – mirrored by a similarly wide range of RMAs suited for responding to these risks.

[444] VDTF, "Risk Allocation and Contractual Issues: A Guide," 112.

This study's proposed allocation scheme for asset ownership risk should only be applied to the general, day-to-day risks denoted with the operation and maintenance of P3 facilities (in lieu of more grandiose risks – like force majeure – which retain their own risk categories). Asset ownership risk is typically denoted with a P3 project's general operation and maintenance, technological obsolescence, and structural degradation. As is generally the case, these common risks are borne solely by the private sector.

6.9.3 Foreign Currency Risk

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.67$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.33$.

Foreign currency risk, dealing with the exchange and convertibility of foreign monies, is a macroeconomic risk that concerns private equity investors, lenders, and SPVs.[445] Privately funded P3 projects are frequently financed with the aid of foreign lenders and investors. P3 project revenue, however, is almost always denominated in a project's local currency (e.g. through local tolls or local government availability payments). When 'revenue' currencies and 'debt' currencies differ, SPVs are faced with currency exchange risks, as the cost of a project's debt may increase – or decrease – depending on international market fluctuations.[446] With reference to Chapter 4, when currency exchange risks decrease project debt, SPVs are faced with risk 'opportunities'; when currency risks increase project debt, SPVs are faced with risk 'threats.'

[445] I.e. for privately funded P3 projects. For P3s procured through public funding (e.g. DBOM projects), the risk of currency exchange is less applicable to a project's finance debt.
[446] The World Bank, "Risk Allocation, Bankability and Mitigation in Project Financed Transactions," *Public-Private-Partnership in Infrastructure Resource Center*, 2016, par. 17-18, https://ppp.worldbank.org/public-private-partnership/financing/risk-allocation-mitigation#currency.

According to "purchasing power parity" – a theory regarding the equilibrium of purchasing powers between different currencies – devalued currencies should face enough inflation pressures over time to bring them back to parity levels with foreign currencies. However, more often than not, foreign project lenders are unwilling to wait for currency equilibriums to be reached before receiving payments owed.[447] Thus, SPVs must pay amortization and interest even when currency exchange rates have adversely affected their net capital (see Figure 2.2).

The VDTF states that foreign currency exchange risks are beyond the control of both public and private partners. Thus, it should "be dealt with in an express provision in the [final] contract."[448] The International Institute for Sustainable Development (IISD) concedes that central banks and government agencies may have limited control of exchange rate risks, but – ultimately – "currency risk is largely unmanageable for the private sector and may be beyond the control of the government agency in charge of infrastructure development, which means that it may not be easily acceptable for either party."[449]

The literature on foreign currency risk is too inconclusive to assign it a consistent allocation framework that does not recognize its variability and contingency on individual P3 project circumstances. However, this study's respondent pool of experts showed high levels of unanimity both *within* and *between* respondents groups over the

[447] Ibid., par. 17.
[448] VDTF, "Risk Allocation and Contractual Issues: A Guide," 21.
[449] Wim Verdouw et al., "Currency Risk in Project Finance" (Winnipeg, Manitoba, 2015), 2.

private allocation of foreign currency risks.[450] A framework can be adopted where foreign currency risk is implicitly allocated to private partners to a large degree with room for contractually explicit addendums to this principle should private partners require fiscal support from the government. Thus, its private allocation recommendation may stand, though the degree to which the private sector should bear this risk will likely need to be assessed on a project-to-project basis.

For example, if the preferred proponent chosen for a Canadian P3 project has ties to foreign financiers – or if foreign shareholders own the SPV itself – it may be assumed that foreign currency risk can be more readily adopted by the private sector due to established rapports with foreign financiers. Carpintero notes that "Spanish developers… have been particularly successful in winning P[3] contracts during the last decade." Further, "the consortiums of financial institutions responsible for arranging the financing for the concessions awarded to Spanish companies abroad have included at least one Spanish bank, if not several."[451]

6.9.4 Income Risk

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.93$; $m_{\text{Spri}}(\text{CI}) = 0.07$

This study defines income risk as the degree to which private sector revenue streams align with revenue projections. Referring back to Chapter 2, SPVs may be compensated by the public sector either directly (i.e. through availability payments or

[450] Based on analyses using *t*-tests, Kendall's W, Chi-squared, and Mann-Whitney U. This risk's public mean score is 4, its private mean score is 4.167, and its combined mean score is 4.083.
[451] These Spanish firms – which include Acciona, ACS, Dragados, and Ferrovial – have been majority stakeholders of their SPV consortiums when leading Canadian P3s projects. See Carpintero, "Public-Private Partnership Projects in Canada : A Case Study Approach," 1, 4.

milestone payments) or indirectly (i.e. through full tolls or shadow tolls).[452] As stated previously, a key factor distinguishing P3 contracts from many conventional DB contracts is that payments are generally contingent on the performance of private partners (e.g. meeting specific project deadlines). It is understood that this incentivizes private partners to complete project tasks in both an adequate and timely manner.

Of the six times income risks appeared in the core literature database, it received five private allocation recommendations and one ‘shared’ allocation recommendation. This is unsurprising, as private partners have a large degree of influence over their ability to meet public sector output specifications denoted with availability payments and milestone payments. With a high level of agreement between sectors over its allocation (i.e. a 0.083 mean difference) and a combined mean score of 3.958, this study’s pool of expert respondents appear to second this opinion.

However, when SPVs accept indirect payments methods such as highway or bridge tolls, they bear a higher income risk if projections over the use of public facilities are not met. This is because private partners have little influence over the degree to which public infrastructure is utilized by citizens. Thus, income risks are most significant to private partners when they accept toll-based payment methods. If volume projections for a facility fall short, SPVs either lose profits, or garner profits at a slower rate than anticipated, depending on a P3 project’s contractual specifities.[453]

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[452] See Chapter 2, Section 2.1 for a summary of SPV payment methods.

[453] For example, if a P3 contract contains explicit agreements that SPVs must receive a minimum amount of toll revenue from the project, then income risk for the private sector concerns *when* payments are received opposed to *how much* is received.

While it is true that private partners have considerably less influence on income risks associated with toll-based payments, this study's findings suggest that they should still bear income risk to a major degree. Li et al. report similar findings, noting:

> … financial attraction and level of demand for a project are important investigations to be carried out in most P[3]… projects during the detailed feasibility study phase by the private consortium. Thus, most respondents do not see either of these… risks as being the responsibility of the public sector.[454]

This is an important consideration. Recall key concepts from Chapter 4 regarding pre-contractual PRM and risk premiums. A key point of risk transfer in P3 procurement projects is that, to a degree, risk cannot be completely avoided or mitigated in all instances.

Accordingly, P3 players will inevitably accept risks that cannot be fully mitigated by neither the risk sender nor the risk receiver. In such instances, risk premiums play an important incentivizing role for risk takers to accept potential project threats they do not have complete influence over. In summation, even when private partners accept toll-based payments, income risks should be borne mostly by the private sector. This study's proposed allocation model for income risk – with a 0.93 'mostly private' membership degree – appears sound.

6.9.5 Interest Rate

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.0$; $m_{\text{Mpri}}(\text{CI}) = 0.83$; $m_{\text{Spri}}(\text{CI}) = 0.17$.

Interest rate risks concern fluctuations in interest on monies owed to project financiers. Recall from Chapter 2 that private financing has recently become a

[454] Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK," 33.

prerequisite condition for public-private contracts to adopt a 'P3' label in Canada. Accordingly, Canadian SPVs are responsible for paying back project debts either fully or partially. Interest rate risks typically pose the largest threat when project lenders charge interest at a "floating" rate opposed to a "fixed" rate. Floating interest rates fluctuate over a project's lifecycle due to periodic changes in benchmark interest rates and indexes (e.g. fluctuating bank lending rates). Fixed interest rates remain stagnant over a specified period of time, thus the amount of money owed for P3 project financing is more foreseeable and stable when fixed interest rates are used.[455]

Interest rate risks can intersect with foreign currency risks when foreign lenders finance projects, presenting "a question of balancing… [interest] rate debt with foreign exchange rate risk or local currency debt subject to interest rate risk."[456] Like foreign currency risk before it, interest rate risk likely receives a high 'mostly private' membership degree because debt providers – local or foreign – generally deal directly with private partners for privately financed P3 projects. It is hypothesized that this study's expert respondents believe that, because SPVs commit to pre-contractual agreements with their financiers, they should be responsible for interest rate fluctuations that adversely affect private partner revenue streams over the course of P3 projects.

Following this study's independent two sample *t*-test, sectorial agreement over the allocation of interest rate risks received a remarkably perfect significance level of one and, naturally, a mean score difference of zero. Both public and private sectors respondents accumulated a mean score of 3.917 for interest rate risks, denoting its

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[455] The World Bank, "Risk Allocation, Bankability and Mitigation in Project Financed Transactions," par. 19-20.
[456] Ibid., par. 20.

‘mostly private’ allocation. Unfortunately, this level of agreement is not found between scholars in P3 literature. Despite unanimously receiving a mean score of 3.917 from both respondent groups in this study, interest rate risk is frequently given public, private, and ‘equally shared’ allocation preferences throughout P3 literature.

Internationally, public and private parties are likely to share interest rate risks for P3 projects to some degree. For example, governments may permit “flexibility in pricing” for private partners or – in instances where P3 projects have a significantly large debt component – governments may allow private partners “to commit to a specified pricing regime before signing the project agreements” (e.g. risk caps for interest rates).[457]

However, in instances where interest rates are fixed, major government intervention should not be needed, as project lenders and SPVs consult with one another over the viability of planned payments methods (e.g. amortization specification) during pre-contractual PRM before financial close (e.g. feasibility studies and due diligence investigations).[458] It is assumed that pre-contractual agreements between SPVs and project lenders will yield accurate projections over interest risks where rates are fixed. Thus, the risk of growing interest rates undermining projected profit margins for SPVs is mitigated through the use of fixed interest rates.

Consequently, interest rate risk’s high ‘mostly private’ membership degree in this study remains sound when fixed interest rates are selected for P3 projects. According to

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[457] VDTF, “Risk Allocation and Contractual Issues: A Guide,” 64-65.

[458] Refer to Chapter 2, Section 2.3 for the relationship dynamic between SPVs and project lenders.

The World Bank, "project finance debt tends to be fixed rate."[459] Further, Yescombe adds that "project-finance bonds for P[3] projects always carry a fixed-rate coupon… [while] commercial banks do not generally lend for such a long term at a fixed rate, because they cannot fund the loan with matching deposits."[460]

In Canada, public financing of P3s entails bonds in lieu of bank loans. Hellowell notes, "Canadian banks [are] more conservatively managed than many of their European counterparts, and also [take] a more cautious approach to infrastructure lending… In [response], Canada has… developed [a] P3 bond market… structured [around] pension funds." Because Canada's pension funds "have spearheaded direct investments in infrastructure since the early 2000s," fixed interest rates are primarily used when governments take part in P3 financing.[461]

In summation: (i) the private sector is better able to bear interest rate risks when fixed interest rates are used because of their predictability; (ii) there is a relationship between bonds and fixed interest rates; (iii) P3s in Canada that incorporate public financing will utilize bonds; thus, (iv) P3s in Canada that incorporate public financing use fixed interest rates and, accordingly, they should allocate interest rate risks mainly to the private sector.

It can be reasonably asserted that this study's pool of expert respondents chose to unanimously allocate interest rate risks to the 'mostly private' category because they are Canadian practitioners who have worked under the influence of a bond-centric P3

[459] The World Bank, "Risk Allocation, Bankability and Mitigation in Project Financed Transactions," par. 20.
[460] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 171.
[461] Hellowell, "Public-Private Partnerships: What the World Can Learn from Canada," 17.

market. In conclusion, this study's findings appear sound for domestic P3s in Canada. When foreign lenders finance large portions of a Canadian P3 project, the government may need to bear a larger portion of interest rate risk to account for foreign currency risks and floating interest rates. However, in the context of nationally financed P3s in Canada, this study's 'mostly private' allocation for interest rate risks appears sound.

6.9.6 Inflation Risk

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.13$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.87$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

Inflation risks, like interest rate risks, are macroeconomic in nature and largely outside of both public and private sector influence. Because long-term P3 contracts typically span between 25 to 30 years, the incremental accumulation of inflation can have a significant effect on projects decades after final contracts are signed.[462] The main risk inflation poses to private actors is the devaluation of agreed-upon payments received during a project's lifecycle. Typically, this adversely affects SPVs and, potentially, project financiers through "diminution in real returns of the private party."[463]

Inflation risk also applies to the public sector in that public authorities want to avoid overcompensating for inflation rates based on contractually agreed upon indexation levels. When public authorities transfer macroeconomic market risks to SPVs, they employ "indexation adjustments" to corresponding risk premiums. Indexation is a payment adjustment method used by governments to compensate for inflation. With

[462] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 187.
[463] VDTF, "Risk Allocation and Contractual Issues: A Guide," 186.

reference to a price index – or some other market benchmark – public authorities adjust payments to SPVs to reflect the "current state of the market" via indexation.[464]

Scholars generally agree that, when the private sector bears inflation risk, public authorities should index private sector service fees – to a degree – to avoid heavy charges associated with risk premiums and contingencies.[465] However, public authorities should be weary of "over-indexation" to avoid the overuse of its resources.[466] For example, if public authorities spend more on indexation measures than they would have spent paying extra fees for transferring non-indexed risks (e.g. through higher risk premiums, contingencies, and other service related costs), then public indexation can become a redundant, or even suboptimal, public RMA for inflation.

Thus, this study's results for inflation risk appear sound. Under the assumption that public authorities should adopt some indexation measures, 0.13 'equally shared' and 0.87 'mostly private' membership degrees for inflation risk allows for a degree of risk sharing between sectors while avoiding the problem of over-indexation for the government.[467] Where risk premiums and service charges do not account for inflation, private actors should anticipate inflation risk's potentially adverse effects on the 'real returns' they receive throughout a project's lifecycle through appropriate contingency strategies during pre-contractual PRM and necessary renegotiation strategies during post-contractual PRM.

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[464] Ibid., 78.
[465] VDTF, "Risk Allocation and Contractual Issues: A Guide," 77; Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 187.
[466] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 199.
[467] With a combined mean score of 3.708 and a mean sectorial difference of 0.25, inflation risk received a relatively moderate 'mostly private' allocation preference supported by a relatively strong level of agreement over allocation between public and private sector respondents.

6.9.7 Market Demand Change

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.22$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.78$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

As a risk, market demand change concerns the accuracy with which actors forecast the future demands and costs of operational services over a P3 project's lifecycle. If the demand for a service transcends forecasted levels, parties that bear market demand change risks may experience a risk 'opportunity' in larger revenue streams. If the cost for a service transcends forecasted levels, parties that bear market demand change risks may experience a risk 'threat' in capital losses. Conversely, if service demands – or costs – fall short of forecasted levels, risk bearers may experience risk 'threats' in smaller revenue streams – or risk 'opportunities' in capital gains – respectively.

Market demand change is closely linked to income risk. Other market risks associated with market demand change include: influential economic events, availability of labour and materials, supporting utilities risk, asset ownership, inflation risk, and interest risks. What demarcates market demand change from other market risks is its distinguished connection with exogenous market factors that arise from shifting market dynamics. Whether the demand or cost for a service is affected by shifts in market competition, composition, or focus, both public and private partners have relatively little influence over their occurrence.

A shift in market competition denotes the progression – or regression – of competing services affecting a facility's revenue positively or negatively (e.g. the construction, or demolition, of an alternative bridge, or toll fee changes from a competing facility). A shift in market composition denotes changing demographic trends affecting a facility's revenue (e.g. an aging populace's increasing frequency of using hospitals). Finally, a shift in market focus denotes technological or industrial changes affecting a facility's revenue (e.g. technological innovation resulting in the replacement of obsolete, yet expensive, border security equipment or the shifting industrial landscape of a country's energy sector embracing gas-fired facilities in lieu of coal-based facilities).[468]

Yescombe notes that the P3 concession model (e.g. DBFOM) with toll-based payment agreements are "the prime example of a P[3] where usage risk is transferred to the private sector."[469] Of course, Section 6.9.4 already established that a 'mostly private' allocation preference for income risk is sound. However, for P3 projects with availability-based payment agreements, usage risk is retained by the public sector. Pending contractual specifities, P3 contracts that use availability payments generally do not require private partners to influence or bear any demand-related risks during a project's lifecycle.[470]

Thus, the allocation of market demand change risk is contingent on project circumstances. It appears that market demand change's 'mostly private' allocation preference is justified to the extent that it is applied to projects where income risks and operating risks are largely borne by the private sector (which is often the case for Canadian P3s).

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[468] VDTF, "Risk Allocation and Contractual Issues: A Guide," 74.
[469] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 13.
[470] Public Works and Government Services Canada, "Policy and Guidelines Supply Manual."

For the majority of Canadian P3 projects, "in cases where… revenues of projects have been forecast poorly, the private operator… and… its equity holders… have 'skin in the game.'" This is a key factor distinguishing P3s from conventional public procurement methods.[471] This study's relevant membership functions for market demand change – i.e. 0.78 degrees towards 'mostly private' and 0.22 degrees towards 'equally shared' – recognize its general private allocation while acknowledging that the degree to which these risks are 'shared' is contingent on individual project circumstances. This result echoes findings from the core literature database, where market demand change risk is given six private allocation recommendations and two 'shared' allocation recommendations.

6.9.8 Tariff Change

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.36$; $m_{\text{Mpri}}(\text{CI}) = 0.64$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

The risk of tariff change is closely linked to other market risks, such as income risk, because it deals with the accuracy of revenue or cost projections associated with market factors that are not 'fixed.' More specifically, tariff risk concerns the suitability and flexibility of tariff design frameworks and their affect on future revenue streams. Tariff change appears eight times in the core literature database, with seven 'private' allocation recommendations and one 'shared' allocation recommendation. Interestingly, this considerably strong association between tariff change and private risk transfer is not mirrored in this study's questionnaire results. With a membership degree of 0.64 towards 'mostly private' and a 0.36 membership degree towards 'equally shared,' its proposed degree of private allocation appears to be relatively weak.

[471] Hellowell, "Public-Private Partnerships: What the World Can Learn from Canada," 9.

This study's expert respondent pool may have opted for a more moderate form of private allocation for tariff risk because tariff changes are conventionally steered by governments and, accordingly, beyond the control of the private sector. While public authorities retain the right to regulate tariff payments, P3 contracts can contain long-term power purchase agreements between governments and SPVs where terms and conditions applying to tariff payments on utilities are contractually outlined.[472] Typically, these contractual stipulations are covered under service charge fees "under certain caps and predetermined rules for indexation."[473]

In instances where tariff costs are regulated by the public authority, the risk of tariff change – i.e. price variations impacting projected revenue – should be borne by the government through some sort of indexation method. This method is typically applied to already subsidized utilities under captive public markets where revenue levels are not maximized (e.g. hydro rates). In instances where tariff costs are regulated under long-term power purchase agreements, the risk of tariff change should be borne by SPVs alongside an agreed upon cap for the private sector. This method is typically applied to projects where tariff rate variability is low and thus tariff rate projections are highly certain.[474]

In light of the aforementioned considerations, this study's weaker proposed private allocation for tariff change remains sound, albeit with recognition of the fact that the allocation of tariff risk is contingent on the tariff in question. Depending on individual

[472] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 11, 267.
[473] APMG International, "PPP Certification Program Guide," Section 1.2.2, par. 3.
[474] Ibid., Section 1.2.2.

project circumstances, certain tariffs may be privately allocated to a degree (e.g. with risk caps) while others may be publicly allocated (e.g. alongside indexation).

6.9.9 Weather Conditions

$m_{\text{Spub}}(\text{CI}) = 0.0$; $m_{\text{Mpub}}(\text{CI}) = 0.0$; $m_{\text{ES}}(\text{CI}) = 0.42$; $m_{\text{Mpri}}(\text{CI}) = 0.58$; $m_{\text{Spri}}(\text{CI}) = 0.0$.

For P3s, the risk of weather conditions affect day-to-day construction and operation practices. Theoretically, weather conditions conducive to seamless construction and operation practices present an 'opportunity' for risk bearers to work uninterrupted (e.g. sunny days); abnormal weather conditions conducive to project delay or impairment present a 'threat' for risk bearers (e.g. storms).

During pre-contractual PRM, public authorities and SPVs will identify these risks and adopt optimal RMAs in response to potential weather-induced schedule delays and/or facility damages. Recall from Chapter 4 that the four broad P3 RMA methods include: avoiding, reducing, transferring, or accepting risks (see Figure 4.4). Weather conditions are exogenous risk factors that private actors cannot influence. In Canada, however, they are largely foreseeable, predictable, insurable, acceptable, and – to an extent – avoidable.

For instance, North American P3 partners will typically plan the construction of crucial infrastructure during summer months to avoid schedule delays from unfavourable weather conditions.[475] Also, site drainage systems like storm water management ponds are used frequently in Canada to prevent – or at least suppress – site flooding and erosion from surface runoff during heavy rainfall. While Canada's weather varies significantly,

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[475] US Department of Transportation and Federal Highway Administration, "Guidebook for Risk Assessment in Public Private Partnerships," 2013, 24, https://www.fhwa.dot.gov/ipd/pdfs/p3/p3_guidebook_risk_assessment_030314.pdf.

this variation is predictable due to seasonal climate patterns. Further, adverse weather conditions in Canada are relatively mild in severity compared to other "extra-tropical areas" like East Asia or the United States' eastern coastline.[476] Hence, the risk of adverse weather conditions – or, in their most extreme form, 'acts of God' force majeure events – are seldom an issue.

This study's proposed private allocation for weather conditions – albeit weak – echoes the findings of Chan et al., Hwang et al., Li et al., and Tolani. Both Hwang et al. and Li et al. note that "natural risks" affecting the construction stage should be borne by SPVs.[477] While public authorities may offer relief events tied to stipulated weather conditions (e.g. force majeure), it is generally understood that private partners are responsible for the "adequate provision [of]… reasonably foreseeable events such as bad weather during the winter, and hence… [they] should not be excused for such delays."[478] Thus, a 0.58 'mostly private' membership function alongside a smaller, yet significant, 0.42 'equally shared' membership function appears sound.

6.9.10 Third Party Tort Liability

$m_{\mathrm{Spub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{Mpub}}(\mathrm{CI}) = 0.0$; $m_{\mathrm{ES}}(\mathrm{CI}) = 0.38$; $m_{\mathrm{Mpri}}(\mathrm{CI}) = 0.62$; $m_{\mathrm{Spri}}(\mathrm{CI}) = 0.0$.

As discussed in Chapter 4, an SPV accepts risks from the public sector through first-step risk transfer, which is directly followed by second-step risk transfer to multiple

[476] Extra-tropical areas are regions situated outside of the two geographical zones from which severe tropical storms originate: the Tropic of Cancer and the Tropic of Capricorn. See Roger G. Barry and Richard J. Chorley, *Atmosphere, Weather and Climate*, 8th ed. (New York: Routledge, 2003), 262.
[477] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors," 431; Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK, 33."
[478] Yescombe, *Public-Private Partnerships: Principles of Policy and Finance*, 260.

JVs throughout its consortium. Once a JV bears a risk, it may transfer a sect of its own risks to a third party subcontractor. This is referred to as 'third-step risk transfer' in Chapter 4, Section 4.5.1.[479] When a third party breaches its project obligations (i.e. defaults risk back to the original risk sender), it poses financial consequences for its original risk sender, which is usually a private partner under the SPV consortium. Private parties will agree to accept this risk's financial consequences "provided [they] can earn a commensurate return for accepting them."[480]

With a public sector mean score of 3.833 and a private sector mean score of 3.083, third party tort liability risk presents a statistically significant mean score difference of 0.75. It is no surprise that private practitioners believe the private sector should be able to share a large portion of third party risks with the public sector; private partners have little direct influence over the ability of third parties to enact post-contractual PRM as expected. However, it is expected that private partners perform due diligence on third parties they transfer risks to. Further, if private partners do transfer risks to third parties, it is expected that they accept the trade-off between the potential returns and losses with doing so.

Thus, it is important that third party subcontractors only accept risks they are capable of bearing, just like JV private partners should only accept risks they are capable of bearing – this rule applies to all steps of risk transfer. Of course, when third party liability risks arise, contractual agreements do not preclude post-contractual renegotiation

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[479] Third parties also accept risks by way of insurance. This is a common practice for insuring risks in P3s. However, this study focuses on third party risks dealing with subcontractors, not third party insurers or financiers. See VDTF, "Risk Allocation and Contractual Issues: A Guide," 12.

[480] Ibid.

and mediation to account for project mishaps. For instance, the degree to which parties are liable for risk defaults can still be legally disputed (see Chapter 4, Section 4.4.1). Accordingly, third party tort liability risks may be shared when private partners prove: (i) they are not at fault for these risks occurring and (ii) due diligence measures on the third party in question were thorough and accurate despite of the third party's contractual breach of obligations. With this in mind, this study's private allocation of third party risks (i.e. m_{Mpri}[CI] = 0.62) – with an acknowledgement of their potential 'shared' dynamic (i.e. m_{ES}[CI] = 0. 38) – appears sound.

6.10 Conclusion

Overall, there is significant agreement between sectors over allocation preferences of the 27 'contentious' P3 project risks identified in this study. It is important to point out the six risks in Figure 6.14 that hold statistically significant sectorial disagreement between mean ratings based on this study's independent two-sample *t*-test and Mann-Whitney U test. These risks include: (i) expropriation and nationalization, (ii) changes in industrial code of practice, (iii) site availability, (iv) supporting utilities risk, (v) third party tort liability, and (vi) exclusive right/competition. Unsurprisingly, these risks make up the highest six mean differences between sectors in this study.[481]

Together, these six risks average a mean sectorial difference of 1.042 on a five-point scale. To put the level of disagreement between these six risks in perspective, the other 21 risks average a mean sectorial difference of 0.254 altogether. Because of their

[481] One risk, 'influential economic events,' has the same mean difference as 'third party tort liability,' each with a mean difference of 0.75 between sectors. The former, however, passed both the independent two-sample *t*-test and Mann-Whitney U test at a confidence level of 95 percent; the latter did not.

large respective mean score differences, the proposed allocation for the six risks with statistically significant sectorial disagreement should be viewed with degrees of skepticism and their allocation and mitigation strategies should be studied further in future studies.[482] As noted in Chapter 4, mutual agreement between sectors over the preferred allocation of risk is seldom conclusive, hence the need for long negotiation periods during the P3 tender phase, which can span years before a final contract is signed. As noted in Chapter 5, the allocations of these 27 risks are not conclusive in the core literature database.[483] Thus, it is unsurprising that divisive stances are held between sectors over the allocation of at least a portion of the risks studied.

However – despite these risks being deemed 'contentious' based on the core literature review – according to Kendall's W and Chi-squared tests, this study's results show a high degree of overall sectorial agreement over their allocation preferences. This is an encouraging revelation; if 'contentious' risks have garnered a high amount of sectorial agreement between public and private practitioners, it can be assumed that 'sound' risks would have garnered a high amount of sectorial allocation agreement as well. Thus, scholars and practitioners alike can be optimistic that the main problem of the principal-agent relationship between P3 partners – namely, aligning the motivations of public authorities and private partners – is both manageable and achievable.

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[482] In this case, because 6 of the 27 contentious risks experienced significantly different public-private perceptions over allocation at a 95 percent confidence level, the allocation of 22.22 percent of risks under Figure 6.14's proposed risk allocation model must be viewed with degrees of skepticism.

[483] I.e. based on the core literature database, which is used as a large representative sample of P3 risk allocation literature.

CHAPTER 7

STUDY LIMITATIONS AND SUGGESTIONS FOR FUTURE RESEARCH

7.1 Introduction

Chapter 6 highlights the many advantages – or rather, lack of disadvantages – associated with this study's methodology compared to previous studies with similar scopes and focuses. Nonetheless, there are notable drawbacks to this study's methodology that must be acknowledged. As is the case with all social science, this study's literature reviews, theoretical framework, and research methodologies are all subject to degrees of subjective selection. This includes a subjective selection of covered P3 processes, a subjective selection of adopted stakeholder perspectives, a subjective selection of data to study, and a subjective selection of tools used to analyze data.

Even the most exhaustive research projects will be faced with such selectivity issues. While it is important to acknowledge such research limitations, it is more important to assess their potential impact on findings so that future scholarly works continue to be built on solid empirical foundations. The following paragraphs attempt to acknowledge this study's methodological and theoretical limitations to ensure that relevant 'gaps' can be filled in future studies both descriptive and prescriptive in nature.

7.2 The Issue of Transparency

Scholar Dennis De Clerck notes that the P3 industry is "difficult to study from an empirical angle due to the scarcity of data."[484] More specifically, the lack of contractual transparency offered from public authorities and SPVs is a "regularly reoccurring" issue

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[484] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 224.

for scholars to overcome.[485] This limitation extends to all forms of P3 research to some degree, as even ex post evaluation studies of past projects suffer from limited access to contractual frameworks and public-private PRM mechanisms.[486] From a theoretical level, the issue of transparency also poses accountability questions on the public sector regarding how it treats the privatization of public resources through P3s. This issue will be discussed in Section 7.4.

The issue of contractual transparency, which is repeatedly mentioned in Chapter 4, is an obstructive factor that limits research "into the human aspects of the procurement process" that practitioners face.[487] To combat this barrier, this study utilizes the feedback of an expert research network to illuminate the industry's current state of practice in Canada (see Chapter 6, Section 6.2.1). Of course, the usefulness of expert input is limited to how research is conducted (i.e. data retrieval, aggregation, calculation, and application).

7.3 Methodological Limitations

This structure of this study's questionnaire, the calculations applied to its results, and the structure of its proposed risk allocation decision model all present respective methodological limitations that must be addressed to ensure such limitations are considered, or at least acknowledged, in future studies of the same nature. The most contentious limitation, perhaps, is the use of parametric analysis on ordinal data.

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[485] Ibid., 37.

[486] Here, the 'ex post evaluation' of a P3 project entails the ex post study of a P3 that does not require any further DB phases. This includes: (i) P3 projects that have run the course of their contract lifecycles, (ii) P3 projects that have renewed project lifecycles to continue under private sector operation and/or maintenance, and (iii) P3 projects that are still currently under contract, but at the operations and/or maintenance phases.

[487] Ibid., 6-7.

7.3.1 The Assumed Equidistance between Ordinal Data Points

As mentioned in Chapter 6, the use of mean score methods on semantic differential scales necessitates the *interval* treatment of *ordinal* data. It is commonplace in academic literature to analyze scaled ordinal data under the incorrect assumption that distances between ordinal points are equal. Further, researchers seldom acknowledge this methodological mishap when it occurs in literature.[488]

For example, in this study's five-point semantic differential scale, data points 1, 2, 3, 4, and 5 have a clear rank order, but by computing sample mean scores and standard deviations for these ordinal points, an illegitimate assumption must be made that the *difference* between points 2 and 3 (i.e. 'mostly public' and 'equally shared') are the same as the difference between points 3 and 4 (i.e. 'equally shared' and 'mostly private').[489] Because "the differences between any two consecutive [points on ordinal] scales [do not] reflect equal differences in the variable[s] measured," parametric methods that assume their equidistance are inappropriately applied.[490]

Literature that criticizes the treatment of ordinal scales as interval tends to focus on Likert scales, where a range of response categories is used to gauge respondent

[488] Susan Jamieson, "Likert Scales: How to (Ab)use Them," *Medical Education*, 2004, doi:10.1111/j.1365-2929.2004.02012.x; Bjorn Lantz, "Equidistance of Likert-Type Scales and Validation of Inferential Methods Using Experiments and Simulations," *Electronic Journal of Business Research Methods* 11, no. 1 (2013): 16–28, doi:10.1111/j.1365-2929.2004.02012.x; Li, "A Novel Likert Scale Based on Fuzzy Sets Theory"; Chien-Ho Wu, "An Empirical Study on the Transformation of Likert-Scale Data to Numerical Scores," *Applied Mathematical Sciences* 1, no. 58 (2007): 2851–62, http://www.m-hikari.com/ams/ams-password-2007/ams-password57-60-2007/wuchienhoAMS57-60-2007.pdf.
[489] It should be noted, however, that this study makes less of an assumption over ordinal equidistance than traditional Likert scales because its points 1 and 5 (i.e. 'solely public' and 'solely private') are denoted with a 100 percent association to a function – whereas points 1 and 5 on traditional five-point Likert scales (e.g. 'strongly agree' and 'strongly disagree') are not.
[490] Li, "A Novel Likert Scale Based on Fuzzy Sets Theory," 1609.

attitudes towards a question or statement. In a five-point Likert scale where the first ordinal point represents ‘strongly agree,’ for example, the fifth ordinal point would reflect its bipolar attitude, ‘strongly disagree.’ However, the intervals between these two points – which separate them between points 2, 3, and 4 – are loosely defined in such a way that it is illegitimate to use fractions, decimals, or any procedure involving mean scores and standard deviations for integers, because the space between these integers cannot be quantifiably measured with certainty.

Because there are degrees of arbitrary selection over the values of ordinal data points and the values between ordinal data points, ordinal scales are not technically suited for parametric tests that assume the equidistance of their integers. Consider the point of Kuzon et al.:

> Just as it is invalid to rank the results of a given surgical procedure as poor, fair, good, or excellent and state that the average result is ‘fair and a half,’ it is invalid to rate those same outcomes as 1, 2, 3, or 4 and state that the average result is 2.5.[491]

Here, Kuzon et al. are saying that the average of ‘fair’ and ‘good’ cannot be displayed as ‘fair-and-a-half’ even when there are integers assigned to represent ‘fair’ and ‘good.’ Similarly, it is invalid to use a half-adjusting scale to rate a P3 project risk with a mean value of 2.5 as ‘mostly public.’ In response to this problem, this study utilizes *membership degrees* towards *membership functions* over an adjusted scale, which allows variables to be rated over a ‘fuzzy range’ (e.g. between 2 and 3) in lieu of an arbitrary

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[491] William M. Kuzon, Melanie G. Urbanchek, and Steven McCabe, “The Seven Deadly Sins of Statistical Analysis,” *Annals of Plastic Surgery* 37, no. 3 (1996): 266, doi:10.1097/00000637-199701000-00026.

‘crisp value’ (e.g. 2.5) between categorical sections that are each allotted 0.8 units of space on a five-point scale.

On their own, ordinal ranges succumb to the same theoretical limitations as ordinal crisp values; the LCL and UCL of each confidence interval still lands over the technically unquantifiable space between ordinal integer points. Further, terms like ‘publicness’ and ‘privateness’ are imprecise linguistic labels that cannot be clearly defined as intervals. Accordingly, the ‘public’ or ‘private’ value of an integer cannot be assumed, let alone the area separating it from neighbouring integers.

However, by using these ranges to prescribe membership degrees from 0-1 towards membership functions m_{Spub}, m_{Mpub}, m_{ES}, m_{Mpri}, and m_{Spri}, data can be assessed in relation to its *strength of association* towards discrete, ordinal variables. This method captures the details that go into parametric statistics – albeit invalidly applied – without providing crisp interval values (e.g. 2.5) for ordinal data. In other words, while this study relies on invalid input by using mean score methods, its output runs more consistent with ordinal methods of measurement, which typically use the “frequencies/percentages of response[s] in each category.”[492] In this study: (i) membership degrees are equated with the projected frequency or percentage of responses given by a sample pool’s population, and (ii) membership functions are equated with each ordinal category.[493]

[492] Jamieson, “Likert Scales: How to (Ab)use Them,” 1217.
[493] It is understood that a limitation for this study is that: (i) invalid parametric methods had to be applied to arrive at membership degrees, and (ii) invalid interval-level assumptions had to be applied to the ordinal five-point scale to divide it evenly between five membership functions.

7.3.2 The Assumed Equivalue of Ordinal Data Points

When assuming equidistance between ordinal points on a five-point scale, it is also easy to overlook the assumed equivalue of these ordinal points in relation to each variable they are assessing. It is now understood that, in this study, 1, 2, 3, 4, and 5 are assumed to represent a public-private spectrum demarcated by equidistant ranges between integers. However, it should also be considered that 1, 2, 3, 4, and 5 are assumed to apply to all 27 contentious P3 risks universally. This issue also has to do with the contentious treatment of ordinal data as interval or ratio data.[494]

Consider, for example, a five-point ratio scale measuring the length of different insects in centimeters. It is clear that an insect that is 2.5 centimeters long is half the length of an insect that is 5 centimeters long – this is due to a legitimate equidistance between data points. Not only are the data points on a ratio scale equidistant, but they also retain equivalue in relation to all variables they measure (e.g. whether a measured variable is one centimeter or a million centimeters, the size of a 'centimeter' always remains stagnant).

Because of the aforementioned issue of assigning non-quantifiable – or inexact – integer values to ordinal points, the assumed stagnant – or universal – relationship between this study's five-point scale and each of its P3 project risks is invalid. The question of assumed ordinal equivalue is really a subset of assumed ordinal equidistance, but it merits discussion on its own for one main reason – while both questions stem from

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[494] The difference between ratio data and interval data is that ratio data entails "a meaningful zero point representing complete lack of the characteristic." See Kuzon, Urbanchek, and McCabe, "The Seven Deadly Sins of Statistical Analysis," 266.

the same essential assumption, the question of data point equivalue directly confronts the problem of *transferability* between this study's five-point scale and its variables.

Unlike centimeters, ordinal risk allocation categories do not equally apply to variables they assess. For instance, a proposed 'solely public' allocation for force majeure risk has a higher potential impact cost to the government than a proposed 'solely public' allocation for weather conditions risk. Thus, where this study provides a proposed risk allocation decision model based on risk relationships to membership functions, these membership functions apply differently to different risks. The assumed universal value for this study's five-point scale in relation to each of the 27 contentious P3 risks is a limitation that could be mitigated by adjusting the allocation model to incorporate each risk's: (i) probability of occurrence and (ii) potential project impact or cost.

Together, these risk factors could be used to arrive at a 'risk significance' level where: "Risk Significance = Risk Probability × Risk Impact." Chan et al.'s study includes 'risk significance' by finding each risk's "probability of occurrence and severity… [through a] five-point Likert scale… [where] 1 = very low, 2 = low, 3 = average, 4 = high, and 5 = very high." [495] However, Chan et al. assess each risk's calculated 'significance' and each risk's allocation preference separately. By considering both in relation to one another, the 'significance' of risks could be used to gauge how they would affect the sectors associated with them. As mentioned in Chapter 4, risk probability of occurrence and potential project impact are two critical considerations that affect P3 PRM and selected RMAs – including risk allocation.

[495] Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China," 140.

7.3.3 Points of Consideration from Expert Respondents

The participation criterion for this study is considered sound; it is assumed that all questionnaire respondents are qualified to provide information into the aforementioned 'human aspects' of P3 procurement from their respective areas of expertise. As is usually the case with all questionnaire studies, a larger respondent pool would have been beneficial to the project. More specifically, ranges derived from each risk's LCL and UCL could have been analyzed from a higher confidence level with a larger sample – it is hypothesized that each risk's CI would have been shorter and thus more accurate.

The very last section of the questionnaire posed an optional question to respondents asking them to provide additional points of consideration that could not be made with the semantic differential scale. This question was framed to direct respondents towards offering 'context dependent' insights that may affect the treatment of certain risks due to the 'situatedness' of P3s. A common point, first brought up by esteemed P3 practitioner Mike Marasco, was that P3 risk allocation is a largely circumstantial endeavor.[496] While there are certain PRM 'trends' and patterns in the field over risk allocation, individual project circumstances determine specific risk allocation models. Despite their popularity, P3 risk allocation studies cannot account for nuanced details.[497]

Other respondents echoed the same point in more specific ways. Will McDonald, Chief Procurement Officer at the City of Ottawa, noted that the allocation of some of the questionnaire's risks was contingent on specific contract negotiations – where risks can

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[496] Mike Marasco is a decorated P3 practitioner with executive-level experience in both the Canadian public and private sector. As CEO of Plenary Concessions, a Director of the CCPPP, and former VP of Partnerships BC, Mike's insights were held in high regards.
[497] Most of the core literature database's studies focus on general risk allocation models of P3s without choosing a project or sector of interest.

be properly identified and appropriately costed. Mark Liedemann, who now occupies Mike Marasco's former VP position at Partnerships BC, noted that the allocation of some risk undergoes planned changes over the course of a project's lifecycle. Liedemann cites inflation risk as an example, which he says should be 'solely private' during construction phases and 'solely public' during operations phases for typical P3 DBFOM projects.[498]

Brenda Liegler, Contract Innovations Engineer at the MTO, notes that this questionnaire's general approach towards risk allocation made it difficult to 'be definitive' over the allocation of risks for which there may be 'extenuating circumstances.' For example, she notes that project approvals and permits risk is often 'solely public,' but this risk can be affected by the activities of the private partner (i.e. the private partner can impact the public authority's ability to obtain project approvals or permits). In such instances, even with contractual allocation to the public sector, the private partner may be responsible for bearing risks associated with the public retrieval of project approvals and permits.[499]

Peter Bullen, Project Director at EllisDon Capital, also believes this study could have benefited from a narrowed scope of focus. For example, Bullen notes that the risk of project design and construction changes should be borne by the private sector when infrastructure does not meet standards set out in a contract's performance specifications; yet, if government changes its DB specifications post-contractually, risks associated with design/construction changes should be borne by the public sector. He also adds that

[498] The semantic differential scale questionnaire could not account for planned shifts in risk transfer over a timeline like Liedemann mentioned.
[499] Liegler's point is connected to Liedemann's in that both acknowledge the contractual proclivity for change in P3s. Whether future changes are anticipated or not, risk allocation is hardly finite upon the singing of a final P3 contract at financial close.

market demand change risk should be mostly or solely borne by the private sector if payments are toll-based, while these risks should be solely borne by the public sector if payments are availability-based. Both of these points are recognized in Chapter 6, Sections 6.8.9 and 6.9.7, respectively.

7.3.4 Narrowing Research Scope

In response to these claims, among others, future studies concerned with project risk allocation in Canadian P3 projects should develop more specific subjects of study. The scope of future studies could be narrowed by providing specific context to their questionnaires. For example, scholars could focus on the allocation of risk for specific projects through ex post studies, garnering expert input over the justification for risk allocation selections and procedures. This type of research also benefits PRM literature because it allows for scholars to reflect on the post-contractual management of risk, citing where ex ante expectations and ex post actualities align and, more importantly, where they fail to align.[500]

Future research that does not focus on individual P3 projects may still benefit from selecting an industry of focus. Many studies are not confined to particular industries. For those that are, the transportation sector remains a heavily predominant topic of interest. Other areas of interest include: education, energy, healthcare, housing, national defence, waste management, and water provision.[501] By honing in on a particular industry, researchers will be able to access more specialized knowledge pertaining to

[500] See, for example, Samuel Carpintero and Ole Helby Petersen, "PPP Projects in Transport: Evidence from Light Rail Projects in Spain," *Public Money and Management* 34, no. 1 (2014): 43–50, doi:10.1080/09540962.2014.865935.
[501] De Clerck, "Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process," 12.

specific sectors of interest and also find risk allocation patterns that may be unique to a given industry. For example, Chapter 6, Section 6.9.8 notes that tariff risks for already subsidized public utilities, like hydro, are generally borne by governments.

7.3.5 Questionnaire Methods

For P3 risk allocation studies that utilize expert input via questionnaire, the Delphi method is already commonly used to allow respondents to modify their original answers, taking into account the selection preferences made by their peers. Both Hwang et al. and Ke et al. utilize a two-round Delphi survey to allow their expert respondents to refine original risk allocation preferences, which in turn promotes more deliberation over the treatment of each risk. Delphi surveys can contain optional records of 'why' certain respondents made the original selections they did, thus allowing respondents to reflect on previously unconsidered points in subsequent Delphi rounds.[502]

Delphi questionnaires promote the convergence of varying values held between different respondents. After reviewing some of the additional points of consideration offered by respondents in Section 7.3.3, it is clear that this study could have benefited from this type of indirect correspondence between respondents. This may have changed respondent selection preferences – albeit marginally – but the changes would have been based on informed consideration. The Delphi method may have also promoted higher agreement levels between sectors over the six aforementioned risks that did not pass the independent two-sample *t*-test or the Mann Whitney U test (i.e. the risks that showed statistically significant disagreement between sectors over their allocation).

[502] Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors"; Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects."

Finally, contextual additions to the definitions of risks provided in the questionnaire would have addressed many of the respondent pool's points of consideration. While it is understood that respondents assumed a DBFOM P3 model when answering questions over each risk, some risks were still too broad to definitively allocate. For example, a few respondents have noted that risks regarding project approvals and permits are regularly shared – defining which type of approvals and permits should be allocated to either sector would have made it easier for respondents to be more definitive in their answers.

Conversely, some risks included in this questionnaire were too contextually specific in that they disregarded scenarios that would have influenced the respondent pool's allocation preferences. In this study, for example, residual value risk is considered as the risk of public authorities receiving impaired assets from the private sector upon return of ownership at the end of a P3 concession period. However, residual value risk also applies to the devaluation of a facility that is not impaired. Generally, the former is denoted with a more private risk allocation than the latter.[503] The omission of the latter consideration from this study undoubtedly influenced respondents over the allocation of residual value risk.

7.3.6 Specifities of Risk Matrices

Risk matrices are mechanisms used by both governments and private parties to assist in the pre-contractual PRM process. They are usually simple and qualitative in scope, whereby parties gauge the degree to which: (i) risks have a probability of occurrence and potential for impact and (ii) risks should be allocated to a party based on

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[503] VDTF, "Risk Allocation and Contractual Issues: A Guide," 191.

proposed RMAs. This study – along with the other questionnaire-based studies performed by Chan et al., Hwang et al., Ke et al., Li et al., and Tolani – utilizes its expert questionnaire input to propose a risk allocation decision model (i.e. a simplified risk matrix). While P3 risks matrices are widely used by scholars and practitioners alike, it is important to acknowledge their limited application value for both parties.

Ng and Loosemore note that scholarly risk allocation schemes have a modest application value to the P3 industry because they contain broad categories of risk and – due to their situated nature – "every [P3] projects has a different array of risks, which need to be thoroughly analy[z]ed and understood." Further, risk allocation is highly contingent on the risk bearing capabilities – and resources – of parties, which "can vary considerably" between projects. Finally, these risk allocation models are *static*; such schemes do not account for the fact that RMA models can change considerably over a P3 project's lifecycle during post-contractual PRM.[504]

In conclusion, because of their "simplified form, [risk matrices] can misrepresent the actual allocation of risk accomplished by both the structure and detail of the [P3] contract." For example, where risks are denoted with a 'shared' allocation preference between public and private partners, risk matrices provide little detail regarding the intricacies of sharing such risks.[505] With these considerations in mind, the VDTF notes

[504] Ng and Loosemore, "Risk Allocation in the Private Provision of Public Infrastructure," 5.
[505] E.g. Figure 6.14 suggests an 'equally shared' allocation for environmental risks, but this does not provide insight into which specific environmental risks are borne by which party or to which degree.

that a project's "contract and… structure, not the matrix, are the tools by which risk allocation is achieved."[506]

Unfortunately, it is difficult for scholars to obtain transaction-specific agreements made behind the closed doors of P3 negotiations. Thus, scholars are continually limited in obtaining empirical data to propose risk allocation decision models via risk matrices. One means of mitigating this issue, but not circumventing it completely, is to conduct ex post analyses of P3 projects where public authorities can provide public documents tied to contractual agreements for the public to view. Albeit, such documents will not reflect project terms and conditions to the same degree as final contracts, but they will allow scholars to develop more specific risk allocation decision models based on the PRM measures adopted over the course of specific P3 projects.

7.4 Theoretical Limitations

As mentioned in Chapter 4, the majority of P3 literature – whether focusing on the positives and negatives of P3s, the key ex post success factors of P3s, or risk identification, assessment, and allocation, among others – adopts a public stakeholder perspective either implicitly or explicitly. Due to the aforementioned issue of contractual transparency, in which projects are mired in secrecy, "significantly less studies… solely focus on the private side of… agreement… [because] private empirical data are scare and the SPVs are often reluctant to share information about their strategies." Even less attention is paid to third party subcontracting, where an SPV's JVs delegate tasks through

[506] VDTF, "Risk Allocation and Contractual Issues: A Guide."

third-step risk transfer. De Clerck notes that, nevertheless, “the public-private relationship… is a well-studied perspective.”[507]

More often than not – however – even when scholars adopt a public-private stakeholder perspective, they implicitly adopt public-sector bias in their analysis. Scholars associate government losses with project losses, evaluating PRM processes and RMA decisions through the lens of the public sector. For example, despite explicitly adopting a public-private stakeholder perspective, Li et al.’s questionnaire-based study on risk allocation states that their research findings “should enable *public sector* clients to establish more efficient risk allocation frameworks.”[508] It is unsurprising that scholars are charitable towards the public sector. After all, governments are meant to be a reflection of the general public’s greater interests. Therein lies the rub, however – scholars should not assume that governments act in accordance with the general public’s interests merely because that is their purpose.

This is not to say that scholars do not criticize government management of P3 transactions (e.g. strategic behaviour leading to optimism bias and adverse selection). In fact, there are several that repeatedly do.[509] However, such acknowledgements are generally confined to studies or commentaries where government criticisms are the focal point of consideration. For studies that consider P3 risk allocation from a public-private

[507] De Clerck, “Public-Private Partnership Procurement : Game-Theoretic Studies of the Tender Process,” 12-13.
[508] Emphasis added. See Li et al., “The Allocation of Risk in PPP/PFI Construction Projects in the UK,” 25.
[509] Boardman, Siemiatycki, and Vining, “Public-Private Partnerships in Canada and Elsewhere”; Graeme A. Hodge and Carsten Greve, “Public-Private Partnerships: An International Performance Review,” *Public Administration Review* 67, no. 3 (2007): 545–58, doi:10.1111/j.1540-6210.2007.00736.x; Monteiro, “Risk Management.”

stakeholder perspective, principal-agent issues like moral risk are often not accounted for.[510] When they are accounted for, these issues are generally denoted with the private sector when scholars implicitly adopt a public stakeholder perspective. This portion of P3 literature still recognizes principal-agent issues like moral hazards and asymmetric information sharing, but only to the extent that private partners can affect governments through strategic or pernicious behaviour.[511]

The scholarly tendency towards adopting a public stakeholder perspective, at least explicitly, is not the issue at hand. The issue is doing so without acknowledging that the respective 'gains and losses' of government do not necessary align with the gains and losses of taxpayers. Both are distinct actors with distinct motivations. Recall from Chapter 3 that P3s are fundamentally documents governed by principal-agent relationships. This implies a relationship between two main parties: the public principals and the private agents. There is a third dynamic to this relationship, however, that Chapter 3, and a large portion of P3 literature, fails to consider – citizens themselves.

Taxpayers are an important party involved in the P3 transaction – they are the very reason public infrastructure is procured to begin with. By implicitly aligning their gains and losses alongside those of public stakeholders, scholars can fail to recognize that

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[510] Chan et al., "Empirical Study of Risk Asessment and Allocation of Public-Private Partnership Projects in China."; Hwang, Zhao, and Gay, "Public Private Partnership Projects in Singapore: Factors, Critical Risks and Preferred Risk Allocation from the Perspective of Contractors"; Ke et al., "Preferred Risk Allocation in China's Public-Private Partnership (PPP) Projects"; Li et al., "The Allocation of Risk in PPP/PFI Construction Projects in the UK"

[511] Firmenich and Jefferies, "Risk Management in PPPs: Emerging Issues in the Provision of Social Infrastructure"; Oliver Hart, "Incomplete Contracts and Public Ownership: Remarks, and an Application to Public-Private Partnerships," *Economic Journal* 113, no. 486 (2003), doi:10.1111/1468-0297.00119; E S Savas, "Privatization and Public-Private Partnerships," *Management* 15 (2000): 1–17, doi:10.1108/09513550210439634; Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria."

governments are capable of opportunism and strategic behaviour themselves. More importantly, when governments employ strategic practices, it can be against taxpayers themselves, not just SPVs. Hence, the final limitation of this study – as well as the final recommendation for future researchers – is theoretical in nature: the public sector and its taxpayers must be demarcated as separate P3 players, even when assessing risk allocation from a public-private stakeholder perspective.

7.4.1 Public-Choice Approach to Agency Theory

In the same vein as this thesis, Tolani – whose research is part of this study's core literature review – also: (i) notes the principal-agent relationship between public authorities and SPVs and (ii) utilizes an expert questionnaire to extract data on risk allocation preferences using psychometrics. However, Tolani also finds that, depending on the theoretical framework used to analyze P3s, public authorities can be viewed as principals *and* agents:

> Theoretically, in P[3]s, the private firm is an agent for the public organization, in providing a piece of infrastructure, *and the public organization is an agent for the consumers*, who finance the public organization through taxes and fees. Thus, the public organization is accountable to the customers of its own agent. It, therefore, has a responsibility to ensure that the agent acts in the best interests of the consumers.[512]

This perception of the principal-agent relationship between public authorities, SPVs, *and* consumers is significant because it highlights a reality that is often ignored in P3 literature – regardless of contractual allocations, P3s are ultimately accountable to the general public.

[512] Emphasis added. See Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 209.

Remember from Chapter 3, general principles of agency theory adopt the assumption that both principals and agents are self-interested actors – both seek to maximize their utility. Thus, when their agendas do not align, their cooperation may be compromised. While much of Chapters 3 and 4 focus on the problem of aligning private agent interests with public principals, both chapters – along with the majority of P3 literature – ignore the fact that public authorities are agents to the general public. More specifically, both chapters ignore the fact that a public authority's interests may not always align with the general public's interests.[513] This previously unconsidered issue coalesces agency theory principles with public-choice theory principles.

Reverting back to Chapter 3's introductory paragraph, neoclassical economics is credited as the predominant field from which many P3 theory frameworks hold their roots. Because P3s operate simultaneously under a political, social, and economic realm, they stand to benefit from assessment under a neoclassical economic framework that includes political, social, and economic theory. Public-choice theory, also referred to as a "neoclassical theory of politics," is a strand of neoclassical economic theory that adopts the same principle assumption as agency theory: "the assumption of egoistic rationality."[514] Rui Sousa Monteiro notes that, from a public-choice perspective, P3 players are self-interested and self-motivated. When assessing principal-agent relationships through public-choice theory, scholars recognize: (i) that the government's interests may not always align with their principals – i.e. taxpayers – and (ii) that

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[513] Or, at least what the general public's rational interests *should* be, according to scholars who are more acclimated to the P3 environment than laypeople. See Boardman, Siemiatycki, and Vining, "Public-Private Partnerships in Canada and Elsewhere"; Monteiro, "Risk Management."
[514] John Quiggin, "Egoistic Rationality and Public Choice: A Critical Review of Theory and Evidence," *The Economic Record* 63, no. 1 (1987): 10–11, http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.169.6784&rep=rep1&type=pdf.

taxpayers have little influence in aligning government agent interests with their own principal interests.[515]

By hierarchically demarcating taxpayers and governments via agency theory, Tolani recognizes taxpayers as distinct principal actors that should, theoretically, hold self-interested government agents accountable for their actions.[516] However, taxpayers experience a comparatively larger separation between ownership and control with governments than governments experience with SPVs.[517] Thus, the potential for principal-agent issues between taxpayers and public authorities is expounded. In theory, taxpayers are "owners" (principals) and governments are "managers" (agents).[518] In practice, however, government officials – as self-interested agents – can go unchecked in adopting strategic behaviour. This leaves room for moral hazards to ensue.

To demonstrate the potential for public authorities to employ strategic behaviour – as agents – against taxpayers during P3 procurement projects, Monteiro cites economist William Nordhaus' public-choice research on political business cycles. Nordhaus "assumes myopic voters, and sees politicians as having no long-term view and as anxious to maximize short term re-election prospects." Politicians, being self-interested agents acting on behalf of the general public, "present a utility that is a function of both the

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[515] Albeit, he does so without explicitly mentioning agency theory. Nonetheless, his insights implicitly denote principal-agent relationships. See Monteiro, "Risk Management," 264-265.
[516] At least in democratic states, where public officials are elected representatives – i.e. agents – acting on behalf of citizens – i.e. principals.
[517] See Figure 3.1 for agency theory's general principle of progressive separation between control and power for principals.
[518] Principals and agents are often colloquially referred to as owners and managers, respectively. See Figure 3.1. Also see Tolani, "An Examination of Risk Allocation Preferences in Public-Private Partnerships in Nigeria," 207-209.

public interest and [their] own personal interests."[519] From a public-choice perspective, public policy decisions can be mired in personal interests issues with politicians, bureaucrats, and private practitioners that seek to maximize power or profits – even at the expense of accruing future public debt at a suboptimal rate.

According to public-choice theory, opportunism can harm public sector PRM in two broad ways: first, from the standard opportunistic behaviour of politicians, who are "looking for the benefits they can get from being in power";[520] second, from politicians with a "willingness to work for the benefit of the population, but who, having [little] statesperson profile… perceive voters as short-memory myopic people, and so cannot stop considering the coming elections (and not the future of the country) as the main goal."[521] Monteiro especially considers the latter factor in assessing public sector PRM for P3s. He adopts a Nordhausian approach to the political-cycle and notes its affects on the 'authenticity' of public sector PRM for infrastructure procurement.

Public-choice theory dictates that the political-cycle can affect political behaviour because politicians face annual budgetary constraints while simultaneously being expected to produce services and infrastructure for the general public. As self-interested

[519] Monteiro, "Risk Management," 264.
[520] Ibid., 265. The majority of this chapter concerns the latter type of public agent because it is important to be charitable to the P3 process and not assume that, just because a politician can benefit from immoral action, means he or she will (the former type of public agent poses a problem to any form of public infrastructure procurement project). However, the moral risks P3s pose on politicians should not be ignored. P3s provide political decision-makers with the opportunity of receiving future government revenue through corrupt practices due to the privatization of public services. More specifically, politicians can take concerted action to degrade P3 PRM out of self-interest because privatizing public services means politicians are "no longer… limited to annual profit skimming. By selling a government enterprise at below market price, they could get a significant chunk of the asset value for themselves rather than leaving it for subsequent office holders." See Joseph E. Stiglitz, *Globalization and Its Discontent* (New York: W.W. Norton & Company, 2002), 58, doi:10.1046/j.0391-5026.2003.00107.x.
[521] Monteiro, "Risk Management.", 265.

agents, politicians are most concerned with voters' perceptions of them, especially during upcoming election periods. In an effort to maximize the probability of winning elections, they may "launch all public projects that present benefits for the users, even without financial resources to do so." Because of public deficits and debts, politicians can utilize P3s as a short-term means of circumventing budgetary constraints while providing additional infrastructural services. This general issue of the political-cycle puts a premium on delivering projects through private financing (i.e. P3s), even at the expense of optimal "production allocations."[522]

For example, a project might achieve better allocative efficiency in the long-term when procured through a conventional procurement model than through a P3 DBFOM model – due to factors like avoiding expensive competitive selection and tender processes – but, because the conventional model would require immediate public financing, the proposed project may seem more viable *in the short-term* when procured through a privately financed P3. If political emphasis is placed on ensuring P3 procurement is adopted for a particular project, P3 screening and PSC stages may be compromised and tailored to present VFM for P3s regardless of what is the optimal choice.[523]

7.4.2 Holding the Taxpayer's Agent Accountable

Regarding the authenticity of the public sector's VFM assessments, Hodge and Greve claim "it is difficult to obtain clear evidence… in the absence of an accurate and uncontroversial public sector comparator." They claim PSCs may suffer from optimism

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[522] Ibid., 264-265.

[523] Hodge and Greve, "Public-Private Partnerships: An International Performance Review"; George Monbiot, "Public Fraud Initiative," *The Guardian*, 2002; Monteiro, "Risk Management"; Jean Shaoul, "Railpolitik: The Financial Realities of Operating Britain's National Railways," *Public Money and Management* 24, no. 1 (2004): 27–36, doi:10.1111/j.1467-9302.2004.00390.x.

bias "and are qualified to the extent that [public] managers may have aimed to report cost-saving… *for political reasons,* knowing that outcomes for long-term contracts are always uncertain."[524] Regarding the United Kingdom's PFI, which has encouraged P3-esque practices for decades, scholars George Monbiot and Jean Shaoul have been openly critical of government PSCs and VFM appraisals. Shaoul also notes the aforementioned issue of transparency – she cites a general lack of contractual transparency for P3s preventing in-depth evaluations for projects.[525]

Monbiot charged the government with failing to uphold the interests of its citizens, labeling P3s as "public fraud and false accounting… commissioned and directed by the Treasury."[526] Shaoul's most peculiar evidence for biased VFM methodology cites multiple cases where PSCs present a VFM case for P3s mainly on the base of risk transfer, but – "ironically" – these cases rest on almost the exact amount of risk transfer needed to 'tip the balance' for P3 procurement in lieu of conventional models. She also cites scandals over the refinancing of P3 arrangements where taxpayers have borne risks defaulted from the private sector back to the government.[527] These criticisms appear bolstered by the fact that specialized crown corporations, like Partnerships BC, influence public policy initiatives, creating "a need for clearer separation of policy advocacy from the stewardship responsibilities of public funds."[528]

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[524] Emphasis added. See Hodge and Greve, "Public-Private Partnerships: An International Performance Review," 549.
[525] Monbiot, "Public Fraud Initiative"; Shaoul, "Railpolitik: The Financial Realities of Operating Britain's National Railways."
[526] Monbiot, "Public Fraud Initiative," par. 12.
[527] Shaoul, "Railpolitik: The Financial Realities of Operating Britain's National Railways," 27-28.
[528] Hodge and Greve, "Public-Private Partnerships: An International Performance Review," 553.

In situations where P3s would show ‘authentic’ VFM over conventional procurement models, it is not guaranteed that the public sector’s main priorities are optimal risk and resource allocation (i.e. in lieu of pushing to get projects into motion). Thus, public sector PRM during P3 tender phases may suffer: “politicians may reduce their concerns with project assessment and assume that more important than selecting the best projects is delivering the maximum number of projects.”[529] For instance, government officials can be guilty of optimism bias in selecting RMAs for risks with a preferred proponent regardless of if SPVs adopt strategic behaviour or not.[530] Flyvberg et al. make a bold claim:

> Underestimation today is in the same order of magnitude as it was 10, 30, and 70 years ago. If techniques and skills for estimating and forecasting costs of transportation infrastructure projects have improved over time, this does not show in the data. No learning seems to take place in this important and highly costly sector of public and private decision making… Strong incentives and weak disincentives for underestimation may have taught… that cost underestimation pays off.[531]

The authors provide several explanations for predicaments of this vein, where risks are identified and acknowledged but continually underestimated. Of note in this chapter is their criticism of public officials, whose mismanagement of risk transfer may be premised on biased forecasts. Flyvberg et al. argue that both politicians and political

[529] Monteiro, “Risk Management,” 267.
[530] Referring back to Chapter 3, Section 3.2.1, optimism bias can arise during risk allocation negotiations with SPVs that fall under two broad categories: (i) ‘the fools’ – those who subjectively evaluate risk probabilities and costs poorly or (ii) ‘the corrupt’ – those who assign inauthentic probabilities and premiums towards risk for which they are prepared to enact strategic methods during post-contractual PRM (e.g. planned renegotiation of project responsibilities or risk premium rates originally accepted at financial close). Both types of private partners are inclined to default risks back to the public sector, posing ‘adverse selection’ risks to governments. See Monteiro, “Risk Management,” 269.
[531] Flyvbjerg, S Holm, and S Buhl, *Cost Underestimation in Public Works Projects: Error or Lie?*, *Journal of the American Planning Association*, vol. 68, 2002, 286, doi:10.1080/01944360208976273.

consultants share an inclination for downplaying the expected costs of large public infrastructure procurement and overplaying expected revenue projections with the goal of increasing the prospect of obtaining legal authorization for projects.[532]

7.4.3 Increased Transparency and Accountability: A Recommendation for All

It is difficult to take a definitive stance on the validity of VFM-based arguments for P3s, both nationally and internationally, in the absence of transparent, uncontroversial PSCs. This rings especially true if cost-savings and successes are reported for political reasons due to strategic behaviour or optimism bias. Perhaps this is why P3s are subject to displays of remarkably juxtaposing commentary. The Canadian model of P3s has been dubbed "one of the most successful in the world" by Hellowell.[533] On the other hand, Louise Bowman candourously described Canadian P3s – which are also referred to as PPPs – as a "Problem, Problem, Problem."[534]

It is not the purpose of this chapter to criticize the P3 procurement process. In fact, there is strong evidence both domestically and abroad that, when risks are transferred optimally and successfully, P3s deliver infrastructure on time and on budget with significant design innovations from the private sector.[535] For a summary of the main benefits P3s can provide to Canadian taxpayers, refer to Figure 1.1.

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532 Ibid., 289-290.
533 Hellowell, "Public-Private Partnerships: What the World Can Learn from Canada."
534 Bowman Louise, "P3--Problem, Problem, Problem," *Project Finance*, no. 206 (2000): 1–25, http://proquest.umi.com/pqdweb?did=56156038&Fmt=7&clientId=13813&RQT=309&VName=PQD.
535 Iacobacci, "Dispelling the Myths: A Pan-Canadian Assessment of Public-Private Partnerships for Infrastructure Investments"; Lammam, MacIntyre, and Berechman, "Using Public-Private Partnerships to Improve Transportation Infrastructure in Canada"; Michael Pollitt, "Learning from the UK Private Finance Initiative Experience," in *The Challenge of Public-Private*

What is at stake, however, is the question of government accountability towards taxpayers under their principal-agent relationship. It is important to study and research the allocation and subsequent management of P3 risk through a public-choice perspective that acknowledges agency theory's ties to both public-private *and* public-taxpayer relations. If scholars adopt such theory frameworks, they can research the P3 procurement process – e.g. P3 screenings, VFM measures, PRM strategies, and RMA methods – holistically, considering all relevant stakeholders involved.

Where public agents do not enact strategic behaviour, the issue of transparency – and an overall scarcity of accessible data – still remains. Stewardship of public officials on behalf of taxpayer interests should demand governments address this "evaluation deficit" so scholars can study primary data instead of, for instance, questionnaire input.[536] Scholars attempt to circumvent this issue through Freedom of Information requests, but governments can still withhold crucial documentation when presented with them.[537] In fact, "in Canada, most freedom of information legislation does not apply to public-private partnerships."[538]

Thus, even when scholars recognize the distinction between adopting a public stakeholder perspective and a taxpayer stakeholder perspective, their studies will be

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Partnerships: Learning From International Experience, ed. Graeme Hodge and Carsten Greve (Cheltenham: Edward Elgar Publishing, 2005), 207–30.

536 Hodge and Greve, "Public-Private Partnerships: An International Performance Review," 549.

537 Linda English, "Using Public-Private Partnerships to Deliver Social Infrastructure: The Australian Experience," in *The Challenge of Public-Private Partnerships: Learning From International Experience*, ed. Graeme Hodge and Carsten Greve (Cheltenham: Edward Elgar Publishing, 2005), 290–304.

538 Howard Davis, "Ethics and Standards of Conduct," in *Public Management and Governance*, ed. Tony Bovaird and Elke Loffler, 2nd ed. (New York: Routledge, 2003), 321, http://inovasi.lan.go.id/uploads/download/1475428233_eBook-Public-Management-and-Governance-Tony-Bovaird.pdf#page=28.

limited to the degree governments cooperate with them. A redeeming sanction to this issue may be found in the form of independent government auditors like the OAG. However, even independent auditors of federal and provincial governments face challenges to their core functions as watchdogs. In the words of Bruce Doern, the OAG is "an indispensible part of the accountability chain. However… the OAG… delicate[ly] balance[s] between its media-related public persona as the taxpayers' white knight and its private day-to-day need to gain trust from dozens of government departments."[539]

This internal contradiction is one of several limitations to the OAG's role as a watchdog – the most important being its limited ability to affect the mismanagement of public resources. Michael Ferguson, Canada's current Auditor General, recently cited the OAG's limited impact on the Federal Government of Canada in light of its continual failure to act on repeated OAG recommendations: "Our audits come across the same problems in different organizations time and time again. Even more concerning is that, when we come back to audit the same area again, we often find that program results have not improved."[540] In the same vein as this chapter, Ferguson has relayed the question: "What about programs that are managed to accommodate the people running them rather than the people receiving the services?" Further, he states that the Federal Government is guilty of issuing "public accountability reports that fail to provide a full and clear picture of what is going on."[541]

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[539] Bruce Doern, *Public Budgeting in Canada: Politics, Economics and Management* (Ottawa, ON: Carleton University Press, 1991), 220.
[540] Gloria Galloway, "Government Consistently Fails to Fix Mistakes, Auditor-General Says," *The Globe and Mail*, November 29, 2016, par. 4.
[541] Ibid., par. 3

Increased principal-agent cooperation between governments and taxpayers is no small feat. As previously mentioned, the ambiguous role of public authorities – as agents to the taxpayer and principals to the private sector – presents governments with a special conflict of interest. They must advocate policies, develop economies, and regulate private DBFOM, all while acting as elected representatives of the public interest. Hodge and Greve neatly summarize the aforementioned detractors from a healthy principal-agent relationship between taxpayers and governments, most of which impede scholars from accessing crucial data:

> … the unavailability of project economic evaluations, the fact that most deals are two-way affairs between governments and business without explicitly including citizens… the apparent willingness to protect investor returns rather than the public interest, the lack of clarity of commercial arrangements, and the desire of governments to proceed with hasty project construction for political purposes all appear to contribute to this conclusion.[542]

Because of the aforementioned considerations, scholarly acknowledgment of the unique principal-agent role governments play in P3s is not enough to bypass contractual secrecy issues. Scholars will continue to face problems retrieving empirical data for the study of P3 risk allocation and P3 PRM as a whole. The only foreseeable means of fixing this issue at large is to change legislation frameworks to account for transparency issues. Thus, this thesis' theoretical recommendations apply not only to scholars, but P3 practitioners themselves – particularly public officials, whose PSCs, VFM assessments, and contractual arrangements are criticized for lacking transparency and, at times, disingenuously promoting the interests of taxpayers. P3s require good governance after all, and good government – if anything – is an effective and accountable government.

[542] Hodge and Greve, "Public-Private Partnerships: An International Performance Review," 551.

7.5 Conclusion

This thesis provides both descriptive and prescriptive passages on the P3 procurement process. Its literature reviews: (i) summarize the main stages of P3 procurement, (ii) provide theoretical frameworks to assess risk and stakeholder motivations, (iii) explain project risk management methodologies, and (iv) cross-examine risk allocation literature to arrive at a catalogue of 'contentious' P3 project risks. Its study presents findings on the risk allocation preferences of P3 practitioners through an expert research network split evenly between the public and private sector. Its final risk allocation decision model, based on privileged industry insight, is provided in Figure 6.14. The risk allocation recommendations this thesis offers would benefit from inspection with reference to past industrial risk allocation schemes in order to validate its claims. Further, risks with statistically significant sectorial disagreement should be studied more in depth.

Both the research's subject matter and methodology are applicable to a wide array of academic disciplines. This work contributes to infrastructure procurement literature in general, particularly PRM literature concerning P3 and P3-esque infrastructure projects (e.g. AFP and PFI models). P3 PRM literature tends towards merely empirical studies without reference to theoretical frameworks. This thesis' theoretical dimension provides an explanatory function for both: (i) the separate motivations of public and private partners over the treatment of risk and (ii) the restrictive regulations that govern contractual agreements, which are mired in secrecy. While this acknowledgment alone does not circumvent the issue of data scarcity, it does highlight areas where industry standards can improve to promote cooperation and transparency between all relevant P3 players under a principal-agent relationship, including taxpayers.

This thesis' relevant subject matter and methodology need not be confined to the broad parameters typically denoted with P3 risk allocation literature. Other scholars who focus on P3 PRM – and risk allocation in particular – should consider narrowing the scope of future questionnaires to develop more refined and specific risk allocation decision models that focus on particular P3 delivery models, sectors of interests, stages of lifecycles, or individual projects. This, in turn, would provide more conclusive results when presenting proposed risk allocation decision models.

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