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Identification of Predominant Construction Project Governance Structure Used by Large Hub Airports in the United States to Deliver Capital Projects

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IDENTIFICATION OF PREDOMINANT CONSTRUCTION PROJECT GOVERNANCE STRUCTURE USED BY LARGE HUB AIRPORTS IN THE UNITED STATES TO DELIVER CAPITAL PROJECTS

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Abstract

The project governance function has been identified by existing research as a critical tool for achieving successful project delivery. This research identifies the predominant project governance structure used by large hub airports in the United States (US), including its form, primary objective, tools, mechanisms, adaptiveness, and participants. Additionally, this research identifies the point when the project governance function starts and ends in the project delivery cycle, providing a standard tool to measure governance and project performance. Other features of this mixed methods research include the identification of prioritized opportunities for improvement to existing project governance structure, practices, utilization, reporting, and contracts. Additionally, this research provides a methodology for assessing opportunities to improve existing project governance structures and practices, as well as to conduct process improvement initiatives.

Key words: project governance, construction contracts, design contracts, project management contracts, project delivery methods, process improvement, project performance, airport, aviation, Stakeholder Theory, Agency Theory, Contract Theory, project oversight.

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CHAPTER 1 – INTRODUCTION

Background

Construction in the United States (US) is a significant economic activity with annual spending totaling $1.4 trillion in 2020[1]. The United States Census Bureau (2020) reported that total construction expenditures reflect an aggregate value of many market sectors, including airport construction. Airport capital needs in the US are forecast to be $115 billion during the period 2021-2025[2]. Given the large volume of current construction-spend and significant projected need for capital spend by airports, the successful delivery of airport construction projects has wide-ranging impacts, including job creation, facilitation of economic activity, and ultimately, ensuring that the US airport system provides the traveling public with an appropriate level of air service.

Airport construction has several unique characteristics not found in different end markets: these include security requirements for any personnel working in restricted areas, airline operational requirements, as well as the diverse range of structures built within airport properties (Touran et al., 2009). In addition to the diverse range of assets constructed by airports (e.g., terminal construction, airfield, roadways, utilities, multimodal nodes of transportation) and previously identified differentiating characteristics, airport construction is also delivered using a

[1] United States Census Bureau, historical values, Construction Spending, work put in place (calendar year 2020)
[2] Airport Council International – North America, 2021 Airport Infrastructure Survey

wide range of delivery methods[3], including design bid build (DBB)[4], design-build (DB)[5], construction manager at risk (CMAR)[6], and public-private partnerships (PPP)[7]. The combination of significant capital spending and unique features of airport construction, coupled with a wide range of project delivery methods, presents a confounding challenge for airports to successfully deliver construction projects to achieve stated objectives, mainly to deliver projects within budget and performance specifications and duration periods.

Against this backdrop of complexity is the issue that construction projects have a long history of cost and schedule overruns, topics on which extensive research has been conducted (Merrow et al., 1988; Siemiatycki, 2009; Love et al., 2014, 2015). Research has identified a wide range of root causes for cost and schedule overruns, including scope definition, scope changes, bidding, project management, staff, and deceitful practices (Siemiatycki, 2009; Flyvbjerg et al., 2002, 2003). Research has also been conducted to identify mitigating actions that can be implemented to control cost and schedule overruns such as better cost estimates earlier in the project definition phase, improvement to project management capabilities, enhanced reporting, and accountability (Siemiatycki, 2009; Abu Hassim et al., 2011; Bekker & Steyn, 2009). The mitigating actions identified to control cost and schedule overruns can be accomplished using effective construction project governance structures and associated

[3] Delivery methods describe the contractual arrangement between the project owner, general contractor, and designer which governs the project execution (Touran et al., 2009).
[4] The DBB method is characterized by the project owner entering into separate contractual agreements with the designer and general contractor (e.g., the builder) (Touran et al., 2009).
[5] The DB method is characterized by the project owner entering into a single contractual agreement with the design/build entity, typically comprised of a joint venture between a designer and builder (Touran et al., 2009).
[6] The CMAR method is characterized by the early engagement of a general contractor to perform quality control activities while the design is being developed and subsequently procuring and pricing the construction work (Touran et al., 2009).
[7] The P3 method is a concession type arrangement between a project owner where the concessionaire provides not only design and build capabilities but also operates and finances a built asset against which it collects fees over a prescribed performance period (Touran et al., 2009).

mechanisms. Research on governance in the construction industry has focused on generalized theoretical frameworks (Bekker & Steyn, 2009; Miller & Hobbs, 2005; Turner & Keegan, 2001; Winch, 2001), theoretical origins (Mueller, 2009), definition (Bekker & Steyn, 2009; Bekker, 2014b), and procurement planning (Abu Hassim et al., 2011). Except for a case study focusing on lessons learned and competency creation in project management from the construction of Terminal 5 at Heathrow Airport (Brady et al., 2007), no research has been found about governance structures and associated tools and techniques used by US airports to successfully deliver capital projects. Generalized references to tools and techniques of governance structures are provided by Artto and Kujala (2008), Abednego and Ogunlana (2006), and Olsen et al. (2005). Still, these references are theoretical and descriptive and do not identify the specific tools used to construct governance structures, let alone their applicability to actual practice.

The purpose of this research is to identify predominant construction project governance structures, the tools, and techniques used to manage and control cost and schedule aspects of large hub US airport[8] capital projects, and based on the research, develop a generalized construction project governance structure that large hub airports in the US prevalently use to achieve project objectives.

Significance of the Problem

The planning and implementation of capital activity at large hub US airports (airports) is a significant undertaking affecting all levels of the airport organization (Touran et al., 2009). In addition to complexity, construction projects have a long history of cost and schedule overruns (Merrow et al., 1988; Siemiatycki, 2009; Love et al., 2014, 2015). Risks associated with

[8] Large hub airport is a definition used by the Federal Aviation Administration (FAA) to represent airports that "receive 1 percent or more of the annual U.S. commercial enplanements." (https://www.faa.gov/airports/planning_capacity/categories/). There are twenty-eight (28) large hub airports in the US as defined by the FAA (https://www.faa.gov/airports/planning_capacity/profiles).

undertaking capital activity are significant (1) having to identify funds to pay for cost overruns to complete a project; (2) higher than budgeted costs to deliver a construction project can increase airline operating costs to lease gates which under severe conditions may render the airport non-competitive, e.g., loss of air service; (3) inability to complete the project causing delays and impacting passenger level of service. The research conducted by Miller and Hobbs (2005) highlights the importance of adequate construction project governance structures to mitigate the occurrence of adverse impacts resulting in project failures for both public and private organizations implementing construction projects. To highlight the magnitude of cost and time overrruns on construction projects, Table 1 applies the research results on cost and schedule overrun behavior conducted by Love et al. (2014) and Merrow et al. (1988) to the total expected capital need of airports totaling $115 billion[9] (2021-2025): results of this calculation reflect expected cost overruns ranging between $15-$101 billion and a schedule delay of approximately 5-10 months (assuming that airport construction projects behave similarly to the projects included in the cited research). If such results are achieved, many airports will be pressed to identify funding streams to pay for overruns and/or be unable to complete the projects. Controlling costs and schedule overruns are central focus points in airport project delivery.

[9] The value represents a total budget including not only construction costs but also design costs, project management costs, and other costs for project delivery which may vary for each airport replying to the 2021 ACI North America, 2021 Airport Infrastructure Survey. Research conducted by Love et al. (2014) was limited to only the construction value, while Merrow et al. (1988) used total project cost but for non-aviation projects.

Table 1

*Cost Overruns**

Source	Airport Infrastructure Need ($ millions) (a)	Duration (Yrs.) (b)	Average Cost Overrun (c)	Expected Overrun (Cost) $ Million (d) = (a)*(c)	Average Schedule Overrun (e)	Expected Schedule Overrun (Yrs.) (f) = (b)*(e)	Project Size
Love et al., 2014	$115,000	5	13.28%	$15,272	8.91%	0.45	$13.5-85.7 million
Merrow et al., 1988	$115,000	5	88.00%	$101,200	17.00%	0.85	$1 billion and greater

***** Love et al. (2014) project size values were for projects in Australia. Average spot rate to convert to US Dollars was used for the year 2014, when the research was conducted. Exchange spot rates were extracted from exchangerates.org.uk (avg. spot rate = $0.9021 $USD to $AUD for 2014)

Area of Research

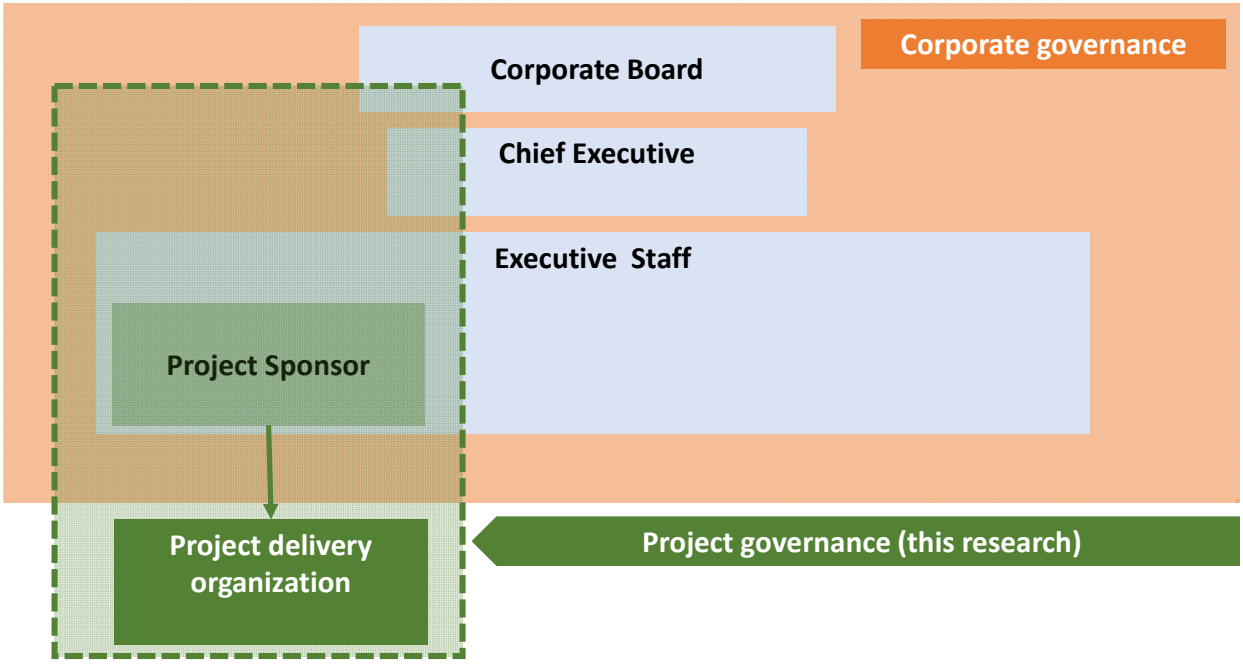
The predominant research on project governance structures has been conducted on projects outside of the US: Finland (Artto & Kujala, 2008), Norway (Olsen et al., 2005), the United Kingdom (Williams et al., 2010), and Indonesia (Abednego & Ogunlana, 2006). There are airport-specific research efforts found in the literature: a case study of organizational knowledge creation to improve project delivery using Heathrow Terminal 5, a case study (Brady et al., 2007), and a guidebook for selecting airport project delivery methods (Touran et al., 2009).

The purpose of this research is to identify predominant construction project governance structures, tools, and techniques used to manage and control cost and schedule aspects of capital projects implemented by large hub US airports and, based on the research, develop and propose a generalized construction project governance framework that considers the models prevalently used by large hub airports in the US. The generalized project governance structure developed through this research can then be used by airports to evaluate existing practices and serve as a

starting point for improvement initiatives (e.g., gap analysis) or to implement/adapt the generalized project governance structure to their specific capital delivery needs. Additionally, the generalized project governance structure can be used at all levels of the implementing organization to educate project stakeholders on its application and expected outcome. Figure 1 provides an overview of the specific area of research within the implementing large hub US airport organization.

Figure 1

Organizational View of Project Governance



Structure of the Research Proposal

This chapter provides general background on the study area by highlighting the significance of the problem and how the research will identify helpful knowledge to improve performance issues found endemically in construction projects, including airport construction projects. Subsequently, in Chapter 2, a literature review provides adopted definitions for key

terms, and as such, it will provide boundaries and common assumptions for this research. The literature review will also evaluate and highlight the areas where academic research has focused on project governance, including different industries, research methods, generalized structures, and the theoretical context under which this research will be conducted. The discussion on academic context will focus on Stakeholder Theory and Agency Theory to highlight the application of corporate governance from its inception focused on the interests of all project stakeholders and the complex interplay of principals and agents implementing a project. Additionally, the literature review will provide an overview of other related topics affecting project governance, such as drivers of cost overruns and schedule delays, procurement methods, and project delivery structures. Chapter 3 provides the research methodology, selection of participants, data capture, and analysis. Chapter 4 contains the research field data analysis and results. Chapter 5 will discuss the research and associated conclusions, external validity and limitations, and potential areas to conduct further research.

CHAPTER 2 — LITERATURE REVIEW

Overview and Structure

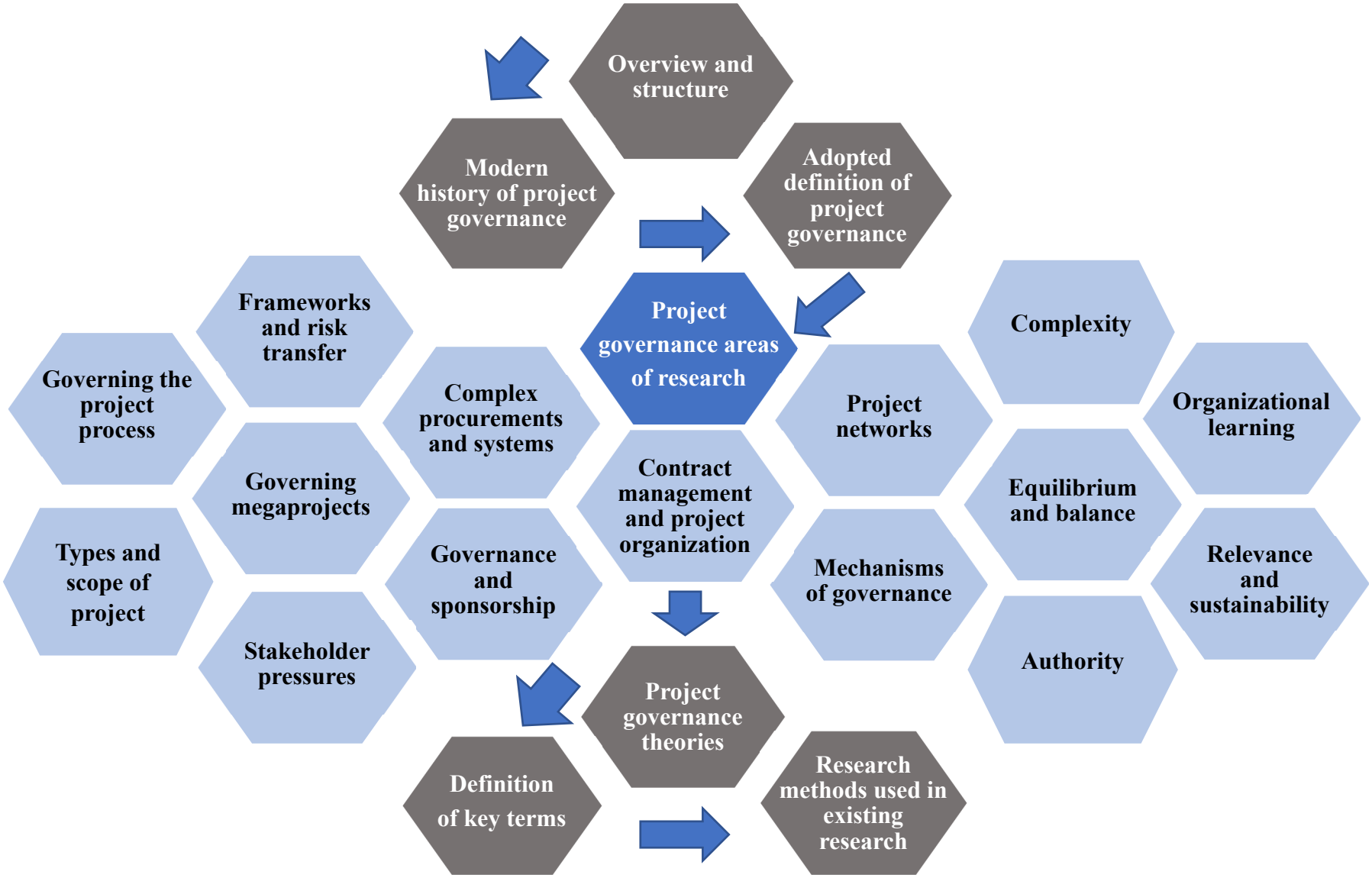
The literature review for this research is structured thematically to build on the modern historical underpinnings of project governance, followed by a review of project governance definitions found in existing research and the adopted definition of project governance to guide this research. Subsequent sections in this chapter examine the various areas of study within the project governance domain found in the existing research, the scope of project governance structures, definitions of key construction and project management terms used in this research, as well as the theoretical basis for this research, which is founded upon Stakeholder Theory and Agency Theory. These two theories capture the complex nature of the transactions associated with project governance, interactions between participants implementing a project, and the networked effect of project organizations. An evaluation of the external validity related to current project governance research is also provided to contextualize the applicability of construction project type and location found in existing research as it applies to this research limited to large hub US airports. As will be shown in later sections of this chapter, the current research is focused primarily on non-aviation projects located in Europe, Asia, and, to a lesser extent, the Middle East. Governance practices used by project owners in these geographies differ from those used by large hub US airports implementing construction projects. Examples

of differences in governance practices include a centralized (nationwide and regional) approach to governance, non-competitive procurements and sourcing practices, and the regulatory environments, which are not the norm or even allowable in certain instances for use by large hub US airports. Finally, the literature review summarizes the various methodologies used to conduct existing project governance research. Figure 2 provides a graphical view of the literature review structure used in this research.

The following sections expand on each element of the literature review described above in further detail. Within each section of this chapter, research objectives are identified, which comprise the specific areas of analysis for this research. The referenced research objectives are summarized and cross-referenced with the existing research at the end of this chapter and in Chapter 3 within the context of the proposed research methodology.

Figure 2

Structure of Literature Review



Modern History of Project Governance

The origins of construction project governance can be traced to Michel Foucault's (1926-1984) socio-political philosophy of Neo-liberalism (Lemke, 2001; Muller, 2009), initially introduced in his seminal 1979 lecture titled *The Birth of Bio-Politics*, at the College de France. Foucault's perspective is that individuals are not directly governed by state organizations but rather "subtle forces in the society they live" (Lemke, 2001). Although initially applied to public policy in the government of countries, the concept of governance began to be applied to corporate organizations engaging in economic activity (Williamson, 1975). The theme of corporate governance was introduced in safeguarding transactions between two actors engaging in economic activity (Williamson, 1981). The measure of how efficiently transactions were conducted led to the identification and adoption of Transaction Cost Economics (TCE) as a tool to make efficient financial and outsourcing decisions (Williamson, 1975). Major accounting and ethical scandals within the corporate world, such as that of Enron in 2001, at the time the largest bankruptcy in US history (Vinten, 2002), gave rise to a heightened focus on corporate governance. In the case of the US, the Enron bankruptcy led to the passing of major governance and ethics legislation under the Sarbanes Oxley Act of 2002 (Oxley, 2002). Around the same time (January 2003) in the UK, a report titled *Review of the Role and Effectiveness of Non-executive Directors* (Higgs Report) was issued discussing the role of non-executive directors and corporate governance aimed at preventing the unethical behaviors shown by companies such as Enron, WorldCom, and Société Générale (Keasey & Hudson, 2002; Muller, 2009). The utilization of corporate governance principles began to be utilized in other areas, such as implementing information technology software. The application of corporate governance principles also began to be seen in the administration of construction projects (Williamson, 1981;

Pryke, 2005). The academic study of governance began earnestly in Europe, and to a lesser extent in North America, with the evaluation and application of various governance standards and frameworks, including the Office of Government Commerce Gateway Process (2004) in the United Kingdom (Williams et al., 2010), Organization for Economic Co-operation and Development (OCED) (McGrath & Whitty, 2019; OECD, 2004), PRINCE 2 governance framework in the UK (McGrath & Whitty, 2019), Quality Assurance Scheme in Norway (2000) (Williams et al., 2010), United Nations - Economic and Social Commission for Asia and the Pacific framework (Abednego & Ogunlana, 2006), the Quebec Governance Framework in Canada (Brunet, 2021), the Association of Project Management (2004) governance and sponsor practice guide (APM, 2004), and the Project Management Institute governance standard of practice (McGrath & Whitty, 2019; Project Management Institute, 2016).

As shown above, the evolution of project governance touching upon a wide variety of fields highlights continuing attempts by practitioners and academics to identify and develop tools, techniques, and processes to successfully achieve project outcomes within an increasingly complex project delivery environment: a central theme of this research.

This chapter identifies areas of study in the existing research that will be used to identify this research objectives and propositions. Additionally, key construction project governance attributes will be identified, and data collected for each in order to describe the prevalent large hub US airport construction project governance structure.

Definition of Project Governance

To properly structure this research, a definition of project governance will be adopted to frame and contextualize this research. What follows is a discussion of the various definitions of

project governance found in existing research, its applicability to this research, and ultimately the adopted definition to be used in this research.

Crawford et al. (2008) describe project governance as the adherence of the implementing project owner to conform to corporate governance requirements such as those established by the Sarbanes-Oxley Act in the US and similar regulatory instruments such as those issued by OECD (2004). Crawford et al. (2008) focus on the context of project governance with an emphasis on the role of the project sponsor as a central figure in establishing and utilizing a project governance structure. Although applicable in some cases, Crawford et al.'s (2008) singular focus on the project sponsor limits their definition of project governance.

Klakegg (2009) states that project governance is a structure within the implementing organization comprised of "processes" and "rules" to achieve desired behaviors and ensure that projects "meet their purpose." An essential element of Klakegg's (2009) research is the identification of the political subsystem within project governance and the administrative aspects where the more traditional elements of project management occur. Limitations to the definition and its applicability to this research lie in that the projects and governance structures evaluated were European, with limited relevance[10] to large hub US airports, the scope of this research.

Abednego and Ogunlana (2006) present attributes of good governance, including (1) quality of decisions, (2) contract fairness, (3) transparency, (4) follow through on decisions, (5) continuous project control, (6) equality for project participants, (7) effectiveness and efficiency, and (8) accountability. Although comprehensive, the attribute list of good governance is too broad and does not present a concrete quantification of construction project governance

[10] Limited applicability pertains to the types of projects evaluated and the European procurement methods identified in the existing research which are different than those used by large hub US airports as well as the project types which were not aviation related.

structures, and as such limited in its ability to be applied to this research as the adopted definition.

Miller and Hobbs (2005) present a dynamic approach to defining project governance, which may be influenced by their research comparing idealized structures versus actual practice. Miller and Hobbs (2005) describe a dynamic project governance structure, borrowing from various elements associated with multiple governance regimes. What is unclear with the approach provided by Miller and Hobbs (2005) is the broadness of potential interpretations of their project governance definition: e.g., which elements on which projects under which conditions, for example. The definition presented by Miller and Hobbs (2005) does not apply to conducting this research on governance practices used by large hub US airports. In general, US airports use varying degrees of defined processes, tools, procedures, and systems as the project governance structure. Despite this limitation, the element of an implied gap between the idealized form of project governance versus actual practices is an essential element identified by Miller and Hobbs (2005), used in the adopted definition of project governance for this research.

Winch (2006) describes project governance as ensuring accountability for a project to the owner organization and managing the relationships (primarily structured through contracts) between the various participants of the project delivery organization. Winch's (2006) description of project governance is rooted in TCE and the initial research of Williamson (1975, 1982). Such strong rooting under TCE limits the applicability of the definition of project governance set forth by Winch (2006) for this research as large hub US airport which typically do not perform efficiency and cost-benefit analysis of project governance structures.

Bekker (2014) conducts a literature review on the terminology and definition of project governance. Bekker (2014) categorizes the definitions of project governance into three “schools

of thought." The first is coined "single firm" of project governance, where the defining characteristics are driven by governance associated with projects performed within a single firm or owner entity. The second project governance school of thought is "the multi-firm governance school," characterized by multiple firms engaging in contractual relationships, each with its own set of interests whose "primary goal is the protection of intellectual property." The third project governance school of thought identified by Bekker (2014) is the "large capital governance school" characterized by a "hybrid of network-like structures," ultimately reporting to a single overall responsible entity. Although the "large capital governance" school of thought described by Bekker (2014) does describe the network feature of project governance structures found in large hub US airports, it does not fully describe the specific features of project governance given the wide range of varied practices and forms.

In the description of behaviors found in complex projects, Jaradat (2015) identifies the need to add a time element to project governance to include the early phases of project development to ensure optimal project delivery effectiveness. Early phases include initial project definition phases, such as the planning and programming phases. The time element of project governance is an important element to be included in the definition of project governance, as his research shows that many of the most severe adverse project outcomes (cost overruns, project duration overruns) occur when improper governance occurs during these early phases of project development (Siemiatycki, 2009; Love et al., 2015) and realized years later during design and construction implementation.

Muller (2009) defines project governance as coexisting within corporate governance and "comprises the value system, responsibilities, system, responsibilities, processes, and policies that allow projects to achieve organizational objectives and foster implementation that is in the

best interests of all the stakeholders, internal and external, and the corporation itself." The identification of project governance as coexisting within corporate governance is an important element reflected in this research's adopted definition of project governance.

Bekker and Steyn (2009) develop a definition of capital project governance based on research conducted with practitioners and academics. The four general categories identified for corporate governance included "composition and functioning of the Board of Directors; financial reporting and internal control; corporate accounting and control, and organizational [sic] ethics and remuneration." The parallel project governance categories were "project steering committee, cost estimating/cost control, project reviews, audits, and ethical/responsible conduct and conflict of interest." The definition devised by Bekker and Steyn (2009) is as follows:

> Project governance of large capital projects is defined as a set of management systems, rules, protocols, relationships, and structures that provide the framework within which decisions are made for project development and implementation to achieve the intended business or strategic motivation. (p. 91)

Given the balanced approach (practitioner and academic), this definition reflects the nature and purpose of US public sector project governance structures, including that of large hub US airports, and will therefore be adopted for this research.

Combining critical elements about the existence of project governance within the realm of corporate governance (Muller, 2009), addressing the entirety of the project cycle from definition to closeout (Jaradat, 2015), being reflective of non-idealized practices (Miller & Hobbs, 2005), and of the forming elements of the project governance structure (Bekker & Steyn, 2009) provides the following adopted definition for this research: project governance is a framework of management systems, rules, protocols, relationships, and structures within which

participants make decisions in all phases of the project development process to achieve identified project goals and objectives. Project governance is a subsystem of corporate governance and operates within and is consistent with the corporate governance policy of the implementing organization.

Project Governance Areas of Research

The wide range of study areas in project governance can be attributed to the multidimensional nature of the domain as it touches on technical elements of construction administration, the broader implementing project owner organization, the structure of the project organization (which is generally a temporary one), the network nature of project organizations, legal and regulatory elements affecting project governance, as well as interpersonal relationships of the project delivery team, owner or sponsoring organization, and other associated internal and external stakeholders.

Governance Frameworks, Competency, and Risk Transfer

Williams et al. (2010) conducted a comparative case study evaluation of the governance structures used by the Office of Government Commerce (OGC) in the United Kingdom and the Ministry of Finance (MoF) in Norway. The OGC governance structure focuses on early approval and programming phases using *gateways* for which specific information and analysis are to be conducted, focusing on the *value for money* planned for expenditure. The MoF approach to governance seeks to avoid budget overruns, focusing on the early scope development and associated cost estimates reviewed extensively by outside consultants before the financing decision is made. Williams et al. (2010) strict focus on early project development phases limits the reach of their research as downstream phases (e.g., design, construction, and

closeout) are also critical in achieving project objectives through construction project governance structures.

Winch (2006) presents Transaction Cost Economics (TCE)-grounded case study research highlighting the concept of the project organization as comprised of multi-firm contracts. Winch (2006) re-introduces the concepts of horizontal and vertical governance introduced earlier (Winch, 2001) as he applies them to the project organization. Winch's (2006) research highlights the unique elements of project organizations, including its determinate, or time-constrained, feature and the process of uncertainty reduction that is product-centric rather than resource-centric (as is the case with traditional forms of production). Winch (2006) highlights the role of the governance level as mediating between the highest (institutional) and most granular (behavioral) level of the project organization and its operational context. Winch (2006) highlights the nature of critical structural elements that inform the nature of project governance and behaviors of its participants, namely the temporary nature of a project organization, the utilization of contractual agreements as the means through which a network of firms is organized to implement projects. The contractual nature of a project organization can create an environment of opportunistic behavior that may not be aligned with overall project goals. Winch's (2006) research highlights the tension created by project governance structures implemented to control self-interests and transactional behaviors and ultimately deliver on stated project goals that may conflict with the interests of participants (individuals and organizations).

Ruuska et al. (2009) introduce the concept of a multi-attribute distance framework to analyze the complex nature of large multi-firm projects. The distance framework comprises three dimensions: firm attributes, network attributes, and project practices. Ruuska et al. (2009) use the concept of "distance" to measure the extent to which project participants work

effectively: the greater the distance, the lower the effectiveness of the measured dimension (a measure of competency). A case study of a major nuclear plant construction (mega project) in Finland was used to populate the constructed distance framework. This approach provides a helpful way to categorize project features of a complex project environment into segregated elements which can then be analyzed discretely. There is a limitation of the research conducted by Ruuska et al. (2009) in its applicability to practitioners, given the abstract concepts presented and the fragmented nature, in this case, of the types of project governance structures used by large hub US airports to be studied in this research.

Abednego and Ogunlana (2006) prepared a gap analysis comparing identified leading practices to actual practices used in a tollway project in Indonesia delivered through a PPP delivery method. The application of leading governance practices was derived from the United Nations Economic and Social Commission for Asia and the Pacific (UN-ESCAP). The characteristics identified as leading by UN-ESCAP included participation, the rule of law, transparency, responsiveness, consensus orientation, equity and inclusiveness, and accountability. The idealized model was then applied to the project level case to measure gaps. Further, Abednego and Ogunlana (2006) also compiled an idealized risk transfer model used for actual project conditions to evaluate its fit within the project-level governance model. Although limited in applicability to large hub US airports, given the geography, regulatory environment, and project type evaluated. There are certain large hub US airports utilizing PPP as a project delivery tool, such as Los Angeles International Airport[11] and John F. Kennedy International Airport[12], for example. It is relevant for this research to understand the PPP governance practices

[11] Los Angeles World of Airports (LAWA) Landside Access Modernization Program (LAMP)
[12] Port Authority of New York/New Jersey Terminal 4 project

identified in the existing study. Related research on PPP has also been conducted by Anderson et al. (2010) and Merrow et al. (1988).

Turner and Keegan (1999) highlight the role of the broker (the client-facing resource) and the steward (the resource assignment/project-facing person) in project-based organizations. Turner and Keegan (1999) highlight the evolution of 'classical governance structures' exemplified by centralized control and command functional structures with pools of expert resources. Classical governance structures functioned well and could scale, yet its fullest benefits occurred in stable environments with slow change. Starting approximately in the 1950's, the trend toward mass customization began, resulting in the need for more dynamic governance structures. Turner and Keegan (1999) used a TCE lens for their research, which somewhat limits the actual transaction costs on project organizations, especially for governance, which is not usually known nor generally used in the US by public owners implementing projects, including large hub airports. The nature of broker and steward (grounded in Agency Theory) and the trend to mass customization presented by Turner and Keegan (1999) are relevant to this research, however, as they explain organizational structures and roles used by organizations implementing projects. Turner and Keegan (1999) also inform about the interactions found in project delivery organizations and the most successful project governance practices within this operating environment.

The Association for Project Management (APM, 2004) presents a generalized practitioner-based governance framework for project management and change. The proposed framework centers on the roles of the organization's board, sponsor, and project manager(s). Limited evidence of academic rigor is provided to assert that governance frameworks must be dynamic to match an organization's needs and the project sponsor's

importance in achieving project success/outcomes. No specifics on the mechanisms to be used in administering the operations of the governance structure nor the specific interactions between the corporate level governance and that of the project team are expressly provided. Even with the identified limitations, APM (2004) is relevant to this research given its use by many construction project owners in the US including airports. The governance structure described in APM (2004) uses gating and sponsorship as foundational pieces to overseeing delivery of construction projects.

Governance and Sponsorship

Crawford et al. (2008) analyze case studies of thirty-six (36) large complex projects in Australia, the US, South Africa, Europe, and China, centering on the role of the project sponsor. Research conducted by Crawford et al. (2008) highlights the limited focus of existing research on the importance of the project sponsor in achieving successful project outcomes. Crawford et al. (2008) found that the project sponsor is a critical role operating between the owner organization and the project organization: providing governance to ensure the interests of the sponsor organization are met while also ensuring the assignment of needed resources and political navigation to support the project team's ability to deliver the project. Softer skills such as facilitation and communication were critical success factors in the project sponsor's ability to ensure the project's successful outcome. The role of the sponsor applies to conducting research at US large hub airports and will be explored further in this research, as the project sponsor is often the critical link to needed resources to maintain project progress, resolve critical project issues and assignment of resources within the project governance structure.

Complex Procurement and Systems

Olsen et al. (2005) identify the multiplier effect as a positive compounding feature realized when the concurrent utilization of multiple governance mechanisms such as incentives, authority, and trust are optimized to achieve project implementation success or, inversely, contribute to project failure when said utilization is absent or poorly done. Olsen et al. (2005) evaluate project structure, governance, and performance on two large-scale projects in the oil and gas industry as the subject matter of their research. Olsen et al. (2005) summarize the various types of contracts used in the oil and gas industry to deliver projects and their associated governance structures. Olsen et al. (2005) also introduce a concept coined "the multiplier effect" which had not been previously identified in existing research. Finally, Olsen et al. (2005) found that the nature and quality of the interaction between project team members at the outset of a project is difficult to change as a project is implemented, highlighting the importance of implementing high quality project team interaction in the early phases of a construction project. The compounding effect of aggregation of concurrent positive practices is material to this research to evaluate how project participants utilize multiple leading project governance practices to achieve positive project outcomes in large hub US airports. Increasingly complex procurement used by large hub US airports such as those for design/build, construction manager at risk (CMAR) can be evaluated within the context of the multiplier effect to assess the criticality of elements within the multiplier chain and whether there is a critical multiplier element or combination therein that is most important in driving positive project outcomes. For example, the multiplier chain for selecting a CMAR can be comprised of procurement document development, issuance of procurement for bidding, evaluating proposals, and execution of the agreement between the CMAR and project owner. Within this chain, a critical element could be

the selection process followed by developing a well-developed CMAR contract agreement. Similar multiplier chains could be developed for a project designer, the project management team, or any identified project element.

Jaradat (2015) conducted a literature review and identified emergent themes associated with complex systems, governance, and the emergent characteristics of individuals to successfully design and use governance within these complex systems. Jaradat (2015) focuses on identifying attributes of complex systems, including interconnectivity, integration, evolutionary development, emergence, complexity, uncertainty, and ambiguity. Emergence and complexity are two characteristics of complex systems that can be applied to governance structures within the construction project organization, as these are also an example of "complex systems." Jaradat (2015) also identifies key themes of complex systems that require different types of thinking, including: "holism vs. reductionism," "dynamic vs. static environments," and "optimization vs. satisficing." Finally, Jaradat (2015) highlights the need for multi-disciplinary system thinking when designing and managing governance structures for complex systems, including project governance. The theme of complexity within the project procurement phase is critical in this research in terms of its composition (e.g., what elements or features of large hub US airports create complexity in project delivery and governance). In turn, the governance of complex systems requires a specific approach and structure to successfully achieve their objective. Jaradat (2015) offers important elements to evaluate and use in this research, especially regarding dynamism, holism, and optimization in complex systems.

Governance of Megaprojects

Miller and Hobbs (2005) present research results of a multi-year study (1996-2000) of large infrastructure projects in the UK and Norway. A central theme identified in their research

is the need "for dynamic governance structures" to be utilized in large complex projects given the unique characteristics of these projects, including long and complex front-end (programming and planning) period and associated uncertainty, the development of network coalitions within the implementation project team, and strategic depth. Miller and Hobbs (2005) highlight the critical need for governance of large projects given their propensity for implementation failure and the associated adverse consequences. One of the key findings in their research is the "high cost of project shaping ($120 million and three years) with various degrees of structure and 'momentum-building' cycles to get to an implementation phase." The second main finding of the mentioned research is the disconnect between idealized governance structures used to control actual project conditions, which are very different: actual conditions are centered on network relations, evolution, the indeterminacy of the work, and the participatory role of the governing body. Evaluating idealized project governance structures compared to actual conditions is relevant to this research to identify critical gaps based on the utilization and adherence of participants to stated project governance practices.

Olsson et al. (2019) conducted a comparative analysis of the *planning phase* governance regimes used by Norway[13] and Sweden[14] to implement large-scale (e.g., larger than 75 million Euros in the case of Norway) transport infrastructure projects. The Norwegian (implemented in 2000) and Swedish (implemented in 2006) planning-phase governance structures are mature and use a gate approval process. Gate approval ensures that the project development cannot move towards the next phase until the requirements of the approval gate are satisfied. In the comparative analysis, Olsson et al. (2019) identified leading practices for planning phase

[13] Refers to the Norwegian quality assurance scheme that was established by the Ministry of Finance in 2000 and updated in 2006
[14] Swedish Transport Administration

governance parameters to include (1) use of gate approval; (2) limitations to process non-adherence; (3) risk analysis; (4) use of lessons learned as a knowledge-generating process, also identified by (Williams & Samset, 2012; Flyvbjerg, 2007; Flyvbjerg et al., 2003). Olsson et al. (2019) showed that these two mature planning phase governance structures successfully used the gate approval process with some significant differences: in Norway, external budget validation improved overall downstream financial adherence to budgets. The benefit-cost analysis (BCA) was more fully developed and carried greater weight in the Swedish governance process while offering a more flexible approach to the gating process. The use of gates (decision points within a process) as part of a governance structure will be evaluated in this research as gating is an element found within the project governance structures of large hub US airports (an example is the governance structure used by the Greater Orlando Aviation Authority[15]).

Governing the Project Process

Winch (1989) provides an alternative view of construction management from an inter-organization rather than an intra-organization perspective. Winch (1989) analyzes the intra-firm approach's limitation as the project organization's fundamental basis is a "temporary coalition" of firms with the owner (e.g., inter-firm). This is important as the basis of analysis and relationships under this arrangement are contractual, resulting in the potential for self-interested behavior, conflicting priorities, price exposure, and ultimately a lack of trust that must be overcome to achieve project objectives. Winch (1989) states that "a plausible perspective on construction management needs to consider the nature of construction projects as temporary coalitions of firms with divergent economic and social interests." Winch (1989) highlights key

[15] Greater Orlando Aviation Authority policies and procedure records. Note that the terms "gate" or "gating" are not explicitly utilized, yet the gating process is accomplished through an approval committee process that provides a binary result (approval or disapproval) of a recommended action. Approval committees report to the Greater Orlando Authority Board, consistent with the reporting concepts identified by Muller (2009).

features of his research about “bounded rationality,” “opportunism,” and “information impactedness” as critical attributes to the self-serving nature of transactions expected on construction projects given contractual arrangements and sometimes divergent interests of participants. The temporary nature and contractual form of organization are relevant to this research as such structures are found in many large hub US airport project organizations.

Winch (2001) presents a conceptual framework for governing the project process based on TCE. The project process is described as the “reduction of uncertainty through time.” Winch (2001) also describes the process of uncertainty reduction as value creation (putting the work in place into a physical asset’s ultimate form). Additional terms in the research include vertical and horizontal governance to highlight the structures that affect the owner and its implementing vendors versus the governance between the vendors (general contractors) and their suppliers (first, second, and lower-tier subcontractors). Winch's (2001) reliance on TCE provides limitations (as practitioners implementing projects at large hub US airports typically do not conduct benefit-cost analyses to justify each element of the governance process) yet recognizes the constraints posed by bounded rationality, limited alternative options for economizing, and the fact that power may be needed to resolve such alternatives. Even with the cited limitations above, Winch's (2001) description of horizontal and vertical governance are important dimensions to consider in evaluating project governance structures used by large hub US airports as part of this research.

Governance and Organizational Learning

One of the only aviation-specific project governance research was conducted by Brady et al. (2007). Brady et al. (2007) analyzed a case study of the management practices and tools used by the British Airport Authority (BAA) to deliver the Heathrow Airport Terminal 5 mega

project. The research highlights the steps taken by BAA executives and senior management to empower the project delivery organization to improve its project delivery practices. The case study by Brady et al. (2007) provides a ten-year (1995-2005) history of how the project delivery leadership initially introduced a standardized, gate-driven approach to project delivery that could be used for all capital projects. The evolution of the governance process, which was found to be too rigid, resulted in the development of integrated team structures and associated "framework agreements" that fundamentally shifted risk from participating entities (including the designer, contractor, and project management staff) to BAA in exchange for open book accounting and active performance quality control. Results show that the T5 project (exceeding $1B in value) was on time and within budget. However, one of the important limitations of this approach is its applicability to large hub US airports, whose competitive procurement and contracting regulatory requirements would not easily allow the type of risk transfer and integrated team structure utilized by BAA on the T5 project.

Equilibrium and Balance in Project Governance

Brunet (2021) analyzes the province of Quebec's governance framework implemented in 2008. The analysis comprises an evaluation of four megaprojects in the planning phase. The analysis takes a three-level approach: institutional (governmental), organizational (owner organization), and project (project delivery team). Governance at each of these levels is manifested in legitimacy (institutional), accountability (organizational), and efficiency (project levels). The research conducted by Brunet (2021) found that participants felt that although the framework was inflexible, it was important given that public funds were utilized to pay for the project. At the organizational level, using a centralized approach was burdensome and rigid. Some participants also recognized that the framework needed more time to mature and reconcile

competing critical stakeholders' interests to move the project forward. At the project level, research results show that participants felt that some of the steps to move projects forward were inefficient (e.g., performing the same task/analysis multiple times before the project could move to the next stage of approval), yet they felt there was value in the governance framework. Brunet (2021) presents a systematic approach that can be used to analyze a broader range of governance structures at the institutional, organizational, and project levels. The method proposed by Brunet (2021) can be applied to this research where the interplay between the regulatory aviation bodies in the US, primarily the FAA, interfaces with implementing large hub US airports and their project delivery teams.

Mechanisms of Governance

Turner (2006a, 2006b, 2006c) introduces a framework to create a project management theory. It comprises four premises on the nature of projects being temporary organizations that benefit the owner using a governance structure to ensure adherence to defined objectives and performance monitoring. Turner (2006a, 2006b, 2006c) provides additional characteristics of projects, including resource assignment and utilization, cost, schedule, and quality control. Additionally, Turner (2006a, 2006b, 2006c) identifies roles on a project, including the owner, user, sponsor, resources to conduct the work (project managers), broker, steward, and manager. Although bold, the theoretical analysis presented by Turner (2006a, 2006b, 2006c) falls short of fully developing a theory as the framework presented does not describe causation or predictive behaviors on a project. Instead, Turner (2006a, 2006b, 2006c) focuses on uniquely descriptive elements of project management, of which project governance is a central element. Under this view, Turner provides valuable research towards developing a standardized

approach, or lens, through which project management and governance can be further developed towards an ultimate theory.

Project Networks

Artto and Kujala (2008) present a conceptual model for treating the project business as a research field, focusing on the presumption that projects are networked temporary organizations whose behavior is explained by Contingency Theory (Donaldson, 2001). Artto and Kujala (2008) further highlight that the behaviors associated with networks of firms are different than that suggested by current research, especially those focused on TCE (Williamson, 1975) as firms may be partners in one project and competitors in another, rendering the optimization prescribed under TCE infeasible. As such, the governance of networked firms needs to be adjusted for the specific project, given the unique functions of each network are affected by the owner's capability to manage and assign resources, capabilities of the network firms, inherent personal and organizational self-interest, and information asymmetry similarly to that found by Miller and Hobbs (2005). The themes of flexibility and adaptiveness are important within complex environments, such as that realized within the project implementation organization and associated governance structures. The composition of networks and complexity presented by Artto and Kujala (2008) will be evaluated in this research within the context of project governance structures utilized by large hub US airports.

Blanco et al. (2011) compare the concepts of governance networks (GN) and policy networks (PN) which they correctly point out are often used interchangeably. The fundamental difference between PN and GN is that PN is bounded by issue-specific/content-specific interactions, which are not as bound as GN. On the other hand, GN is determined by a government or organization, and the GN emphasizes the open nature of macro networks centered

on a common purpose. Although this research was written using a political lens, there are applications to the project organizations which serve much like PN: networks and issues are centric on a common purpose and may span across organizations (owner and temporary project structure).

Carlsson (2000) provides a theoretical construct to policy networks highlighting how the application of Collective Theory more accurately captures the complexity of policy networks not captured by the traditional view of policymaking which are typically comprised of a sequential set of predictive steps ultimately resulting in policy-making. Carlsson (2000) highlights that policy networks are not linear nor predictive in organizations and have multiple levels and complexities of non-sequential activities and relationships resulting in policy making. Similar to Artto and Kujala (2008) and Blanco et al. (2011), the theme of complexity is described by Carlsson (2000) through the lens of policy networks applied to the project governance environments of large hub US airports.

Contract Management and the Project Organization

Turner and Simister (2001) conducted case-study research to design a contract type selection matrix to include fixed price, unit price (two types), and cost-plus contracts. Turner and Simister's (2001) analysis focuses on aligning project participants' motivation towards achieving project goals rather than unique contract elements such as shared savings. Although their research is underpinned in TCE, Turner and Sinister (2001) also cite its limitations in capturing the cost of project delivery transactions and associated governance structures. Ultimately, the contract selection matrix is synthesized into four criteria: project uncertainty, process uncertainty, project complexity, and ability of the owner to contribute. It can also be counterargued that any of the contract types researched can be structured to achieve desired

project outcomes rather than the selection matrix provided, highlighting a significant limitation. Other limitations to the external validity of this research include the limited number of cases (two cases), geography (Norway), industry (oil and gas) as well as the private sector, which does not have many similarities to large hub US airports, the focus of this research. Differences in practices found in existing research and those used by large hub US airports include a very localized (decentralized) approach to project governance, airport construction projects being comprised of a wide range of different types of assets, and the regulatory environment (e.g., FAA, Transportation Security Administration [TSA], US Custom and Border Patrol [CBP]).

Relevance and Sustainability

Klakegg (2009) surveys 146 professionals comprised of senior-level practitioners, project managers, sponsors, and researchers to synthesize a prioritized list of project failures. Identified project failures were categorized in relevance and sustainability (not the environmental type, but instead defined as the ability to sustain planned economic and operational results). Relevance issues identified included planning arrogance, political goals more important than user's needs, and planner and decision-maker goals more important than user's needs. Sustainability-related prioritized failure issues included conflicting project objectives and strategies, lack of stakeholder commitment, economic infeasibility, and changing business or macro conditions throughout the project life. Klakegg's (2009) triangulated identification of issues related to project failures and the research methodology is important to this research. Project failures identified by Klakegg (2009) apply to this research of large hub US airports in understanding root causes of such failures, thus critical to establishing a governance structure that can mitigate these conditions.

Stakeholder Pressures

Aaltonen and Sivonen (2009) performed a four-case study comparative analysis of projects in emerging markets (Uruguay, Eastern Europe, and China) to highlight different approaches to stakeholder pressures at the project level. The research highlighted the difference between internal and external stakeholders. Internal stakeholders were defined as members of the project team (whether the owner, architect, contractor, or project management team), while external stakeholders are outside of the project team organization yet may be affected or have an interest in the project. The five followed strategies identified were (1) acquiescence; (2) compromise, (3) avoidance, (4) defiance; and (5) manipulation. Aaltonen and Sivonen (2009) highlight a continuum of these strategies from passive to active and are used under different power levels or ability to influence outcomes. This research describes the type of interplay between shareholders (in the case of large hub US airports, the owner of the airport [typically a public organization]), and the public as described by Shareholder Theory. There is also the interplay of the various stakeholders (in the case of large hub US airports: passengers, tenants, operators, the general public, and airport organization) and the organization, which is described by Stakeholder Theory. The interplay, conflicts, and information asymmetries of these principals and agents in this environment (which could be both shareholders and stakeholders) are described by Agency Theory. Lastly, the research showed that a focal organization could use influence as a strategy when previous knowledge or experience can be leveraged to affect desired outcomes. The types of stakeholder pressures identified are relevant to this research in that large hub US airports have a wide range of external and internal stakeholders: regulatory (e.g., FAA and TSA); political (e.g., board members to an airport may be politically appointed); sociological (e.g., local, and regional communities).

Complexity

Baccarini (1996) conducts a literature review on the definition of project complexity. Baccarini (1996) describes project complexity through the lens of the project organization, which is temporary and comprises a wide range of project delivery participants, including the owner, architect/engineer, contractor, and project management staff. Baccarini (1996) also describes project complexity along the dimension of increasingly more involved and interdependent technological aspects of construction assemblies, associated supply chains, and project management, all of which must be managed to deliver a project successfully.

Bertelsen (2003) provides an overview of construction as a complex system. Bertelsen (2003) highlights three fundamental complex systems descriptors: "autonomous agents, undefined values, and non-linearity." The non-linear behavior of construction applies to this research, given the complex upstream and downstream set of interdependencies that may affect project performance in ways that cannot be accounted for through contractually based risk transfer. The widespread use of price as the basis for establishing contractual values further highlights its effect on contractors and the broader local construction market. Similarly, the fact that the permanent organizations employ project participants contracted to create the temporary project organization further highlights the disconnect in the interests of project participants loyal to employing agencies. The environment of complexity described by Bertelsen (2003) reflects the functional features of large hub US airport organizations and will serve to inform this research and its analysis of project complexity and associated project governance structures used to deliver desired outcomes.

Caniëls et al. (2012) use a case study to evaluate how different types of governance work when utilized concurrently. Caniëls and Gelderman (2010) studied a complex, six-year project

to build an oil platform and evaluated how three primary governance mechanisms functioned: authority, contractual, and trust. Of importance was that the contracted parties were two firms very familiar with each other with a joint owner who issued a cost-reimbursement contract to execute the work. The agreement was very broad and only two pages in length. Unsurprisingly, Caniëls et al. (2012) found that subcontractors began to exhibit opportunistic behaviors such as prioritizing other, more profitable work, given the cost reimbursement nature of the executed agreement. There was no effective authority governance. The assigned project steering committee did not have any power to exercise control, given the high level of trust initially perceived between the performing firms at the outset of the project. Conflict further arose when the trust was broken given the opportunistic behavior, at which time performance incentives were introduced on cost and schedule. When all three governance mechanisms were used concurrently, the project outcomes improved. Caniëls et al. (2012) found that there is a positive effect when multiple (in this case, three) governance mechanisms are used, similar to the multiplier effect identified by Olsen et al. (2005). Limitations to this study included limited external validity given a single case study and geography. Regarding this research, the description of opportunistic behavior is relevant in evaluating project governance structures utilized by large hub US airports. Opportunistic behavior can also arise due to information asymmetries predicted by Agency Theory.

Qiu et al. (2019) conducted a single case study research on the $10 billion Hong Kong-Zhuhai-Macao Bridge project to identify sources of complexity and how such complexities manifest in the organization, as well as how the oversight organization mitigated resulting issues. Qiu et al. (2019) conduct research through the lens of Institutional Theory as it better explains complexity resulting from "institutional differences among actors, groups, political

regimes, and the macro-environments that can bring about conflicts and uncertainty." The research moves away from the predominant use of Shareholder and Stakeholder Theories to explain project complexity. The case study research was undertaken over multiple years and offers a comprehensive picture of the multijurisdictional elements of the project. The research is limited because it describes and analyzes implementing agencies in Asia whose project delivery and governance methods differ from those used by large hub US airports.

Denicol et al. (2021) conducted a multi-case analysis of megaprojects to identify a generalized total delivery organization covering all phases of the work. The term used for the organization is the Project System Organization. It highlights the temporary and permanent aspects of project delivery. Various supply chain organizations needed to plan, design, deliver, and operate the asset constructed and the owner-side versus supplier-side structures. Denicol et al. (2021) highlight the importance of the governance structure for the project owner to integrate and control the behaviors and outcomes of the various supply chains developed to deliver the megaproject. Another significant contribution of this research was identifying the *project delivery model* to encompass all participants in all phases of the project delivery team: not just the contractor but also consultants, project management staff, and designer, as well as owner staff. The project delivery model is relevant to this research as it describes the totality of all project participants holistically, which can be applied to evaluate the entirety of participants in project delivery organizations used by large hub US airports.

Vukomanović et al. (2021) present an overview of current research in the domain of megaproject governance and trust. The research centers on complex aspects of the megaproject organization, associated social interactions, and their dynamic nature. Given the complexity of megaprojects, Vukomanović et al. (2021) suggest that associated governance structures must be

assembled and managed in a way that can successfully navigate the complexity dimension. Similarly to Baccarini (1996), Bertelsen (2003), and Denicol et al. (2021), the research conducted by Vukomanović et al. (2021) is relevant to this research as it pertains to the complexity faced by the implementing project organization, social interactions, and associated project governance structures.

Ruijter et al. (2021) conducted field studies to study trust-building efforts on the Schiphol, Amsterdam, and Almere (SAA) megaproject. Trust-building methods used by the leadership of this megaproject included multiple types of workshops and partnering sessions. Ruijter et al. (2021) note existing research shows that the prevalent use of pre-determined governance structures does not result in trust amongst project participants, nor is it beneficial to govern megaprojects' dynamic and evolutionary nature. Ruijter et al. (2021) identified that a substantial and sustained effort was needed to develop trust which in this this case was accomplished using workshops. Given such significant investment, Ruijter et al. (2021) found that "the enactment of partnership philosophies frequently fails" (p. 361). US aviation project practitioners cite the theme of integrated delivery and partnering and are relevant to analyze as part of this research.

Types, Mechanisms, and Scope of Project Governance Frameworks

Project governance structures take many forms in practice. Muller (2009) provides a helpful categorization of project governance structure paradigms: "Flexible Economist, Versatile Artist, Conformist, and Agile Pragmatist paradigms." These four paradigms emphasize outcome control focus or behavioral control focus. Outcome control project governance paradigms provide stated benchmarks for the project team to deliver and do not dictate the specific steps to achieve the outcome. On the other hand, behavioral-based project governance paradigms are

rigid and prescribe the actions to be taken (thereby instilling the desired behavior) in achieving the desired outcome. Categorizing project governance paradigms is a valuable tool for developing characteristics and mechanisms used by implementing entities in their applicable project governance structures. This research will use elements of the four paradigms identified by Muller (2009) to conduct exploratory research on project governance structures used by large hub US airports.

Klakegg et al. (2008) compared the governance structures used in Norway and the UK. To complete the research, Klakegg et al. (2008) developed a tool to assess each of the governance frameworks evaluated and it consists of four areas of study: (1) understanding how the governance structure came to exist; (2) identification of embedded governance principles within the evaluated project governance framework; (3) the structure of the governance framework, e.g., policies and procedures, participants, end goals; and (4) mechanisms of the governance framework such cost estimates to develop budgets and schedules to establish milestones and critical paths. The assessment tool developed by Klakegg et al. (2008) can be used to characterize the project governance structures used by large hub US airports, offering an integrated and robust approach to data collection and categorization to be conducted as part of this research.

Another important element of project governance frameworks is the project owners' specific tools and techniques used to analyze, evaluate data, generate reports, and guide project participants on approvals or other metrics. Klakegg et al. (2008) identified mechanisms used within project governance frameworks, such as cost estimates to develop budgets and schedules to evaluate project timelines. Similarly, Siemiatycki (2009) highlights the importance of cost estimates embedded in mechanisms used within the project governance framework. Olsen et al.

(2005) highlight contract mechanisms and procurement management as important mechanisms to establish authority and control in oil and gas projects in Norway. The use of gating (a process with binary go/no-go decisions, the *gate* within a governance framework) is critical within the governance frameworks of Norway and Sweden (Olsson et al., 2019) and in the UK (Williams et al., 2010). This research will also capture the project governance mechanisms identified above and where in the project development phase such are applied by large hub US airports (Siemiatycki, 2009; Merrow et al., 1988).

Scope of Authority

The final dimension of project governance to be evaluated in this research is the scope of the authority assigned. The scope of authority includes two elements: the first pertains to time, e.g., when the control function begins, while the second is what project outcomes are the project governance structure trying to control. Much research has been conducted to evaluate the early project phases, such as planning and programming (Olsen et al., 2005; Brunet, 2021; Williams et al., 2010), yet there is limited research on the efficacy of project governance structures during design, bid award, and construction phase activities.

It is important under this research to understand the totality of the project cycle under the influence of project governance structures as many large hub US airports typically use less formal governance structures for the planning phase and more formal upon funding of approved project budgets[16].

Cost and schedule control are often cited as critical elements of a project governance framework (Klakegg et al., 2008; Olsson et al., 2019; Siemiatycki, 2009), yet there can be a much broader set of project objectives including sustainability (e.g., the environmental impact of

[16] Example includes Charlotte International Airport and Salt Lake City International Airport

the project), economic (does the project achieve financial goals of return on investment), and quality (Klakegg, 2009; Olsson et al., 2019). This research will identify the primary project objective of large hub US airport project governance structures.

Project Governance Theories and Theoretical Basis for this Research

Given the multi-disciplinary nature of project governance, it is not surprising to find many theories used in existing research to explain its behaviors. TCE is the bedrock of the influential research conducted by Williamson (1975, 1981), highlighting the use of economic optimization as the tool for making decisions, yet such an approach is limiting in describing the behaviors found in governance structures for large hub US airports that do not use TCE as a tool to make decisions or describe project organization behaviors. Turner and Keegan (1999) and Muller (2009) cite Agency Theory to explain the multiple interests that exist in project organizations between the owner and agents, as well as inherent information asymmetries found as projects are implemented and the role of project governance structures to control behaviors to ensure desired project outcomes are achieved. Although Agency Theory does describe certain behaviors of project governance, it is limiting in that not all participants can be captured within the realm of principal and agent roles. Identifying information asymmetry and associated elements of principal-agent behaviors are important, and when coupled with the features of Stakeholder and Shareholder Theories, offers a robust theoretical grounding for this research.

Institutional Theory is cited by Qiu et al. (2019) and Brunet (2021) to explain the significance of institutional logic and sources of institutional complexity that often result in adverse project outcomes and to evaluate project and governance complexity. Although complexity is an important component of project governance, it does not capture root causal features.

Artto and Kujala (2008) offer Contingency Theory to account for an adaptive approach to project governance as it is adapted to specific project conditions. The focus on adaptation does not fully describe project governance , limiting the explanation of causal elements.

Caniëls et al. (2012) use Contract Theory to explain the use of contracts as the "structural dimension in [project organization] relationships." Contracts are a vital element of structuring project organizations and are the primary tool used by large hub US airports to construct delivery organizations, yet contracts do not predict participant behavior as the same contract terms and conditions can manifest in widely different project participant behavior. However, it would be fair to acknowledge that the contract terms and conditions establish baseline parameters that influence behaviors.

Turner (2006a) offers a starting point for developing a Theory of Project Management to provide structure and a consistent approach to project management's evaluation and domain definition. The Theory of Project Management offered by Turner (2006a) is not a fully developed theory but a set of premises structured for further development, therefore not used in this research.

Muller (2009) cites the Shareholder, Stakeholder, and Agency theory to identify the features associated with maximizing shareholder value and the behaviors of a broader range of participants within the project implementation organization, such as the owner and project managers. Shareholder Theory is used to explain how organizations find a common cause (e.g. financial returns and stewardship of public funds in the case of public organizations) by which management can navigate the various interests many project stakeholders (Muller, 2009) towards achieving project objectives. Given the multi-disciplinary nature of construction project governance, Shareholder Theory alone, however, does not capture the complex nature of

construction project governance. In fact, the most current theoretical research has moved away from using Shareholder Theory as reflected by the research conducted by Derakhshan et al., (2019). Bekker and Steyn (2009) cite the same theories to highlight the various schools of thought in project governance research. Derakhshan et al., (2019) developed a conceptual framework to explain the features and influence of stakeholders in all aspects of construction project delivery. Derakhshan et al., (2019) limit Agency Theory to explain behaviors at the project level, with the interplay between principals and agents, information asymmetry, and exhibition of self-interests. However, the case could be made that the same principal-agent behaviors are exhibited at the corporate level where different members of senior and executive management are assigned roles on a construction project to be implemented (Aaltonen & Sivonen, 2009).

This research will be based on two theories: (1) Stakeholder Theory to explain how the needs of internal and external stakeholder needs are addressed (Muller, 2009; Derakhshan et al., 2019) ; and (2) Agency Theory to explain the principal-agent dynamic and associated behaviors stemming from information asymmetries and self-interest behavior found at all levels of project delivery organizations (Aaltonent & Sivonen, 2009; Muller 2009; (Derakshshan et al., 2019).

Definition of Key Terms

To fully describe the features, processes, systems, and behaviors that comprise a project governance framework, there are several construction and project management-related terms for which adopted definitions will be identified. A critical reason to adopt these definitions is the wide variety of interpretations associated with each, which can create confusion, biases or result in gathering information from respondents participating in this research which may be providing

data based upon an assumed definition than that used in this research thereby jeopardizing the construct validity of this research. .

Large Hub Airport

Most US airports are public entities that are part of state/local government or particular stand-alone purpose (e.g., aviation authority) and public organizations overseen by a politically selected board (Nichols, 2007). There are 28 large hub airports in the US as defined by the FAA: an airport that "receives one (1) percent or more of the annual U.S. commercial enplanements."[17] Of the twenty-eight large hub airports in the US, 46% are operated as a department within a city/county/state organization, while the remaining 54% are aviation-specific special-purpose public organizations (e.g., airport authorities, for example). The ability to implement project governance frameworks is, to varying degrees, dictated by the implementing organization's policies, procedures, enabling legislation, and board composition. This research will evaluate the structure and features that affect and inform the type of project governance framework adopted by the implementing large hub airport.

Megaproject

There is a wide range of definitions for the term *megaproject*. Flyvbjerg et al. (2003) define a megaproject as a construction project with a $1 billion (US) overall budget, is complex, and has a long implementation duration. Brookes and Locatelli (2015) do not identify a budget threshold but instead focus on megaprojects characterized by large financial commitments, having significant organizational complexity, and affecting "the economy, the environment, and society." Denicol et al. (2021) identify megaprojects as comprised of large infrastructure

[17] (https://www.faa.gov/airports/planning_capacity/categories/). In 2020 there were twenty-eight (28) large hub airports in the US as defined by the FAA (https://www.faa.gov/airports/planning_capacity/profiles)

improvements, complex structure and delivery, and whose cost and schedule performance record has been poor, similar to that of Merrow et al. (1988). Large hub US airports have a long history of implementing large, complex projects,[18] yet these projects comprise multiple elements, including various construction packages, such as roadways and airfield elements associated with the construction of a new terminal, for example. As such, the adopted the definition of a megaproject for this research will use aspects of that provided by Flyvbjerg et al. (2003) coupled with the multi-element composition of the project implemented by US large hub airports: a megaproject is a project comprised of one or multiple elements whose combined total budget (to include design, construction, project management, associated professional services, and any other allocated cost from the implementing airport) of $1 billion, is complex, is fully funded, and has a multi-year implementation period.

Project Budget, Cost, and Schedule Overruns

Cost overruns have been extensively analyzed in the existing research (Merrow et al., 1988; Siemiatycki, 2009; Flyvbjerg et al., 2003). Yet even with such extensive analysis, there is no standardized method for measuring the cost overrun condition. For example, Love et al. (2015) conducted a literature review of cost overruns, yet the primary focus was construction costs. Existing research would provide a clearer picture of cost overruns if all project costs (not just construction phase costs) associated with a project are adequately captured in the baseline budget upon which actual conditions are measured. Yet a project budget evolves as the project moves through the planning, funding/approval, design, and construction phases. Ultimately the budgeted costs become actual costs, and the asset constructed begins to be depreciated using

[18] Examples include the $4.5 billion Airport Redevelopment Program at Salt Lake City International Airport (source Salt Lake City Department of Airports) and the $1.5 billion Terminal 4 project at John F. Kennedy International Airport (source Port Authority of New York/New Jersey)

Generally Accepted Accounting Principles (GAAP),[19] as is the practice of large hub US airports. For this research, the adopted definition of the project budget is the project budget at the time the project was approved and funded for implementation[20] to include not only construction costs but also design costs, project management costs, environmental consultant costs, internal owners, staff, and other costs allocated to the project, specialty consultant costs, legal costs, and associated embedded or programmatic contingencies. Final costs are the aggregate value of all costs comprising the ultimate asset constructed that forms the basis of the built asset value depreciation using GAAP standards. This approach to defining budget and cost allows for narrower analysis within budget cost categories such as planned versus actual design costs and project management costs, providing a much more useful analysis tool. Budget history is defined as the evolution of the project budget at the end of the project planning phase, the approval/funding phase, the bid/award phase, and final costs as defined above.

Similar to cost overruns and budgets, there is no standard approach to measuring schedule overruns (Love et al., 2014, 2015). As such, for this research, the associated performance periods for design, construction, and asset turnover with each budget approved is the applicable baseline duration measured against the actual final performance period defined as notice-to-proceed design to final design and notice-to-proceed of construction to final completion date.

[19] In the US, GAAP is a standard of accounting practices issued by the Financial Accounting Standards Board (FASB).

[20] In certain cases, large hub US airports approved the entire project budget yet only funds that expected to be encumbered in the current fiscal year. This condition is most prevalent in airports which are part of a department of a city: examples include Salt Lake City International Airport, a department of the City of Salt Lake and Charlotte-Douglas International Airport, a department of the City of Charlotte.

Project

Artto and Kujala (2008) define a project as a combination of entities forming a temporary organization whose aim is to deliver an asset. The transient nature of project organizations, typically structured through contracts as presented by Winch (2006), introduces network effects to include "information asymmetry, social and institutional risks, … and other risk management procedures that do not fit into a networked context." The adopted definition of a project will combine elements of that presented by Artto and Kujala (2008) and Winch (2006): a project is an asset to be constructed in a finite amount of time and cost through the use of a temporary organization structured by the use of contracts delineating terms and conditions (and associated risk)[21] to be borne by each participating organization and the owner organization. The adopted definition describes many projects implemented by large hub US airports.

Methods Used in Existing Research

This section provides an overview of the research methods used to conduct existing research. The first part of this section is a summary of single method research, while the balance of this section, comprising most of the existing research, highlights the type of mixed research methods used to conduct research.

Love et al. (2014) used questionnaires on 58 projects to create the best-fit project performance analysis. They present a valuable tool for identifying themes and summarizing salient root causes. However, the questionnaires were somewhat limited to a particular feature of project performance rather than project governance which affects all project phases. Siemiatycki (2009), Liu et al. (2015), and Ahola et al. (2014) conducted literature reviews of project governance, performance, and project controls. The literature reviews provided useful

[21] Terms and conditions provide definition of scope and quality dimensions of the asset.

summarization of critical themes in the extant research and identification of the most cited research and history of existing project governance research upon previous related research (Ahola et al., 2014). Ruuska et al. (2009), Caniëls and Gelderman (2010), and Winch (2006) used single case studies as the method to research project governance. Winch (2006) provides a rich view and contextual information of each case study evaluated, yet all were conducted on non-aviation construction projects outside the US. Ruijter et al. (2021) used an auto-ethnographic research method to evaluate megaproject trust-building. Although the results are interesting as it pertains to what actions/structures of project governance result in trust-building, the research scope is too lengthy to implement as part of this research, yet elements could be used in this research if the workshop settings are used to triangulate data while not adding multiple years to finalize research results.

Bekker and Steyn (2009) used the Delphi technique to develop a definition of project governance. One issue with this research was a low response rate from participants during the evaluation phase. A low response rate is not indicative of the quality of the method yet points to parts of the research process where limitations may be introduced. Abednego and Ogunlana (2006) conducted various case study research to study a PPP project in Indonesia. A combination of case study and theoretical sampling was used by Olsen et al. (2005) to evaluate Norway's complex oil and gas construction project procurements. Turner and Keegan (1999) conducted comparative multiple case study research of four private sector companies for assessing project governance structures over time and the need for project-based (versus central command and control) governance structures. Turner and Simister (2001) conduct comparative studies of oil and gas companies in Norway to devise a contract type selection matrix that optimizes risk transfer and performance incentives. Williams et al. (2010) use comparative case

studies to evaluate the governance structures used in Norway and England. Aaltonen and Sivonen (2009) use multiple case studies of four projects to assess the different types of stakeholder pressures and associated mitigation strategies faced in delivering megaprojects. Denicol et al. (2021) develop multiple (six) case studies, interviews, and publicly available information to identify a generalized view of the entire project delivery organization. Crawford et al. (2008) use a two-part approach to evaluate the results of five studies using a multi-national team to code results and then evaluate the coding to identify emergent themes associated with the role of the project sponsor. Papadakis et al. (1998) use surveys and semi-structured interviews to research whether a capital investment is a strategic decision. Qiu et al. (2019) use a single case study and interviews to evaluate the performance of the project governance structure used in a $10 billion project whose jurisdiction was shared by mainland China, Macao, and Hong Kong. Abednego and Ogunlana (2006) used a single case study with an interview approach to research the leading project governance practices of a PPP project in Indonesia. Brady et al. (2007) used a single case study (Heathrow Terminal 5 project) and interviews to identify leading project delivery practices and organizational learning on one of the lone research efforts of an airport project.

Existing research has used many research methods to capture the complexity of project governance and extract useful findings: its multi-disciplinary nature, the multi-level elements including corporate governance, project organization and structure, project participants, and associated processes, systems, and tools used. As will be expanded in Chapter 3, this research lends itself to an efficient research methodology to gather respondent data.

Research Objectives and Propositions

The research objectives and associated propositions are structured to comprehensively assess large hub US airport governance structures' structure, practices, and scope of influence. Additionally, this research objectives and propositions are linked to construction project governance attributes identified from existing research (Table 2 and Figure 3).

Research Objective #1: Identify presence and form of the predominant governance structure used by large hub US airports to govern construction projects (Jaradat 2015; Artto and Kujala 2008, and Carlsson 2001).

P1: large hub US airports have formalized policies and procedures that describe the processes, tools, systems, and controls of their construction project governance structure.

Research Objective #2: Identify the tools, systems, and processes used to structure project governance structures at large hub US airports (Muller 2009; Jaradat 2015; Miller & Hobbs, 2005, and Bekker & Steyn 2009).

P2: governance structures for construction projects at large hub US airports span of control begins at the time a project budget is approved and funded and ends after a project.

P3: achievement of financial objectives is the primary objective of large hub US (airport construction project governance structures.

Research Objective #3: Identify the extent to which large hub US airports have internally developed standard agreements used to engage designers, contractors, and project management services (e.g., the project organization) Abednego and Ogunlana (2006) and Winch (2006).

P4A: large hub US airports do not utilize internally developed standard agreements to contracts for construction services.

P4B: large hub US airports do not utilize internally-developed standard agreements to contract for design services.

P4C: large hub US airports do not utilize internally developed standard agreements to contract for project management services.

Research Objective #4: Measure how large hub US airport project governance structures are dynamic or adapted to suit the project's specific needs being delivered (Miller & Hobbs, 2005).

P5: each large hub US airport implementing construction projects utilizes the same governance structure for all construction projects it implements**.**

CHAPTER 3 – METHODOLOGY

The research of large hub US airport construction governance structures is a subject not heavily studied in academic research providing an exciting opportunity to conduct exploratory research in this domain. The small number comprising the population of large hub US airports also provides a unique opportunity to research the entire population rather than using a sample, thereby strengthening the validity of this research. This chapter describes the research methodology, including the research method selected, sample size, respondent selection, alignment of research objectives, and associated propositions.

Research Method Selection

This research is exploratory as it seeks to answer a *what* question: e.g., identifying the predominant governance structure used by large hub US airports to deliver construction projects. Various methods are available to conduct this research, including case studies, interviews, surveys, and mixed methods that combine one or more of these methods. Case studies were discarded as the selected research method, given the prohibitive amount of work needed to develop case studies for the targeted population (Myers, 2013; Yin, 2014). Conversely, given the high variability in large hub airport governance structures and practices, a single (or a few) case study would offer limited insights into the practice representative of the population. Interviews were also considered and discarded as a research method given the expected time

needed to conduct them in the necessary number. Surveys using questionnaires provide an efficient and effective way to elicit information from the respondent population. A combination of close and open-ended questions allows for gathering targeted data on construction governance structures from the respondent population (Christensen et al., 2014). Despite limitations on the potential for low response rates and the need to validate measures, surveys still provide the most appropriate data gathering method for this research. Survey methods are also "advantageous when the research goal is to describe the incidence or prevalence of a phenomena" (Yin, 2014, p. 10). A survey using a questionnaire as the data gathering tool was selected as the methodology to conduct this research (Draugalis et al., 2008).

Research Methodology

This research methodology entails issuing a survey questionnaire to a senior airport business executive[22], senior airport financial executive[23], and senior airport executive overseeing construction[24] at each US large hub airport (28 US large hub airport population x 3 respondents per airport = 84 potential respondents)[25]. The same survey will be issued to all respondents and structured to elicit information about the respondent's organization's *existing* governance structure attributes, form, tools, and practices. Ultimately, the primary objective of this research is to receive at least one response from each US large hub airport organization in the population (28 responses). Receipt of additional responses will provide additional data for analysis but is secondary in research priorities. Using this approach to data acquisition, the resulting responses will provide data to describe the predominant construction project governance structure and identify opportunities for improvements.

[22] Titles of responding airports may differ for the same position.
[23] Titles of responding airport may differ for the same position.
[24] Titles of responding airport may differ for the same position.
[25] Justification of questionnaire length and response rates will be discussed in a later section.

Population

This research will evaluate the construction governance structures used by the entire population of large hub US airports to oversee the delivery of construction projects. As previously explained in Chapter 1, the term *large hub* pertains to the number of passengers processed by a US airport in a calendar year and is a term that is defined and reported by the FAA. This research uses the population of large hub airports as published by the FAA for the calendar year 2020, totaling 28 airports.

Respondent Selection

The successful delivery of a construction project is a collaborative process affecting the entire implementing organization, primarily when the implementing organization invests a large amount of funds in implementing construction projects, as is the case with large hub US airports. The success of a project and the associated project governance structure is materially affected by the senior managers of the implementing organization (Fareed et al., 2022; Alnasseri et al., 2013). Among the potential respondents, there are three positions uniquely qualified to have intimate knowledge of and experience with their organization's construction governance structure. The three individuals include a senior business operations executive, a senior financial executive, and a senior executive in the engineering and construction department.

The role of the senior business operations officer centers on the understanding of the overall objectives of the organization, including capital spending, interface, and accountability with the organization's board, which in the case of large hub airports is comprised of politically appointed or politically selected board members, and a wide range of project, community, passenger, and regulatory stakeholders. The role of the senior finance executive is critical to the success of a construction project and its associated governance in general, given they are a vital

resource in the identification and procurement of the funding needed to implement a capital activity, including general obligation bonds (General Airport Revenue Bonds), grants[26], internal sources of capital, and other alternative funding streams. Additionally, the senior finance manager can also be the lead agency dealing with financial regulatory compliance, such as external audits, which include Single Audits in the case of large hub US airports. From the technical perspective, the senior construction executive is critical in devising and implementing project delivery structures, management, controls, procurements, and risk mitigation across multiple projects. Each of these individuals provides a unique yet informed perspective on the organization's construction project governance structure, practices, tools, and processes and were selected as the respondents of the survey questionnaire.

Identification of Critical Themes in Existing Research

The questions in the proposed questionnaire are based on key themes associated with structure, practices, tools, and processes comprising construction governance structures identified from existing research in Chapter 2. Table 2 summarizes these key construction governance structure topics found in the existing research, which will be used to construct the questionnaire questions to conduct this research. The methodology used to link question topics to current research follows the methods used by Klakegg (2009), who conducted exploratory research on the sources of construction project failures. Note that each referenced question highlights whether such question is structured to gather information about existing or idealized elements of construction project governance structures.

[26] Including Airport Improvement Grants issued through the FAA, Other Transaction Agreements issued through the TSA and FAA, and state grants issued through the participating state's transportation department.

Table 2

Research Topics Extracted from Existing Research Used to Source Questionnaire Questions[27]

Existing Research Attribute	Existing Research Reference	Questionnaire Reference
Formality and maturity of governance structure for construction projects	Miller & Hobbs (2005), Bekker & Steyn (2009), Jaradat (2015), Artto & Kujala (2008), Carlsson (2001)	Question #3 & Question #4
Point in project cycle where the governance begins	Brunet (2021), Williams et al. (2010), Klakegg et al. (2008)	Question #19 & Question #20
Primary objective of PG	(Anderson et al., 2010) (Siemiatycki, 2009) (Bekker & Steyn, 2009)	Question #24
Level of owner control in administration of PG	(Bekker & Steyn, 2009), (Winch, 2006	Question #25
Adaptation of governance structure	(Turner & Keegan, 1999) (Muller, 2008, 2009) (Miller & Hobbs, 2005) (Jaradat, 2015) (Artto & Kujala, 2008)	Question #11 & Question #12
Level of owner control in administration of PG	(Bekker & Steyn, 2009), (Winch, 2006	Question #21, Question #22, Question #23
Project delivery categories	(Al Khalil, 2002)	Question #26
Reporting and tracking	(Bekker & Steyn, 2009) (Siemiatycki, 2009) (Klakegg et al., 2008)	Question #13 & Question #14
Procurement	(Olsen et al., 2005), (Jaradat, 2015), (Brady et al., 2005)	Question #15 & Question #16
Method of approval and approval control	(APM, 2004) (Williams et al., 2010) (Bekker & Steyn, 2009) (Olsen et al., 2005)	Question #17 & Question #18

[27] Questions #1 and #2 are not shown in Table 2 as they are administrative in nature, seeking consent and identifying the respondent.

Table 2

Research Topics Extracted from Existing Research Used to Source Questionnaire Questions[27]

Existing Research Attribute	Existing Research Reference	Questionnaire Reference
Contracts and contracting	(Harper et al., 2016) (Touran et al., 2011) (Berteslen, 2003) (Olsen et al., 2005) (Abednago & Ogunlana, 2006) (Winch, 2006)	Question #5, Question #6, Question #7, Question #8, Question #9 & Question #10

Survey Length and Response Rates

Existing research offers no consensus on the optimal length of surveys (Kanuk & Berenson, 1975; Christensen et al., 2014). Some argue that using specific techniques can enhance response rates, including pretesting and following up with respondents (La Mar Adams & Gale, 1982). The targeted respondents in this survey are time-constrained professionals, and it is expected that a survey greater than thirty minutes will negatively affect the response rate. Anderson et al. (2010) provide insights on survey length as they conducted exploratory research on cost estimating practices used by State Highway Agencies and used a 15-minute time frame to complete their survey comprised of 35 questions (mixing open- and closed-ended questions) (Dillman et al., 2014; Spitz et al., 2006). The questionnaire in this research will be developed following the structure used by Anderson et al. (2010) and Spitz et al. (2006), who used similar techniques on web-based surveys, which were also exploratory and conducted within the US transportation industry.

For this research, the definition of response rates provided by Draugalis et al. (2008) will be used: the ratio between the number of received responses (limiting multiple responses for the same airport to count as one against the population to align the unit of measure) by the number of

large hub airports in the population. There is no consensus on establishing an acceptable response rate standard: Spitz et al. (2006) suggest that 50% is acceptable, and those found by Manfreda et al. (2008) in a meta-analysis of 45 cases ranged between 11.13% and 82.13%. This research will adopt Spitz et al.'s (2006) acceptable response rate of 50% given the research was conducted in the US and within the transportation industry. To achieve the highest response rate, follow-up procedures will be used in the form of follow-up emails and phone calls where the respondents are known individuals to this researcher (Anderson et al., 2010).

Questionnaire Development and Measurement Scales

The questionnaire to be used in this research comprises closed-end questions about existing and idealized practices and selected exploratory questions about the improvement of existing practices. Close-ended questions provide a valuable tool to gather exploratory data from the population of respondents that is both targeted and for which responses are provided for the same data (Christensen et al., 2014). In addition, the use of open-ended questions and an optional open-ended explanatory section following each question provides the ability and opportunity for respondents to provide specific information in the respondent's own words (Christensen et al., 2014; Anderson et al., 2010).

The questionnaire (Appendix A) will be comprised of the following sections following the format and structure developed by Anderson et al. (2010):

1. Introduction, an overview of the research problem, and general context within which the questionnaire questions are being asked.
2. Respondent's information, including title and department within the organization within which they operate.

3. Questions about existing conditions of the respondent's organization's construction governance structure as well as opportunities for improvement.

Pre-Testing Questionnaire

Pretesting has been identified as an important tool for improving the quality (reliability and validity) of questionnaires (Draugalis et al., 2008; Collins, 2003). Pretesting the questionnaire for this research will entail a focus group of at least five industry practitioners with similar experience levels to the targeted respondents in their areas of expertise (business, finance, and construction). Feedback from the focus group will be used to refine the questionnaire before issuance to respondents.

Survey Software

The technical requirements of the questionnaire to be issued are not complex: (1) issuance of closed- and open-ended questions issued to a small respondent population and (2) short length of the survey (26 questions in total, including 2 of which are administrative). There are many web-based survey software tools available that could be used to conduct this research. Bocarnea et al. (2012) compared Qualtrics, SurveyMonkey, Polleverywhere, and LimeSurvey web-based software tools, and found that LimeSurvey offers less functionality than Qualtrics and SurveyMonkey (which both offer similar and extensive functionality depending on subscription levels). Bocarnea et al. (2012) also found that Poll Everywhere is geared towards live polling, which would not be a viable survey tool for this research. Wright (2005) conducted a review of 20 web-based survey software solutions and found that most offered similar base-level functionality, with pricing being the driver to access more sophisticated functions and data analysis. Wright's (2005) evaluation shows that SurveyMonkey provides comparable functionality to the other software tools analyzed. SurveyMonkey offers the needed technical

functionality for this research, is comparable to other similar software packages and is used frequently by US airport trade associations to gather feedback and opinions. Given these factors it was adopted as the web-based survey software solution to conduct this research.

Quality Control

Existing research highlights the importance of quality control methods used in surveys (Draugalis et al., 2008; Manfreda et al., 2008; de Wolf et al., 2001), emphasizing the need to ensure proper methods are in place for the sound creation of questionnaire structure, data integrity, and response quality. The quality control methodology for this research is adopted from that provided by (de Leeuw et al., 2008), highlighting the features of a quality control system to include questionnaire design (focus group and pre-testing of the questionnaire), response rates (this research provides for two methods of survey request follow-ups), survey data capture (using on-line survey through SurveyMonkey which has end to end secure data capture capability), and data analysis.

Research Objectives and Propositions

The research objectives identified in Chapter 2 are revisited below to align how the research methodology will achieve each. Propositions are also provided with each research objective to be evaluated in the execution of this research as follows:

Research Objective #1: Identify the presence and form of the predominant governance structure used by large hub US airports to govern construction projects (Jaradat, 2015; Artto & Kujula, 2008; Carlsson, 2001).

Method to Accomplish Research Objective #1: The governance structure of large hub US airports will be identified through a questionnaire (Appendix A). The questionnaire will gather data from three individuals of each large hub US airport with different senior roles within

the organization, providing a multi-dimensional perspective of the construction project governance structure. In addition to surveying the entire population of large hub US airports, the survey process is structured to provide data not only about existing structures and also provide data about opportunities for improvement.

P1: large hub US airports have formalized policies and procedures that describe the processes, tools, systems, and controls of their construction project governance structure.

Research Objective #2: Identify the tools, systems, and processes used to structure project governance structures at large hub US airports (Muller, 2009; Jaradat 2015; Miller & Hobbs, 2005; Bekker & Steyn, 2009).

Method to Accomplish Research Objective #2: Questions #12 through #25 in the questionnaire (Appendix A) are structured to gather information about the governance structure tools, systems, and processes associated with the population of large hub US airports surveyed.

P2: governance structures for construction projects at large hub US airports span of control begins at the time a project budget is approved and funded and ends after a project is completed.

P3: achievement of financial objectives is the primary objective of large hub US airport construction project governance structures.

Research Objective #3: Identify the extent to which large hub US airports have internally-developed standard agreements used to engage designers, contractors, and project management services (e.g., the project organization) (Abednego & Ogunlana, 2006; Winch, 2006).

Method to Accomplish Research Objective #3: Responses to Questions #4 through #9 of the questionnaire to be issued (Appendix A) address the utilization of standard contracts in existing and idealized conditions.

P4A: large hub US airports do not utilize internally developed standard agreements to contracts for construction services.

P4B: large hub US airports do not utilize internally developed standard agreements to contract for design services.

P4C: large hub US airports do not utilize internally developed standard agreements to contract for project management services.

Research Objective #4: Measure how large hub US airport project governance structures are dynamic or adapted to suit the project's specific needs being delivered (Miller & Hobbs, 2005).

Method to Accomplish Research Objective #4: Responses to Questions #10 and #11 of this research's questionnaire (Appendix A) will provide data about the extent to which large hub US airports adapt their construction project governance structures for each project's specific needs for both existing and idealized conditions.

P5: large hub US airports implementing construction projects utilize the same governance structure for all construction projects implemented.

CHAPTER 4 – RESULTS, DATA ANALYSIS, AND FINDINGS

This chapter presents the research results, data analysis, and findings using the research plan presented in Chapter 3. The first section of this chapter contains observations about the pre-testing process, composition and feedback from pre-test panel members, as well as resulting modifications to the questionnaire issued to respondents. Following it is a discussion of response rates achieved and the statistical relevancy of this research. A discussion of the research questionnaire structure follows, and a proposition map (Figure 3) is introduced, linking areas of study in the existing research to the attributes and related survey questions used in this research (Table 5). The scoring methodology is then presented, highlighting how response data was converted into standardized scores where applicable. A detailed analysis of each element (Table 5) within the research map (Figure 3) includes results, analysis, applicable proposition testing, and findings. The final section of this chapter aggregates these research results to construct and identify the predominant construction project governance structure used by large hub US airports to oversee capital project delivery. Also included in the final section of this chapter are aggregated findings about identified gaps and areas for improvements of existing construction project governance structures in the population surveyed.

Pre-testing Questionnaire

The pre-testing process entailed identifying panel participants who are experienced aviation industry professionals familiar with aviation-specific construction, aviation

management, and aviation construction project governance structures. The pre-test panel consisted of twelve (12) participants with an average of 35 years of aviation industry experience (Table 3). Pre-test panel members were provided with the same version of the questionnaire using the selected survey software to reflect actual questionnaire issuance conditions.

Table 3

Pre-Test Panel Participants

Panel Participant Number	Role	Experience (Years)
1	Former large hub airport chief architect	19
2	Former large hub airport chief executive officer and chief financial officer	31
3	Former large hub airport chief executive officer	44
4	Former large hub airport chief development officer	41
5	Former large hub airport chief development officer	45
6	Former large hub airport procurement officer	38
7	Former large hub airport chief development officer	35
8	Large hub airport head of capital program controls	36
8	Medium hub airport chief commercial development executive and past chief financial officer	33
10	Medium hub airport chief executive officer, large hub airport chief financial officer	35
11	Former Large hub airport chief commercial services officer and procurement officer	25
12	Former Large hub airport head of planning, engineering, and construction	38
	Average	**35**

Pre-test panel participants were given two weeks to complete their questionnaire review and provide feedback. A summary of the pre-test personnel feedback is included in Table 4. The feedback provided resulted in updates to the questionnaire to create the final version issued to respondents (included in Appendix A).

Table 4

Summarized Pre-Test Panel Questionnaire Comments

Summarized Comments	Resulting action in the final version of the questionnaire
Provide additional introductory language on the purpose and domain of project governance	Added language in the introduction
Provide additional language clarifying the anonymization process of the respondent and organization's data	Added language in the introduction
Highlight the ability to skip questions if participants do not wish to answer	Added functionality in survey form and language in the introduction
Provide expanded language on options for gap identification	Added options throughout applicable questions in the questionnaire
Define types of construction projects to be considered in answering applicable questions	Added language to applicable questions
Define participants in the project governance structure	Added language to applicable questions
Provide additional choices about the purpose of the construction project governance structure	Added options to applicable question
Removal of questions with overlapping themes	Removed two questions from the questionnaire
Survey length reduction	Removed two questions from the questionnaire
Provide additional data on project governance definition and elements, as some respondents may have difficulties responding if their construction project governance structure is not mature	Added language in the introduction
Provide additional fields for comments and explanatory information on the data provided	Added language and options to applicable questions
Provide the opportunity for respondents to identify tools and mechanisms of their construction project governance structure	Modified the applicable question to provide an opportunity to identify mechanisms
General editorial suggestions	Updated questionnaire document as applicable

Respondent Selection and Response Rate

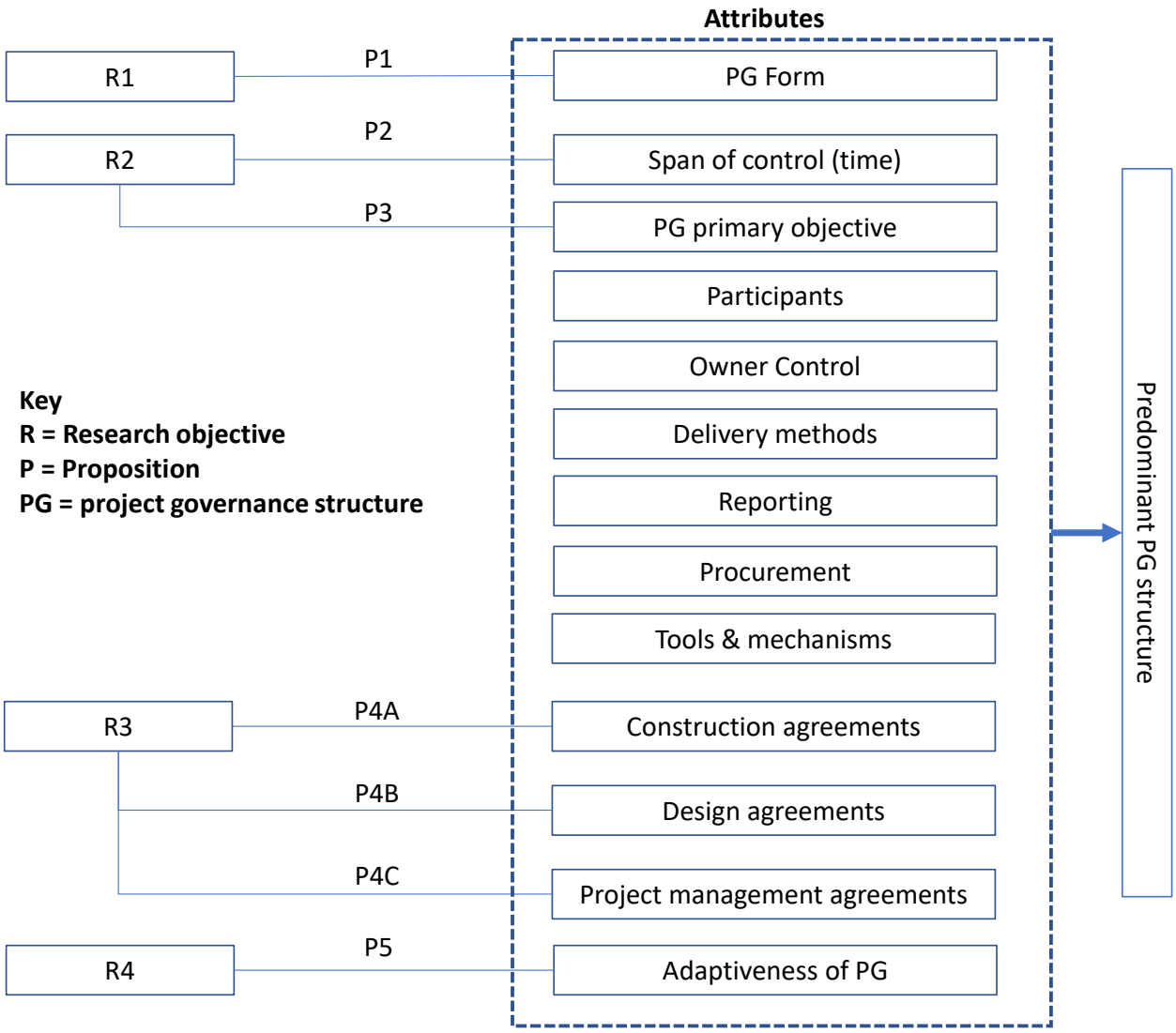
The respondent selection followed the methodology presented in Chapter 3. Requests for participation were issued to executives working with each of the 28 large hub airports comprising the population. Single responses were received from 22 of the 28 airports representing a 79% response rate which exceeds the 50% acceptable response rate for this research identified in Chapter 3. Additionally, it took respondents an average of 47 minutes to complete this research questionnaire comprised of 26 questions which is 32 minutes longer than what was used as the adopted survey expected response time of 15 minutes presented by Anderson et al. (2010).

Proposition Map, Research Questionnaire Structure, the Structure of Project Governance Descriptors

The tools described in this section link the project governance descriptors used in this research to existing research and this research questionnaire. The first tool maps this research objectives and propositions to attributes identified from the existing research to be used in constructing the predominant governance structure (Figure 3).

Figure 3

Research Objectives and Propositions Map



The second tool expands the proposition and research roadmap (Figure 3) linking existing research sources to this research questionnaire questions. To facilitate data analysis and interpretation, this research categorizes identified attributes based on their descriptive features: boundary attributes and internal mechanism attributes. For this research, boundary attributes are defined as construction project governance structure attributes that set forth dimensional

parameters of the construction project governance structure. The dimensional elements identified by boundary attributes include when a construction project governance function begins, its formality, the level of control exercised by the implementing large-hub airport, and the extent to which the governance structure adapts to govern unique elements of projects. Boundary attributes are used to construct the dimensions within which the internal mechanism attributes operate. Internal mechanism attributes are defined in this research as describing the tools, mechanisms, systems, and processes that make the construction project governance structure function to achieve desired objectives (as identified by the boundary descriptors). Using this approach to categorizing attributes, five boundary attributes and six internal mechanism attributes were identified as shown in Table 5.

Table 5

Linkage of Existing Research to the Project Governance Attributes used in this Research

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Formality and maturity of governance structure for construction projects	Miller & Hobbs (2005), Bekker & Steyn (2009), Jaradat (2015), Artto & Kujala (2008), Carlsson (2001)	Research Objective 1	Proposition 1	FORM	Boundary	Question #3 & Question #4
Point in the project cycle where the governance function begins	Brunet (2021), Williams et al. (2010), Klakegg et al. (2008)	Research Objective 2	Proposition 2	SPAN (time)	Boundary	Question #19 & Question #20
Primary objective of PG	Anderson et al. (2010), Siemiatycki (2009), Bekker & Steyn (2009)	Research Objective 2	Proposition 3	OBJECTIVE	Boundary	Question #24
Level of owner control in the administration of PG	Bekker & Steyn (2009), Winch (2006)	Research Objective 2	N/A	OWNER CONTROL	Boundary	Question #25
Adaptation of governance structure	Turner & Keegan (1999) Muller (2008, 2009), Miller & Hobbs (2005), Jaradat (2015), Artto & Kujala (2008)	Research Objective 4	Proposition 5	ADAPTATION	Boundary	Question #11 & Question #12

Table 5

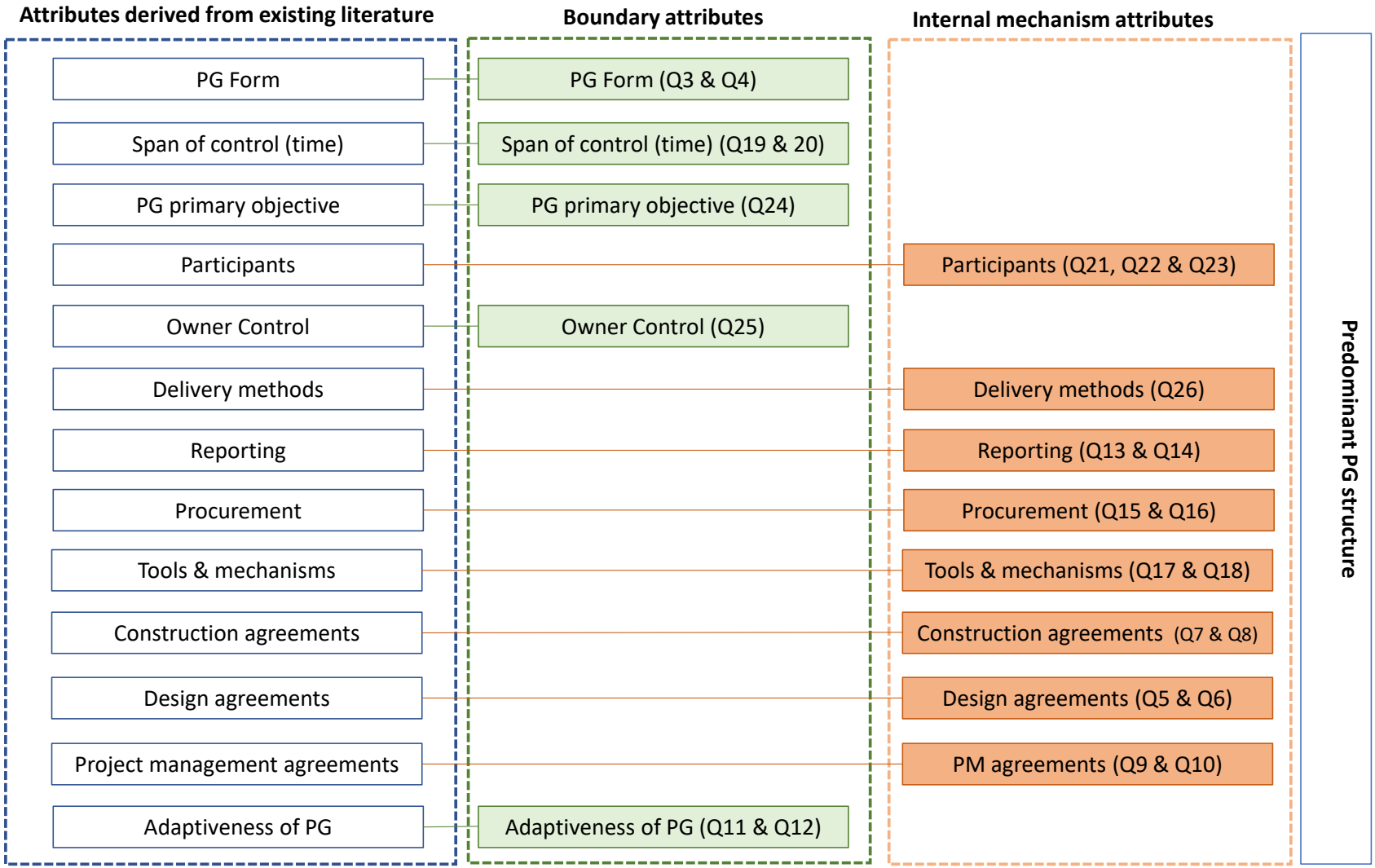
Linkage of Existing Research to the Project Governance Attributes used in this Research

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Level of owner control in the administration of PG	Bekker & Steyn (2009), Winch (2006)	Research Objective 2	N/A	PARTICIPANTS	Internal	Question #21, Question #22, Question #23
Project delivery categories	Al Khalil (2002)	Research Objective 2	N/A	DELIVERY METHODS	Internal	Question #26
Reporting and tracking	Bekker & Steyn (2009), Siemiatycki (2009), Klakegg et al. (2008)	Research Objective 2	N/A	REPORTING	Internal	Question #13 & Question #14
Procurement	Olsen et al. (2005), Jaradat (2015), Brady et al. (2005)	Research Objective 2	N/A	PROCUREMENT	Internal	Question #15 & Question #16
Method of approval and approval control	APM (2004) Williams et al. (2010) Bekker & Steyn (2009), Olsen et al. (2005)	Research Objective 2	N/A	TOOLS & MECHANISMS	Internal	Question #17 & Question #18
Contracts and contracting	Harper et al. (2016) Touran et al. (2011) Berteslen (2003) (Olsen et al. (2005) Abednago & Ogunlana (2006) Winch (2006)	Research Objective 3	Propositions 4A, 4B and 4C	CONTRACTS	Internal	Question #5, Question #6, Question #7, Question #8, Question #9 & Question #10

Data generated from each research question is then used to describe the applicable attribute, that when aggregated, will be used to describe the predominant construction project governance structure used by large hub US airports to oversee delivery of capital projects (Figure 4). As shown in Table 5, certain attributes are not tied to any propositions: these attributes are used in this research to provide additional exploratory information about the applicable research objectives. Benefits of this approach include grounding each element of this research to existing research, defining each boundary descriptor comprising the overall project governance structure, and establishing a methodology that can be used in future research to evaluate overall project governance performance or discrete elements within.

Figure 4

Mapping Boundary and Internal Mechanism Attributes to Describe the Overall Construction Project Governance Structure



Research results, analysis, and proposition testing (where applicable) will be presented following attribute order in Table 5. Summary-level observations about the objectives of this research, findings, and aggregated analysis will be provided following the presentation of each construction project governance attribute.

Scoring Methodology

This research questionnaire contains questions requiring respondents to prioritize and rank responses, select responses from a list (not prioritized), or provide data. Aside from tabulating responses, no scoring is needed for respondents selecting an answer from a list or providing a data response. Conversion of a prioritized/ranked response into a standard prioritized score is helpful for data analysis. For example, a standard score serves to identify and quantify the ranking of a specific response and show if there is a convergence of responses. There are two types of prioritization methods used in this research questionnaire: (1) open-ended questions, which asked respondents to rank opportunities for improvement (e.g., most important, 2nd most important, 3rd most important, etc.) and (2) closed-ended rankings, which asked respondents to rank responses using an ordinal scale from available selections where "1" represents the most important selection and "5" the least important.

Table 6

Scoring Methodology

Response Scale #1 (Open-ended)	Most Important	2nd	3rd	4th	5th
Response Scale #2 (Close-ended)	1	2	3	4	5
Assigned score (for either scale)	100	75	50	25	1
Question Response Population	N	N	N	N	N
Response weight[28]:	w	w	w	w	w
Weighted response score:	100*(w)	75*(w)	50*(w)	25*(w)	1*(w)

Each prioritized or ranked response is scored using the methodology described in Table 6. The purpose of utilizing the assigned score ranging from 100 to 1 was to create distance equally applied to ranked responses in a uniform manner to all ranked responses, especially when different respondents provided the same response under the same or different rankings. In such cases the weighted response score is aggregated into an overall weighted response score for the applicable responses to a question. Using this approach, both the frequency and prioritization scores of similar responses can be aggregated into a cumulative weighted score while maintaining the integrity of the ranking provided by respondents.

Data Analysis, Proposition Testing, and Findings

This section provides a detailed analysis of data collected for each element identified in Table 5, linking attributes of construction project governance found in existing literature, propositions, and research objectives, to this research's questionnaire questions and attributes to be used in identifying the predominant construction project governance structure. The analysis is

[28] Where w = 1/N: each response counts equally (prior to application of score based on ranking) towards the total population (e.g., 100% of responses to a given question).

presented by attribute type: Section 1 contains the results, analysis, and proposition testing for boundary attributes, while Section 2 contains the same information for internal mechanisms attributes (consistent with the structure presented in Figure 4). Where applicable, the results of proposition testing are conducted within each attribute where data is generated to allow for its evaluation.

Section 1 – Boundary Attributes

Attribute: FORM

Table 7

Overview of FORM Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Formality and maturity of governance structure for construction projects	Miller & Hobbs (2005), Bekker & Steyn (2009), Jaradat (2015), Artto & Kujala (2008), Carlsson, (2001)	Research Objective 1	Proposition 1	FORM	Boundary	Question #3 & Question #4

Description: This attribute describes the formality of the respondent's organization construction project governance structure. The measure used ranges from fully formal (e.g., all aspects of the construction governance function are described in adopted standard policies and procedures) to fully informal (e.g., no adopted policies and procedures exist describing any part of the construction project governance structure)

Question type and resulting data: Question #3 is a closed-ended question about the level of formality of respondents' organization construction project governance structure. Categorical groupings were created from responses to Question #3, summarizing the level of formality for a given category and calculated as a percentage of the total responses to this question. Question #4 is open-ended, asking respondents to rank the top three areas of their organization's construction project governance structure needing the most improvement in decreasing order. Responses to Question #4 were scored using the methodology presented in the Scoring Methodology section of this chapter and summarized in Figure 6. Figure 7 summarizes each improvement category by type, shown at the bottom of the figure as a key. For this research, 'type' is defined as the underlying characteristic of an improvement category.

Research Objective 1 (RO 1): Identify the predominant governance structure used by large hub US airports to govern the delivery of construction projects.

Table 7

Overview of FORM Attribute

Proposition 1 (P1): large hub US airports have formalized policies and procedures that describe the processes, tools, systems, and controls of their construction project governance structure	**P1 Test:** majority of respondents (50% or greater) having formalized policies and procedures that describe their construction project governance structure	**P1 Result:** ***P1 is accepted as*** **77**% of respondent organizations have formal policies and procedures fully describing **Most** or **All** of the aspects of their construction project governance structure (Figure 5)

FORM Findings

The test utilized to evaluate the presence of a formal construction project governance structure was whether the majority (50% or greater) used formal policies and procedures to describe their organization's construction project governance structure. The predominant FORM taken by the predominant construction project governance structure is formal, as the majority of respondents (77%) use formal policies and procedures that describe ALL (45%) or MOST (32%) elements of their organization's construction project governance structure (Figure 5).

Although formal policies and procedures exist, respondents identified a wide range of potential improvements to their existing governance structures as follows: (1) reporting (timeliness, relevance, key performance indicators), (2) intra-organizational management competencies and issues (not project issues), the (3) procurement function (efficiency, management, control), and (4) cost control function of the project governance structure (Figure 6).

Of the 12 improvement categories identified, 52.6% pertained to various aspects of management (functional areas, decision-making, coordination, resource assignment), 41.15% were process-related (functional processes, elements, data generated by processes), and 6.25% about contractual and regulatory requirements or issues (Figure 7).

Figure 5

Utilization of Formalized Construction Project Governance Policies and Procedures

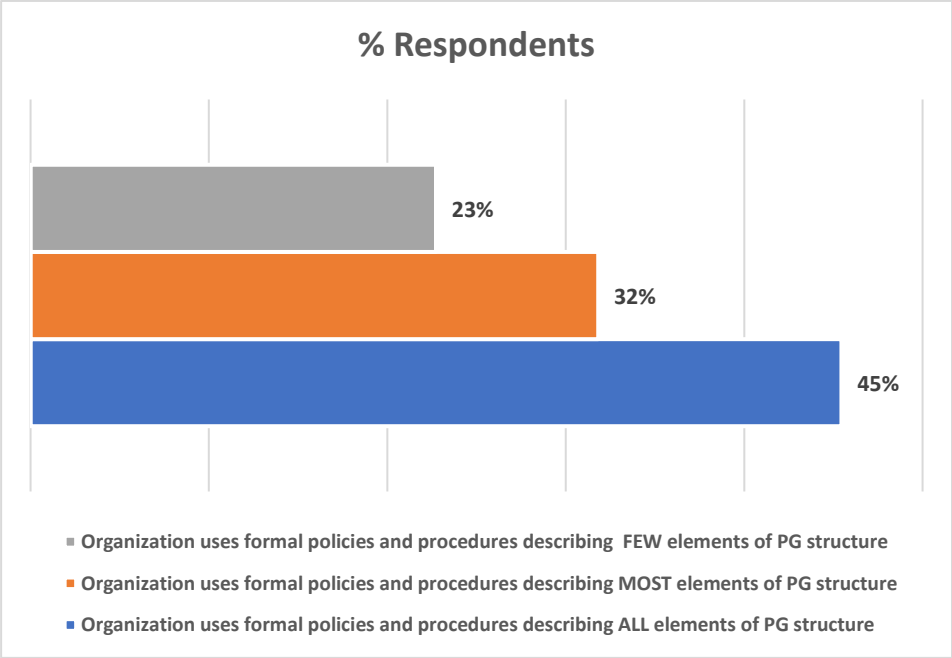


Figure 6

Cumulative Distribution of Prioritized Project Governance Potential Improvement Categories[29]

Ref/ Rank	Improvement category - governance structure (GS)	Improvement Type	Weighted Score	As % of total weighted score	Cumulative %
1-GS	**Reporting**	**P**	**13.31**	**17.19%**	**17.19%**
2-GS	**Intra Organizational Management**	**M**	**13.31**	**17.19%**	**34.38%**
3-GS	**Procurement process**	**P**	**12.90**	**16.67%**	**51.04%**
4-GS	Cost control & management	**M**	12.10	15.63%	66.67%
5-GS	Schedule control and management	**M**	8.06	10.42%	77.08%
6-GS	Design Management	**M**	4.84	6.25%	83.33%
7-GS	Regulatory and contract management	**C**	4.84	6.25%	89.58%
8-GS	Project priorization	**P**	3.23	4.17%	93.75%
9-GS	Risk Management	**M**	1.61	2.08%	95.83%
10-GS	Project governance structure	**P**	1.21	1.56%	97.40%
11-GS	Pay application processing	**P**	1.21	1.56%	98.96%
12-GS	Role of consultants / owners representative	**M**	0.81	1.04%	100.00%
	Sum of all weighted prioritization scores:		**77.42**	100%	

KEY: P = process, M = management, C = contractual/regulatory

(Dey, 1993)

Figure 7

Distribution of the Prioritized TYPE of PG Structure Improvement Categories[30]

Ref/ Rank	Improvement category - goverance structure (GS)	Improvement Type	Weighted Score (Category)		Weighted Score (Type)	As % of total weighted score
2-GS	**Intra Organizational Management**	**M**	**13.31**			
4-GS	Cost control & management	**M**	12.10			
5-GS	Schedule control and management	**M**	8.06	M	**40.73**	**52.60%**
6-GS	Design Management	**M**	4.84			
9-GS	Risk Management	**M**	1.61			
12-GS	Role of consultants / owners representative	**M**	0.81			
1-GS	**Reporting**	**P**	**13.31**			
3-GS	**Procurement process**	**P**	**12.90**			
8-GS	Project priorization	**P**	3.23	P	**31.85**	**41.15%**
10-GS	Project governance structure	**P**	1.21			
11-GS	Pay application processing	**P**	1.21			
7-GS	Regulatory and contract management	**C**	4.84	C	**4.84**	**6.25%**
	Sum of all weighted prioritization scores:		**77.42**		**77.42**	**100%**

KEY: P = process, M = management, C = contractual/regulatory

[29] Improvement type taxonomy derived using the methodology set forth by Dey (1993)
[30] Ibid

Attribute: SPAN (time)

Table 8

Overview of SPAN Attribute

Attribute: SPAN (time) existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Point in the project cycle where the governance function begins	Brunet (2021), Williams et al. (2010), Klakegg et al. (2008)	Research Objective 2	Proposition 2	SPAN (time)	Boundary	Question #19 & Question #20
Description: This attribute describes the point in the project development cycle when a project becomes subject to the construction project governance structure. The importance of establishing this point is that it creates the basis for establishing a standard measure from which a wide range of performance evaluations can be conducted as part of future research, such as cost and schedule performance, efficiency, and development of key performance indicators.						
Question type and resulting data: Question #19 is a close-ended question asking respondents to select the point at which projects become subject to their organization's construction project governance structure. Responses to Question #19 are summarized by response type and presented as a percentage of the responding population, as shown in Figure 8. Similarly, Question #20 is a close-ended question asking respondents to identify if the existing point of entry identified in Question #19 was appropriate or select a different point of entry that would improve existing conditions. Responses to Question #20 are summarized based on response categories, as shown in Figure 10.						
Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.						
Proposition 2 (P2): governance structures for construction projects at large hub US airports span of control begins when a project budget is approved and funded sometime after planning and prior to start of design and ends after a project is completed.	**P2 Test**: point of entry in the lifecycle where the project becomes subject to the organization's construction project governance structure.			**P2 Result**: ***P2 is not supported*** as 68% of respondents identified the point of entry in the planning/ programming phase of a project when the scope is defined rather than the time the project budget is approved (Figure 8).		

SPAN Findings

The predominant construction project governance SPAN of control begins in the planning/programming phase and ends after completion of construction (Figures 8 and 9, respectively), whereby the governance function is in place prior to significant funds being expended.

Fifty-nine percent of respondents believe that the existing point where a project is subject to the governance structure is appropriate and no changes are needed to current practice while 41% of respondents suggested modifying the point at which projects become subject to the project governance function (Figure 10).

Figure 8

Point in the Development Cycle Where a Project Becomes Subject to the Project Governance Structure Span of Control

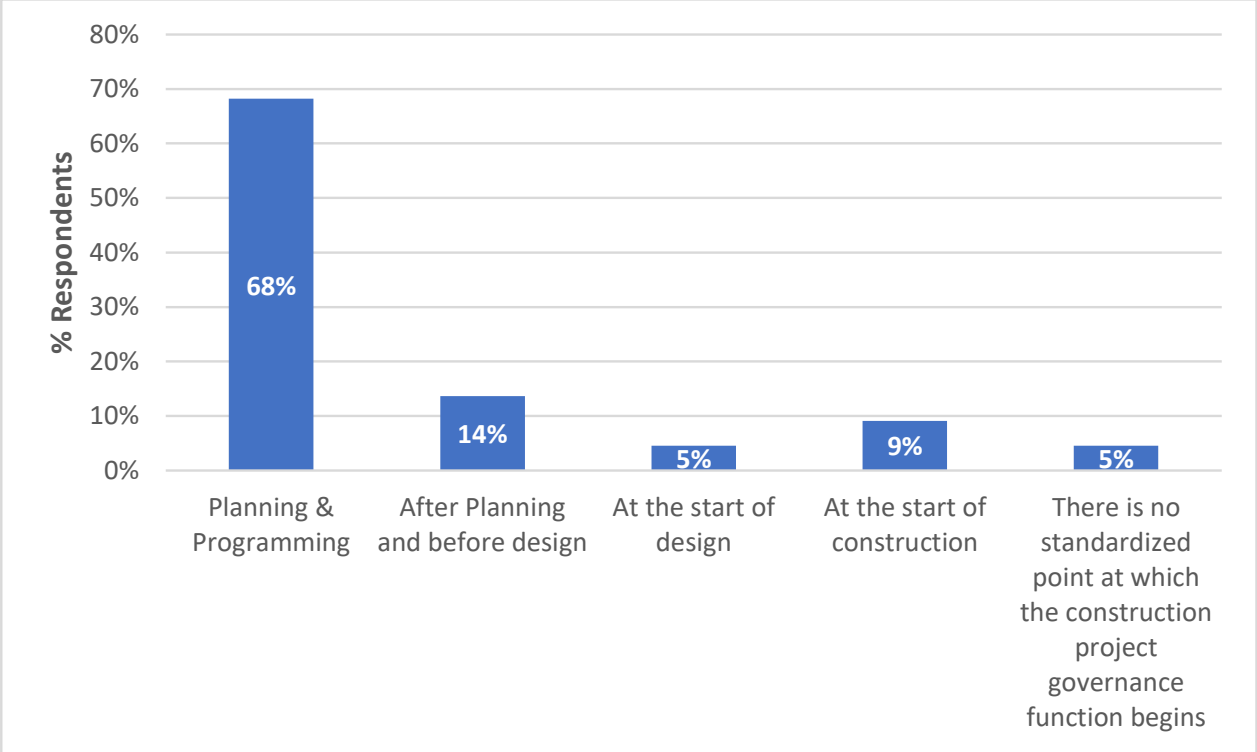


Figure 9

Project Governance Span of Control versus Illustrative Project Cashflow Curve

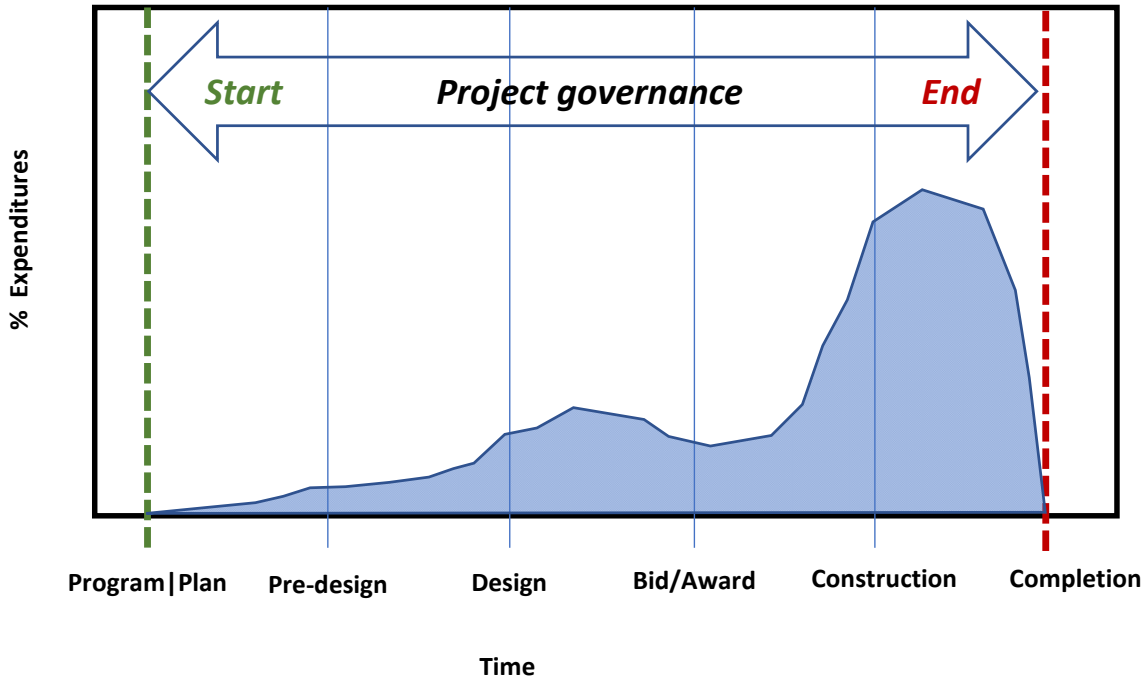
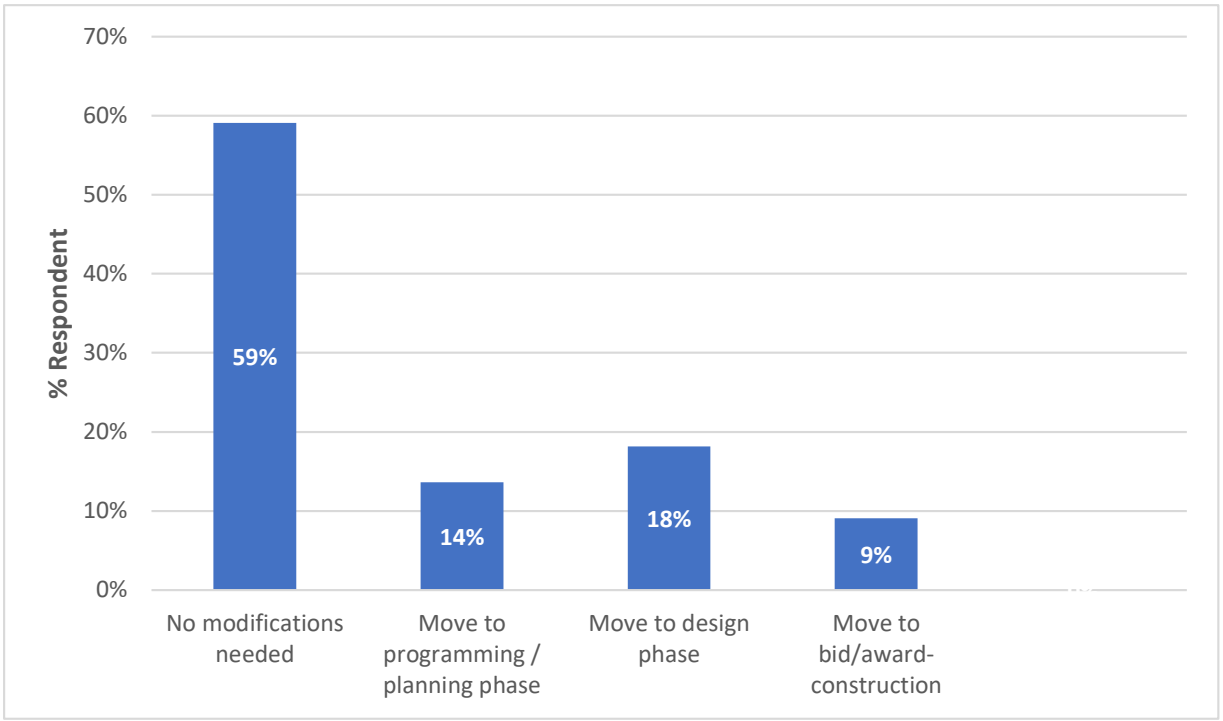


Figure 10

Changes to the Existing Project Governance Span of Control



Attribute: OBJECTIVE

Table 9

Overview of OBJECTIVE Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Primary objective of PG	(Anderson et al., 2010) (Siemiatycki, 2009) (Bekker & Steyn, 2009)	Research Objective 2	Proposition 3	OBJECTIVE	Boundary	Question #24

Description: This attribute describes the primary objective of the large hub US airport construction project governance structure. This attribute is important because the structure, tools, and mechanisms used are structured to achieve the primary objective: a construction project governance structure focused primarily on achieving time/schedule objectives will have different elements and form than one whose primary objective is to achieve financial goals. As structured, respondents ranked selections from a list and were allowed to comment and add attributes.

Question type and resulting data: Question #24 is a close-ended question asking respondents to rank five responses in decreasing order. Responses were scored using the methodology described in the Scoring Methodology section of this chapter, as shown in Figure 11.

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

Proposition 3 (P3): achievement of financial objectives is the primary objective of large hub US (airport construction project governance structures.	**P3 Test:** identification of primary project governance objective from the respondent population**.**	**P3 Result**: ***P3 is supported*** as the respondent population identified the financial objectives being the primary objective of large hub airport construction project governance structures (with a weighted priority score of 17.27, Figure 9)

OBJECTIVE Findings

The primary OBJECTIVE of large-hub US airports construction project governance structure is to achieve financial objectives, followed by time/schedule and regulatory compliance (Figure 11).

Figure 11

Primary Objective of the Construction Project Governance Structure

Objective	Weighted Score	As % of total weighted score	Cumulative %
Financial	**17.27**	**34.41%**	**34.41%**
Time/Schedule	**12.52**	**24.94%**	**59.34%**
Regulatory and compliance	**11.14**	**22.18%**	**81.53%**
Small/disadvantaged business	7.96	15.86%	97.39%
Sustainability/social impact	1.31	2.61%	100.00%
Sum of all weighted prioritization scores:	**50.20**	**100.00%**	

Attribute: OWNER CONTROL

Table 10

Overview of OWNER CONTROL Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Level of owner control in the administration of PG	Bekker & Steyn (2009), Winch (2006)	Research Objective 2	N/A	OWNER CONTROL	Boundary	Question #25

Description: This attribute describes the level of control exercised by the owner on financial and schedule project decisions. The level of OWNER CONTROL attributed can be used in conjunction with the PARTICIPANTS attribute to evaluate how the owner achieves the desired level of control over the construction project governance function, such as utilizing outsourced staff versus the employees of the large hub airport.

Question type and resulting data: Question #25 is a close-ended question providing four choices for respondents to select and presented as a percentage of the category responses to the population of responses, as shown in Figure 12.

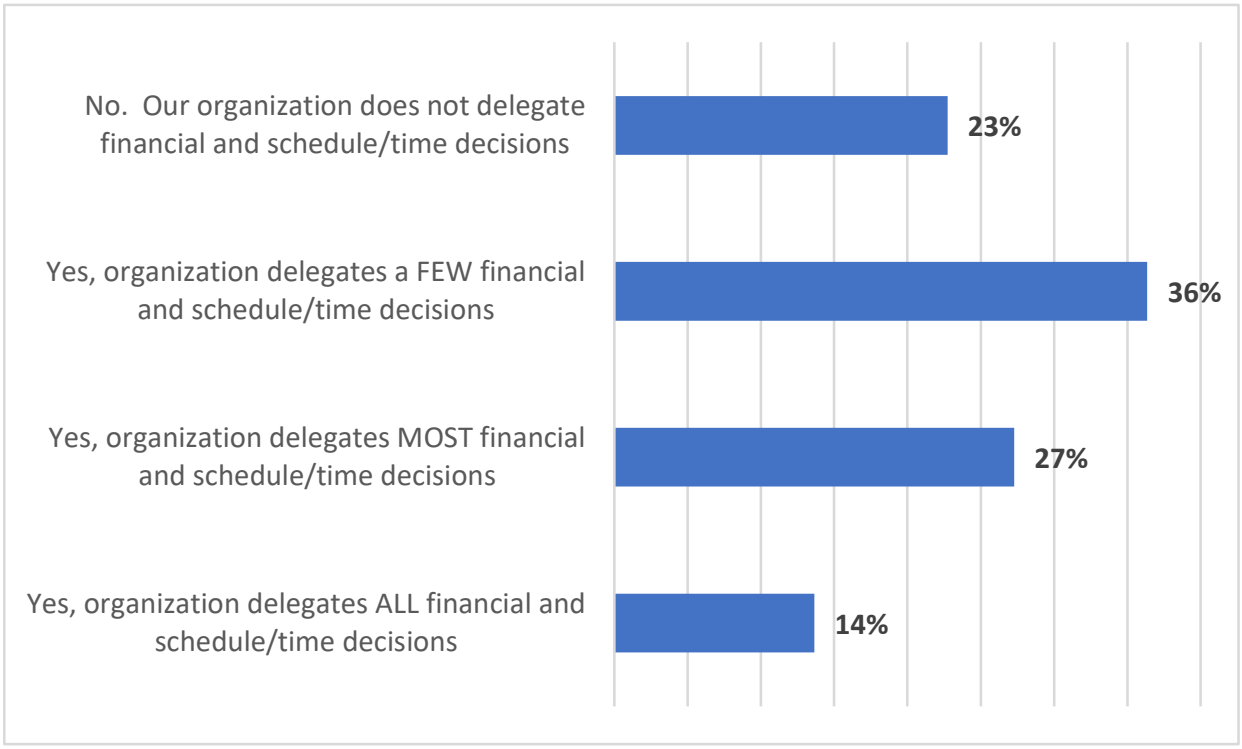
Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

OWNER CONTROL Findings

There is a bifurcation in the responding population about owner control of project financial and decisions. On one hand, 59% of respondents reported their organization did not delegate ANY (23%) or a FEW (36%) financial decisions and schedule decisions to the project delivery team. On the other hand, 41% of respondents reported delegating MOST (27%) or ALL (14%) financial and schedule project decisions to the project delivery team (Figure 12).

Figure 12

Extent Responding Large Hub Airport Organizations Delegate Decisions



Attribute: ADAPTATION

Table 11

Overview of ADAPTATION Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Adaptation of governance structure	Turner & Keegan (1999), Muller (2008, 2009), Miller & Hobbs (2005), Jaradat (2015), Artto & Kujala (2008)	Research Objective 4	Proposition 5	ADAPTATION	Boundary	Question #11 & Question #12

Description: This attribute describes the extent to which a large hub US airport construction project governance structure is adapted for a specific project. For example, a project delivered under a design-build delivery method will have different requirements than a project delivered through a "traditional" design-bid-build delivery method. Measuring the extent to which large hub US airports modify their project governance structure provides information on existing conditions of prevalent practices but also serves as a tool that establishes a basis for performance measurement of the extent to which adaptation affects project outcomes or ability to achieve higher throughput.

Question type and resulting data: Question #11 is a close-ended question asking respondents to identify the extent to which the same construction project governance structure is used to oversee projects. Scoring for Question #11 is presented as a percentage of responses to each category compared to the respondent population, as shown in Figure 13. Question #12 is an open-ended question asking respondents to list the top three actions their organization can take to increase the utilization of their organization's construction project governance structure. Scoring for Question #12 follows the methodology described in the Scoring Methodology section of this chapter (Figure 14). Figure 15 summarizes each improvement category by type at the bottom of the figure as a key. For this research, 'type' is defined as the underlying characteristic of an improvement category.

Research Objective 4 (RO 4): Measure how large hub US airport project governance structures are can adapt to govern the specific requirements of a project being implemented.

Table 11

Overview of ADAPTATION Attribute

Proposition 5 (P5): each large hub US airport implementing construction projects utilizes the same governance structure for all construction projects it implements.	**P5 Test:** quantify the extent to which large hub US airports use the same governance structure for all construction projects	**P5 Result**: ***P5 is supported*** as 55% of the population reported their organization utilizes the same project governance structure for ALL their construction projects, and 41% of respondent organizations reported using the same project governance structure for MOST of their construction projects (Figure 13)

ADAPTATION Findings

Ninety-six percent of respondents reported their organization utilized the SAME construction project governance structure: 55% for ALL projects and 41% for MOST of their projects (Figure 13).

Although 96% of respondents used the same construction project governance structure for ALL or MOST of their projects (Figure 13), 91% of respondents used more than one delivery method (Figure 19). As such, there may be a potential disconnect between the governance requirements associated with existing conditions where rigid construction project governance structures are utilized to govern complex and dynamic project delivery methods. Symptoms associated with this condition may be manifest in the identification of a wide range of improvements to the governance structure (Figure 6), utilization (Figure 15), and contracting (Figures 33, 35, and 37, respectively).

Respondents identified training (both to improve technical competency and fluency in understanding utilization of existing project governance function), performance measures (definition, leading practices, quantification of project data), and reporting, as the top three areas of improvement to increase the utilization of their organization's construction project governance structure (Figure 14). Note that Figure 14 captures respondent data about possibly improving the utilization of the existing project governance structure, while Figure 6 captures respondents' responses about possible improvements to the overall construction governance structure.
Of the 12 improvement categories identified to increase utilization of project governance structure, 14.29% pertained to various aspects of management (functional areas, decision-making, inter-department coordination, resource assignment), 57.14% are process-related (functional processes, elements of a process, definition, and data generated by processes), and

28.57% about the need for training (fluency utilizing existing tools and mechanisms of project governance structure and technical capability to manage complex project environments) (Figure 15).

Figure 13

Extent Large Hub US Airports Utilize the Same Construction Project Governance

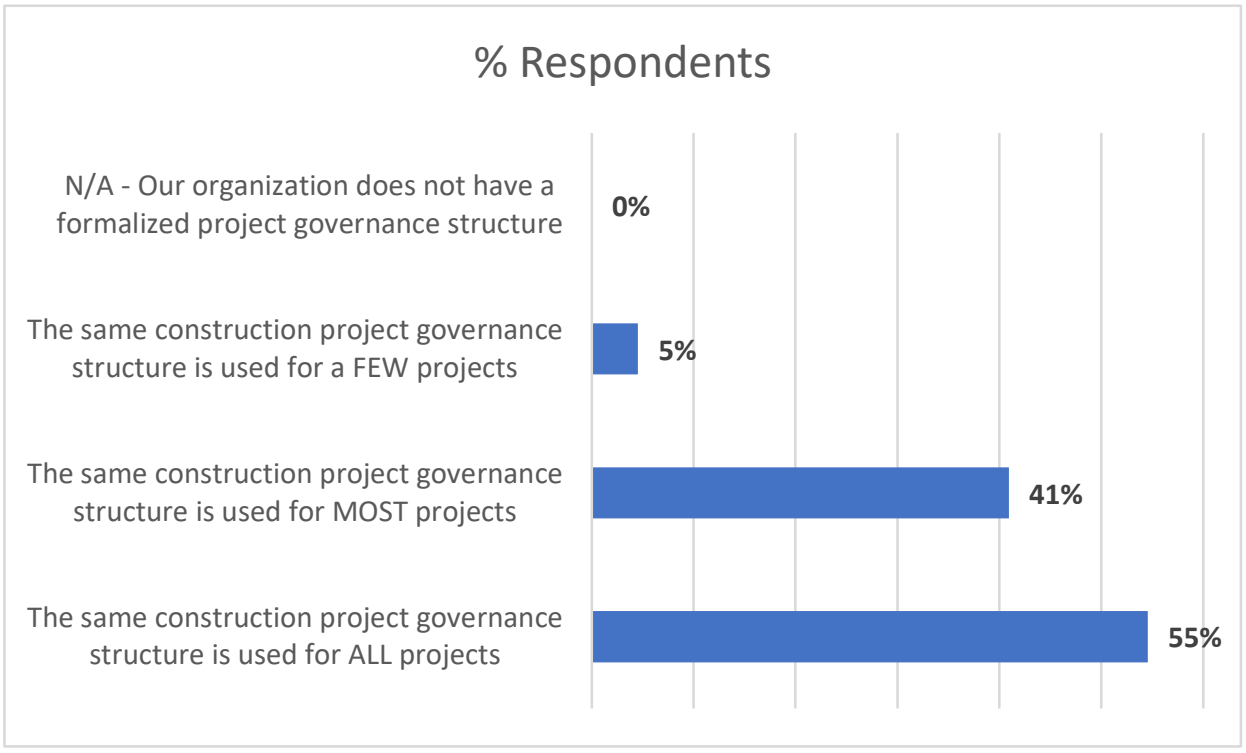


Figure 14

Ranked Improvements to Increase the Utilization of the Construction Project Governance Structure

Ref/ Rank	Improvement category - Utilization	Improvement Type	Weighted Score	As % of total weighted score	Cumulative %
1-UT	**Training**	**T**	**22.41**	**28.57%**	**28.57%**
2-UT	**Performance measures**	**P**	**12.93**	**16.48%**	**45.05%**
3-UT	**Reporting**	**P**	**12.07**	**15.38%**	**60.44%**
4-UT	Increase standarization and efficiency of goverance process	**P**	10.78	13.74%	74.18%
5-UT	Adapting PG based on project delivery method	**P**	6.03	7.69%	81.87%
6-UT	Intra organization departmental management	**M**	6.03	7.69%	89.56%
7-UT	Schedule control	**M**	2.59	3.30%	92.86%
8-UT	Formalize project governance process	**O**	1.72	2.20%	95.05%
9-UT	Definition of delegated authority	**O**	1.29	1.65%	96.70%
10-UT	Compliance audits	**M**	0.86	1.10%	97.80%
11-UT	Data management	**M**	0.86	1.10%	98.90%
12-UT	Resources to administer governance function	**M**	0.86	1.10%	100.00%
	Sum of all weighted prioritization scores:		**78.45**	100%	

KEY: P = process, M = management, T = Training

Figure 15

Distribution of the Prioritized TYPE of Project Governance Utilization Improvement Categories

Ref/ Rank	Improvement category - Utilization	Improvement Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
6-UT	Intra organization departmental management	M	6.03			
7-UT	Schedule control	M	2.59			
10-UT	Compliance audits	M	0.86	M	11.21	14.29%
11-UT	Data management	M	0.86			
12-UT	Resources to administer governance function	M	0.86			
8-UT	Formalize project governance process	P	1.72			
9-UT	Definition of delegated authority	P	1.29			
2-UT	**Performance measures**	P	**12.93**			
3-UT	**Reporting**	P	**12.07**	P	44.83	57.14%
4-UT	Increase standarization and efficiency of goverance process	P	10.78			
5-UT	Adapting PG based on project delivery method	P	6.03			
1-UT	**Training**	T	**22.41**	T	22.41	28.57%
	Sum of all weighted prioritization scores:		78.45		78.45	100%

SECTION 2 – Internal Attributes

Attribute: PARTICIPANTS

Table 12

Overview of PARTICIPANTS Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Level of owner control in the administration of PG	Bekker & Steyn (2009), Winch, (2006)	Research Objective 2	N/A	PARTICIPANTS	Internal	Question #21, Question #22, Question #23

Description: This attribute describes the number and nature of participants within large hub US airports construction project governance structure. The number of participants identifies how many individuals are part of the construction project governance structure in roles such as administrative, management, finance, or project delivery team. The nature of the participant identifies whether they are employees of the implementing large hub airport or external to the organization such as consultants. Finally, respondents provide information about whether a higher number of project governance participants should be employees of the implementing airport organization. Information about this attribute can be combined with data about OWNER CONTROL to compile a more holistic picture of how the project governance structure is staffed.

Question type and resulting data: Question #21 asks respondents to provide the percentage of participants in their organization's construction project governance structure who are employees of the airport organization (versus consultants and other non-employee participants). Responses to Question #21 are provided as a single percentage value or, in other instances, a range (both were acceptable responses). Question #23 asks respondents to identify the total number of individuals who participate in their construction governance function, irrespective of whether they are an employee of the airport organization, a consultant, or as part of another arrangement. The results of Question #21 and Question #23 are summarized in Figure 16. Question #22 is a closed-ended question about modifications to their existing construction project governance structure staffing. Respondent selections to Question #22 are summarized as a percent of a category to the responding population (Figure 17).

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

PARTICIPANTS Findings

The construction project governance structure administered by large hub US airports is, on average, staffed by 66 participants, 48% of which are airport employees, and the remaining 52% are non-employees, such as consultants. Figure 16 provides the range of reported minimum and maximum staffing levels and the percentage of which are airport employees.

59% of respondents reported that the existing level of respondent airport employee staffing was appropriate, and no changes are needed, while 36% reported that an increase to the level of airport employee participation was desired, and the balance, 5%, reported a desire to decrease the existing level of airport employee staffing the construction project governance structure (Figure 17).

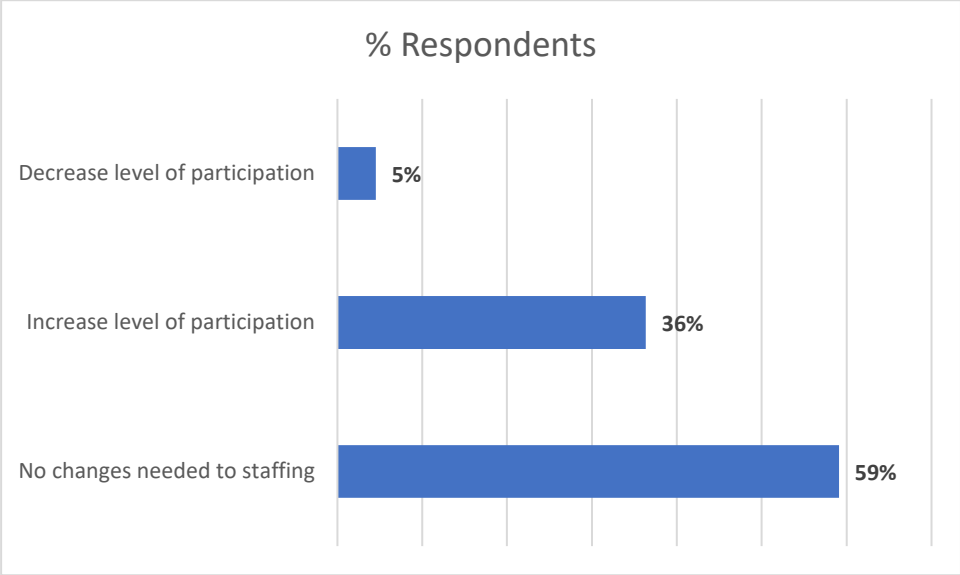
Figure 16

Staffing of Construction Project Governance Structure Function

Element	AVG	LOW	HIGH
Total number of individuals (ea) administering the PG function (admin, oversight, support staff, management)	66	2	200
Element	**AVG**	**LOW**	**HIGH**
% of individuals administering PG function which are employees of organization	48%	8%	100%

Figure 17

Reported Need to Adjust Staffing Levels



Attribute: DELIVERY METHODS

Table 13

Overview of DELIVERY METHODS Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Project delivery categories	Al Khalil (2002)	Research Objective 2	N/A	DELIVERY METHODS	Internal	Question #26

Description: This attribute describes the type(s) of project delivery methods used by large hub US airports to deliver capital projects. There are five categories covering most delivery methods: design-bid-build with a general contractor ('traditional d-b-b'), design-bid-build with a CMAR, design-build with a general contractor and a CMAR, public/private partnerships (P3), and developer agreements. A sixth option was provided where respondents could identify an additional delivery method. The significance of respondent data about this attribute is the ability to understand the range of delivery methods used by respondent organizations, which can then be compared to the degree of adaptation associated with the respondent's organization's existing project governance structure (ref. ADAPTATION attribute).

Research question and resulting data: Question #26 is a mixed, close, and open-ended question asking respondents to select each applicable type of project delivery method utilized by their organization with the added option to select "Other" and specify a new category. Responses to Question #26 are summarized as a percentage of each category to the responding population provided in Figure 18. Metrics on the number and configuration of delivery methods used by each respondent organization are provided in Figure 19.

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

DELIVERY METHODS Findings

Traditional design-bid-build with a general contractor and design-build delivery methods are used by 86% of the respondent organizations, followed by 77% of the respondents who utilize design-bid-build with a CMAR (Figure 18).

The highest frequency of delivery methods used by respondents is three reported by 59% of respondent organizations: The most popular combination within this grouping is design-bid-build with a general contractor, design-bid-build with a CMAR, and design-build. A detailed breakdown of the number of procurements utilized by respondent organizations and associated combinations is provided in Figure 19.

Figure 18

Utilization of Delivery Method Type

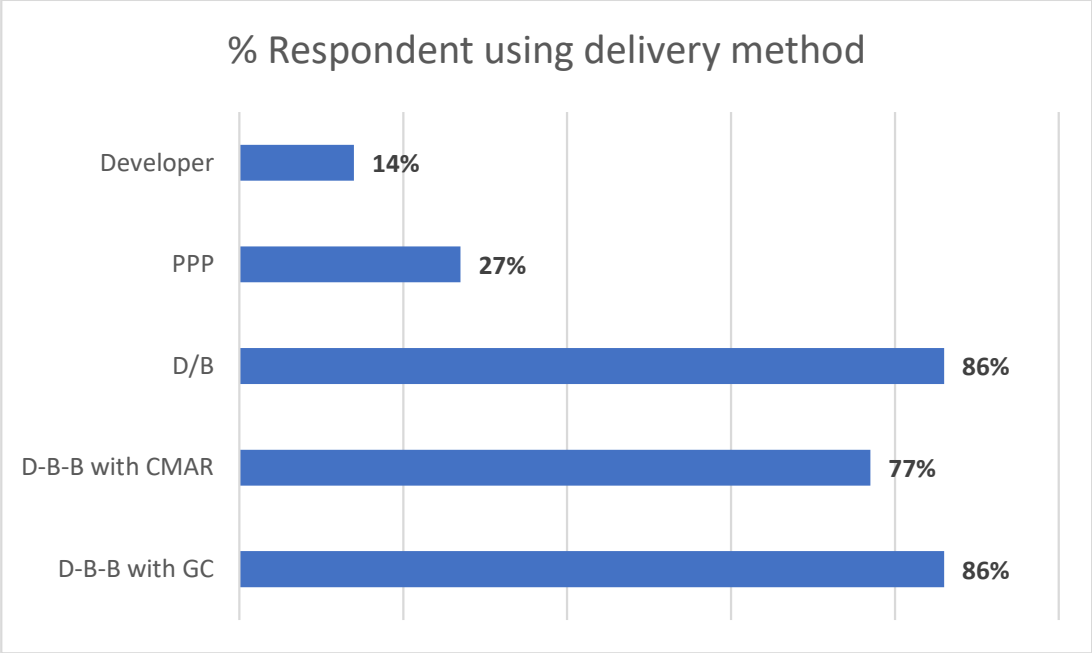
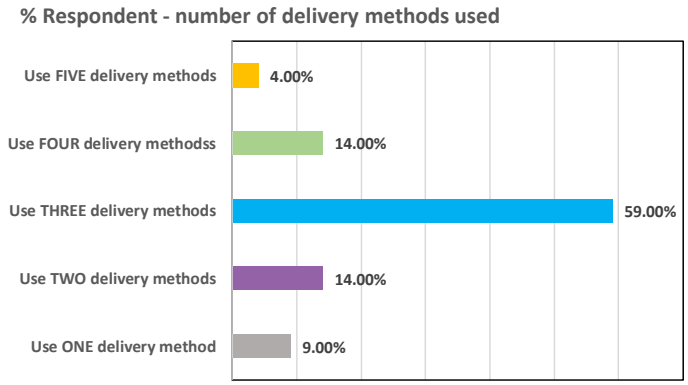


Figure 19

Utilization of Multiple Delivery Methods and Associated Combinations



% Respondent using FIVE delivery methods (4%)			
D-B-B GC			
D-B-B CM			
D/B			
P3			
Developer			
% of combination	100%		100%

% Respondent using FOUR delivery methods (14%)			
D-B-B GC			
D-B-B CM			
D/B			
P3			
Developer			
% of combination	66%	34%	100%

% Respondent using THREE delivery methods (59%)				
D-B-B GC				
D-B-B CM				
D/B				
P3				
Developer				
% of combination	69%	8%	23%	100%

% Respondent using TWO delivery methods (14%)			
D-B-B GC			
D-B-B CM			
D/B			
P3			
Developer			
% of combination	66%	34%	100%

% Respondent using ONE delivery method (9%)			
D-B-B GC			
D-B-B CM			
D/B			
P3			
Developer			
% of combination	50%	50%	100%

Attribute: REPORTING

Table 14

Overview of REPORTING Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Reporting and tracking	Bekker & Steyn (2009), Siemiatycki (2009), Klakegg et al. (2008)	Research Objective 2	N/A	REPORTING	Internal	Question #13 & Question #14

Description: Reporting is a critical function of the construction project governance structure. Seven different types of reports were identified and evaluated to understand respondent utilization.

Question type and resulting data: Question #13 is a closed-ended question where respondents identify the reports used by their organization. Responses to Question #13 are presented as a percentage of the category responses to the population (Figure 20). Question #14 is a close-ended question asking respondents to rank improvement areas in decreasing order. Scoring for Question #14 followed the methodology described in the Scoring Methodology section of this chapter and summarized in Figure 21. Figure 22 summarizes each improvement category by type, shown at the bottom of the figure as a key. For this research, 'type' is defined as the underlying characteristic of an improvement category.

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

REPORTING Findings

Ninety-one percent of respondents reported utilizing financial/cost reports, which would be consistent with the fact that the primary objective of large hub US airport construction project governance structure is financial (Figure 11). Utilization of schedule/time and small business participation followed by reported rates of 86% and 82%, respectively (see Figure 20 for a detailed listing of utilization rates by report type).

From an improvement perspective, the respondents' highest-ranked improvement area was the development of processes to generate appropriate/timely/relevant reporting data, followed by the implementation of systems to generate reports and accountability measures to adhere to stated performance measures/KPIs (see Figure 21 for a listing of prioritized categories of improvement).

59.98% of the reporting improvements ranked were *process-related, 23.20%* pertained to *information technology systems*, and the balance, 16.82%, was about *training to improve the utilization of the project governance function* (Figure 22).

Figure 20

Reporting Utilized by Respondents

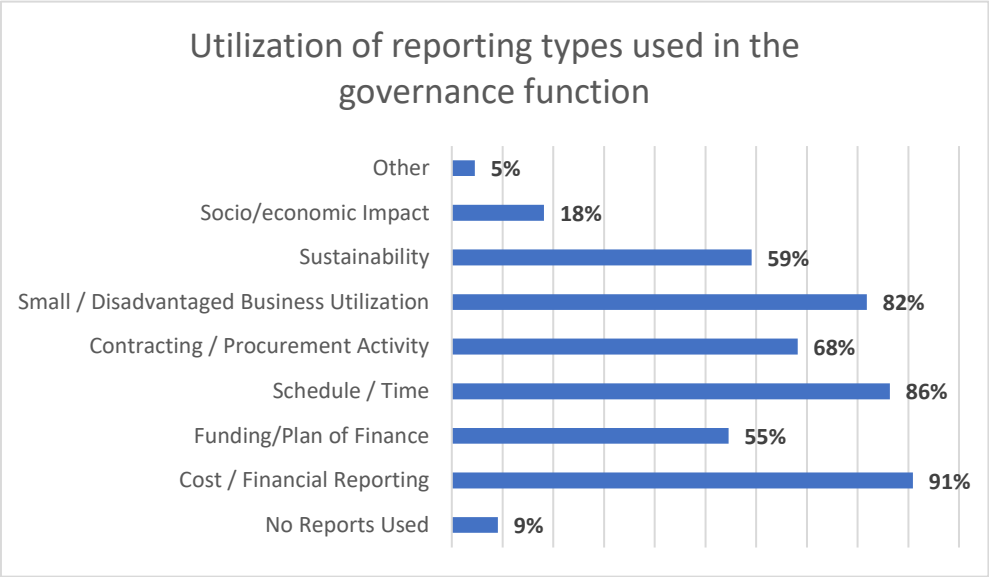


Figure 21

Prioritized Actions to Improve Project Governance Reporting

Ref/ Rank	Improvement category - reporting	Improvement Type	Weighted Score	As % of total weighted score	Cumulative %
1-RE	**Develop processes that generate performance data**	**P**	**12.28**	**25%**	**25%**
2-RE	**Implement systems to generate reporting data**	**S**	**11.59**	**23%**	**48%**
3-RE	**Implement accountability measures to ensure adherence to KPIs/performance**	**P**	**8.85**	**18%**	**65%**
4-RE	Develop KPIs as none in place	**P**	8.84	18%	83%
5-RE	Training to improve data analysis and management actions	**T**	8.41	17%	100%
	Sum of all weighted prioritization scores:		**49.97**		

KEY: P = process, M = management, T = Training, S = Systems

Figure 22

Distribution of the Prioritized TYPE of Reporting Project Governance Improvement Categories

Ref/ Rank	Improvement category - reporting	Improvement Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-RE	**Develop processes that generate performance data**	**P**	**12.28**			
3-RE	**Implement accountability measures to ensure adherence to KPIs/performance**	**P**	**8.85**	**P**	**29.97**	**59.98%**
4-RE	Develop KPIs as none in place	**P**	8.84			
2-RE	**Implement systems to generate reporting data**	**S**	**11.59**	**S**	**11.59**	**23.20%**
5-RE	Training to improve data analysis and management actions	**T**	8.41	**T**	**8.41**	**16.82%**
	Sum of all weighted prioritization scores:		**49.97**		**49.97**	**100%**

KEY: P = process, M = management, T = Training, S = Systems

Attribute: PROCUREMENT

Table 15

Overview of PROCUREMENT Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Procurement	Olsen et al. (2005), Jaradat (2015), Brady et al. (2005)	Research Objective 2	N/A	PROCUREMENT	Internal	Question #15 & Question #16

Description: This attribute describes the activities used by large hub US airports to select and contract with organizations to design, manage, and construct a capital asset. The product of the procurement process is a contract between the airport owner and the organization engaged to provide goods, services, or build a project. Contracts are the method by which project organizations are predominantly established and are temporary in nature. The data gathered about this attribute focuses on the level of integration of the procurement function and the construction project governance function.

Question type and resulting data: Question #15 is a closed-ended question asking participants to select from four options. Responses to Question #15 are expressed as a percentage of each category to the response population in Figure 23. Question #16 asks respondents to rank a list of potential improvements to the procurement function. Scoring for Question #16 followed the methodology described in the Scoring Methodology section of this chapter. Question #16 also provided an added feature option where respondents could select "not applicable as no improvement needed." Figure 24 summarizes the percentage of the population reporting that no improvement was needed to the existing procurement function. Figure 25 contains the prioritized score of the remaining responses whose score was calculated using the methodology described in the Scoring Methodology of this chapter. Figure 26 summarizes each improvement category by type, shown at the bottom of the figure as a key. For this research, 'type' is defined as the underlying characteristic of an improvement category.

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

PROCUREMENT Findings

Forty-six percent of respondents reported that their organization's procurement function is fully integrated with the construction project governance function, while 36% reported that MOST elements of their organization's procurement function are integrated with the construction project governance structure. Nine percent of respondents reported that their organization's procurement function was either not integrated with the construction project governance function or only a few elements were integrated (Figure 23).

Additionally, 67.97% of the procurement categories for improvement are *process-related,* while the balance, 32.03% are related to *management* activities (Figure 26).

Approximately one-third of respondents reported that no modifications are needed to the identified improvement categories as existing practices were adequate (Figure 24). In contrast, respondents reported that the procurement function was the third highest-ranked improvement category (Figure 6). One reason that could explain this potential disconnect is that the areas requiring improvement in the procurement function are different from those identified in Figures 24 and 25.

Figure 23

Integration of Procurement with Construction Project Governance Function

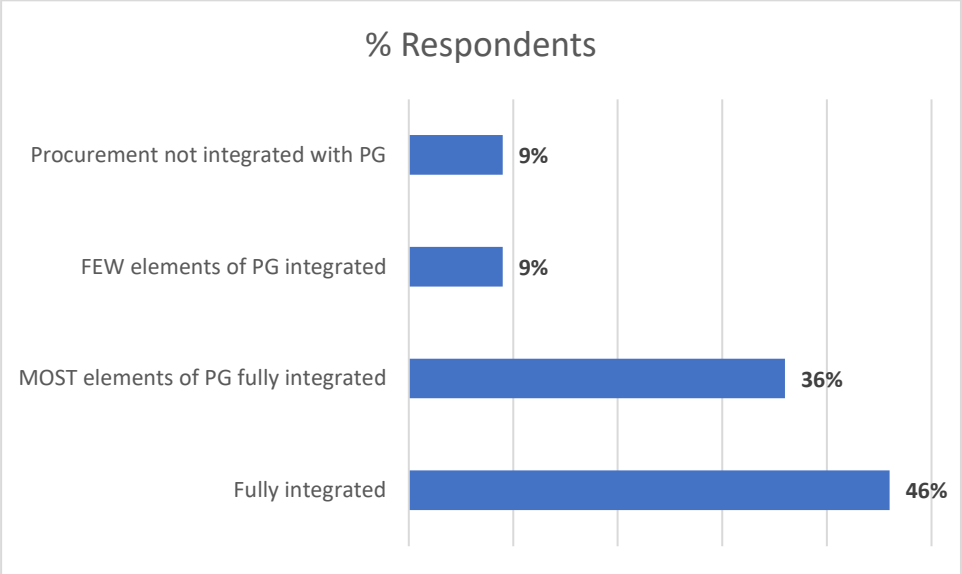


Figure 24

Respondents Reporting No Improvements Needed to the Procurement Function Identified Areas of Improvement

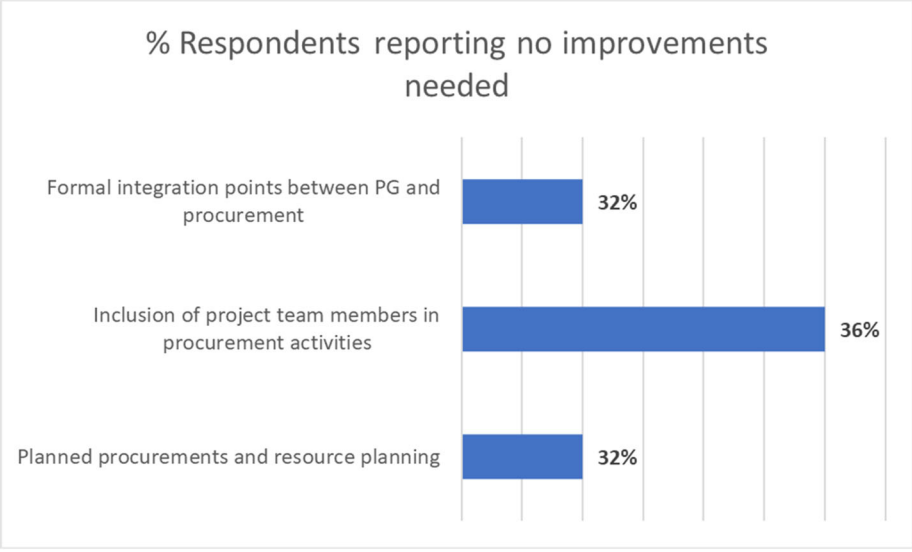


Figure 25

Prioritization of Improvement Areas (Excluding Respondents Citing No Improvements were Needed)

Ref/ Rank	Improvement category - procurement	Type	Weighted Score	As % of total weighted score	Cumulative %
1-PR	Formal integration points between PG and procurement	P	17.58	35%	35%
2-PR	Planned procurements and resource planning	P	16.41	33%	68%
3-PR	Inclusion of project team members in procurement activities	M	16.02	32%	100%
	Sum of all weighted prioritization scores:		50.01		

KEY: P = process, M = management

Figure 26

Distribution of the Prioritized TYPE of Procurement Improvement Categories

Ref/ Rank	Improvement category - procurement	Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-PR	Formal integration points between PG and procurement	P	17.58	P	33.99	67.97%
2-PR	Planned procurements and resource planning	P	16.41			
3-PR	Inclusion of project team members in procurement activities	M	16.02	M	16.02	32.03%
	Sum of all weighted prioritization scores:		50.01		50.01	100%

KEY: P = process, M = management

Attribute: TOOLS & MECHANISMS

Table 16

Overview of TOOLS & MECHANISMS Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Method of approval and approval control	APM (2004), Williams et al. (2010), Bekker & Steyn (2009), Olsen et al. (2005)	Research Objective 2	N/A	TOOLS & MECHANISMS	Internal	Question #17 & Question #18

Description: this attribute identifies and describes the elements through which the construction project governance function is achieved. These elements include oversight committees assembled to approve budgets, and contracts, address project compliance issues and provide direction to the project organization. Other elements include the organization's corporate board and/or public oversight body, such as a county commission, city commission, or similar, and are primarily created through legislation. Additional elements include the audit function to ensure adherence to stated policy and compliance-related matters.

Question type and resulting data: Question #17 is a closed-ended question asking respondents to select from a list of seven tools/mechanisms found in most construction project governance structures. Responses to Question #17 are expressed as a percentage of each category to the response population (Figure 27). Additional metrics were also calculated about the number of tools/mechanisms reported being used by respondents and the associated combinations within each (Figure 28). Question #18 asks respondents to rank a list of potential improvements to existing tools and mechanisms used by the respondent's organization. Scoring for Question #18 followed the methodology described in the Scoring Methodology section of this chapter. Question #18 also provided an added feature option where respondents could select "not applicable as no improvement needed." Figure 29 summarizes the percent of the population reporting "not applicable as no improvement needed", while Figure 30 contains the prioritized score of remaining responses whose score was calculated using the methodology described in the Scoring Methodology of this chapter. Figure 31 summarizes each improvement category by type, shown at the bottom of the figure as a key. For this research, ‘type’ is defined as the underlying characteristic of an improvement category.

Research Objective 2 (RO 2): Identify the tools, systems, and processes used to structure project governance structures at large hub US airports.

TOOLS & MECHANISMS Findings

Large hub US airports utilize a wide range of tools within their construction project governance structure. The most predominantly used are contracts/procurement (95%), followed by approval/decision-making thresholds (77%) and audits (77%) (Figure 27).

Eighteen percent of respondents (9% utilizing one and another 9% utilizing two) reported utilizing one or two elements within their construction project governance structure (Figure 28).

Respondents reporting utilization of five construction project governance structure elements had the widest range of combinations (3), while the remaining respondents' utilization levels had up to two configurations (Figure 28).

Respondents reported that no improvements were needed to identify tools and mechanisms areas of improvement at rates between 38% and 55% (Figure 29). For the remaining responses, reported data shows that ability to make decisions at the organizational level versus at the board level was the highest-ranked improvement category, followed by the ability of the organization to assign approval thresholds to project delivery team members (Figure 30).

86.67% of the improvement categories are related to *management*, while the balance, 13.33% are *process* related (Figure 31).

Figure 27

Respondent Utilization of Various Construction Project Governance Tools and Mechanisms

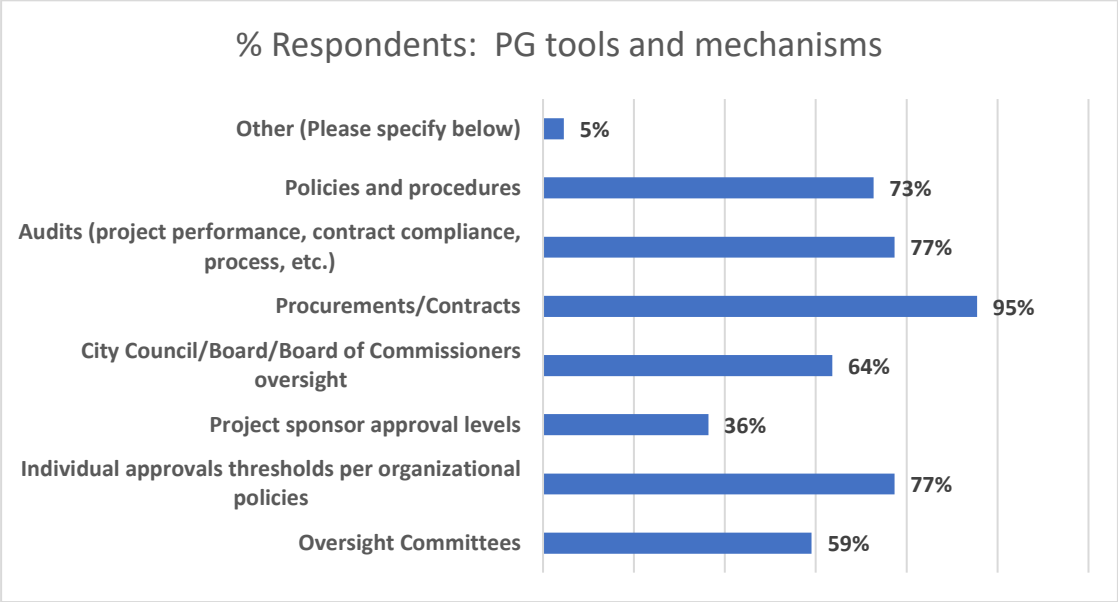
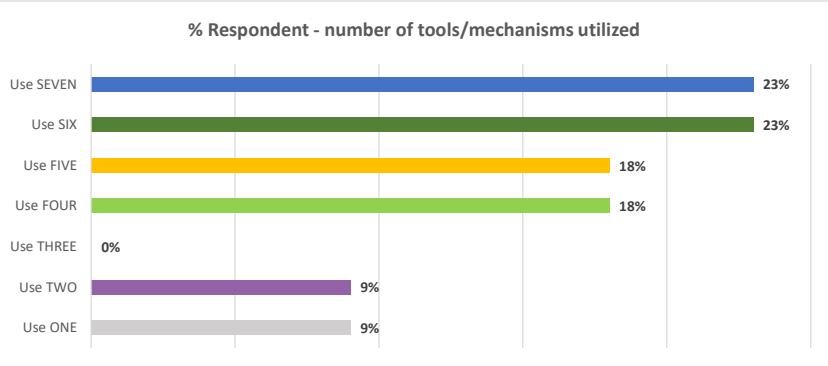


Figure 28

Breakdown of Tool and Mechanism Utilization



% Respondent using ONE tool/mechanism (9%)		
Oversight Committees		
Individual approvals		
Sponsor approvals		
Board approval		
Procurements/Contracts		
Audits		
Policies and procedures		
Other		
% of combination	**100%**	**100%**

% Respondent using TWO tools/mechanisms (9%)		
Oversight Committees		
Individual approvals		
Sponsor approvals		
Board approval		
Procurements/Contracts		
Audits		
Policies and procedures		
Other		
% of combination	**100%**	**100%**

% Respondent using FOUR tools/mechanisms (18%)			
Oversight Committees			
Individual approvals			
Sponsor approvals			
Board approval			
Procurements/Contracts			
Audits			
Policies and procedures			
Other			
% of combination	**25%**	**75%**	**100%**

% Respondent using FIVE tools/mechanisms (18%)				
Oversight Committees				
Individual approvals				
Sponsor approvals				
Board approval				
Procurements/Contracts				
Audits				
Policies and procedures				
Other				
% of combination	**25%**	**50%**	**25%**	**100%**

% Respondent using SIX tools/mechanisms (23%)			
Oversight Committees			
Individual approvals			
Sponsor approvals			
Board approval			
Procurements/Contracts			
Audits			
Policies and procedures			
Other			
% of combination	**75%**	**25%**	**100%**

% Respondent using SEVEN tools/mechanisms (23%)			
Oversight Committees			
Individual approvals			
Sponsor approvals			
Board approval			
Procurements/Contracts			
Audits			
Policies and procedures			
Other			
% of combination	**80%**	**20%**	**100%**

Figure 29

Respondent Levels Reporting No Needed Improvements to Identified Tools and Mechanism Areas of Improvement

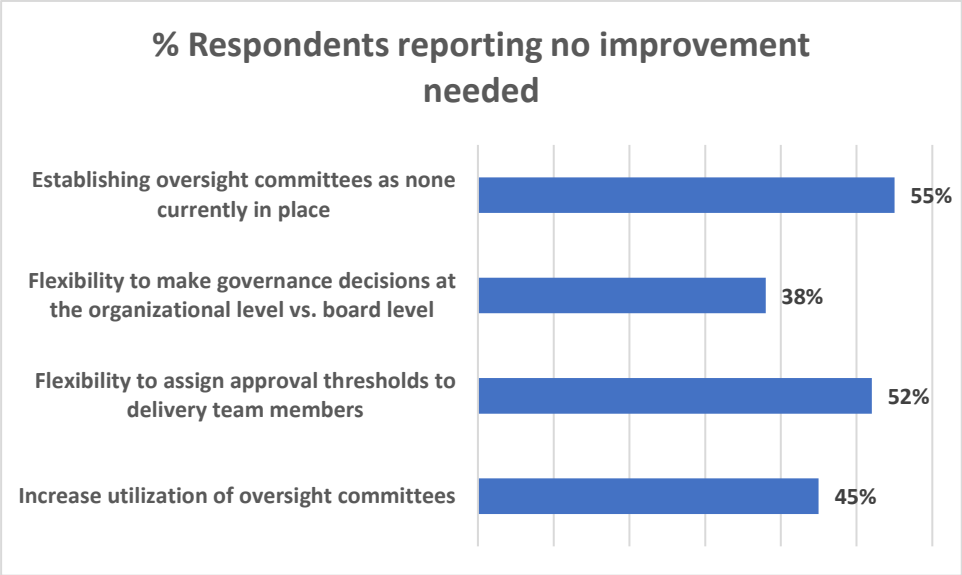


Figure 30

Prioritized Areas for Improvement for Project Governance Tools and Mechanisms

Ref/ Rank	Improvement category - tools and mechanisms	Type	Weighted Score	As % of total weighted score	Cumulative %
1-TM	Flexibility to make governance decisions at the organizational level vs. board level	M	12.50	35.00%	35.00%
2-TM	Flexibility to assign approval thresholds to delivery team members	M	9.82	27.50%	62.50%
3-TM	Increase utilization of oversight committees	M	8.63	24.17%	86.67%
4-TM	Establishing oversight committees as none currently in place	P	4.76	13.33%	100.00%
	Sum of all weighted prioritization scores:		35.71	100%	

KEY: M = Management, P = Process

Figure 31

Distribution of the Prioritized TYPE of Tools & Mechanisms Improvement Categories

Ref/ Rank	Improvement category - tools and mechanisms	Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-TM	Flexibility to make governance decisions at the organizational level vs. board level	M	12.50	M		
2-TM	Flexibility to assign approval thresholds to delivery team members	M	9.82			
3-TM	Increase utilization of oversight committees	M	8.63		30.95	86.67%
4-TM	Establishing oversight committees as none currently in place	P	4.76	P	4.76	13.33%
	Sum of all weighted prioritization scores:		35.71		35.71	100.00%

Attribute: CONTRACTS

Table 17

Overview of CONTRACTS Attribute

Existing Research Attribute	Reference	Research Objective	Research Proposition	Attribute used in this research	Attribute Type	Questionnaire Reference
Contracts and contracting	Harper et al. (2016), Touran et al. (2011), Berteslen (2003), Olsen et al. (2005), Abednago & Ogunlana (2006), Winch (2006)	Research Objective 3	Propositions 4A, 4B and 4C	CONTRACTS	Internal	Question #5, Question #6, Question #7, Question #8, Question #9 & Question #10

Description: this attribute describes the utilization, standardization, and form of large-hub US airport contract agreements for *Design Services, Construction Services,* and *Project/Program Management* services. Existing research (see References above) established that most project organizations are assembled through contractual agreements: (1) with a design/engineering firm to develop design and specifications for a project; (2) a contractor to build the project; and (3) a project/program management firm to oversee and administer the work on behalf of the owner organization. This attribute describes the level to which standard agreements are utilized to contract for design, construction, and project/program management services, as well as prioritized areas for improvement associated with each.

Question type and resulting data: Questions #5, #7, and #9 are close-ended questions where respondents select the utilization level of standard agreements by their organization to contract for design, construction, and project/program management services, respectively. The resulting data for Questions #5, #7, and #9 are reported as percentages of each category compared to the respondent population (Figure 32). Questions #6, #8, and #10 are open-ended questions asking respondents to rank the top three areas of improvement for design, construction, and project/program management agreements (Figures 33, 35, and 37, respectively). Scoring for data gathered from responses to Questions #6, #8, and #10 followed the methodology described in the Scoring Methodology section of this chapter. Figures 34, 36, and 38, respectively, summarize each improvement category (Figures 33, 35, and 37, respectively) by type of improvement shown at the bottom of the figure as a key. For this research, 'type' is defined as the underlying characteristic of an improvement category.

Table 17

Overview of CONTRACTS Attribute

Research Objective 3 (RO 3): Identify the extent to which large hub US airports have internally developed standard agreements to engage designers, contractors, and project management services (e.g., the project organization).		
Proposition 4A (H4A): large hub US airports do not utilize internally developed standard agreements to contracts for construction services.	**P4A Test:** measure the percentage of respondents that reported utilizing standard construction agreements.	**P4A Result**: **P4A is *not supported*** as 73% of respondents reported their organization utilized standard construction agreements for ALL their construction projects and 27% reported using standard construction agreements for ***MOST*** of their construction projects (Figure 32).
Proposition 4B (H4B): large hub US airports do not utilize internally developed standard agreements to contract for design services.	**P4B Test:** measure the percentage of respondents that reported utilizing standard design agreements	**P4B Result**: ***P4B not supported*** as 68% of respondents reported their organization utilized standard design agreements for ALL the design projects and 27% for MOST of their design projects (Figure 32).
Proposition 4C (H4C): large hub US airports do not utilize internally developed standard agreements to contract for project/program management services.	**P4C Test:** measure the percentage of respondents that reported utilizing standard project/program management agreements.	**P4C Result**: ***P4C is not supported*** as 45% of respondents reported their organization utilized standard project/program management agreements for ALL their project/program management projects and 27% for MOST of their project management projects (Figure 32).

CONTRACTS Findings

Respondents reported using standard construction (73%), design (68%), and project/program management (45%) agreements for ALL their projects (Figure 32)

There is no dominant category for improvement to the respondent's organization construction agreement. The highest-ranked improvement categories focused on the pricing of changes (prioritization score of 6.36), schedule control (prioritization score of 5.08), and change order management and definition of allowable costs (both with a prioritization score of 4.24) (Figure 35). Of the three types of contracts researched, construction contracts had the highest number of unique categories identified for improvement (36 categories of improvement identified). The 36 improvement categories identified were then evaluated by their type (figure 36): 25.97% of the improvement categories pertained to *management*, 27.07% to *process*, and 46.96% of the weighted responses were specifically about *contractual-related* items such as improved language to contract terms and definitions (Figure 36).

To a lesser degree than construction contracts, there was no single predominant area of improvement identified in design agreements (26 improvement categories identified). The top three ranked areas for improvement were designer performance measures (score of 10.09), designer compensation and calculation (of rates) (score of 9.21), and definition of design deliverables (score of 5.70), as shown in Figure 33. The 26 improvement categories identified by respondents were also evaluated by their type (Figure 34) with the following results: 16.29% of the improvement categories pertained to *management*, 34.27% to process, and 49.44% of the weighted responses specifically about *contractual-related* items such as improved language to contract terms and definitions (Figure 34).

Responses to improvement categories for project/program management agreements presented data that was focused on performance measures (score of 23.08) and definition of compensation and fee (score of 15.38). These two categories alone accounted for 50% of the aggregate weighted score as shown in Figure 37. The seventeen (17) identified improvement categories (Figure 37) were also analyzed by type, with the following results: 8.75% of the improvement categories pertained to *management, 15.00% to process, and 76.25%* were specifically about *contractual-related* items such as improved language to contract terms and definitions (Figure 38).

Figure 32

Utilization of Standard Agreements

Agreement type	Standard agreements for **ALL** projects	Standard agreements for **SOME** projects	Standard agreements for a **FEW** projects	No standard agreements
Design	68%	27%	0%	5%
Construction	73%	27%	0%	0%
Project Management	45%	27%	18%	10%

Figure 33

Prioritized Improvements to Existing Standard Design Agreements

Ref/ Rank	Improvement category - design agreements	Type	Weighted Score	As % of total weighted score	Cumulative %
1-DS	Performance measuress	C	10.09	12.92%	12.92%
2-DS	Designer compensation and calculation	C	9.21	11.80%	24.72%
3-DS	Definition of design deliverables	C	5.70	7.30%	32.02%
4-DS	Definition of construction phase services	C	5.26	6.74%	38.76%
5-DS	Investigation of existing conditions	P	4.82	6.18%	44.94%
6-DS	Design review process	P	4.39	5.62%	50.56%
7-DS	Design coordination and liability changes	M	3.95	5.06%	55.62%
8-DS	Defining design standards	P	3.51	4.49%	60.11%
9-DS	Technical language standarization	C	3.07	3.93%	64.04%
10-DS	Design management	M	2.19	2.81%	66.85%
11-DS	Design quality	P	2.19	2.81%	69.66%
11-DS	Combining multiple phases of work into one agreement	C	1.75	2.25%	71.91%
13-DS	Definition of scope	C	1.75	2.25%	74.16%
14-DS	Efficiency and quality of RFI review	M	1.75	2.25%	76.40%
15-DS	Errors & Omissions enforcement	M	1.75	2.25%	78.65%
16-DS	Owner control of design team staffing	M	1.75	2.25%	80.90%
17-DS	Process to update contract language	P	1.75	2.25%	83.15%
18-DS	Procurement process	P	1.75	2.25%	85.39%
19-DS	Redefining the design process	P	1.75	2.25%	87.64%
20-DS	Small/minority business participation requirements	P	1.75	2.25%	89.89%
21-DS	Alignment of design deliverables and owner expectations	M	1.32	1.69%	91.57%
22-DS	Conversion to paperless approvals and retention	P	1.32	1.69%	93.26%
23-DS	Design status reporting	P	1.32	1.69%	94.94%
24-DS	Designer evaluation process	P	1.32	1.69%	96.63%
25-DS	Claims and Disputes process for Owner initiated claims	P	0.88	1.12%	97.75%
26-DS	Design to budget requirements	C	0.88	1.12%	98.88%
26-DS	Increase flexibility to contractual terms	C	0.88	1.12%	100.00%
	Sum of all weighted prioritization scores:		78.07	100%	

KEY - C = Contract, M = Management, P = Process

Figure 34

Distribution of the Prioritized TYPE of Design Agreements Improvement Categories

Ref/ Rank	Improvement category - design agreements	Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-DS	Performance measuress	C	10.09	C	38.60	49.44%
2-DS	Designer compensation and calculation	C	9.21			
3-DS	Definition of design deliverables	C	5.70			
7-DS	Definition of construction phase services	C	5.26			
8-DS	Technical language standarization	C	3.07			
11-DS	Combining multiple phases of work into one agreement	C	1.75			
12-DS	Definition of scope	C	1.75			
25-DS	Design to budget requirements	C	0.88			
26-DS	Increase flexibility to contractual terms	C	0.88			
6-DS	Design coordination and liability changes	M	3.95	M	12.72	16.29%
9-DS	Design management	M	2.19			
13-DS	Efficiency and quality of RFI review	M	1.75			
14-DS	Errors & Omissions enforcement	M	1.75			
15-DS	Owner control of design team staffing	M	1.75			
20-DS	Alignment of design deliverables and owner expectations	M	1.32			
4-DS	Investigation of existing conditions	P	4.82	P	26.75	34.27%
7-SS	Design review process	P	4.39			
7-DS	Defining design standards	P	3.51			
10-DS	Design quality	P	2.19			
16-DS	Process to update contract language	P	1.75			
17-DS	Procurement process	P	1.75			
18-DS	Redefining the design process	P	1.75			
19-DS	Small/minority business participation requirements	P	1.75			
21-DS	Conversion to paperless approvals and retention	P	1.32			
22-DS	Design status reporting	P	1.32			
23-DS	Designer evaluation process	P	1.32			
24-DS	Claims and Disputes process for Owner initiated claims	P	0.88			
	Sum of all weighted prioritization scores:		78.07		78.07	100.00%

KEY - C = Contract, M = Management, P = Process

Figure 35

Prioritized Improvements to Existing Construction Agreements

Ref/ Rank	Improvement category - Construction agreements	Type	Weighted Score	As % of total weighted score	Cumulative %
1-CA	Change order pricing	C	6.36	8.29%	8.29%
2-CA	Schedule enforcement	M	5.08	6.63%	14.92%
3-CA	Change order management	M	4.24	5.52%	20.44%
4-CA	Definition of allowable costs	C	4.24	5.52%	25.97%
5-CA	Progress reporting	P	3.81	4.97%	30.94%
6-CA	Construction phase cost containment (D/B)	P	3.39	4.42%	35.36%
7-CA	Definition of scope	C	3.39	4.42%	39.78%
8-CA	Pay application process	P	2.97	3.87%	43.65%
9-CA	Contractor resource planning for craft labor	M	2.54	3.31%	46.96%
10-CA	Insurance requirements	C	2.54	3.31%	50.28%
11-CA	Identification of existing conditions	C	2.54	3.31%	53.59%
12-CA	Project specific safety and environmental enforcement	M	2.54	3.31%	56.91%
13-CA	Quality control reporting	P	2.54	3.31%	60.22%
14-CA	Accommodating multiple phases of work in single agreement	C	1.69	2.21%	62.43%
15-CA	Alternative delivery method process	P	1.69	2.21%	64.64%
16-CA	Change management documentation	M	1.69	2.21%	66.85%
17-CA	Definition of liquidated damages	C	1.69	2.21%	69.06%
18-CA	Definition of performance incentives	C	1.69	2.21%	71.27%
19-CA	Definition of substantial completion	C	1.69	2.21%	73.48%
20-CA	LEAN preconstruction processes	P	1.69	2.21%	75.69%
21-CA	Regulatory driven contractual ineficiencies	C	1.69	2.21%	77.90%
22-CA	Reorganizing contract general and special conditions	C	1.69	2.21%	80.11%
23-CA	Timely processing of change orders	M	1.69	2.21%	82.32%
24-CA	Continued Incorporation of LEAN Construction Practices	C	1.27	1.66%	83.98%
25-CA	Conversion to paperless approval and retention	P	1.27	1.66%	85.64%
26-CA	Definition of contractor compensation	C	1.27	1.66%	87.29%
27-CA	Funding sources and scope of work	P	1.27	1.66%	88.95%
28-CA	Owner versus contractor contingency	M	1.27	1.66%	90.61%
29-CA	Procurement process	P	1.27	1.66%	92.27%
30-CA	Contractor performance evaluation	C	0.85	1.10%	93.37%
31-CA	Definition of changes orders	C	0.85	1.10%	94.48%
32-CA	Definition of contractor contingency	C	0.85	1.10%	95.58%
33-CA	Design budget definition (D/B)	C	0.85	1.10%	96.69%
34-CA	Monitoring owner labor budgets charged to projects	M	0.85	1.10%	97.79%
35-CA	Removal of CMAR contingency sharing provision	C	0.85	1.10%	98.90%
36-CA	Value engineering process	P	0.85	1.10%	100.00%
	Sum of all weighted prioritization scores:		76.69	100%	

KEY - C = Contract, M = Management, P = Process

Figure 36

Distribution of the Prioritized TYPE of Construction Agreements Improvement Categories

Ref/ Rank	Improvement category - Construction agreements	Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-CA	Change order pricing	C	6.36	C	36.02	46.96%
4-CA	Definition of allowable costs	C	4.24			
7-CA	Definition of scope	C	3.39			
10-CA	Insurance requirements	C	2.54			
11-CA	Identification of existing conditions	C	2.54			
14-CA	Accommodating multiple phases of work in single agreement	C	1.69			
17-CA	Definition of liquidated damages	C	1.69			
18-CA	Definition of performance incentives	C	1.69			
19-CA	Definition of substantial completion	C	1.69			
21-CA	Regulatory driven contractual ineficiencies	C	1.69			
22-CA	Reorganizing contract general and special conditions	C	1.69			
24-CA	Continued Incorporation of LEAN Construction Practices	C	1.27			
26-CA	Definition of contractor compensation	C	1.27			
30-CA	Contractor performance evaluation	C	0.85			
31-CA	Definition of changes orders	C	0.85			
32-CA	Definition of contractor contingency	C	0.85			
33-CA	Design budget definition (D/B)	C	0.85			
35-CA	Removal of CMAR contingency sharing provision	C	0.85			
2-CA	Schedule enforcement	M	5.08	M	19.92	25.97%
3-CA	Change order management	M	4.24			
9-CA	Contractor resource planning for craft labor	M	2.54			
12-CA	Project specific safety and environmental enforcement	M	2.54			
16-CA	Change management documentation	M	1.69			
23-CA	Timely processing of change orders	M	1.69			
28-CA	Owner versus contractor contingency	M	1.27			
34-CA	Monitoring owner labor budgets charged to projects	M	0.85			
5-CA	Progress reporting	P	3.81	P	20.76	27.07%
6-CA	Construction phase cost containment (D/B)	P	3.39			
8-CA	Pay application process	P	2.97			
13-CA	Quality control reporting	P	2.54			
15-CA	Alternative delivery method process	P	1.69			
20-CA	LEAN preconstruction processes	P	1.69			
25-CA	Conversion to paperless approval and retention	P	1.27			
27-CA	Funding sources and scope of work	P	1.27			
29-CA	Procurement process	P	1.27			
36-CA	Value engineering process	P	0.85			
	Sum of all weighted prioritization scores:		76.69		76.69	100.00%

KEY - C = Contract, M = Management, P = Process

Figure 37

Prioritized Improvements to Existing Project Management Agreements

Ref/Rank	Improvement category - project management agreements	Type	Weighted Score	weighted score	Cumulative %
1-PM	Performance measures	C	23.08	30.00%	30.00%
2-PM	Definition of compensation and fee	C	15.38	20.00%	50.00%
3-PM	Small/Disadvantaged business participation (increase and decrease)	C	8.65	11.25%	61.25%
4-PM	Procurement processes	P	5.77	7.50%	68.75%
5-PM	Risk sharing	C	4.33	5.63%	74.38%
6-PM	Conversion to 'Managed Service' versus individual roles	C	1.92	2.50%	76.88%
7-PM	Cost control	M	1.92	2.50%	79.38%
8-PM	Definition of PM scope versus designer scope	C	1.92	2.50%	81.88%
9-PM	Definition of scope	C	1.92	2.50%	84.38%
10-PM	Process to update contract language	P	1.92	2.50%	86.88%
11-PM	Quality of project staffing	M	1.92	2.50%	89.38%
12-PM	Redefinition of the Owners Representative in Design Build	M	1.92	2.50%	91.88%
13-PM	Converting to paperless approvals and retention	P	1.44	1.88%	93.75%
14-PM	Cybersecurity and contracts	S	1.44	1.88%	95.63%
15-PM	Project management guidelines	P	1.44	1.88%	97.50%
16-PM	Definition of common goals	M	0.96	1.25%	98.75%
17-PM	Improved and consistent PM processes and procedures	P	0.96	1.25%	100.00%
	Sum of all weighted prioritization scores:		76.92	100%	

KEY - C = Contract, M = Management, P = Process, S = Systems

Figure 38

Distribution of the Prioritized TYPE of Project Management Agreements Improvement Categories

Ref/Rank	Improvement category - project management agreements	Type	Weighted Score		Weighted Score (Type)	As % of total weighted score
1-PM	Performance measures	C	23.08			
2-PM	Definition of compensation and fee	C	15.38			
3-PM	Small/Disadvantaged business participation (increase and decrease)	C	8.65			
5-PM	Risk sharing	C	4.33	C		
6-PM	Conversion to 'Managed Service' versus individual roles	C	1.92			
8-PM	Definition of PM scope versus designer scope	C	1.92			
9-PM	Definition of scope	C	1.92			
14-PM	Cybersecurity and contracts	C	1.44		58.65	76.25%
7-PM	Cost control	M	1.92			
11-PM	Quality of project staffing	M	1.92			
12-PM	Redefinition of the Owners Representative in Design Build	M	1.92	M		
16-PM	Definition of common goals	M	0.96		6.73	8.75%
4-PM	Procurement processes	P	5.77			
10-PM	Process to update contract language	P	1.92			
13-PM	Converting to paperless approvals and retention	P	1.44			
15-PM	Project management guidelines	P	1.44	P		
17-PM	Improved and consistent PM processes and procedures	P	0.96		11.54	15.00%
	Sum of all weighted prioritization scores:		76.92		76.92	100.00%

KEY - C = Contract, M = Management, P = Process

Assembly of Attributes to Describe the Predominant Construction Project Governance Structure used by Large Hub US Airports to Delivery Capital Projects

Data about each project governance structure attribute in this research is used to describe the predominant construction project governance structure used by large hub US airports (Figure 4 and Table 5). Large hub US airports implementing construction projects begin utilizing their construction project governance function in the programming/planning phase of project development and end at the completion of construction (Figure 9). The primary objective is to achieve financial objectives (Figure 11) for construction projects and is formal in form, as all or most of the elements comprising this function exist in formalized policies and procedures (Figure

5). The same project governance structure is used to manage all or most of the projects delivered, irrespective of the project delivery method used (Figure 13). The rigid nature of the predominant governance structure creates a potentially conflicting dynamic as large hub airports utilize a wide range of project delivery methods (five different project delivery methods used under ten different combinations, Figure 19). There is a bifurcation in the approach taken by large hub airports to delegation of financial and schedule decisions where 59% do not delegate any or a few decisions and the balance of respondents, totaling 41%, delegate most or all (Figure 12).

Internally, the construction project governance function is staffed, on average, by 66 individuals, 48% of which are employees of the large hub airport organization, with the balance being consultants and other contracted staff (Figure 16). The primary tools and mechanisms used by large hub airports to perform the construction project governance structure include policies and procedures, audits, procurement and execution of contracts, individual approvals set forth in the policy, oversight committees, and the organization's board (or equivalent as different airports are operated by various public entities) (Figure 27)[31]. Similarly, a wide range of reports is utilized in the construction project governance function, including financial, contracting/procurement activity, schedule, funding, small/disadvantaged business, and sustainability (Figure 20)[32]. Large hub airports use standard agreements to contract for design, construction, and project management services (Figure 32) using a procurement process that is integrated with the construction project governance function (Figure 23).

[31] Limited to responses with a value greater than 50%
[32] Limited to responses with a value greater than 50%

Improvements to Large Hub Airport Construction Project Governance Structure

This research identified 115 ranked improvements about eight different aspects of large hub US airport construction project governance structures as shown in Table 18. The same scoring methodology identified earlier in this chapter was applied to applicable open-ended and close-ended question responses to establish common scoring. The highest-scoring elements within each of the eight categories studied are listed in Figure 39. Detailed findings and observations are provided within the section analyzing each attribute (Tables 7 through 17, respectively).

Table 18

Summary of Improvement Categories

Improvement category	Scored improvements. (ea.)	Reference
Structure	12	Figure 6
Utilization	12	Figure 14
Reporting	5	Figure 21
Procurement	3	Figure 25
Tools and mechanisms	4	Figure 30
Design agreements	26	Figure 33
Construction agreements	36	Figure 35
Project/program management agreements	17	Figure 37
Total:	**115**	

The nature of each improvement category type is summarized as Figure 40 as well as the aggregated value for this entire research (detailed analysis on the nature of each improvement category is provided within the applicable section of each attribute). This research identified 115 improvements to various aspects of large hub US airport construction project governance

structure, which in the aggregate are 24.87% about *management,* 32.60% *process*, 37.80% *contractual terms and conditions*, 3.71% *training*, and 1.02% *systems* (Figure 40).

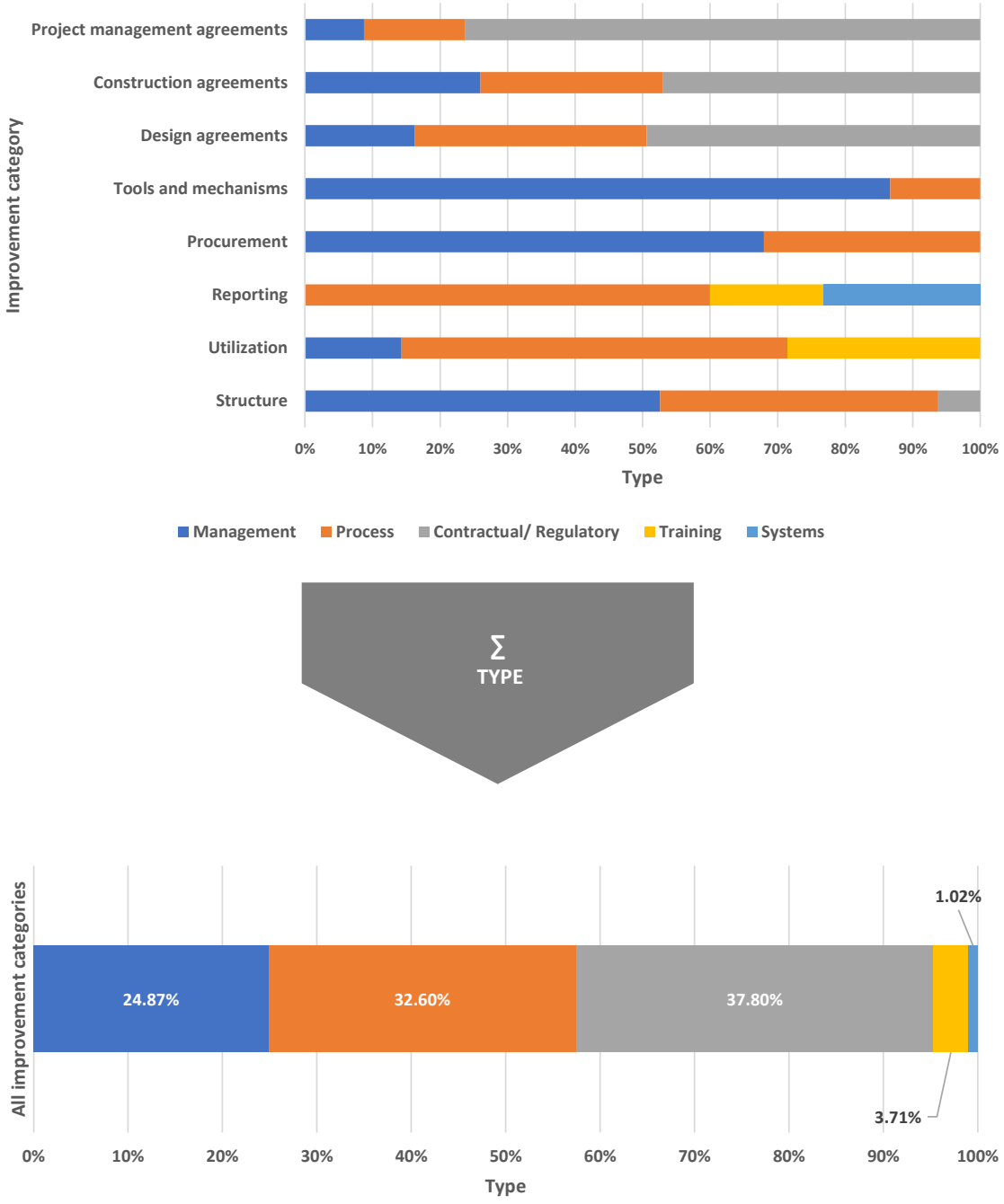
Figure 39

Highest Scoring Elements for Each of the Improvement Categories Evaluated

Ref./Rank	Improvement category	Highest Priority	Type	Weighted score	Reference
1-PM	Project management agreements	Performance measures	C	**23.08**	Figure 37
1-UT	Project governance utilization	Training	T	**22.41**	Figure 14
1-PR	Procurement	Formal integration points between PG and procurement	P	**17.58**	Figure 25
1-GS	Project governance structure	Reporting	P	**13.31**	Figure 6
1-TM	Project governance tools & mechanisms	Flexibility to make decisions at org vs. board level	M	**12.50**	Figure 30
1-RE	Project governance reporting	Develop processes that generate performance data	P	**12.28**	Figure 21
1-DS	Design agreements	Performance measuress	C	**10.09**	Figure 33
1-CA	Construction agreements	Change order pricing	C	**6.36**	Figure 35

Figure 40

Summary of the Nature of the Identified Improvements in this Research



CHAPTER 5 – IMPLICATIONS, LIMITATIONS, FUTURE RESEARCH, AND CONCLUSIONS

This chapter describes this research's implications, limitations, future research areas, and conclusions. The implications of this research are presented in multiple ways depending on the specific area of analysis: at the attribute level, as clusters of attributes, or, where applicable, at the system level, where all attributes are aggregated. A discussion follows about how the results of this research fit within, contrast, or extend existing research, as well as managerial and theoretical implications.

ATTRIBUTE: FORM - Implications

The level of formality in the respondent organization's project governance structure is also a measure of maturity (Hammer, 2007; Srinivasan, 2010). More than three-quarters (77%) of respondents reported using formalized policies and procedures describing ALL (45%) or MOST (32%) elements of their construction project governance structure. Although formal policies and procedures exist, respondents identified a wide range of potential improvements to their existing governance structures (Figures 6 and 7).

Data gathered about the FORM attribute in this research provides information enabling respondent organizations to benchmark their construction project governance structure to the population and identify opportunities for improvement. For example, the respondent population

identified opportunities for improvement that were 52.6% related to the management function and 41.15% specific to the process. This data suggests that efforts to improve the construction project governance process cannot be strictly process-centric but must also address the enterprise perspective and capabilities: a significantly more complex undertaking than an isolated process redesign. Additional context and intelligence can be gathered from responses using a maturity model. The nature of responses focusing on process and organizational capabilities lend themselves to a practitioner (management)-based maturity framework. Hammer (2007) found meaningful and sustained process improvements occurred when organizations addressed the process(es) in question as well as enterprise capabilities. Based on understanding the link between process and enterprise, Hammer (2007) developed the Process and Enterprise Maturity Model (PEMM). This framework measures the maturity of processes and enterprise capabilities, reflecting a management lens. The PEMM measures competency on a four-level scale: Level 1 (a process exists and is documented), Level 2 (the process is optimized at the functional level), Level 3 (optimized at the enterprise level and fully integrated to information technology systems), and Level 4 (optimization extended optimization to stakeholders such as vendors and customers). Similar measures are also created for the enterprise-side maturity analysis framework (Hammer, 2007).

An added benefit of evaluating process and organizational maturity is for management to gather a deeper understanding of their organizational and process capabilities, which informs about the organization's ability to implement identified improvements. Organizational capabilities drive the quality of strategic decision-making and, ultimately, the ability to achieve outcomes (Fredrickson, 1986). Data from this research shows a wide range of potential improvements identified by respondents, some of which require significant resources to address

(Figures 6 and 7). Coupling the requirements associated with process improvements identified by respondents to the organization's capability to address identified improvements provides management with key insights to optimize resource assignment to address identified improvements. For example, using this approach, management can prioritize which improvement initiatives are feasible to implement given existing organizational capabilities (capability thresholds) or decide to assign resources to improve needed organizational capabilities before focusing on improving a process.

The PEMM was used to measure the maturity of the FORM attribute shown in Figure 41, reflecting a measured maturity at Level 1 (out of 4) for the respondent population. As reflected in Figure 41, there are ample improvement opportunities to improve the process maturity to Level 2 (design efficient end-to-end process) without a significant investment of resources (provided existing organizational capabilities are in place to implement successfully), which otherwise would be required to achieve maturity in Levels 3 and 4.

Figure 41 does not evaluate enterprise maturity and competencies, such as leadership commitment to change, management capabilities, or culture, as this research did not gather information about these attributes. Despite this limitation, understanding the nature of needed improvements coupled with population-level data provides a robust change management tool that respondent organizations can use to design effective process improvement initiatives for their construction project governance structure.

Figure 41

Process Maturity Assessment - FORM[33]

	Level 1		Level 2		Level 3		Level 4	
Process design	Process documentation is functional with identification of interconnections	**YES**	End to end documentation fully developed	**NO**	Process designed to fit with other enterprise processes and with enterprise IT systems to optimize the enterprise performance	**NO**	Process has been designed to fit with customer / supplier processes to optimize enterprise performance	**NO**
	Not designed on and end-to end basis	**YES**	Process designed with end to end to optimize performance	**NO**	Process documentation describes the process interfaces, expectations, and other processes and links the process to the enterprise system and data architecture	**NO**	An electronic representation of the process design supports its performance and management and allows analysis of environmental changes and process reconfigurations	**NO**

ATTRIBUTE: SPAN - Implications

This research identifies that the construction project governance function begins in the planning/programming phase of project development and ends upon completion of construction (Figures 8 and 9). Additionally, more than half of respondents (59%) reported that no modifications are needed to the point where the project governance function begins and ends. Establishing the active period within which the construction project governance function operates provides a standardized basis for measuring project performance and associated governance competencies (at each stage of development or as a whole system).

Existing research identifies the lack of a standard timeline to measure project performance as creating confusion when reporting measured data (e.g., budget and schedule measured based upon different performance periods) and the ability to understand the nature of cost overruns accurately (Flyvbjerg et al., 2002; Love et al., 2015, Merrow et al., 1988) Establishing the SPAN of the project governance function also informs on needed project governance competencies to deliver projects successfully.

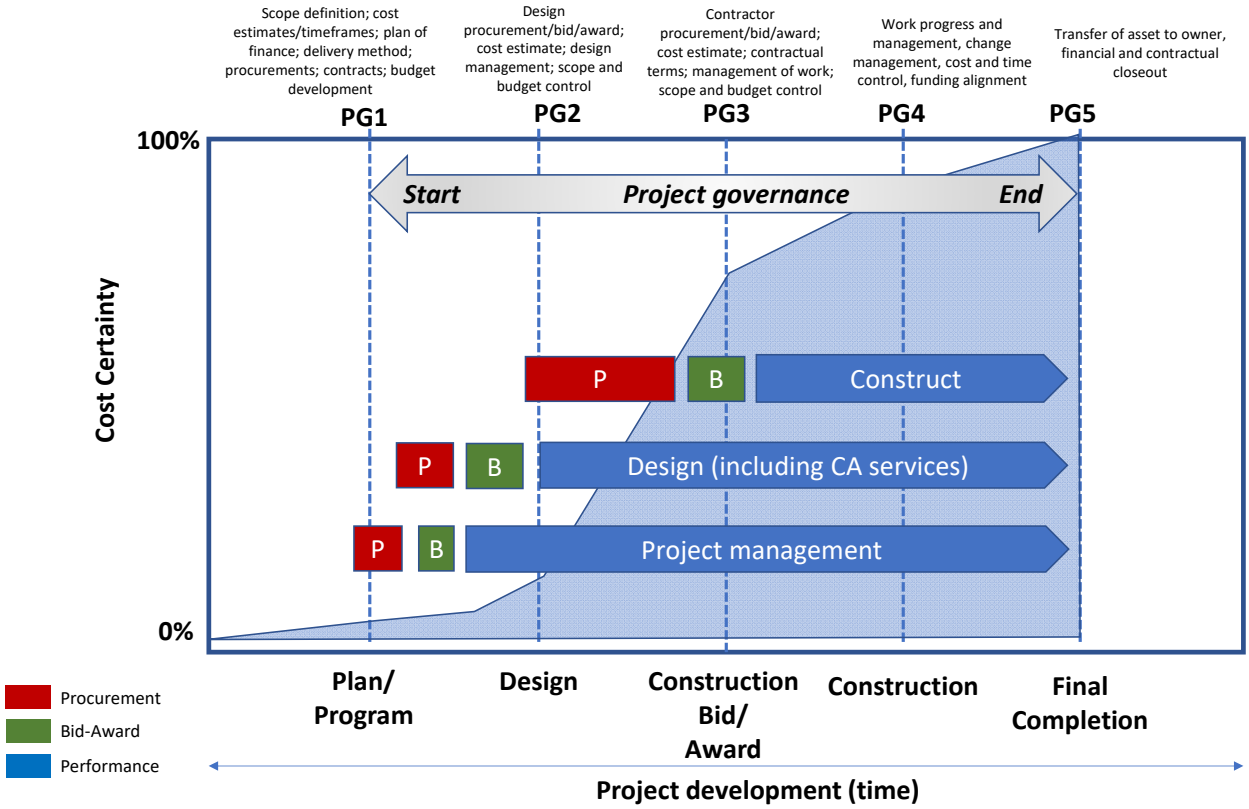
[33] Figure 41 provides results of aggregated respondent data; there may be large hub airports operating at different maturity levels.

Figure 42 illustrates the risk transfer evolution (shown as changes to cost certainty over time) along the project development cycle. Existing research identifies the temporary nature of project delivery organizations primarily structured through contracts that determine the nature of risk transfer (Winch, 2006) and resulting complexities (Jaradat, 2015). Figure 42 identifies project governance competencies (PG1-PG5) that owner organizations must demonstrate to successfully govern and deliver projects at each stage of project development. Figure 42 informs about the challenges created through procurement concurrency for each complex undertaking (procurement complexity driven by procurement length, procurement structure, contract terms, selection criteria, and vendor evaluation). The ability of an organization's construction project governance structure demonstrate needed competencies in this complex environment ultimately manifests in project performance.

Data identified to establish the SPAN of the project governance function can also be segregated to evaluate the performance within the discrete phases of project delivery: e.g., budget development changes from planning/programming to design phase and construction, for example. Metrics can also be developed for an organization (and population) using the governance competencies (PG1-PG5, Figure 42) for each stage of project development to evaluate and benchmark performance as part of process improvement initiatives.

Figure 42 –

Project Development Cycle and Project governance[34]



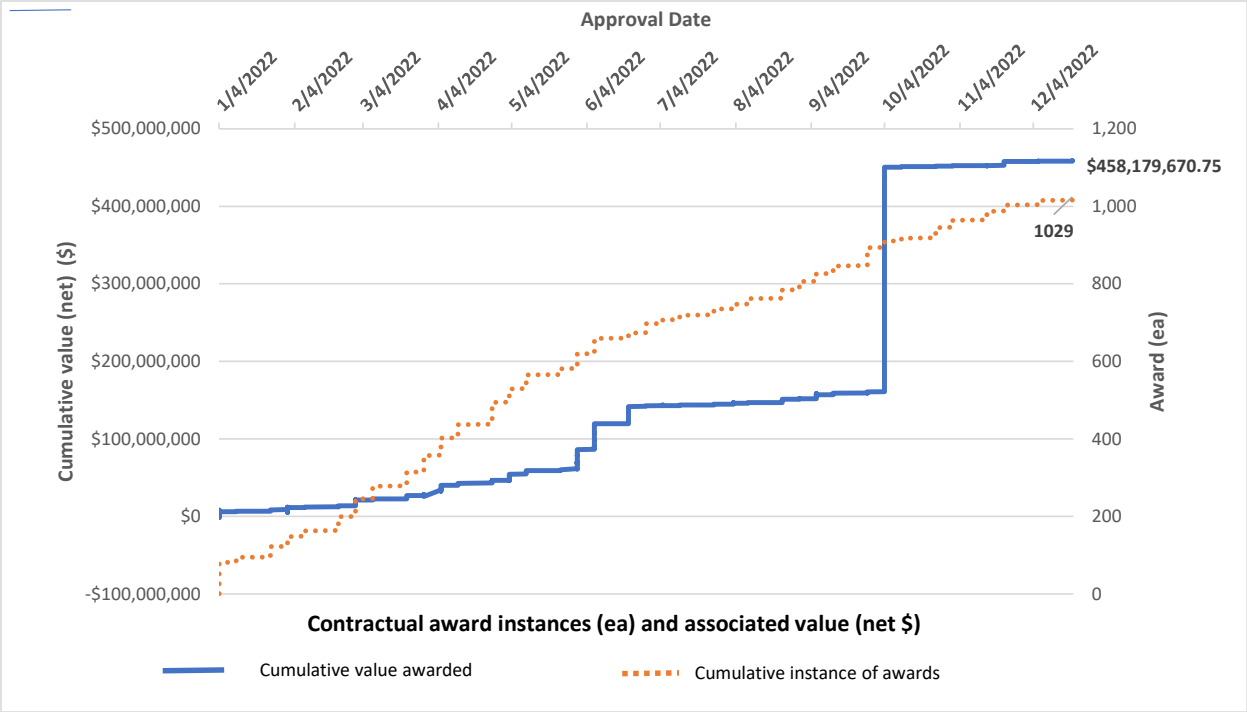
To highlight the complexity of this environment (Figure 42), Figure 43 provides the number of contractual award instances[35] achieved by the Greater Orlando Aviation Authority (GOAA) and overseen by this organization's construction project governance function for January 1, 2022-December 31, 2022. During the calendar year 2022, GOAA executed 1,029 contractual award instances with an aggregate value of $458 million. This data highlights the

[34] Figure 41 reflects a 'traditional' design-bid-build with a general contractor project delivery methodology. Design-bid-build with a CMAR would reflect pre-construction services performed by CMAR as well as award or one or multiple GMP contracts through which work is accomplished. Similarly, a design-build project delivery methodology would reflect the design-build entity being procured prior to design phase of the project cycle.
[35] Source: Greater Orlando Aviation Authority, Construction Committee Agenda public records (Jan 2022-December 2022). Contracts reflected in Figure 42 include construction contracts (CMAR, GC), change orders, change orders within GMPs, purchase orders, job order contracts, design agreements, and other professional services agreements pertaining to capital project delivery.

realities and strains placed on project governance structures through high levels of throughput required coupled with a wide range of contractual actions, each with different requirements (Figure 44 segregates the 1029 contractual actions shown in Figure 43 into eight different categories).

Figure 43

GOAA Contract Award Activity during the Calendar Year 2022



ATTRIBUTE: OBJECTIVE - Implications

The primary objective of the project governance function drives its structure and application. For the large hub US airport population, the primary objective of their construction governance function is to achieve financial objectives of project delivery followed by time/schedule (Figure 11). Implications of this data include the ability to measure and evaluate

the competencies identified in Figure 42 against an organization's specific objectives, develop metrics, and evaluate existing practices to test whether their construction project governance function is structured to deliver successfully on the identified primary objective.

ATTRIBUTE: OWNER CONTROL and PARTICIPANTS - Implications

On average, the construction project governance function is accomplished by 66 participants, of which 48% are airport employees (Figure 16). The majority of respondents reported that the current level of participants was appropriate (60%), while 30% reported a desired increase level of airport employee involvement, and the balance reported a 10% decrease.

There has yet to be a consensus on how large hub US airports control project financial and schedule decisions. On the one hand, 59% of respondents reported that their organization did not delegate financial and scheduling decisions to the project delivery team, while the balance, 41%, took the approach of delegating financial and scheduling decisions to the project delivery team (Figure 12). This data provides a valuable tool to assess process scalability, resource utilization, systems, and level of control over financial and scheduling decisions. For example, project performance data, such as budget evolution and procurement activity, can be compared against existing staffing levels. As an illustrative example (and recognizing the limitations of mixing population averages versus a single entity's annual contractual award output), if the average number of 66 participants achieved 1029 annual contract awarded instances, it yields overall throughput of 16 contracts awarded per participant per year (1029/66 = 15.59 rounded to 16 as the unit of measure is a contract). Throughput contract award data can be overlayed against procurement periods, slippage, or another contractual procurement metric,

linking resource utilization to output. Such an approach can be made more granular by evaluating contract types (design, construction, project management, other professional service, change orders, etc.) or different metrics (such as complexity of procurement) by specific staff responsible for the functional element of procurement/governance. As part of a process redesign initiative (Hammer, 2007), this data can inform the appropriate level, type, and competencies of resources needed to effectively achieve desired levels of owner control and outcomes.

ATTRIBUTE: ADAPTIVENESS, DELIVERY METHODS, PROCUREMENT - Implications

This research identified that 96% of respondents utilized the same project governance structure to oversee ALL or MOST of their projects (Figure 13). Additionally, the data gathered by this research shows that 59% of respondents use at least three different delivery methods (Figure 19), of which the predominant combination of delivery methods was D-B-B-GC / D-B-B-CMAR/DB (69%). The implication of the predominant mix of delivery methods used by large hub airports is significant: to function effectively, a non-adaptive project governance structure has to accommodate and govern a wide range of requirements associated with each delivery method (procurements, risk transfer/contracts, selection, funding plans) in a high throughput environment (Figures 43 and 44). Figure 42 (PG 1-PG 5) provides a list of competencies required to govern project development successfully. The use of a static construction project governance structure, irrespective of complexity and dynamic environment, runs counter to the conclusions reached by Miller and Hobbs (2015) and Artto and Kujala (2008), who recommend using project-specific adaptive project governance structures, especially for megaprojects.

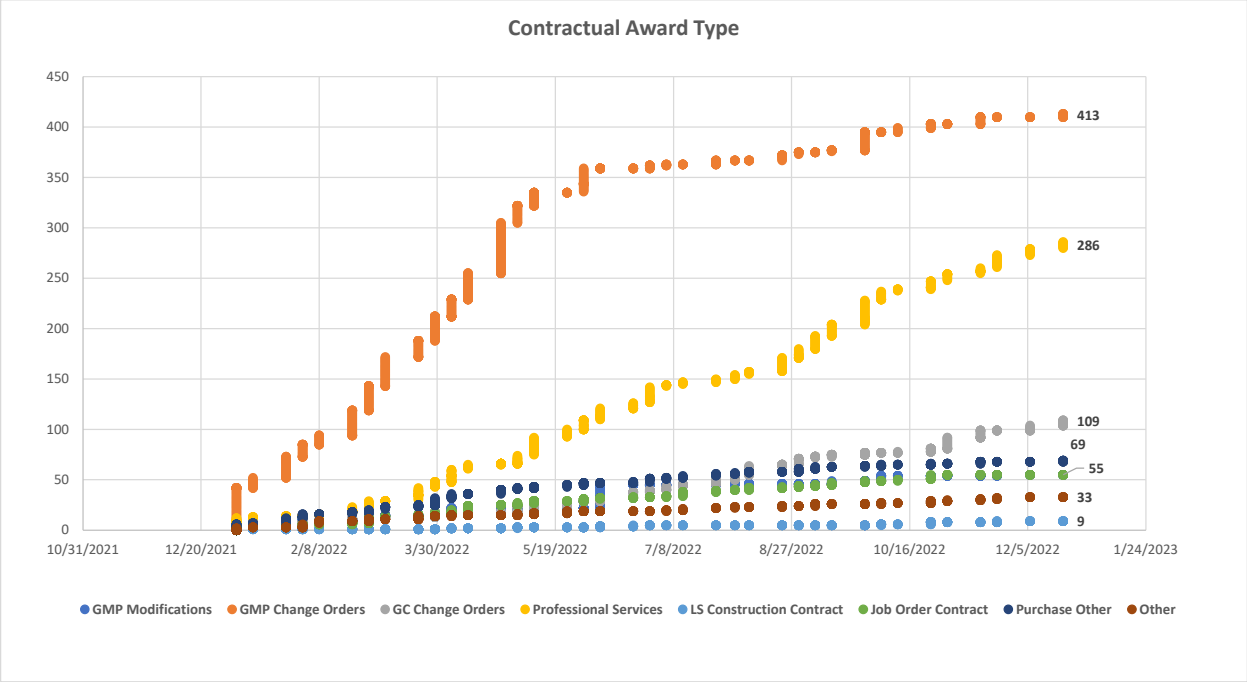
To provide context about the complex governance environment associated with an organization that utilizes multiple project delivery methods, Figure 43 is revisited by segregating the total annual activity by contract award type. Eight contract award categories encompass the 1029 annual contractual actions for GOAA in the calendar year 2022 (Figure 44) were identified. More specifically, during the calendar year 2022, there were two active D-B-B-CMAR agreements[36] in place which accounted for 45% (40% GMP Modifications and 5% GMP Change Orders) (Figure 43) of all contractual activity (this is only for the construction side activity as no data is available to breakdown professional services associated with these two agreements).

Given this complex environment and a high level of required throughput (typical for respondent organizations), it is not surprising to see respondents identify training, performance measures, and reporting as the top three areas that could be improved to increase the utilization of their organization's project governance structure (Figure 14). More importantly, the data from this research provides a framework to analyze the resource requirements (and effectiveness) and manage the risk transfer associated with each delivery method (Figure 44). Ultimately the administrative (resource utilization) effort can be compared with project performance (cost, schedule, quality), linking composition, process, and resulting outputs of the project governance structure. Maturity analysis can then readily be conducted using PEMM (Hammer, 2007) as part of a process improvement initiative.

[36] GOAA public records

Figure 44

GOAA Contract Award Activity by Contract Type during the Calendar Year 2022



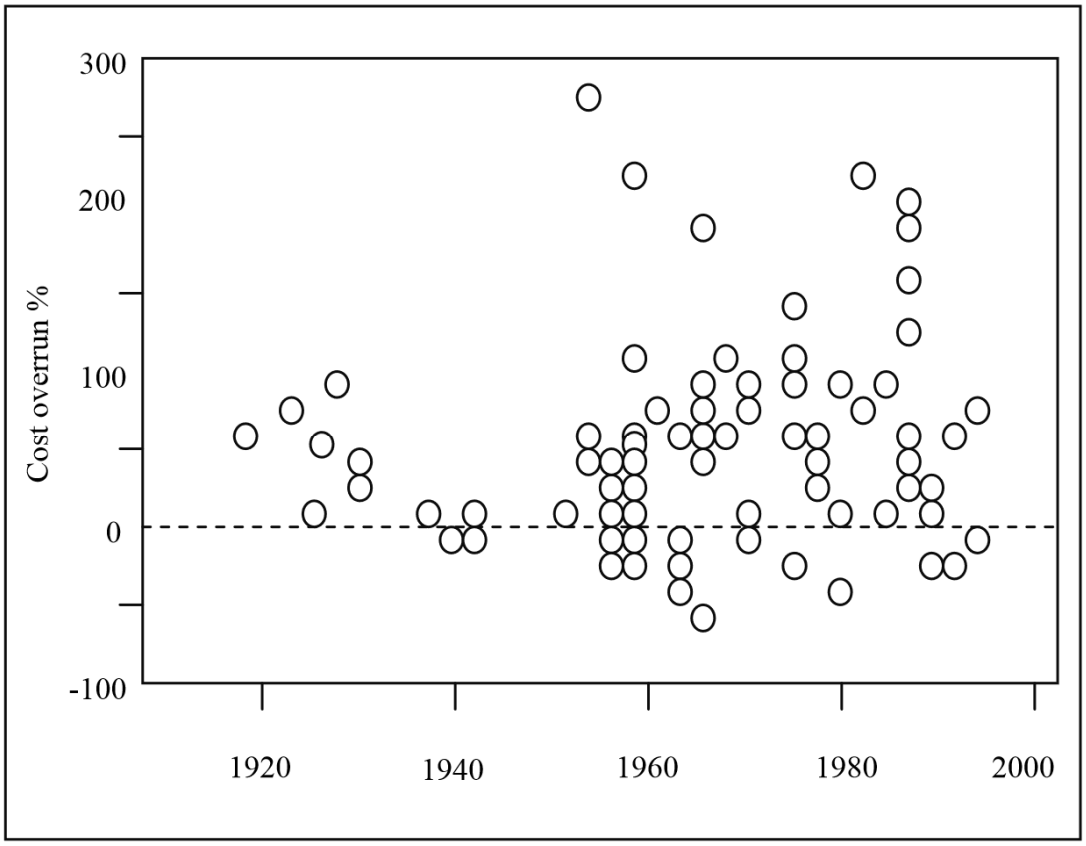
Delivery Method	Contract Type	Actions (EA)	% Of Total
D-B-B-CMAR	GMP Modifications	55	5%
D-B-B-CMAR	GMP Change Orders	413	40%
D-B-B GC	GC Change Orders	109	11%
D-B-B-GC	LS Construction Contract	9	1%
Other	Job Order Contract	55	5%
All	Professional Services	286	28%
Other	Purchase Other	69	7%
Other	Other	33	3%
Total		**1,029**	**100%**

ATTRIBUTE: CONTRACTS – Implications

Contractual agreements set forth the basis for risk transfer and the primary tool through which project owners assemble the temporary project delivery organization (Winch, 2006, Caniëls et al., 2012). Contract terms and conditions are typically developed before the commencement of the procurement process, ultimately resulting in the selection of an organization and the execution of a contract to provide services. Contract terms and conditions are complex given the significant value of risk (e.g., financial performance) being transferred. This research gathered data about three types of contracts= that project owners utilize to assemble the project delivery organizations: project/program management agreements, design agreements, and construction agreements. Data from this research shows that respondent organizations use standard construction agreements (73%), design (68%), and project/program management (45%) for ALL their projects (Figure 32). The utilization of standard agreements suggests that the contracting process is mature (Hammer, 2007). Despite mature contracting practices, there is a wide range of improvements provided by respondents with the highest ranked priorities as follows: (1) improve the tools used to measure performance and establish compensations for both design and project management agreements (Figures 33 and 37) and (2) improve the terms and conditions associated with pricing changes and defining allowable costs on construction contracts (Figure 35). Interestingly, the highest ranked improvement priorities are financial, which is also the identified primary objective of respondents' organization construction project governance structure (Figure 11), suggesting that respondent organizations are experiencing deficiencies in achieving project financial objectives, and consistent with project performance research conducted by Flyvbjerg et al., (2003) (Figure 45).

Figure 45

Project Performance



Note: (Flyvbjerg et al., 2003)

This research provides a granular tool to measure the contractual performance of a respondent organization. Figure 46 provides tests for the five highest-ranked contractual areas of improvement of respondent design agreements to generate performance data from which mitigating activities can be developed (e.g., modifying contract language, management, or processes). A similar set of tests was also designed for construction and project/program management agreements (Figures 47 and 48).

Figure 46

Design Agreements: Prioritized Contractual Improvement Categories and Associated Performance Tests

Ref/ Rank	Improvement category - design agreements	Weighted Score	Test
1-DS	Performance measuress	10.09	Review the actual performance of the designer (e.g., number of design bulletins, RFIs, changes, timeliness of design deliverables, budget history, and cost performance) versus contract terms and conditions to identify gaps and root causes. This can be achieved through a single project review, or ideally through review of a sample of projects.
2-DS	Designer compensation and calculation	9.21	Review multiplier and hourly rates and fees; develop metrics to evaluate fees such as deliverables identified under 1-DS, for example. Identify a sample set of projects to review compensation metrics over a three year period to evaluate cost growth versus performance metrics identified for 1-DS.
3-DS	Definition of design deliverables	5.70	Conduct gap analysis of scope definition document versus deliverables, compare initial scope deliverable with change history and designs delivered to identify gaps. Clearly identify sources of changes to scope to identify source.
7-DS	Definition of construction phase services	5.26	This is a subset of 1-DS and 2-DS to include submittal review, RFI, change order performance, timeliness, and completeness of design.
8-DS	Technical language standarization	3.07	Identify sample of design packages for review; develop criteria for analysis and measure current level of standarization and gaps to address in contract updates and/or a methodology that establishes a standard approach to writing technical contract language.

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Figure 47

Construction Agreements: Prioritized Contractual Improvement Categories and Associated Performance Tests

Ref/ Rank	Improvement category - Construction agreements	Weighted Score	Test
1-CA	Change order pricing	6.36	Review sample set of change orders using a compliance term matrix to analyze how pricing was derived, whether costs are allowable based on contractual terms (special focus on labor burden rates categories, equipment rates, and basis for accepting lump sum pricing of subcontractor costs); identify if root cause for gaps is driven by contract terms, and if so develop improvements, or if a project management issue, and develop measures to mitigate.
4-CA	Definition of allowable costs	4.24	(can be part of 1-CA). See test above if for GC. If for GMP contract review CMAR general conditions costs, site cleanup, or other non-lump subcontractor costs in a pool of GMP agreements. Identify trends and gaps to develop contract language to mitigate salient issues.
7-CA	Definition of scope	3.39	Review design documents defining scope vs. changes in a pool of projects. Evaluate changes to understand the root source: are they owner-generated? As result of incomplete design? Coordination of trades? Develop trends and mitigation plan to address through contract language or process/management improvement iniative.
10-CA	Insurance requirements	2.54	Develop a matrix of required insurance coverages; identify final costs with specific care to contractor-provided insurances such as Contractor Controlled Insurance Programs (CCIP) or similar. Evaluate final costs and coverage differences between projects in a sample pool of projects; ensure that review is conducted by a multidisciplinary team (legal, financial, risk management, and project delivery).
11-CA	Identification of existing conditions	2.54	Identify a sample pool of projects from which to review approved changes to evaluate those related to unforeseen existing conditions; evaluate design documents and existing condition documentation and identify gaps where changes occurred; evaluate if there exists commonalities in sample projects and identify mitigating language that can be added to applicable geotechnical agreements, design and engineering/site assessments that ultimately are incorporated into construction documents.

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Figure 48

Project/Program Management Agreements: Prioritized Contractual Improvement Categories

Ref/Rank	Improvement category - project management agreements	Weighted Score	Test
1-PM	Performance measures	23.08	Review project performance with a focus on overall budgetary and schedule project performance, ability to process changes in a timely fashion; claims/dispute resolution performance; processing of submittals, RFIs; quality and timeliness of KPI and management reports. These tests can be done on a single project or ideally, through the data from a sample set of projects.
2-PM	Definition of compensation and fee	15.38	Review multiplier and/or hourly rates and fees; develop metrics to evaluate fees such as deliverables identified under 1-PM, for example.
3-PM	Small/Disadvantaged business participation (increase and decrease)	8.65	Review organizational requirements for local (MBE/LBE) and federal (M/WBE) programs; quality of disadvantaged participation; participation results.
5-PM	Risk sharing	4.33	Evaluate existing pricing models versus results; conduct outreach to evaluate alternative pricing schemes such as lump sum or performance-based pricing. Evaluate organization's capability to administer contracts with alternative pricing schemes.
6-PM	Conversion to 'Managed Service' versus individual roles	1.92	Develop expected outcomes of a managed service approach and associated pricing models. Test current performance on individual role assessment and develop gaps that can be mitigated through a managed service approach.

and Associated Performance Tests.

ATTRIBUTE: PROCUREMENT – Implications

Procurement is the process by which respondent organizations select and contract with organizations to deliver projects. This research obtained data about design, project management, and construction agreements. Large hub US airports have to comply with public procurement regulations which typically require prescribed minimum advertising and selection periods and requirements that can result in procurements that have durations of up to several months (examples include Title 2 Code of Federal Regulations (CFR) part 200 for certain federally funded projects and local procurement regulations). At the time the project budget, schedule,

and delivery method are identified, the strategy associated with each major project procurement has to be reflected in the project delivery schedule as it drives many activities outside (yet which are critical for project delivery) of the technical project delivery team such as legal counsel (to develop/modify contracts, procurement deliverables such), the project finance team (who must identify an executable plan of finance to fund early work activities and the project, which may include the issuance of debt which to procure and the fund can take six to twelve months), and risk management to ensure proper coverages are reflected in the procurement documents and contracts. Procurements conducted by large-hub airports are also highly regulated: approvals by the airport organization's board, governance committee, or, in certain instances, FAA. This research shows that 82% of respondent organizations reported that their procurement function is either fully integrated (46%) or mostly integrated (36%) with the construction project governance function. This implies that procurement activities are organized in a manner that supports project delivery schedule, budget, and method, as well as coordination with a wide range of participants (described above). Approximately one-third of respondents reported that no modifications were needed to the improvement categories identified as existing conditions were satisfactory (Figure 24). However, the procurement function was the third highest-ranked improvement category identified by respondents about their construction project governance structure (Figure 6). Contributing factors affecting procurement performance could include the non-adaptive nature of predominant governance structures used by large hub airports (Figure 42Governance period of performance, Figure 43-Annual contractual activity, and Figure 44-Type of contracts) in conjunction with utilization of multiple delivery methods (Figure 19) and high throughput (Figure 43). Procurement is the activity through which risk transfer is achieved,

so it is on the critical path of project delivery. The importance of the data identified in this research points to the procurement function as an area of evaluation and improvement.

Implications to Existing Research

This research identifies the existing construction project governance structure used by large hub US airports as non-adaptive; the same structure is generally used to govern all projects, irrespective of delivery method, size, or type. This observation runs counter to the conclusions presented by Miller and Hobbs (2005) as well as Artto and Kujala (2008), who (for different reasons) champion an adaptive approach to project governance based on the characteristics of the project being delivered and the networked nature of the construction delivery organization. The resulting data from this research about the FORM attribute can also be used to measure the gap between idealized and empirical process observations made by Miller and Hobbs (2005) (Table 5).

Data from this research can also be used to extend the project governance framework identified by Bekker and Steyn (2009), especially in identifying specific tools and mechanisms (Figure 27), reporting (Figure 20), primary objective (Figure 11), and span of control (Figure 8) utilized by large hub US airports. Similarly, this research can be used to extend the research by Klakegg et al. (2008) by adding a non-European perspective to their research about project governance structures in the UK and Norway.

This research identified that the governance function used by large-hub US airports typically starts at the programming/planning phase and ends at the end of construction. The discrete identification of the span of control allows for a standard approach to measuring the project shaping costs and timeframes identified by Miller and Hobbs (2005) covering pre-

planning/programming activities. Additionally, if shaping costs are part of the overall project budget, the discrete identification of the governance span of control identified in this research allows for discrete measurement in each project development phase: programming/planning, design, and construction.

Data from this research could be used to evaluate Olsen et al. (2005) identification of the multiplier effect, whereby discrete elements of the predominant large hub US airport governance structure can be identified as a value chain and tested to evaluate which drive desired (or adverse) project outcomes.

This research supports the conclusions reached by Siemiatycki (2009), especially in the areas of contractual improvements, which centered on the definition of allowable costs and change orders (Figure 46) and extends the discussion to design and project/program management agreements (Figures 45 and 47, respectively). Identifying the governance function performance period also provides a discrete tool to extend Siemiatycki's (2009) research and provide discrete, measurable points to improve forecasting competency, performance monitoring, and change management.

One of the few aviation-specific governance research efforts conducted by Brady et al. (2005) highlights the utilization of non-competitive/open book contracting practices as a key tool to achieving manageable levels of risk transfer, which was an important factor in the Heathrow Terminal 5 project success. Brady (2005) also identified the governance structure developed and modified that aligned with the risk transfer method utilized. This research results contrast with the procurement approaches described for the Terminal 5 project, given the regimented procurement methods used by large hub US airports because of regulatory requirements.

The prioritized contractual areas of improvement to design, construction, and project/program management contracts provide expanded data from which the research conducted by Harper et al. (2006) can be extended by evaluating the extent to which the identified contractual gaps manifest as well as extend this research to assess the effect of interpersonal relationships affect contract administration.

This research supports the existence of complexity (Figures 42, 43, and 44, respectively) where respondent organizations utilize a non-adaptive project governance structure to deliver projects using multiple different delivery methods in a high throughput environment, consistent with elements of complexity identified by Carlsson (2000), Berteselen (2003), Baccarini (1996), and Qiu et al. (2019).

Four construction project governance paradigms are offered by Muller (2009) to categorize the approach and orientation used by project owners to achieve this function. Applying Muller's paradigm structure to this research results shows that the predominant large hub US airport construction project governance structures would best be categorized as behavior-oriented ('Behavior control focus') with a stakeholder orientation ('Agile Pragmatist Paradigm'). Data from this research could be used to expand Muller's research as it pertains to an entire population within a construction end market. Respondent organizations can also use this same tool to evaluate their specific organization's orientation to understand resulting features and gaps and identify opportunities for improvement.

Theoretical Implications

From a theoretical perspective, results of this research are consistent with the outcomes predicted by the Stakeholder Theory, given the extensive number of participants in the large hub

US airport construction governance function (Muller, 2009, Derakshan et al., 2019). For example, this research identified that 66 participants operate the construction project governance function, of which 48% are employees of the respondent organization (and 42% are comprised of consultants and other non-employees). Additionally, the high level of the contracting activity (Figure 43) and the wide range of contractual types administered (Figure 44) reflect an environment with a high level of stakeholders, even if strictly limiting the number to the parties involved in the contracting activity (which is but one of many elements of the project governance function) . Similarly, this research results are consistent with Agency Theory, where the high presence of contracted activity and participants (and identified areas of improvement) are conducive to the presence of information asymmetries between principals and agents (Alltontent and Sivonen, 2009; Muller, 2009; Derakshan et al., 2019). The use of a non-adaptive project governance structure identified in this research (Figures 43 and 44) is inconsistent with the Contingency Theory, which would predict an adaptive approach to project governance. (Artto and Kujala, 2008). Conversely, the extensive use of contracts to assemble temporary project delivery organizations is consistent with Contract Theory (Caniels et al., 2012) to explain the composition of project delivery organizations, yet given the scope limitations of this research, it cannot be extended to predict behavioral outcomes.

Managerial Implications

The construction project governance function is strategic to large hub airport organizations: to maintain a competitive operating structure, attract air service, reduce passenger congestion, and create economic activity within the community within which they operate. The processes and organizational competencies associated with construction project

governance manifest in project delivery performance. This research identified the predominant form of this function, identified categories for improvement, and provides a methodology for data collection and assessment that can be used to implement process improvement initiatives. This research also identifies the nature of improvements to the project governance function and the need to address organizational capabilities in conjunction with process enhancements, a complex undertaking to a strategically important business capability (Hammer, 2007). In addition to the complexity of this function, data gathered from this research shows that the governance function is, generally speaking, not achieving financial objectives. Lack of results may be driven by its non-adaptive nature while implementing a wide range of complex project delivery methods in a high procurement and contractual throughput environment.

Given the unstable nature of the aviation industry[37], the strategic nature of the construction project governance structure, and long list of improvement opportunities identified in this research, airport management teams should evaluate whether existing approaches to this function are appropriate and, as a first step, can use this research results to measure performance. Fredrickson (1986) suggests that strategic improvements in unstable environments, such as aviation, can achieve better outcomes when following an incremental approach to strategic decision-making with a focus on the quality of strategic decision-making capabilities. Coupling process improvement initiatives with organizational capabilities could provide a starting point for airport managers when designing improvement initiatives.

This research also highlights a wide range of improvement categories to the construction project governance structure whose nature drives the type of tools and approaches to achieve desired improvements. One tool that can be used is functional/departmental assessment to

[37] Events of September 11, 2001, economic crisis of 2008-2010, and COVID-19 pandemic to name recent examples.

identify who should lead and support a process improvement initiative. Appendix B provides an example of this tool, containing functional/departmental assessment for all improvement categories identified in this research. Figure 49[38] summarizes the data in Appendix B into five process improvement category types and nine functional/departmental areas best suited to lead the corresponding improvement. A similar approach can be taken by the management teams of a respondent organization to conduct their assessment using this methodology. Interestingly, results show that executive management was identified as best suited to lead 31% of process initiatives (the highest ranked function/department), especially when addressing improvements to the utilization, tools, and mechanisms for the construction project governance structure. The Planning/Engineering/Construction (P/E/C) function (which may be comprised of one or multiple departments depending on the organization) is followed, with 27% of process initiatives focusing on structure, reporting, and contracting. Additionally, Figure 49 highlights the complex nature of identified improvements, which are cross-disciplinary and require a wide range of inter-departmental coordination for successful implementation.

[38] Figure 48 summarized data aggregating weighted scores to derive reported data. This approach was taken to maintain the priority ranking provided by respondents (as opposed to weighting each response equally)

Figure 49

Comparison of improvement category type and lead function/department to implement change to drive improvement activities

As importantly, this research also provides a methodology for assessing a respondent airport organization project governance function at a much more granular level as follows: (1) the research questionnaire (Appendix A) can be issued to all participants of an organization's project governance structure (process improvement assessment); (2) interviews and workshops can be conducted to triangulate survey results (data triangulation); (3) project performance data (budget history and cost evolution, key project delivery organizations assessed such as designer, project manager, and contractor) can be evaluated to refine further and validate areas of improvement (metrics); (4) organizational and process maturity can then be assessed to evaluate resource requirements needed to implement planned improvements to target levels of competency and identify organizational capability gaps; (5) implementation of improvements can be measured and efficiently conducted (outcome measure).

This research also identified common elements of the construction project governance structure, which can be used to develop standardized performance assessments and identify key performance indicators which, with technology systems, can be developed to generate business intelligence and, ultimately, predictive tools to govern successful project delivery.

Limitations

Although there are certain similarities, this research is limited to US construction project governance practices whose regulatory environment at the local/state/national level differs from that used internationally. This research is limited to a small population (large-hub airports) which may limit the application to construction governance practices exhibited by medium, small, and non-hub airports whose project delivery activity is significantly less. Additionally, data was gathered using a single method, a questionnaire, which is subject to respondent bias. The length of the questionnaire was also shortened so that respondents, who are busy professionals, would

participate. Statistical significance is a potential limitation for two propositions given the utilization of proposition testing without generating confidence intervals.

External Validity

In addition to aviation, this research results apply to other US public sector end markets such as non-aviation transportation, ports, and other public sector organizations implementing megaprojects. Reasons for the external validity of this research include similarity in public sector procurement and contracting practices, organizational structures, project delivery methods used, and local/state/national regulatory environment.

Areas of Future Research

This research presents a roadmap and framework upon which the predominant construction project governance structure can be identified in any construction end-market. If aggregated across end markets, the methodologies and frameworks developed in this research provide a powerful tool that can also be aggregated across end markets to support the development of construction project governance policy. This research also sets the structure to measure project performance in a standardized manner which ultimately can be used to optimize processes and enterprise competencies. The data from this research can also be triangulated by conducting interviews and other data-gathering techniques to triangulate data and implications. Enterprise-side capabilities can also be evaluated based on the framework identified in this research, to which comprehensive maturity models, such as PEMM, can be adapted to the unique features of large-hub airports and fully utilized to assess and implement process improvement initiatives holistically.

Conclusion

The adopted definition for this research considered construction project governance as *a framework of management systems, rules, protocols, relationships, and structures within which participants make decisions in all phases of the project development process to achieve identified project goals and objectives. Project governance is a subsystem of corporate governance that operates within and is consistent with the corporate governance policy of the implementing organization.* This research identified the predominant construction project governance structure used by large hub US airports to be non-adaptive in form, whose primary objective is to achieve financial goals. The project governance function begins when a project is defined during the planning and programming phase and ends upon completion of construction. Irrespective of its lack of adaptiveness, large-hub airports generally use three delivery methods to deliver projects within an active contracting environment (throughput and various contractual actions). From a process improvement standpoint, this research identified 115 prioritized improvements within eight areas of project governance, providing a rich source of opportunities to measure, assess, and conduct process improvement initiatives. Ultimately, this research offers formality to what practitioners understood informally about large hub US airport project governance structures and actionable data and information that academics can use to conduct research in this domain.

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Appendix A

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Appendix B

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