Transformational Leadership and the Adoption of Sustainability and Asset Management Practices in Ground Transportation organizations

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Abstract

The unprecedented challenges the infrastructure domain has been facing for the past few decades are forcing the authorities and owners of relevant organizations, particularly within the ground transportation sector, to introduce more innovative measures and to mitigate risks by embracing and adopting sustainability and asset management practices.

This study examined the relationship between transformational leadership and the embracing and adopting of sustainability and asset management practices in the U.S. ground transportation sector. Further, this study assessed the mediation effect of organizational innovation on the relationship between transformational leadership style and the leaders’ perception in terms of adaptation of sustainability and asset management practices. Moreover, the study investigated the moderation effect of organization type (public and private) on the relationship between transformational leadership and the perception of adopting sustainability and asset management practices.

Structural Equation Modeling – Partial Least Square (SEM-PLS) technique was used to analyze the quantitative data collected using a questionnaire survey distributed to a sample of leaders working in ground transportation sector in the U.S.

The results revealed a positive and significant relationship between transformational leadership and the leaders’ perception of adopting asset management and sustainability practices. Moreover, the results supported the mediation influence (partial mediation) of organizational innovation on the relationship between transformational leadership and the leaders’ perception of adopting sustainability and asset management.

The results also revealed the prominent leadership style (transformational) that embraces sustainability and asset management practices. The findings claim that organization type does not have a significant influence on the relationship between transformational
leadership and the research’s outcomes (adoption of sustainability and asset management). Moreover, according to the results, no significant moderation effect was detected of organization type (public vs. private) on the relationship between transformational leadership and the leaders’ perception of embracing and adopting sustainability and asset management practices.

The study attempts to fill an important gap in the body of knowledge by investigating the influencing role of leadership style on the leaders’ willingness to adopt and embrace sustainability and asset management practices and applications in the ground transportation sector. In addition, the study investigated the mediation effect of leadership styles on the organization’s climate for innovation that, in turn, influences the adoption of sustainability and asset management practices.

As the results revealed the prominent leadership style that is more likely to embrace sustainability and asset management practices, ground transportation authorities and owners are expected to effectively and seriously consider hiring, recognizing, promoting and endorsing leaders with transformational skills and traits. Further, as the results revealed a positively mediating influence of organizational innovation on the relationship between transformational leadership style and the adoption of sustainability and asset management, ground transportation organizations are urged to identify the factors that both facilitate and inhibit the development of non-technological innovation in their work environment.
TRANSFORMATIONAL LEADERSHIP AND THE ADOPTION OF SUSTAINABILITY AND ASSET MANAGEMENT PRACTICES IN GROUND TRANSPORTATION ORGANIZATIONS

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Chapter 1 - Introduction

The building of new infrastructure networks and facilities and expanding the capacity of existing ones was a common trend in developed countries throughout most of the 20\textsuperscript{th} century. Economic growth coupled with a high demand for public services provided by such infrastructures were the dominant drivers for such development. Generally, the mindset of decision-makers at that time was set mostly on new construction; little attention was given to the issues of maintenance, service optimization, preservation, and sustainability. As time passed, much of the structures, networks, and systems began to age. The rate of deterioration raised substantially due to the lack of proper proactive preservation plans.

Aging infrastructure coupled with economic limitations led to a paradigm shift. More attention has been placed on maintenance planning and service optimization, whereas new construction faced a decline. In addition to budgetary constraints, infrastructure organizations started to suffer from other significant factors, which had direct and indirect impacts on the level of services offered. Issues such as climate change, natural-resource consumption and depletion, urbanization, population increase, new regulations, and considerable pressure on ecosystem services have begun to pose significant challenges in the infrastructure domain (WEF 2010).

Within the last three decades, infrastructure asset-management has emerged as an economical solution to these challenges. After a considerable period of successful implementation in the private sector (FHWA 2007), it has been introduced to the public sector. The main goal of adopting asset management is to optimize the level of service provided by facilities at the lowest possible cost. Several infrastructure organizations around the world have embraced asset management as a framework for the strategic and systematic addressing of challenges related to budgetary constraints and resource allocation. Asset
management processes usually involve four fundamental components: asset inventory, performance measures, analysis, and decision-making (Schofer et al. 2006). Yet, to achieve greater flexibility, these processes have adopted sustainability as a primary component. On its own, an organization’s adoption of asset management principles does not necessarily make it sustainable. Sustainability can only be achieved when its principles are incorporated in the asset management decision-making process. Moreover, asset management provides a framework to set strategic goals, policies, and objectives and, subsequently, the desired level of service.

Asset management provides a holistic framework that addresses challenges and resource allocation by utilizing service optimization and successful decision-making. It also serves to promote sustainability at all decision-making levels, where tradeoffs between competing options are analyzed. The integration of asset and sustainability management requires real leadership that ensures their effective and efficient adoption and implementation.

Sustainability principles need to be part of that framework, in which sustainability criteria are incorporated at all decision-making levels. Asset management, therefore, becomes a vehicle for delivering approaches that can optimize service levels, while addressing social, environmental, and economic variables. The concept of sustainability needs to be viewed and addressed as an opportunity rather than an additional financial burden. The focus should be on its added value to users and not solely, or even primarily, on cost. Stringent regulation and legislation may play important roles in encouraging more wide-spread adoption of sustainability applications within the infrastructure sector. However, full adoption of sustainability as an integral approach can only be successfully achieved when its principles are embedded in decision-making processes and when various stakeholders embrace it.
Finally, sustainability must be integrated and embedded within the organization’s vision and values.

The concept of sustainability has been studied within the field of infrastructure from different contexts and dimensions on multiple occasions. Many of these studies have highlighted the importance of sustainability and its role in shaping the overall performance and efficiency of the industry environmentally, socially, and economically. Singh et al. (2010) proposed a benchmarking framework to assess aggregate efficiency of 18 water utilities in urban locales throughout India in order to enable sustainable water supply services (Singh et al. 2010). Jeon and Amekudzi (2005) addressed sustainability of transportation systems by reviewing major initiatives in North America, Europe, and Oceania for the purpose of characterizing the emergent thinking on what constitutes transportation sustainability and how to measure it (Jeon and Amekudzi 2005). Hull and Tricker (2005) investigated the barriers in the decision processes leading to the delivery of sustainable surface transport solutions in the UK. The study summarizes the findings of a questionnaire survey carried out in 16 local transport authorities, covering the organizational, technical, and external challenges faced in the delivery of local transport strategies and schemes (Hull and Tricker 2005). Less attention has been given to research schemes that discuss the innovation of sustainability and asset management practices within infrastructure organizations. Moreover, research that attempts to study the relationship between innovation and the adoption of sustainability and asset management practices in the domain of infrastructure does not address the role of leadership in such processes.

Successful leadership can shift the focus from a traditional mindset of management to more advanced performance-oriented practices that seek optimal outcomes and promote sustainability. Leadership is able to manifest various constructive initiatives such as culture change, which represents a cornerstone process in any comprehensive reform. Subsequent
measures are required to deconstruct an existing management format, and to then restructure an organization’s system in alignment with the desired strategic goals and objectives that promote sustainable outcomes. Real leadership can inspire people to change, adopt ambitious visions, develop new strategies, and clarify values. Consequently, the focus will shift from individual performance within departments to a more comprehensive and integrated approach promoted across various departments and systems. Leadership is not only able to address and deal effectively with the challenges, but it is also able to observe and highlight other social, personal, behavioral, and political issues deeply inherent to an organization’s culture.

The infrastructure sector, therefore, is in urgent need of a paradigm shift in business procedures. This can be reached through innovation that fosters new ideas and initiatives that address common challenges. Organizational innovation is defined as “the adoption of an idea or behavior, whether a system, policy, program, device, process, product or service, that is new to the adopting organization” (Damanpour 1992). A review of the literature on innovation shows that technological innovation receives more emphasis, while little attention is given to sustainable innovation. Additionally, much of the discussion is limited to innovation within the construction industry. Specifically, the research focuses on construction companies at the firm level, primarily, because the principal drivers for innovation are often created at that level (Ozorhon et al. 2014).

For instance, Chan et al. (2014) investigated the associations between different types of leadership and innovation within construction firms in Hong Kong. The study provides a good example of the link between leadership and innovation. The results revealed by Chan et al. (2014) indicated that transformational leadership is positively associated with innovation climate. Hence, organizational climate should be recognized as a true enabler for innovation (Chan et al. 2014).
Other researchers studied the innovation process at the project level. For example, Ozorhon et al. (2014) highlighted innovation practices in projects that involved different parties and stakeholders, with the main focus placed on adoption of new ideas in construction, such as modern methods of construction (MMCs) and lean production (Ozorhon et al. 2014). Other researchers focused on the relationship between leadership style and project performance. Larsson et al. (2015), for instance, investigated the influence of leadership style on the project performance, and found that leadership style is a critical success factor that influences project performance in terms of cost, time, and quality criteria (Larsson et al. 2015).

As non-technological innovations in terms of sustainability and asset management initiatives in infrastructure organizations received less attention, and as the research investigating the role of leadership on adopting sustainability and asset management practices as non-technological innovation is very limited and rare, infrastructure domain is in urgent need to manifest a stream of research highlighting the significance of adopting sustainability and asset management practices. Addressing this gap in the body of knowledge is the main motivation behind this research. One of the objectives of this study is to investigate the role of leadership in facilitating innovation in infrastructure organizations. This research is built on the definition of innovation provided by Damanpour (1992) who argues that sustainability and asset management are “new” methods (for a majority of infrastructure organizations) that require leaders with special technical and professional skills, who are able to act as “champions”. The term ‘champion’ is used here to designate individuals who lead the innovation process (Nam and Tatum 1997).

Past research has proven that an innovation idea without a champion gets nowhere (Van de Ven 1986). Taylor et al. (2011) examined the champion phenomenon using findings from a case study featuring six urban water management agencies in Australia that employed
prominent champions. The study attempts to explain how the extant models of transformational, distributed, and complexity leadership are relevant to different dimensions of champion-driven leadership processes in the water industry (Taylor et al. 2011). In fact, this is one of the very few studies that addresses the role of leadership style in the adoption of sustainable practices in the infrastructure sector. Another research direction focused on the role of leadership in the process of innovation that promotes sustainable practices in the construction sector as presented in the work of Bossink (2007). The author investigated the characteristics and effects of leadership on sustainable innovation processes in construction projects in the Dutch house-building sector (Bossink 2007). Although construction is one component of infrastructure-business functions, the intention of this research was to look into the innovation process and the influencing drivers from an organizational standpoint that covers other functions in addition to construction (e.g., planning, design, operations, and maintenance).

The literature review indicates a presence of links between innovation and leadership. In fact, leadership is referred to as one of the main enablers of innovation in the construction literature (Ozorhon et al. 2014). Additionally, the vision of senior management is found to be a key factor for adopting innovation practices in construction firms (Tatum 1987). Other researchers also emphasize the importance of key individuals in the innovation process (Nam and Tatum 1997). These findings encourage a research-based assessment of leadership style in infrastructure organizations that adopt sustainability and asset management practices in an integral manner.

This study focuses on the ground transportation sector, covering different business functions and levels, including planning, design, construction, operation, and maintenance. As infrastructure business comprises both temporary (projects) and permanent (administrations and agencies) organizations, each level is investigated as contextual factors
that can impact the prominent leadership style that embraces and adopts sustainability and asset management practices.

1.1 Problem Statement

Infrastructure assets and services are facing extensive, interrelated, and manifold challenges that require a paradigm shift in the way that agencies currently operate. The following problems are those that this study most tries to address:

- Despite notable progress in technological innovations and increased insights and developments in management, engineering and sustainability, the domain of infrastructure in the United States still falls behind in capturing the potential benefits that such advancements could provide.

- A report published by the National Cooperative Highway Research Program (NCHRP) revealed that, in 2013, out of the 43 state departments of transportation (DOTs) that participated in the study, only 14 DOTs had asset management programs as a mandate (NCHRP 2013). However, the Fixing America's Surface Transportation Act (FAST Act) released in 2015 required all DOTs to generate a transportation asset management plan (TAMP) by 2018.

- Similar observations can be made about sustainability. Several infrastructure organizations, especially those within the ground transportation sector, failed to include sustainability in their strategic goals or in their existing plans and to integrate sustainability with asset management policies (NCHRP 2011).

- The ASCE 2021 infrastructure report card showed an alarming gap of investments needed to reverse the decline of deteriorating infrastructure assets to bring them to an acceptable level. The report claims that the investment needed to improve the deteriorating infrastructure jumped from $1.3 trillion in 2001 to $5.937 trillion in 2021, that is more than quadruple the cost 20 years ago.
• Lack of leadership, on the other hand, can prevent an organization from achieving multiple organizational outcomes such as innovation, performance, motivation, satisfaction, etc. An extensive body of research has found that leadership has a significant role in inducing and defusing innovation, which in return, fosters new ideas and initiatives.

• Leadership was found to have a major influence on creating an organizational climate for innovation that promotes and embraces sustainability and asset-management practices. Leadership development in most infrastructure organizations was found to be lacking a systematic approach; this, in turn, undermines the programs that could distinguish, promote, and develop the “champion” and “change-agent” individuals across all organizational levels.

• Financial problems are not the only challenges from which infrastructure suffers; other environmental and social problems also impact this significant domain that needs to be addressed. Global warming; urbanization; aging infrastructure and the risk of failure; resource consumption; and resource availability are some of the major challenges observed in infrastructure sector.

The infrastructure domain, in general, is in urgent need of innovative solutions, which can mitigate the various challenges and risks previously described. These innovative practices need to meet an organization’s desired mission and an owners/leaders’ vision, which should center on asset management and sustainability to remain competitive. Previous research claims that asset management is perceived as an enabler for adopting and implementing sustainable practices in infrastructure organizations. This claim stems from the fact that both asset management and sustainability comprise overlapping principles and elements organized and performed in two separate frameworks that can be integrated to achieve an ultimate outcome such as sustainable asset management initiatives.
Sustainability and asset management approaches can mitigate the challenges and risks originating from multiple sources including two main issues—namely underinvestment and a lack of leadership. These two issues are significantly interconnected and interdependent, as having excellent leadership without adequate funds is insufficient to mitigate the challenges and risks facing an infrastructure organization. In the same manner, a wealthy organization that lacks leadership would be unable to create a climate of innovation that addresses challenges and promotes new ideas, methods, and systems—such as sustainability and asset management—and subsequently would not spend the funds efficiently and effectively. Underinvestment in the programs related to maintenance, rehabilitation, and the reconstruction of crumbling infrastructure assets have major consequences and can cause significant problems that lead to interconnected risks in terms of economic, social, and environmental variables.

Comprehensive research is needed to better understand the significant role of leadership in promoting innovation that results in adoption of sustainability and asset management methods and practices. This research should aim to identify the leadership style of those champion individuals within the ground transportation sector across the functions of different organizations in various contexts, including cultural and environmental (temporary vs. permanent organizations) factors and from different business functions (planning, construction, operations and maintenance) in public and private sectors.

1.2 Research Questions

The threefold objectives of this research are listed as follows:

1. To examine the role of leadership in creating an organizational climate for innovation that promotes and adopts sustainability and asset management in civil infrastructure organizations and, more specifically, within the ground transportation sector.
2. To identify the prominent leadership styles of individuals who promote and adopt innovation in sustainability and asset management methods and practices. Moreover, the aim is to investigate whether organizational innovation mediates the relationship between transformational leadership and sustainability/asset management. The argument raised in this research is that transformational leadership style can create an organizational culture that enables innovation and creativity which, in turn, leads to adoption of sustainability and asset management practices.

3. To examine and evaluate the influence of contextual factors on the development of leadership style among leaders working in different contextual situations that comprise internal and external factors, including organizational characteristics, work functions, and external environmental factors. For that purpose, the research covers multiple levels of leadership (middle and top management), different organization types (public and private), and a range of infrastructure functions (planning, design, construction, operations, and maintenance).

The scope of this research is limited to transportation organizations, especially those involved in the ground transportation sector that includes roads, bridges, tunnels, and railroads as per the infrastructure classification presented by Uddin et. al. (2013). The authors delineate seven categories of infrastructure assets including transportation. The transportation domain consists of six sectors, including ground transportation (Uddin et al. 2013).

Despite the abundant body of research, within and outside of the domain, that study the subjects of leadership, innovation, sustainability, and asset management, very little of existing research addresses the relationships between leadership styles and sustainable innovation in infrastructure organizations. In fact, to the author’s best knowledge, there is no previous research that attempts to examine the link between asset management and sustainability as innovative practices in infrastructure organizations within the ground
transportation sector, nor the role of leadership style in promoting such innovation initiatives across multi-level contextual factors. This work attempts to fill this gap and proposes a practical framework for leadership development that underlines the prominent leadership style and behavior in promoting innovation. This work is designed to generate answers to the following research questions:

1. Is there a relationship between leadership styles and adopting (embracing) sustainability?

2. Is there a relationship between leadership styles and adopting (embracing) asset management?

3. Is there a relationship between leadership styles and an organizational climate of innovation?

4. Is there a relationship between climate of innovation and adopting (embracing) sustainability?

5. Is there a relationship between climate of innovation and adopting (embracing) asset management?

6. Is there any mediation influence of climate for innovation on transformational leadership styles and adopting (embracing) sustainability?

7. Is there any mediation influence of climate for innovation on transformational leadership styles and adopting (embracing) asset management?

8. What are the prominent leadership styles of leaders who promote sustainability and asset management practices?

9. To what extent is an executive leadership style (transformational and transactional) predicted by contextual factors such as an organization’s culture (organization’s type)?
Based on the research questions listed above and a comprehensive literature review, the following research hypotheses have been generated for further investigation:

**Hypothesis 1a**: Transformational leadership is significantly related to sustainability.

**Hypothesis 1b**: Transactional leadership is positively related to sustainability.

**Hypothesis 1c**: Passive/Avoidant behavior is negatively related to sustainability.

**Hypothesis 2a**: Transformational leadership is significantly related to asset management.

**Hypothesis 2b**: Transactional leadership is positively related to asset management.

**Hypothesis 2c**: Passive/Avoidant behavior is negatively related to asset management.

**Hypothesis 3**: Transformational leadership is positively related to climate for innovation.

**Hypothesis 4**: Climate for Innovation is positively related to sustainability.

**Hypothesis 5**: Climate for innovation is positively related to asset management.

**Hypothesis 6**: Climate for Innovation mediates the relationship between transformational leadership and sustainability.

**Hypothesis 7**: Climate for innovation mediates the relationship between transformational leadership and asset management.

**Hypothesis 8a**: When using an Organization’s type as a moderator, the positive relationship between transformational leadership and sustainability is stronger in the private sector than in the public sector.

**Hypothesis 8b**: When using an organization type as a moderator, the positive relationship between transformational leadership and asset management is stronger in the private sector than in the public sector.

### 1.3 Definition of Key Terms

The following section provides definitions for the terms used throughout this study. These definitions provide explanations for expressions as they appear in the context of
leadership styles, organizational innovation, sustainability, and asset management practices within the ground transportation sector.

Asset Management: a strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle (AASHTO 2013). It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well-defined objectives (AASHTO 2013).

Sustainability: Using, developing, and protecting resources in a manner that enables people to meet current needs while providing for future generations to meet their needs, from the joint perspective of environment, economic, and community objectives (NCHRP 2011).

Organizational Innovation: “the creation of a valuable, useful new product, service idea, procedure, or process by individuals working together in a complex social system” (Woodman et al. 1993).

Non-Technological Innovation: organizational innovation that includes significant changes in organizational structures; the implementation of advanced management techniques; and the implementation of new or substantially changed corporate strategic orientations (Ozorhon et al. 2010).

Leadership:

[The exertion of social influence between and among multiple loci of leadership (leader, follower, leader–follower dyad, collective, and context) working toward a common goal, via the leadership mechanisms of traits, behaviors, affect, and cognition, through a series of event cycles that may or may not include the same mechanisms and/or loci. (Eberly et al. 2013, p. 439)
Transformational Leadership: “the process of influencing major changes in the attitude and assumptions of organization members and building commitment for the organization’s mission, objectives, and strategies” (Yukl 1989).

Transactional Leadership: in this type of leadership, leaders focus on satisfying the extrinsic needs of their subordinates; whereas the subordinates, in return, perform what the leader asks. It involves development exchange and corrective avoidant leadership (Bass 2008).

Passive/Avoidant Style: this leadership style refers to leaders who have no intention of being involved when significant issues arise. They do not hold their employees accountable for the actions they take. They tend to exert actions and behaviors where followers think that they are free to act in any direction they want (Howell and Avolio 1993).

Mediator Variable: function of a third variable, which represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest (Baron and Kenny 1986).

Moderator Variable: is a variable that influences the direction and/or strength of the relation between an independent variable and a dependent variable. Moderator can be qualitative (e.g., sex, age, education) or quantitative (Baron and Kenny 1986).

Structural Equation Modeling (SEM): is a statistical multivariate method that allows the simultaneous examination of the relationships among the exogenous (independent) latent variables and endogenous (dependent) latent variables within a model (Aibinu and Al-Lawati 2010).

Partial Least Square Analysis (PLS): a method that “generates estimates of standardized regression coefficients (i.e., path coefficients) for the model paths, which can then be used to measure the relationships between latent variables” (Jung et al. 2008).
Multifactor Leadership Questionnaire (MLQ): a 45-item instrument that identifies and measures key leadership and effectiveness behaviors. It comprises nine leadership components representing a full range of leadership styles, each of which are measured by four highly inter-correlated factors (Avolio and Bass 2004).

Hierarchical Component Model (HCM): it is used when a model includes constructs involving more than one dimension. It is a process of testing higher-order structures that contain two layers of constructs (Hair, Hult, et al. 2017; Wetzels et al. 2009)

1.4 Dissertation Outline

This dissertation is divided into seven chapters. The first chapter describes the study’s nature and provides a brief introduction to the study’s drivers, purpose, and significance. This chapter also presents the research questions and hypotheses. Chapter 2 reviews the literature on several relevant subjects such as asset management, sustainability, innovation, and leadership theories. This chapter describes, in detail, transformational and transactional leadership styles. Chapter 3 discusses the method used in this study, which comprises research design, the target population and sampling process, operational measures and instrumentation, data collection, and data analysis. Chapter 4 demonstrates the survey results including participant characteristics and a summary of survey results. Chapter 5 presents the SEM-PLS results, including the results of hypotheses testing. In Chapter 6, the theoretical and practical implications are discussed. Finally, Chapter 7 offers conclusions and acknowledges research limitations while also making recommendations for future research.
Chapter 2 – Literature Review

The scope of this research covers four major subjects that need to be addressed and reviewed. Investigating the links among relevant factors and establishing a rational mindset to better understand the accumulated knowledge in each area will be sought herein. Leadership, innovation, sustainability, and asset management are four different research areas that constitute a mix of social science, business management, economics, psychology, and engineering. This multi-disciplinary research requires close attention to the context through which the study is undertaken. The aim in this part of the research is to study, synthesize, and observe the literature that covers the whole research sphere, with the hope of reaching a position that enables better understanding of the subject matter and leads to full awareness of the nature of the research’s deliverables and objectives. To reach that position, a comprehensive literature review is undertaken in infrastructure, innovation, asset management, sustainability, and leadership. The first section is dedicated to discussing the infrastructure components, systems, and functions. The interaction between the infrastructure services and communities, and how such services contribute to the community’s well-being and lifestyle are discussed as well. Trends, challenges, and drivers in the domain of infrastructure are underlined, which provide an opportunity to better understand the critical situation the domain is experiencing, and to find out the proper solutions for such challenges. In the remainder of this chapter, the discussion is expanded to include the other relevant research areas such as innovation, leadership, asset management, and sustainability.

2.1 Infrastructure Trends and Challenges

Infrastructure is the backbone of the economic and social development of any country around the world. The development of any nation is measured by how its infrastructure is built and maintained. We build infrastructure facilities to get specific services, which ultimately provide interdependent and multi-disciplinary networks of structures and facilities.
that make the community and society function effectively (Cleveland 2013). The infrastructure domain encompasses a wide range of sectors that provide different services for our daily use such as transportation, communications, water/wastewater stations and lines, power generation stations and lines, dams, solid waste management, and public buildings (schools, hospitals, government offices, fire stations, etc.). “In many ways, infrastructure is the interface between people and our planet” (Cleveland 2013). For a society, advancing beyond a very basic agrarian lifestyle requires infrastructure. Nearly all of our day-to-day interactions with the environment are mediated in some way by services provided by infrastructure. Infrastructure comprises a multiple that “… provide clean water, sanitation systems to remove human waste, schools, hospitals, roadways to distribute food, power plants to deliver electricity, factories to provide manufactured goods, and on and on – these are all forms of infrastructure” (Cleveland 2013).

Pagano and Perry (2008) described how infrastructure services evolved inside and around urban settlements where humans first lived. Those human activities require an investment in fixed assets, such as transportation and water. For their permanent settlements, people usually prefer locations near networks of roads, navigable waterways, and harbors. Therefore, they select places near seaports, waterfalls, and rivers. These places eventually became the first commercial-district settlements with a significant concentration of people and road networks. When railroads inaugurated as a main mode of transportation for people and goods, major settlements began concentrating around railroad crossings and at railroad–river intersections. (Pagano and Perry 2008). This inter-relationship between demographic movement and economic development is influenced by the physical infrastructure of the community. Infrastructure is the foundation for economic growth and eventually the main driver for the ultimate quality of life that people desire and seek.
Building new infrastructure facilities and expanding the capacity of the existing ones was a common theme in most of the developed countries during the era of the industrial revolution in the 20th century. Federal and local authorities in the U.S. utilized most shared funds at that time to increasing the capacity of public services, placing very little attention on optimizing decision-making procedures for operations, maintenance, resource allocation, asset management and sustainability. Today, the capacities of infrastructures have become constrained, and facilities have reached an alarming rate of deterioration. ASCE’s infrastructure report card is an assessment tool that rates the U.S. infrastructure facilities by giving grades across 16 categories. The overall grade for America’s infrastructure in the 2021 report is a “C-”, slightly better than the grade of “D+” given in the 2017 report card. Despite notable progress in some sectors, the overall pattern of decline in most US infrastructure facilities is obvious (ASCE 2021). Even though a few infrastructure sectors saw a decline in grade in 2021, most of the infrastructure facilities are way below the target grade of “B” (ASCE 2021, 2107). Roads received a grade of “D” and have shown no progress since 2017. Bridges received a “C” rating, slightly declining from “C+” in 2017. Ports have had a noticeable improvement, as their grades raised from “C+” in 2017’s report to a “B-” in 2021 (ASCE 2021, 2107).

Preserving and expanding the capacity of the existing infrastructure facilities requires tremendous capital and investments. Revenues that government agencies collect from taxes, charges, and fees have become less than what is needed in order to operate and maintain the nation’s infrastructure assets (Pagano and Perry 2008).

Despite the fact that many public agencies have continually allocated large budgets for maintenance, renovation, and reconstruction (MR&R) to guarantee performance levels that meet the expectations of stakeholders, these budget allocations are just a fraction of the total remedial bill required to bring the infrastructure’s service level to the required standards.
Managing infrastructure assets is very complex due to three different factors. First, infrastructure comprises a number of facilities, structures, and systems covering a wide range of businesses that provide all kind of domestic services to the entire society. Second, the process of managing these assets requires input from different interdisciplinary organizations and business units, which are often interdependent. Finally, there are other technical, environmental, political, and social factors adding complexity and challenges to the domain of infrastructure, which need to be addressed properly.

2.1.1 Ground Transportation

Transportation organizations have been at the forefront of developing infrastructure management approaches because of the substantial amount of assets they own as well as the significant role of transportation networks in the development of a nation’s economy and the lifestyles of its inhabitants. In fact, the amount of investment in transportation assets owned and operated by public agencies is amplifying every fiscal year, providing additional justification for the need for urgent and indicators decision making in this regard (FHWA 2007).

As far as the United States is concerned, Federal funds for preservation and maintenance programs have been limited due to economic distress and a lack of awareness about the consequences of maintenance deferrals. The cost of remedying infrastructure has amplified since the first report card on America’s infrastructure was issued by ASCE in 1998. The cost to improve the deteriorating infrastructure jumped from $1.3 trillion in 2001 to $5.937 trillion in 2021, slightly more than quadruple the cost twenty years ago. It is only a matter of time until the investments needed to reverse the decline reaches an unaffordable amount. At that time, it will be difficult, if not impossible, to preserve and maintain the public infrastructure to the desired level of performance. Of $5.937 trillion, the transportation sector has the largest stake at $2.834 trillion, that is 48% of the total investments needed,
putting it in the lead over other infrastructure sectors (ASCE 2021). This includes the investments needed for the entire sector, which comprises three main components: roads, bridges, and transit facilities. Bridges also have been affected by budgetary constraints and management related issues. Herrmann (2014) explains that “over two hundred million trips are taken daily across deficient bridges in the nation’s 102 largest metropolitan regions. He adds that “one in nine of the nation’s bridges are rated as structurally deficient, while the average age of the nation’s 607,380 bridges is currently 42 years” (Herrmann 2014). Additionally, it is found that “42% of America’s major urban highways remain congested, costing the economy an estimated $101 billion in wasted time and fuel annually” (Herrmann 2014).

Underinvestment in infrastructure is not only affecting the United States; it is a global issue and the likelihood of high-risk events to occur is expected to rise affecting the world’s economics, geopolitics, environment, societies, and technology. It has been reported that The World Bank has put global infrastructure investment needs at US$ 35 trillion over the next 20 years (WEF 2010). Under such budgetary constraints, infrastructure facility owners are seeking ways to perform their duties with fewer resources without compromising the overall level of quality and performance. The challenge here is to uniddle how to renew the existing deteriorated assets and, simultaneously, maintain, preserve, and increase the capacity of the entire systems with fewer resources.

2.1.2 Drivers for Sustainability and Asset Management Applications

Within the last two decades, the concept of asset management has been evolving in response to the effects of economic constraints on many developed countries. However, economic constraints do not represent the sole challenge facing the infrastructure sector. There are other challenges that have direct and indirect consequences on the performance and operation of infrastructure facilities, subsequently, affecting the quality of service provided to
customers. Addressing these challenges must become a regular component of asset management frameworks. Global warming; urbanization; aging infrastructure and its risk of failure; and resource consumption and availability are some of the major challenges impacting the infrastructure sector as well as other areas of life. Greenhouse-gas emissions (GHG) constitute the main cause of global warming as CO₂ and other harmful gases are being released into the environment during the combustion of fossil fuels.

Second to the energy (electrical power generation) sector, the transportation industry is the next largest contributor to global warming. It is responsible for 28% of the total GHG emissions in the U.S. in 2018 (EPA 2021). The EPA (2021) has found that:

*The largest sources of transportation-related greenhouse gas emissions include passenger cars and light-duty trucks, including sport utility vehicles, pickup trucks, and minivans. These sources account for over half of the emissions from the sector.*

*The remainder of greenhouse gas emissions comes from other modes of transportation, including freight trucks, commercial aircraft, ships, boats, and trains, as well as pipelines and lubricants.* (EPA 2021)

Additionally, transportation sector accounts for 29% of the global energy consumption (iea 2019). The primary source of fuel used in transportation is fossil fuel such as petroleum, although the fuel source mix is continually evolving (Herrmann 2014). Consequently, this makes the transportation sector one of the main contributors of air pollution and one of the largest sectors in CO₂ emissions as well as GHG emissions.

Changing earth temperatures and precipitation patterns; an increasing frequency of storm surges and other catastrophic weather events; and rising sea levels are some of the challenges associated with global warming. Predicting environmental changes and preparing accordingly are among the main challenges to arise in asset management processes. Modeling
and simulation tools are now available and being used to evaluate alternatives and generate options for decision-makers (NCHRP 2014).

Urbanization, a global issue with origins in developed nations, occurring most frequently within the last century, has continued to increase at an accelerated rate. Developing countries are also experiencing a significant wave of urbanization fueled by economic development and prospering lifestyles. With more people living in urban areas, the pressure placed on infrastructure services are becoming a burden and exceeding the capacities of these infrastructures for which they were initially designed.

As of 2014, 82% of the North American population were living in urban areas; the same figure is 80% and 73% for Latin America and Europe, respectively. In Asia, the number of people living in urban areas is relatively lower (48%), however, urbanization in Asia is accelerating at a faster pace than other regions and is projected to reach 64% by 2050. Globally, the urban population has grown rapidly since 1950, from 746 million people to 3.9 billion in 2014 (United Nations 2014). In fact, 54% of the world’s population lives in urban areas; 53% of this number is living in Asia alone, followed by Europe at 14% (United Nations 2014). It is estimated that the U.S. population will increase by 130 million people by 2050 (ASCE 2013). This population is more likely to live in urban areas, which will intensify the demands placed on already aging and deteriorating facilities.

Increases in natural-resource consumption, in a world with already limited resources, is an emerging issue, especially in the developing countries where the pace of consumption is increasing (IEA 2013). Economic growth in China and India and the subsequent socio-economic changes have escalated the demand on natural resources, placing significant pressure on ecosystem services. This demand, if not managed and controlled properly, may eventually result in a critical increase in the consumption of natural resources.
The depletion of natural resources occurs when the rate of consumption is higher than the rate of reproduction and recovery. Oil, for example, is a finite fossil fuel element that will vanish sometime soon, and that time depends on the rate of production and other factors such as technology and discovery. The economic indications predict that oil production will increase globally to cover the increasing demand in developing countries (IEA 2013). While the demand on oil has decreased and will continue to decrease in developed countries, other developing countries (China and India) will keep the same pace of demand until 2050. Declining oil supplies and increasing severity of water scarcity will have major impact on the production and supply of commodities as well as infrastructure services (IEA 2013).

The environmental and socio-economic challenges highlighted here intersect with the core principles and criteria of sustainability (more discussion on sustainability is presented in section 2.3). Asset management, on the other hand, originated in the private sector, with one main aim—optimize the service level delivered by infrastructure over its life cycle. Economic challenges proved dominant forces shaping asset management practices. The concept of asset management has evolved over the past decades, becoming more flexible in its integration of sustainability criteria. Adopting and implementing asset management in an infrastructure facility does not make it sustainable; owners may or may not consider sustainability principles as part of their decision-making processes.

Another notable driver of asset-management adoption in the public infrastructure sector came from the U.S. Congress. In 1993, the congress passed the Government Performance and Results Act, legislation that enforced accountability at all levels in the Federal Government. Since that time, it is required by law for a public agency to report with justifications their spending of public funds, how spending decisions are made, and the progress of ongoing projects (FHWA 2007). Another step in the movement towards greater accountability came from the U.S. Governmental Accounting Standards Board (GASB). In
1999, the GASB issued a new financial reporting mandate requiring greater decision-making transparency and accountability from state and local agencies. The GASB statement 34 established and improved “standards of state and local governmental accounting and financial reporting that will result in useful information for users of financial reports and guide and educate the public, including issuers, auditors, and users of those financial reports” (GASB 1999). It also required states and local governments to report on the conditions and costs of capital assets. Infrastructure agencies are now required to appraise the value of their infrastructure assets and indicate whether that appraisal includes a depreciation assessment or a report on the cost of capital assets and the outcomes of their preservation. In response to the evolving movement of asset management in the last two decades, several public, academic, and research organizations have contributed to the development of asset management principles, foregrounding the gaps in our understanding about the challenges facing infrastructure agencies.

2.2 Asset Management as a Solution

Asset management has been viewed in the public infrastructure sector as an approach that addresses the above-mentioned challenges and constitutes a paradigm shift from condition-based approach to a more holistic performance-based system. The definition of asset management varies in the literature, depending on context and origin. The principles and objectives vary by individual operations and services, as there is no “one-size-fits-all” asset-management solution applicable across all agencies. Asset management may mean different things to different organizations; however, a core tenet is promoting performance optimization and cost-effectiveness.

2.2.1 Asset Management in the Infrastructure Sector

Asset management was developed and used first in the private sector; companies with substantial asset inventory like electrical power, telephone, railroads, etc. needed an effective
approach to dealing with their mega-scale operations. The main goal for those companies was clear – maintain a predefined service level at the lowest possible cost. Assets that did not satisfy this goal were taken out of service and sold. This focus on implementation and subsequent achievement of the prescribed level of service to the customers has had positive results and made those companies very successful in terms of profit and customer satisfaction (FHWA 2007). The public sector has observed these successful practices in the private sector and begun to investigate possible ways to adopt such advancements in their infrastructure operations. Profit was not a motivator for public infrastructure agencies; the main objective was to run their operations with a certain level of service at the lowest cost possible; this is exactly the core concept of asset management.

Asset management provides a framework for setting strategic goals, policies, and objectives, and, subsequently, the level of service required. Outlining these goals and requirements is not a part of asset management. Strategic objectives are generally based on stakeholder preferences. As such, if stakeholders require sustainability principles to be included in the facility’s operations, the asset management process will adhere to these requirements. Likewise, stakeholders can set requirements to deliver non-sustainable goals in managing their assets (Marlow, Person, et al. 2010). A stakeholder is defined here as: “groups or individuals who can have effects on, or are affected by, the objectives of an organization” (Freeman 2010; von Meding et al. 2013).

Asset management does not impose goals, criteria, and requirements for sustainability. Owners decide if sustainability would add value to their operations and objective service levels. As Marlow et al. (2010) put it, “[t]he decision to operate in a more or less sustainable fashion is thus outside the scope of asset management, residing instead in the domain of environmental, socio-political, and business ethics” (Marlow, Person, et al. 2010). For asset management to be a vehicle for delivering approaches that optimize service levels while
addressing challenges, two main criteria have to be imbedded within the decision-making process at all levels, namely sustainability and leadership.

The Institute of Asset Management (IAM) responded to calls demanding for an integrated framework to assess, plan, and implement asset management applications. IAM is a non-profit, professional agency established in 1994 to “develop asset management knowledge and best practice, and generates awareness of the benefits of the asset management discipline for the individual, organizations and wider society” (IAM 2021). IAM is owned and controlled by its members and committed to remaining independent from commercial and trade associations. In 2014, IAM launched an asset management assessment methodology tool (SAM+) that is designed to provide an organization with the following (IAM 2015, p. 7):

1. **Quantified empirical evidence to assist its understanding of its current level of application of asset management processes, tools and techniques, including any significant gaps in application calibrated against a recognized scale.**

2. **A baseline and benchmark upon which it can build action plans to address key gaps and monitor progress over time, and which can be used to compare its own asset management capability against other organizations.**

3. **A better understanding of good practice in asset management to aid in the preparation of an improvement program or action plan.**

The main characteristics of (SAM+) tool can be summarized as following:

- Can be applied to all infrastructure sectors
- Unbiased methodology from any commercial input
- Allows organizations to assess their capability including:
  - Strengths and weaknesses
  - Deficiencies
Areas of excellence.

- Is complementary to and supportive of certification to BSI PAS 55:2008 and ISO 55001:2014
- Enables organizations to share and compare their own capability with others
- Facilitates the identification of good practice
- Facilitates the preparation of action plans for improvement
- Allows organizations to track improvements in their asset management systems.

2.2.2 Asset Management in Ground Transportation

The ground transportation sector in the U.S. comprises a large scale of physical structures and systems and is considered by many to be at the heart of the nation’s economic development. Ground Transportation includes systems such as roads, bridges, tunnels, and railroads. The focus of this research will be on U.S. ground transportation facilities. NCHRP (2013) specify ground transportation as features that include “… roads, bridges, signs, pavement markings, traffic signals, support commerce and mobility, and is, in essence, a shared financial public resource worthy of being managed at the highest level of efficiency” (NCHRP 2013). Transportation Asset Management (TAM) covers a wide portfolio of assets, such as (NCHRP 2009):

- Roads
- Shoulders
- Bridges
- Tunnels
- Other structures such as retaining walls, culverts, sign structures, etc.
- Curbs, channels, dams, and drainage facilities
- Barriers, railings, and medians
• Guardrails
• Impact attenuators
• Surveillance and monitoring equipment
• Signal and control equipment
• Road signs
• Pavement markings
• Intelligent transportation systems (ITS)
• Street lighting
• Sidewalks
• Bicycle lanes and paths on the right of way
• Parking facilities, and parking meters
• Rest areas
• Toll plazas
• Weigh stations
• Maintenance buildings and equipment
• Landscaping
• Pump houses
• Communication facilities

These assets are typically managed by state departments of transportation (DOTs), local transportation authorities, and federal agencies who are responsible for the fiscal management of the transportation system. These entities have shown a growing interest in advancing the state of practice in managing these critical assets. Such interest and the movement toward higher levels of adoption, in terms of asset-management practices, is a result of a number of governmental initiatives and acts such as Government Performance and

To understand the roles, responsibilities, components, and principles of the concept of asset management, it is of great importance to first define what exactly asset management means. In the transportation context, the American Association of State Highway and Transportation Officials (AASHTO) defines asset management as:

[A] strategic and systematic process of operating, maintaining, upgrading, and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well defined objectives.

(AASHTO 2013, p. 2)

This definition highlights some of the key concepts of any transportation asset management system. They involve strategic and systematic processes; incorporate cost and benefits over the entire life cycle of assets; deals with resource allocation; and promotes quality data and well-defined objectives. The Federal Highway Administration (FHWA) has also defined Asset Management as:

[A] business process and a decision-making framework that covers an extended time horizon, draws from economics as well as engineering, and considers a broad range of assets. The asset management approach incorporates the economic assessment of trade-offs among alternative investment options and uses this information to help make cost-effective investment decisions. (Sinha 2006, p. 13)

Asset management is defined in the British Standards Institution’s (BSI’s) asset management standards PAS 55 (BSI 2008) as “the systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the
purpose of achieving its organizational strategic plan”. Another definition developed by the European Federation for National Maintenance Societies (EFNMS) considers asset management as “The optimal life cycle management of physical assets to sustainable achieve the stated business objectives” (EFNMS 2010).

Edwards (2010) describes asset management as a concept that comprises six key areas: “strategy and planning; whole-life cost justification; lifecycle delivery; asset knowledge; organization and people; and risk and review” (Edwards 2010). Asset management may mean different things to different organizations within the infrastructure domain. However, for those who work within the public transportation sector, it captures three common primary goals: “1- Keeping the infrastructure in as good or better condition than it is now. 2- Developing and implementing a logical capital improvement plan. 3- Containing the costs of planning, building, operating, and maintaining the facilities” (FHWA 2007).

Asset management processes involve four fundamental components: asset inventory, performance measures, analysis, and decision-making (FHWA 2010). Implementation of these components varies from one organization to another, depending on a number of factors such as an organization’s structure, work culture, leadership, public awareness, data availability, technology, and skill level of work force (competency). Asset management principles, as described by the National Cooperative Highway Research Program (NCHRP) in their report, 551 - Performance Measures and Targets for Transportation Asset Management - are: “policy-driven, performance-based, analysis of options and tradeoffs, decisions based on quality information and monitoring to provide clear accountability and feedback” (NCHRP 2006, 2009). Many agencies are now implementing performance-based approaches and frameworks and developing more integrated data and analytical tools to evaluate options and tradeoffs in their decision-making processes. The implementation of
asset management in the transportation industry invites a number of strategic, institutional, measurement, integration, and analytic challenges (FHWA 2007).

2.3 Sustainability

The concept of sustainability is not new. It is based on a simple and very old premise that everything human beings require for their survival and well-being depends, directly or indirectly, on the natural environment (NRC 2011). The word “sustainability” comes from the verb “to sustain” and it merely implies the intention to continue to do something indefinitely (Marlow 2010). Sustainability as a term is used widely throughout many sectors, having a broad spectrum of meanings, depending on context. The number of sustainability definitions found in the literature can be estimated at anywhere between 200 and 500, giving the term a level of ambiguity (Willetts et al. 2010). The term is synonymous with a state whose nature can be sustained for a defined period of time with no setbacks to the original nature. Sustainability can be viewed as a state where the key goals of sustainable development are satisfied, a high quality of life is achieved, and the environment is protected (Mills and Attoh-Okine 2014). Although the term “sustainable development” was first used in the mid-1970s, the UN World Commission on Environment and Development’s (WCED) definition is recognized as the benchmark for what sustainability should mean. The report also known as “Brundtland Report” defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (Brundtland 1987). The report identified the importance of three sustainable components, which, if considered and balanced effectively, would achieve human prosperity, and satisfy long-term sustainability goals. These components are environmental, economic, and social sustainability; which are closely linked and interdependent.

Sustainability can be achieved only when there is a balance between economic development, growing and changing human needs, conservation of natural resources, and the
capacity of the environment to absorb the consequences of human activities (Burrow et al. 2013). As mentioned earlier, the infrastructure sector faces major challenges that fall mainly in the previously outlined sustainability areas. The so-called “Triple Bottom Line” (TBL) of sustainability, presents a framework that splits the idea of sustainable development into three areas: environmental protection, social equity, and economic prosperity. There are many sets of sustainability principles, originating from different domains and having been proposed by professionals involved in fields such as economics, social justice, and human development. Because of such variance in background, Nuttall (2014) stated that “the definitions are often not self-consistent, and can be perceived as conflicting, which has led some to believe that Sustainability is not a goal that can be obtained” (Nuttall 2014). Since many of the first principles of sustainability are found outside the engineering domain, engineers have had to adapt, modify, and adjust those principles to solve engineering-related problems. Consequently, different organizations tend to generate their own definition to suit a predefined set of needs and objectives, which are mostly consistent with the WCED concept of sustainability and the TBL.

2.3.1 Sustainability in the Infrastructure Sector

In the water infrastructure context, sustainability can be achieved when

... all its activities, both internal to the business and across its supply chain, achieve net added value when assessed across each of the triple bottom line outcomes (financial, social and environmental) over the medium to long timescales, considering all costs and benefits, including externalities. (Marlow et al. 2010, p. 22)

The focus of management should be on the added values to users and not solely, or even primarily, on cost. In the context of overall asset management, the Institute of Asset Management (IAM) defined the goal of asset management as “the optimum way of managing assets to achieve a desired and sustainable outcome” (BSI 2008). The definition implies that
the optimum outcomes of asset management can be achieved when performance, quality, cost and risk are balanced over the asset’s life cycle by integrating the TBL factors in a rational decision-making process (Niekamp et al. 2015).

As mentioned earlier, in addition to the economic factors, environmental and social challenges are better analyzed and highlighted within the sustainability approach. Principles of sustainability have the potential to help infrastructure agencies meet these challenges while aligning their actions with overall strategic plans. In Australia, for example, a linkage between sustainability and asset management has been recognized in the water sector. The aim has been to achieve a situation where they will be able to make sustainable asset management decisions that balance economic, environmental, and social outcomes. They have concluded that the only way to achieve that would be through the integration of sustainability principles into decision-making frameworks, which has been found to be challenging (Marlow et al. 2010). Another implicit challenge hindering the effective integration of asset management and sustainability can be the lack of clarity about what sustainability actually means to decision-makers and how it may be useful in addressing real business problems before determining practical and effective solutions. This, in turn, requires asset management tools and procedures to be developed and validated in order to adopt these principles.

The Institute for Sustainable Infrastructure (ISI) responded to calls demanding proper and effective implementation of sustainability principles in the infrastructure domain. They developed a holistic framework and rating system that enables a thorough examination of a civil infrastructure’s sustainability and resiliency. ISI is a nonprofit education and research organization based in Washington, D.C established in 2010 by the American Public Works Association (APWA), the American Society of Civil Engineers (ASCE), and the American Council of Engineering Companies (ACEC). In 2011, ISI and the Zofnass Program for
Sustainable Infrastructure at Harvard University’s Graduate School of Design collaborated to develop Envision ® (ISI 2021).

Envision is an initiative that provides a consistent, consensus-based framework for assessing sustainability, resiliency, and equity in civil infrastructure (ISI 2021). Envision’s mission and objectives can be summarized by the following (ISI 2021):

- Sets the standard for what constitutes sustainable infrastructure.
- Incentivizes higher performance goals beyond minimum requirements.
- Gives recognition to projects that make significant contributions to sustainability.
- Provides a common language for collaboration and clear communication both internally and externally.

The framework, as described by ISI (2021) can provide a set of criteria and performance indicators to enable decision makers to identify sustainable approaches during the project’s life cycle, including the project’s operations, maintenance, and end-of-life phases (ISI 2021).

Envision also takes into consideration the major challenges facing infrastructure such as resource constraints and the diversity of mandates, schedules, budget cycles, and funding sources (ISI 2021).

2.3.2 Sustainability in Ground Transportation

In the transportation infrastructure sector, the New York State Department of Transportation (NYSDOT) defines sustainable transportation as follows:

- Allows individual and societal transportation needs to be met in a manner consistent with human and ecosystem health, with equity within and between generations.
- Is safe, affordable, accessible, operates efficiently, offers choice of transport mode, and supports a vibrant economy.
• Protects, preserves, and enhances the environment by limiting transportation emissions and wastes, minimizes the consumption of resources, and enhances the existing environment as practicable. (NCHRP 2011, p. 37)

For that purpose, NYSDOT designed an assessment tool called “GreenLITES,” which gauges new highway miles. Contrastingly, the Oregon Department of Transportation (ODOT) defines sustainability as: “Using, developing, and protecting resources in a manner that enables people to meet current needs while providing for future generations to meet their needs, from the joint perspective of environment, economic, and community objectives” (NCHRP 2011). That is, ODOT addresses sustainability through the development of an integrated strategic sustainability program and an implemented sustainability plan. As a result of the integration of sustainability applications and the agency’s strategic plans, sustainability will become a guiding principle for the agency. One of the major influences leading to a successful implementation of sustainability at ODOT is that they do not view sustainability as an impact, but instead as an opportunity to improve efficiency (NCHRP 2011).

2.4 Innovation

Sustainability and asset management approaches are presented in this research as solutions for the challenges facing the domain of infrastructure and, more specifically, facing the ground transportation sector. Concepts of sustainability and asset management involve a set of methods, approaches, and practices that might be perceived as “new” to most organizations in this field. People tend to oppose change and often fear the unknown and uncertainty. Questioning and changing the status quo and thinking outside the box require individuals with certain attributes who are committed to new ideas, working hard to turn these ideas into reality. Those individuals usually flourish in places where new ideas are welcomed and appreciated. In other words, organizations need to embrace innovative ideas and strategies to maintain an innovation-friendly environment.
The concept of innovation is not new; it has been studied for several decades, especially in the manufacturing sector (Nam and Tatum 1997; Slaughter 1998). Researchers in the fields of economics, management, engineering, and many others have investigated processes of innovation (Johnson and White 2010). It has become a central issue in the industrial world due to the significant benefits that have been discussed in the literature (Ozorhon et al. 2010). Innovation is found to be essential to several factors of organizational performance, such as operational effectiveness, financial outcomes, and market competitiveness. It has also proven critical to organizational growth, the industrial sector, and society as a whole (Chan et al. 2014).

Slaughter (1998) highlighted a number of benefits attributed to innovation in the construction industry, which include economic growth, productivity improvement, an increase in market share, social benefits (equity and equality), improved quality of life, reducing environmental impacts, higher technical feasibility, and other intangible benefits (Slaughter 1998). At the project-level, previous research found innovation practices to increase the efficiency and effectiveness of construction-site operations (Dulaimi et al. 2005). A linear dimensional model of innovation tends to focus mainly on economics as the sole outcome of innovation. Studies from this kind of research provide evidence of the benefits of innovation on performance, measured in sales of innovative products, sales growth, or number of patents (Mention 2011).

Another wave of research considers innovation as a complex phenomenon involving a wide range of input and output affected by a number of contextual and environmental (work related) factors (Ozorhon et al. 2010). Complexity stems from two different directions: First, from the diverse factors that shape their interrelations in different contexts. Second, from the multiple players involved in any innovation process within the infrastructure domain. The latter falls under the external category of factors, and the former is relevant to the internal
ones. Such research was found to be inapplicable to the infrastructure/construction sector due to institutional and organizational factors since many aspects of construction differ from manufacturing (Nam and Tatum 1997). Van de Ven (1986) believes that, in order to understand the process of innovation, it is important to understand the factors that both facilitate and inhibit the development of innovations, which include ideas, people, transactions, and context over time (Van de Ven 1986).

In a study aimed at investigating the interactions and interdependencies of organizations that have important roles in adopting and implementing innovation and sustainable measures in the Scottish construction sector, the results were found to support research findings that consider inter-organizational networks as an important external factor that influences the innovation process (Dewick and Miozzo 2004). Kissi et al. (2012) had similar findings and drew attention to the influence of internal and external contextual factors on the process of innovation in the construction industry. In addition to the inter-organizational factors, regulations (Kissi et al. 2012) and political support (Johnson and White 2010) were deemed as key external factors that influence innovation. Internal factors, on the other hand, cover a wide range of contextual variables such as organizational climate (Chan et al. 2014; Dulaimi et al. 2005; Johnson and White 2010; Jung et al. 2003; Kissi et al. 2012; Tatum 1987; Taylor et al. 2011), culture (Chan et al. 2014; Cowan-Sahadath 2010; Dess and Picken 2000; Dulaimi et al. 2005; Johnson and White 2010; Jung et al. 2003; Munshi et al. 2005; Patanakul and Aronson 2012; Quin 1985; White 2007), work environment (Chan et al. 2014; Dess and Picken 2000; Johnson and White 2010; Naranjo-Gil 2009), administrative competence (Johnson and White 2010), size (Damanpour 1992; Nam and Tatum 1997; Naranjo-Gil 2009), structure (Armbruster et al. 2008; Chan et al. 2014; Nam and Tatum 1997; Ozorhon et al. 2010; Van de Ven 1986), communication (Chan et al. 2014; Patanakul and Aronson 2012), organizational strategy (Chan et al. 2014) and

The diffusion of innovation is defined as “the process by which an innovation is communicated through certain channels over time among the members of a social system” and “the process in which participants create and share information with one another in order to reach a mutual understanding” (Rogers 1995). Woodman et al. (1993) viewed organizational innovation as “the creation of a valuable, useful new product, service idea, procedure, or process by individuals working together in a complex social system” (Woodman et al. 1993). The organizational context needs to be considered when studying the innovation process. Those contextual variables and others vary in their intensity and influence based on innovation type, organization type and function, and stage of innovation (Damanpour 1992).

The two main types of innovation are technological and non-technological (organizational or administrative) (Hyard 2013). “Administrative innovations are related to the managerial procedures, administrative processes and rules of the organization” (Naranjo-Gil 2009). In general, non-technological innovations are less visible to the public, hence they may receive less attention and minor political support. However, Hyard (2013) believes that non-technological innovations, in the context of transportation, are not less important than technological innovations in that they contribute to limiting the environmental problems and challenges. Ozorhon (2010) defines non-technological innovation as organizational innovation that “includes significant changes in organizational structures; the implementation of advanced management techniques; and the implementation of new or substantially changed corporate strategic orientations” (Ozorhon et al. 2010). Technological innovation, on the other hand, encompasses product, service, process, and marketing
Innovation has a context-sensitive nature, and the patterns of innovation in manufacturing, for instance, differ from those in other sectors (Ozorhon 2013). Armbruster et al. (2008) distinguish four different types of organizational innovations: (1) technical product innovations, (2) non-technical service innovations, (3) technical process innovations, and (4) non-technical process innovations (Armbruster et al. 2008).

The distinction between technological and non-technological innovations is important because it reflects the general differences between social structure and technology in organizations (Naranjo-Gil 2009). Past research conceptualized innovation in many ways, studying it from several perspectives typified in three main categories: 1) diffusion of innovation; 2) innovation and innovativeness; and 3) innovations at different levels of analysis (Damanpour 1992).

2.4.1 Organizational innovation

The focus of this research is mainly limited to the organizational innovation that promotes sustainability and asset-management practices. This type of innovation is different from technological innovation. While technological innovation focuses on the development of a new product and the manufacturing/operation process, non-technical innovation deals with the administrative procedures part in which organizational mission, strategies, policies, and processes are all integrated into the adoption and implementation of sustainability and asset management strategies. Organizational innovation in a firm can be observed in the form of significant changes within organizational structures; implementation of advanced management techniques; and implementation of new or substantial modifications to corporate strategic plans (Ozorhon et al. 2010).
2.5 The Role of Leadership

Infrastructure is a domain of enormous complexity. The complexity is basically driven from the tremendous scale of physical components that deliver services from a wide range of facilities. It is also embedded in the process of planning, designing, financing, constructing, maintaining, and operating infrastructure assets. The management of such complex systems requires close attention to the fact that it consists of multi-disciplinary, inter-disciplinary, and interdependent processes, which interact within an individual area as well as with other infrastructure areas. Positive and negative results are expected in the form of economic, environmental, and social factors. Such complexity, coupled with the challenges and trends described in the previous sections, requires knowledge and special skills that have not been common in the infrastructure management domain. Sustainability and asset management methods are hence proposed as a step forward to address challenges. Implementing a sustainability approach within asset-management practices calls for highlighting the vital role of decision making. This is a process that considers concept of sustainability in the decision-making process, and inherits the values of asset management, and hence requires substantial changes from current practices. It is worth mentioning that “change requires not just a different vision but different values, practices, and skills on the part of decision makers and implementers” (Sparrow 2001).

Decision making that satisfies the principles of sustainability and that ensures the successful implementation of infrastructure asset-management practices requires ‘real leadership’ that can inspire people to change, adopt an ambitious vision, develop new strategies, and clarify values (Burns 2010). A shift from current management practices, that focus mainly on isolated technical and planning issues, to a broader vision and strategic goals is required. Embracing asset management in any infrastructure organization while adopting social, environmental, and economic principles requires more than managers and
professionals running their departments individually in ‘silos’ (Slevin and Pinto 1988; Zaleznik 1977). Functional departments in many infrastructure agencies tend to work in a vacuum, setting their own goals and performance measures with minimal attention to overall strategic goals and objectives. Hence, they tend to micro-manage their business processes rather than adopting a macro-level management approach. They typically attempt to optimize the service level of the assets under their jurisdiction while remaining within their area of supervision (FHWA 2010). Such practices may partially fulfill localized objectives within a given silo; however, they will still undermine the efforts of achieving the organization’s overall goals.

A lack of cooperation, coordination, and collaboration between an organization’s functional departments is not the only challenge that undermines a successful implementation of sustainability and asset-management practices. There are various personal, behavioral, social, institutional, cultural, educational, and political factors that affect the overall performance of any infrastructure agency (FHWA 2010). Only the presence of real leadership can overcome such challenges and pave the way to a paradigm shift away from the “business-as-usual” practices to effectual change. Leadership tends to reform the existing norms and shift the direction to a major and radical cultural change, which promotes rational and comprehensive decision-making processes that encourage innovation. Eventually, a higher level of adoption and implementation of sustainability and asset management in transportation infrastructure organizations is maintained.

2.5.1 Leadership vs. Management

There are three main reasons why differentiation between leadership and management is important to address. First, blurring the differences can engender difficulties in measuring, testing, assessing, hiring, developing, and promoting leaders and managers. Second, misinterpretation of terms can also hinder programs that seek to prepare managers and
leaders for organizations. Finally, confusion in the role of leadership and management is likely to occur, which may, in turn, lead to conflict and dysfunctional business units.

In his 1977 groundbreaking article, Abraham Zaleznik (1977) challenged the traditional view of management by drawing a distinct line between leadership and management. In his view, managers take an impersonal, passive outlook towards goals that arise out of necessities, not desires. They tend to avoid risk, limit choices and design compromises through negotiation. Managers usually prefer working with people but maintain minimal emotional involvement. They focus on processes and how decisions are made rather than what decisions to make. Communication with their subordinates tends to be ambiguous, which can, in turn, be perceived as inscrutable and manipulative. Organizations under their administration accumulate bureaucratical procedures and political intrigue.

In contrast, leaders take personal and active involvement in goals. They shape rather than respond to ideas, alter moods, and encourage imagination and broaden expectations. Leaders try to change how people think about what is desirable and possible. They develop fresh approaches to problems and increase options for further tradeoff analyses. Ideas, in their view, turn into exciting possibilities. Unlike managers, leaders seek risk when opportunities appear promising. Leaders attract ideas that can, subsequently, be turned into plans. They relate to others directly, intuitively, and empathetically (Zaleznik 1977).

The differences between leadership and management and the distinguishing roles, skills and attributes of leaders and managers, do not necessarily indicate that managers cannot lead, or leaders cannot manage. In fact, leadership and management significantly overlap and the two functions are blended and complementary because sometimes leaders manage and sometimes managers lead. However, leadership needs power and authority to function successfully. Toor (2011) underscored this phenomena and stated that “Leadership relies on personal power, informal ways and means of influence, one-to-one touch and
communication between leaders and followers, and coherence between the goals of leaders and those of followers” (Toor 2011). The leader’s power is legitimized by their followers, and they influence others by giving them hope, inspiration, and through the consistent following of a set of personal values. In contrast, “management predominantly relies on position power, formal authority, and control of processes through the power of a small group who take orders directly from the top” (Toor 2011). A manager’s power, unlike a leader’s, is legitimized by the position they occupy, and they influence others by formal instructions in a reward/reinforcement approach. Managers can adopt leadership skills in their own departments or on individual projects where they have the power and authority to do so. They can adopt a mix of management and leadership functions to achieve their goals. Every manager in an organization is able to do so and, consequently, the typical end result is isolated achievements that lacks collaboration in satisfying the overall strategic goals of the organization; hence the importance of leadership that is able to harmonize the work and integrate efforts to serve a shared vision and to achieve the organization’s goals.

2.5.2 Leadership in the Infrastructure Sector

Empirical research on leadership development in the infrastructure sector is rare. Similarly, studies investigating the link between sustainability and leadership within the infrastructure is even rarer. The number of studies that address the role of leadership in the infrastructure domain is very small compared to the number of studies in the construction industry. At the same time, the construction industry is also suffering from too little attention given to studying leadership (Chan and Chan 2005). Although construction is a main component of an infrastructure’s asset life-cycle, apart from design, operations, and maintenance, existing studies focusing on the construction industry are mainly outside the infrastructure domain. Most research is concerned with studying the impact of leadership within construction projects and, primarily, studying the leadership behavior and style of
project managers and executives working exclusively in construction firms. On the other hand, the infrastructure sector received very little attention in terms of studying the role of leadership and its impact on the development of infrastructure. This can mainly be attributed to the massive complexity and scale of the infrastructure domain. As mentioned earlier, the infrastructure domain covers a wide range of sectors, systems, and industries. This diversity makes it difficult to develop a general model or framework that fits all different infrastructure systems and functions.

The literature review also reveals an absence of studies investigating the role of leadership in the development and implementation of sustainability practices in the infrastructure domain, which constitutes an important gap in knowledge. Only a small number of studies addressed the role of leadership in promoting and adopting sustainable practices in infrastructure. And few more focused on the sustainable practices in the construction industry. However, studies investigating the link between leadership and sustainability/asset management within the infrastructure and, more specifically, within the ground transportation sector, tend to be extremely rare. This research attempts to fill this gap.

2.5.3 Defining the Role of Leadership in Sustainability and Asset Management

As mentioned earlier, leadership is defined in many ways and the literature abounds with thousands of definitions, approaches, and views of leadership (Yammarino 2013). Siegel (2010) adds that leadership is one of those words that everyone understands in a different way but one that can be difficult to define precisely. This stems from the fact that “leader” is used to describe many different types of people. Only a “real” leader can inspire followers beyond what they must provide to a manager under disciplinary requirements. In other words, leadership is not just about formal authority, leadership has an implicit power that emerges from influence. Eberly et al. (2013) defines leadership as
... the exertion of social influence between and among multiple loci of leadership (leader, follower, leader–follower dyad, collective, and context) working toward a common goal, via the leadership mechanisms of traits, behaviors, affect, and cognition, through a series of event cycles that may or may not include the same mechanisms and/or loci. (Eberly et al. 2013, p. 439)

This definition implies that leadership can be practiced by any individual within an organization regardless of the individual position (Opoku et al. 2015a), as long as they exert leadership practices that influence people, encouraging behavioral changes in pursuit of a common goal. Yukl (2006) provides several definitions of leadership as well.

Leadership traits, behaviors, and attributes are all conceived as personal tools and mechanisms a leader uses collectively in different contextual situations. The combination of such personal skills is what shapes a leader’s style, which helps to explain why people with the same asset management competencies can act differently in certain situations and why some leaders exert influence while others do not (IAM 2014a). Competence is defined here as: “the ability to perform tasks consistently to the expected standard” (Lloyd 2010). It is one’s leadership style that reflects their personal attributes and, subsequently, shapes their choice of leadership tools, which are, in turn, utilized to inspire a common vision, establish teamwork vibe, provide guidance and assistance, and exert influence on the subordinates' beliefs, behaviors, and actions toward a common goal.

Change management is a difficult process that requires a compatible and precisely tuned leadership style, which considers time, situation, and context. Leadership styles will be discussed in more detail in the following section, while the discussion here will focus on the link between leadership and sustainability/asset management practices in infrastructure organizations.
Organizations adopting sustainability and asset management practices face a critical challenge: how to resolve the persistent conflict between sustainability issues (environmental, social and economic) and the short-termism of political effects and individual self-interests (Woodhouse 2010). Environmental, economic, social, and cultural factors are all relevant considerations when evaluating the adoption of sustainability. The best performing organizations recognize this fact and have moved beyond just making references to “green-washing” stereotypes (ANZ 2010).

In this research, sustainability practices refer to those aimed at achieving sustainable asset management in a ground transportation organization. Those practices will be evaluated at different organizational functions (planning, design, construction, operation, and maintenance) in both temporary (projects) and permanent organizations (office) including within public and private sectors. Sustainability principles need to be embedded in an organization’s culture and integrated into their asset-management plans. Regardless of genuine environmental reasons for taking sustainability into account, the average lifespan of many infrastructure assets requires the consideration of sustainability.

The main idea of adopting sustainability and asset management practices is that it “should determine the most cost-effective solution that balances the needs of present and future customers” (ANZ 2010). Sustainability dimensions and goals to be achieved in the infrastructure domain depend on significant measures and actions such as: enhancing health, safety, and security; conserving energy; creating equitable livable communities; optimizing services to an optimum level of performance at minimal cost; and promoting economic prosperity (Uddin et al. 2013).

In New Zealand, many infrastructure organizations were found to be struggling to clearly describe their approach to sustainability or sustainable development (ANZ 2010). They often fail to show a clear understanding of how to integrate a broad concept of
sustainability into their asset-management practices. As such, they tend to fill spaces with general discussion of sustainability and some obvious ‘green’ measures such as “recycling facilities at sports centers, native planting in road medians, and so on,” which are not necessarily directly related to the core assets in the plan (ANZ 2010).

Edwards (2010) underscored the link between leadership and organizational culture as an enabler for successful implementation of asset management, where it was stated that “Leadership and development of an asset management culture are being recognized as increasingly important in helping organizations move from a departmental view of their business towards a more integrated view on asset management” (Edwards 2010). In their 2010 report, Audit New Zealand (ANZ) conceived “insufficient interest by senior management” as one of the pitfalls that infrastructure organizations should avoid (ANZ 2010). Another report published in the U.S. by the Transportation Research Board (TRB) titled: ‘Transportation Asset Management: Strategic Workshop for Department of Transportation Executives’ presents a similar conclusion: “top-level agency commitment (at the very highest levels) in support of asset management was apparent” in every successful case the report reviewed (TRB 2008).

A survey of experts in asset management conducted by Kellick (2014) revealed that leadership is the most important success factor in the adoption of asset management practices in infrastructure organizations (Kellick 2014). Among ten factors, ‘executive support’ ranked at the top, which indicates the significant role of leadership in the adoption and implementation of asset management practices. This is highlighted also by Kellick (2010) who believes that “asset management needs to be driven from the boardroom not the engine room”, which implies the important role of senior management support for the adoption and implementation of asset management practices (Kellick 2010). In the same manner, Burns (2010) agrees that “asset management strategy is a corporate, not a middle management
occupation” (Burns 2010). Kellick (2014) also added that “If asset management begins in the middle-level of the entity, middle-level managers need to elevate it to executive as well as communicating its benefits right across the organization” (Kellick 2014).

However, leadership skills are essential for both middle and senior managers (Edwards 2010). There is, therefore, an agreement between researchers within the asset management domain that even if asset management does not start in the boardroom, it definitely ends there. This conclusion is in line with what has been acknowledged across the industry and the literature. Lloyd (2010) highlights the importance of strategy development and leadership skills over any specific professional qualification, which emphasizes the role of behaviors, personal attributes, and business management skills over other professional-profile variables (Lloyd 2010).

In their (2010) report: “Beyond the Short Term - Transportation Asset Management for Long-Term Sustainability, Accountability and Performance”, the Federal Highway Administration (FHWA) stated that:

> [A]sset management ethos depends on leadership, either from the individual executive, from an executive body such as a commission or from legislative mandate. It takes leadership to overcome the organizational inertia which tends to prevent individual units from working seamlessly and selflessly together on initiatives which transcend the boundaries of any one unit. It takes leadership to adopt new practices which are not common in the organization. It takes leadership to get divisions and individual personnel to change past practices. It takes leadership to make difficult financial-tradeoff decisions. (FHWA 2010, p. 30)

Adopting sustainability and asset management practices in an infrastructure organization requires culture change, which calls for top management to understand its benefits to the business and accommodate its full integration into the business strategy (Kellick 2014). Asset
management ought to be integral to the organization’s culture. Changing the mindset is not costly, it requires leadership (ANZ 2010). As the U.S. Federal Highway Agency put it “the successful change from “business as usual” to a “rational and comprehensive” system requires compelling leadership” (FHWA 2010). Aligning sustainability and asset management principles with the organization’s strategic plan requires leadership commitment, which, in turn, leads to successful implementation and integration (BSI 2008). To manifest the process of cultural and organizational change, multiple organizational skills related to the areas of “Change Management, Organizational Communication and Organizational Theory” should be collectively adopted (FHWA 2010). Culture change requires “consistent, sustained leadership, communication, education and the creation of a common consensus among the different subcultures within a large organization” (FHWA 2010).

The findings from an International Scanning Study published in TRB’s report (TRB 2008) revealed that “the evolution in the use of asset management was viewed as changing the culture of the organization”. The report stresses that creating an asset-management culture in an organization is one of the most important components of all observed asset-management programs. In fact, the leadership’s support for full integration of asset management into the planning framework is identified as the second most important success factor in Kellick’s (2014) study. Kellick (2010) also believes that leadership support is crucial; its absence in an organization could endanger the flow of financial and human resources and could amplify the ‘silo’ effect of asset management only being implemented in its traditional departments. In such a work environment, where an organization is functioning within ‘silo’ status, other departments cannot be held responsible or accountable for the successful delivery of products or services (FHWA 2010). Kellick (2010) also asserts that the asset manager should act as a leader in order to perform his/her job effectively by possessing
different competencies in different disciplines such as leadership (leading and influencing others, training and mentoring, and building and maintaining relationships), management (strategy setting, human resources, financial planning, information management), service delivery, and interpersonal skills (empathy, communication, social networking, diplomacy, negotiating and influencing) (Kellick 2010).

Asset management does not mean merely ‘managing assets’ in a superficial way, which has been the norm for a very long time. “Implementing Asset Management requires much more than buying a new software package or adopting new terminology” (FHWA 2010). It requires a new approach that involves a high level of communication, cooperation, and collaboration between traditionally dispersed departments within an infrastructure organization. Asset management encompasses a number of business functions such as those related to planning, program development, design, construction, operation, maintenance, information technology, and knowledge management (FHWA 2010). It is a multi-disciplinary approach that covers more than just an engineering background and skills.

An ANZ report (2010) supports this fact and considers it as one of the most effective improvements an organization can make to achieve higher levels of asset-management adoption and implementation. The report states that asset management “is an integrated process that needs to be carried out in a coordinated way. It is a multidisciplinary process that involves engineers, financial and corporate planners, and policy makers who need to work together and respect each other’s contribution” (ANZ 2010). Asset management also includes a process of integrated actions and activities that eventually link the organization’s outcomes to its plans and stakeholder’s expectations. Moreover, it uses various managerial and administrative tools such as inventory registration, monitoring, condition evaluation, asset valuation, life-cycle analysis, and other optimization tools (Mihai, Binning, and Dowling 2010). Kellick (2010) believes that several measures and actions are needed for
ensuring successful implementation of asset management, stating that “the development of asset management framework in an organization does not guarantee success” (Kellick 2010).

There are numerous factors – both external and internal – in addition to desire and motivation, that affect the successful implementation of sustainability and asset management. The traditional approach that views asset management as only a function of constructing and maintaining infrastructure components must be amended. Leadership can establish a basis for a paradigm shift away from a ‘business-as-usual’ mindset to practices that adopt sustainability and asset management, making it part of the organization’s strategic plans. Organizations can do that by reorienting traditional mindsets, moving beyond conventional practices in terms of standard procedures and career paths of good and competent staff. They must look for state of the art methods to equip them with the required principles and practical thinking skills they need to contribute to the organization’s mission (Lloyd 2010).

Motivation, education, training, communication, team-work and sense of ownership are all critical enablers to a successful implementation of asset management that promotes sustainable practices (Woodhouse 2010). Interpersonal traits and behaviors, along with communication skills that establish and maintain sustainable relationships between leaders and followers across an organization, are more essential than any technical or professional qualifications (Kellick 2014). Those enablers are well conceptualized under the leadership development, where a leader uses a mix of behavioral and technical skills that assimilate their leadership style to effectively influence change. A leadership style is needed that is able to radically transform the traditional way of ‘doing business’ into “more active workforce and stakeholder consultations, communication and consistency of purpose, and new behaviors in cross-disciplinary team-work that can reduce the effects of functional tribalism or departmental silos” (Woodhouse 2010). This is not easy and requires ‘real’ leadership with a
distinctive style that is able to deal with various divisions doing their jobs, simultaneously, towards a common goal.

In infrastructure organizations where traditional hierarchical commands tend to flow from the top down, while information flows from the bottom up, transformational and revolutionary measures need to be taken to achieve ‘Horizontal Alignment’, where coordination and cooperation flow across the organization in an integral fashion. Leadership styles have to be embedded and integrated into the organization’s culture and instilled in the common day-to-day practices throughout the organization (FHWA 2010). The main goal of leadership is to create and maintain a working environment that fosters innovation in all different functions and levels and recognizes the champions who spark new ideas that promote sustainability and asset-management practices.

Taylor (2011) studied the role of “champions” in promoting sustainable practices in the Australian water industry (Taylor et al. 2011). The study observed the champion phenomenon as a movement toward effective leadership processes that lead to change. The research sample covered six urban water-management agencies in Australia that employed prominent champions. Taylor’s research aims to explain how the extant models of transformational, distributed, and complexity leadership are relevant to different dimensions of champion-driven leadership processes as they evolve. The research scope focuses on “project champions” in high level management just below the chief executive officer within publicly managed water agencies. Within this scope, two types of analyses were conducted, one for sustainable urban water management (SUWM) project champions as individual leaders, and another for typical champion driven SUWM leadership process. The research explored the champion phenomenon by identifying key behaviors of individual leaders and how they interact with each other, the influence of contextual factors, and how the form of leadership changes as champion-driven leadership processes evolve. The research indicates
also that as typical champion-driven leadership processes evolve, forms of leadership described by the transformational, distributed and complexity leadership models occur at different times based on the situation. (Taylor et al. 2011).

Another study investigating the impact of leadership in construction industry is presented by Ofori & Toor (2008), who addressed the urgent need for “authentic leadership”. They believe that only authentic leaders are able to deal effectively with the 21st century challenges, in terms of environmental, economic and social factors. The study highlighted the role of leadership in attaining sustainability in the operations of construction industry, and found out that such leaders possess the values, attributes, and qualities that helped them accomplish challenging tasks, and address the issues pertaining to sustainable development. They consider leadership as one of the key determinants of success in the drive towards sustainability (Ofori and Toor 2008).

In their view, leaders should emerge and evolve at different levels of the society to garner support and direct the actions and requirements of all stakeholders towards the common goal of sustainability. The authors argue that what is needed to overcome the challenges facing the construction industry is a leadership style that is able to “acquire the necessary support, marshal essential resources, integrate the efforts of individuals and institutions to address the challenges on the sustainability agenda” (Ofori and Toor 2008). Such leadership, as they describe it, considers sustainability as a cause, endorses it as a vision, and promotes it as a mission. The leader in this context will be “genuine, altruistic, self-aware, socially conscious, value-based, and future oriented”, and as per the authors this is what authentic leadership can contribute to the development of a sustainable construction industry (Ofori and Toor 2008).

To support their argument, Ofori and Toor (2008) presented results from their study in which 32 leaders have been interviewed in the construction industry of Singapore. The
results revealed that leaders who participated in the study were not only fully aware of the issues related to sustainability and the environment, but also, they were taking steps in an effort to achieve sustainable development in their daily work. The analysis showed that authentic leaders in construction industry occupying positions that represent the full spectrum of the construction sector (clients, designers, and contractors) fully recognize their responsibilities for ethical leadership in the scope of sustainability in relation to their own profession.

Opoku et al. (2015a) investigated the leadership style of intra-organizational leaders within UK construction firms who advocate the adoption of sustainable practices (Opoku et al. 2015a). They believe that Leadership is significantly important to the construction industry and a true enabler of sustainability. Organizations, in their view, should embrace sustainability concepts in their policies and part of their strategic goals. The study focuses on the intra-organizational leadership that promotes sustainable construction projects. That stems from the fact that construction industry has a major role in the drive towards sustainable development. However, the process of embracing and adopting sustainability practices often presents a leadership challenge (Opoku et al. 2015a). The quest for successful leaders in this direction should not be limited to becoming managers that are technically and professionally capable of running complex operations and projects within the construction industry, but also to transitioning into prominent leaders who are able to guide construction organizations towards sustainable practices. Such leaders require unique leadership styles, and this is what Opoku et al. (2015a)’s study aims to investigate.

Sustainability practices as presented in Opoku et al. (2015a)’s study refer to the firm’s policies and activities aimed toward providing the balance between economic, social, and environmental aspects in the delivery of construction projects. These practices can be implemented in all construction stages of a construction project cycle including sustainable
design, procurement, site waste management, and use of materials and resources. The leadership styles identified among the intra-organizational leaders were strategic, democratic, charismatic, and transformational. The sample of leaders participated in the study was selected from the top 150 consultants and contractor organizations operating in UK. The results revealed that the strategic leadership style was the most common style/behavior among intra-organizational leaders promoting sustainability practices in the UK construction industry. The authors used the same research sample to investigate the role of organizational leadership in the development of sustainable practices in construction industry in UK. The results were published in another paper (Opoku et al. 2015b), which reveals that organizational leadership has a major role in the adoption and implementation of sustainability in the construction industry.

Opoku and Ahmed (2014) also used the same research sample to investigate the challenges facing the adoption and implementation of sustainability in the construction industry of the UK. The leaders that have taken part in the study were asked to scale a list of challenges based on their views. The results revealed a list of challenges such as: common understanding of sustainability, lack of client demand, real and perceived cost, large company size, the current economic climate, diverse business activities, knowledge and skills of employees on sustainability, the procurement process and contract requirements of projects, support from company board and time constrains (Opoku and Ahmed 2014). Leaders in this regard need to be proactive rather than reactive since clients in general fail to appreciate the long-term benefits of adopting and implementing sustainable practices and methods in construction. This is due to the perceived high cost of sustainable construction because most clients only look at the initial cost of construction projects instead of considering the whole life cost (WLC) of projects. Life cycle assessment (LCA) and life cycle cost analysis (LCCA)
could be presented during the pre-design stage to induce more adoption and acceptance of sustainable solutions.

Grigg (2011) highlights the challenges facing the water industry in the quest for implementation of sustainable practices. The study urges civil engineers to utilize their technical and professional skills to overcome institutional barriers that block progress toward sustainable water management solutions. It also encourages civil engineers to “move beyond a focus on technical systems to become leaders in the broad societal decision making required” (Grigg 2011). Technical methods alone are not enough to overcome those barriers, and this is because problems are complex enough that they can be explained only through case studies. Case studies can illustrate the technical and institutional problems that require the kind of leadership able to achieve sustainable water management solutions. Grigg (2011) draws from a case study about an instream flow problem to investigate the technical and institutional factors that impede solutions. The case study emphasizes the role of leadership in influencing change. It also illustrates a common issue in the water industry about shared-responsibility commodities (instream flow) that require coordination and mutual understanding between multiple organizations and jurisdictions. The author believes that the role of leadership is important to helping different parties to reach consensus concerning conflicting positions and technical methods. Subsequently, the study proposes the concept of water governance to streamline efforts towards promoting leadership.

Taylor (2008) conducted another study highlighting the importance of building leadership capacity in organizations that are seeking to promote more sustainable resource management practices. In this study, it was found that there are navigational challenges facing leaders who seek knowledge and information from the body of literature in sustainability-focused organizations. The author also noticed the burden on practitioners who seek information about leadership development that has been tailored for environmental
leaders. Navigational challenges explain why there are often significant gaps between leadership-related theory and practice in organizations promoting sustainability (Taylor 2008). Taylor supports the contemporary view of leadership and defines it as “a process of influence that occurs within the context of relationships between leaders and their collaborators, and involves establishing direction, aligning resources, generating motivation and providing inspiration to achieve mutual interest” (Taylor 2008). It is also claimed that such a definition will accommodate leaders and anyone in the organization who can influence others whether at the top level of leadership or individuals who take part in any team-oriented activities.

Based on this definition of leadership, Taylor (2008) argues that “anyone in a sustainability-focused organization could potentially be a leader at some point in time if they are involved in a process of influence that involves encouraging sustainable practices.” Leadership, within this context, can be seen as both an individual and group-based phenomenon. Individual leaders can initiate the call for sustainable practices and lead the process of sustainability adoption by influencing others and managing change. Executive leaders, on the other hand, provide support and resources for those leaders who are behind the initiatives. Subsequently, during implementation, multi-disciplinary groups and leaders typically work together across organizational boundaries to insure optimal implementation. This illustrates how leadership begins as an individual phenomenon then evolves into a group-based phenomenon. “It also involves critical input from different types of leaders throughout the organization, not just at executive levels” (Taylor 2008). The paper summarizes, in three points, the important role of leadership in infrastructure organizations seeking sustainability. First, the literature provides evidence-based findings that the quality of leadership usually makes a significant difference to team and organization performance. Second, the context in which most sustainability-oriented organizations currently operate
promotes the significant need for leadership. Finally, those organizations are experiencing trends that necessitate a paradigm shift away from a “business-as-usual” approach to a process of leadership development that embraces more sustainable practices. Common trends include a greater need to work across organizational boundaries; increasingly complex and unpredictable challenges; more decentralized decision-making processes; greater use of teams; and an increased use of partnerships.

2.6 Leadership Theories and Styles

The main research objective of this work is the assessment of leadership styles that adopt innovation and promote sustainability and asset-management practices in infrastructure organizations. For that purpose, this paper provides a comprehensive review of the history of leadership research that produced several leadership theories and approaches within the past century. The aim of this section is to explore available knowledge in this field and, subsequently, to understand the concept and parameters behind each leadership approach.

First, a review of leadership approaches discussed in relevant studies within the domains of infrastructure and construction is undertaken. In the second step, a review of literature on the leadership theories that have been examined within the field of general management and social sciences is executed. Additionally, a discussion on the strengths and weaknesses of each approach is highlighted to assess the most ideal leadership approach for this research. Finally, an examination of key leadership approach through the lens of relevant literature is presented and further investigation is undertaken.

This multi-step exploration process is employed to obtain a clear understanding of the cutting-edge research on the subject matter and to limit our discussion to the leadership theories that are most relevant to our current objectives. Finally, the potential leadership approach that emerges from this literature exploration process will form the basis for constructing a proper data collection and measurement instrument. There is no such universal
instrument for collecting data and measuring certain variables for every leadership approach that exists. Likewise, no single instrument can assess leadership style, behavior, or trait in every organizational context at any given time. Therefore, it is important to select the most relevant leadership approach that serves the research purpose; it is equally as important to select a proper research instrument.

Leadership style, traits, behavior, attributes, skills, and characteristics have been studied immensely in numerous publications from a wide range of research fields. The field of leadership is truly inter-disciplinary, where publications on leadership can be found in a large variety of journals in several disciplines, including management, psychology, sociology, political science, public administration, and educational administration (Yukl 1989). The research in this regard has two primary directions, namely about leadership and leaders. The former focuses on leadership as a concept or a system that influences positively the performance and effectiveness of an organization, and the latter highlights the personal attributes and traits of leaders who are able to influence people and inspire dramatic changes. Rost (1993) advocates a paradigm shift in the way we do this research. That is, he suggests that we distinguish between leadership and leaders. He stresses that leader traits, behavior, and styles do not represent leadership. He also adds that:

Instead of leader development, we need to think about leadership development. Under the new paradigm, leadership and leader are not the same. Leadership is not what the leader does but what the leaders and collaborators do together to change organizations. (Rost 1993, p. 101)

Such a trend in research stems from a conception that equated leadership development with leader development. That is, leadership has been understood as what a leader does. Historically, and since 1975 the literature on leadership has been divided into three
approaches: trait approaches, behavior approaches, and situationally contingent approaches. Several other new approaches to leadership have also emerged since 1975 (Phillips 1995).

The leadership approaches introduced from 1975 until the end of the 20th century can be categorized into three themes: cognitive, power and influence, and role theory. A comprehensive review of these approaches and theories can be found in the work of Avolio et al. 2009; House and Aditya 1997; Northouse 2016; Phillips 1995; Yukl 1989. The details and characteristics of each relevant approach will be discussed later in this section. Meanwhile, a review on leadership approaches that have been studied within the infrastructure and construction domains is discussed here. Reiterating that research on leadership in the domain of infrastructure is rare is unavoidable. There is also a major body of research on leadership in the construction sector, which will be traced and examined since it is the closest fit to this research.

Toor and Ofori (2008) review leadership research in the construction industry and reveal that the mainstream paradigm of leaders has been revolving around technology and projects, and is mainly focused on management (S.-R. Toor and Ofori 2008). This was the trend for several years where construction organizations suffered from a shortage of skillful “projects leaders” due to more attention being placed on management development. During that time, the lack of focus on leadership was not only limited to practical factors of construction; academic research also seems to have neglected the topic.

The literature concentrated more on investigating the motivational factors and the personal characteristics of project managers rather than studying the role of leadership in the success of projects and overall organizational performance. Toor and Ofori (2008) provide details about current and emerging research on leadership in the construction sector. Although researchers who studied project success factors within the construction industry did not address leadership, about two decades ago a considerable increase in empirical studies on
leadership began to emerge. A review of leadership research in the construction industry (S.-R. Toor and Ofori 2008) also reveals that “most of the studies were on project managers, site managers, project professionals, project engineers, and building professionals.” This focus on a certain organizational level indicates a limited scope of leadership as a concept that is essential at all levels of industry, not simply the top. Consequently, rather than a “single-level-of-analysis”, which is more frequently used as observed in the literature, a “multi-level-of-analysis” should be adopted when studying leadership. This can be achieved by including different organizational levels, like foremen and supervisors, into construction research projects. Different leadership levels such as middle management and team leaders in both permanent and temporary infrastructure organizations can also be studied. Furthermore, the process of leadership analysis needs to include cross-cultural and cross-organizational issues in both permanent and temporary infrastructure teams and organizations when examining leadership issues. Previous research shows a lack of emphasis on multi-level and multi-dimensional analysis when studying leadership issues within the construction industry.

A review of literature on leadership in the domain of infrastructure and construction and its role in various organizational outcomes (e.g., performance, effectiveness, efficiency, innovation, etc.) reveals that many studies have relied on a set of leadership theories and approaches. The most common approach adopted within infrastructure/construction literature is Transformational Leadership (Aga et al. 2016; Butler and Chinowsky 2006; Chan et al. 2014; Clarke 2010; Erdogan et al. 2014; Matzler et al. 2015; Opoku et al. 2015a; Tabassi et al. 2014; Tabassi and Bakar 2010; Taylor et al. 2011; Taylor 2008), as it is studied extensively when compared to other leadership approaches. Emotional Intelligence (Butler and Chinowsky 2006; Clarke 2010; Dulewicz and Higgs 2005; Müller and Turner 2007) has also been examined in several studies, followed by Distributed Leadership (Taylor 2008; Taylor et al. 2011) and Situational Leadership (Seymour and Elhaleem 1991; Tabassi and
Bakar 2010). Other leadership approaches have been used less frequently, such as Theory X and Theory Y Leadership (Thomas and Bendoly 2009); Grounded Theory (S. Toor and Ofori 2008); Contingency Approach (Larsson et al. 2015); Complexity Leadership (Taylor et al. 2011); Charismatic Leadership (Yukl 1999); Instrumental Leadership (Bossink 2007); Strategic Leadership (Bass 2008); Interactive Leadership (Bossink 2007); Authentic Leadership (S. ur R. Toor and Ofori 2008); Competency Approach (Müller and Turner 2007); Leadership Grid Theory (Tabassi and Bakar 2010); and Trait Approach (Jha and Iyer 2006). A review of the literature also shows that, within the infrastructure and construction domain, no empirical studies have been conducted investigating several other old or emerging approaches, such as Leader-Member-Exchange (LMX); Follower-centric approach; Substitute for Leadership Theory; Servant Leadership; Spiritual Leadership; E-Leadership; Path-Goal Theory; Adaptive Leadership; and Psychodynamic Approach (Bass 2008). Adopting such emerging leadership approaches would support research efforts that advocate “integrative leadership theory-building” (Avolio 2007) in the infrastructure domain.

These findings align with research trends observed by researchers in other fields. In a review of 188 articles published in Leadership Quarterly within its first decade, Lowe and Gardner (2001) found that one third of the research was about charismatic and transformational leadership (Lowe and Gardner 2001). Furthermore, Judge & Piccolo (2004) conducted a keyword search of materials published from 1990 to 2003 in the PsycINFO database, which revealed that there have been more studies on transformational or charismatic leadership than on all other popular theories of leadership combined (Judge and Piccolo 2004). It has also been discovered that the number of papers and citations in the field of leadership research has grown at a high rate, not only in traditional areas like management and social psychology, but in other disciplines such as nursing, education, and industrial engineering (Northouse 2016). Furthermore, as indicated by past research, most research on
transformational leadership has been conducted in the U.S.; yet, international studies has demonstrated increasing interest in the subject as well (Bass 1997).

Based on this overall review, a few relevant and suitable leadership approaches are discussed here to identify the most applicable approach that would help in building a concrete research methodology. It should be noted that it is very important to keep the contextual factors that may influence the methodological options in mind. The research scope, organizational climate, culture, and environment must be considered to maintain our focus on the current research objective(s). Recalling these influential factors here is essential to identifying the most applicable leadership approach for answering this study’s research questions.

2.6.1 Transformational Leadership

Transformational leadership was introduced to management and organizational behavior research back in the 1980s. It is a process that changes and transforms people (Northouse 2016). It has roots in the charismatic leadership theory introduced back in the first half of the 20th century as found in the work of Weber (1947) (Judge and Piccolo 2004). House’s (1977) article on charismatic leadership was the spark for research efforts within the management field. House proposed a theory that identified how charismatic leaders behave, what makes them different from other people, and the conditions under which they develop and emerge. The theory describes the indicators of charismatic leadership that reveal attitudes and perceptions of followers about their leader. The theory also defines leader traits that increase the likelihood of being perceived as charismatic (Yukl 1989). Furthermore, researchers attempted to identify charismatic-leader behaviors and traits that lead followers to attribute charismatic qualities to that leader, based on an assumption that charisma is an attributional phenomenon (Phillips 1995). This assumption was proposed by Conger and Kanungo (1987) who pointed out that followers attribute charismatic qualities to a leader.
based on their perception of the leader’s behavior and its outcomes. Behaviors vary by charismatic leader and situation (Conger and Kanungo 1987).

The basic premise of charismatic theory is that charismatic leaders can influence their followers by building and maintaining intensely personal relationships. Typical behaviors of charismatic leaders include

... impression management to maintain follower’s confidence in the leader,

articulation of an appealing vision that defines the task in terms of ideological goals
to build follower commitment, communication of high expectations for followers to clarify their expectations, and expression of confidence in followers’ ability to build their self-confidence. (Yukl 1989, p. 270)

Charismatic leaders, as speculated by House (1977), are “exceptionally self-confident, strongly motivated to attain and assert influence, and have strong conviction in the moral correctness of their beliefs” (House and Aditya 1997). Based on charismatic leadership theory, leaders who are motivated to assert and exercise influence are expected to advocate change and challenge the status quo. Furthermore, leaders who are exceptionally self-confident, and who have strong faith in their beliefs, are expected to be more persistent when faced with obstacles and, therefore, are expected to be more effective.

House’s charismatic theory has set the stage for subsequent leadership approaches that shift the focus of leadership research from predominantly examining transactional models based on how leaders and followers interact to models that modify transactional leadership to charismatic, inspirational, transformational, and visionary leadership (Avolio et al. 2009). The traditional leadership models—which described leader behavior in terms of leader-follower exchange relationships, setting goals, providing direction and support, and behavior reinforcement—have evolved as researchers have become interested in charismatic leadership and the transformation of organizations (Yukl 1989). This research trend proved
relevant at a time when many companies in the United States were acknowledging the need for revolutionizing changes in the traditional and bureaucratic climate to survive increasing economic competition from foreign companies. The “new-genre” approaches have emerged as a response to calls that emphasized the need for a paradigm shift from traditional leader-follower relationships to new leadership models that “emphasize symbolic leader behavior; visionary, inspirational messages; emotional feelings; ideological and moral values; individualized attention; and intellectual stimulation” (Avolio et al. 2009).

Transformational leadership is defined as “the process of influencing major changes in the attitude and assumptions of organization members and building commitment for the organization’s mission, objectives, and strategies” (Yukl 1989). Transformational leadership, as a process, occurs when leaders raise follower aspirations and mobilize their higher-order values (Avolio et al. 2009) to share in and pursue the leader’s mission or vision. Such leadership generally motivates followers to reach beyond the performance of simple transactions or common expectations, and to not just act in their own self-interest or in exchange for some extrinsic reward (Tekleab et al. 2008). It is concerned with emotions, values, ethics, standards, and long-term goals (Northouse 2016).

Transformational leadership involves influence exerted by a leader on subordinates, in which the leader persists in empowering such subordinates to participate in the process of transforming an organization. Leaders at different levels and in various subunits of an organization can lead in transformational manner (Yukl 1989).

The basic principles of transformational leadership derive from descriptive research on political leaders. Burns (1978) was the first to introduce this concept and defined leadership as “leaders inducing followers to act for certain goals that represent the values and the motivation – the wants and needs, the aspirations and expectations – of both leaders and followers” (Burns 1978). For Burns, leadership is conceptualized as a reciprocal process
in which leaders influence followers and, in return, are influenced to recalibrate their behavior as they receive feedback. According to Burns, transformational leaders seek to raise the consciousness of followers by focusing on higher values that are relevant to the organization’s interests and needs rather than limiting their focus to simplistic emotions and self-interests. A transformational leader encourages subordinates to exert extra effort and to achieve beyond expectations. Transformational leadership, as viewed by Burns, can be adopted by anyone in the organization at any level and in any position.

The interaction of people with varying degrees of motivation and authority within an organization helps to shape the relationship between leader and followers. That interaction, as described by Burns, takes two fundamentally different forms, namely transactional and transformational (Burns 1978). Burns distinguishes transformational leadership from transactional, in which followers are motivated by appealing to their self-interests. Burns also differentiates transformational leadership from influence that derives from occupying a position of bureaucratic authority (Yukl 1989).

Building on Burns’ theory, Bass (1985) proposes a more detailed theory by improving some conceptual limitations of House’s (1977) theory of charismatic leadership. Bass also differentiates charismatic from transformational and transactional leadership (Bass 1985; Judge and Piccolo 2004; Phillips 1995; Yukl 1989). Bass identifies charisma as a necessary but not sufficient condition for transformational leadership (Phillips 1995). Transformational leadership as viewed by Bass is centered on how a leader affects and influences followers. Transforming involves motivating followers and making them aware of how valuable task outcomes are by appealing to their higher-order interests. They also galvanize followers by prioritizing the organization’s needs over their own self-interests (Yukl 1989) through idealized influence (charisma), inspiration, intellectual stimulation, or individualized consideration (Bass 1985, 1999). Consequently, followers maintain trust and respect for the
leader (Yukl 1989). A leader who compels followers to concern themselves with more than their immediate self-interests does so by elevating their level of maturity, values, and ideals. They cultivate concern for achievement, self-actualization, and the well-being of others, the organization, and society (Bass 1999).

Transformational leadership as theorized by Bass (1985) is more than just another version of charismatic leadership. While transformational leaders were found to seek to empower and elevate followers, charismatic leaders seek to keep followers weak or dependent (Phillips 1995; Yukl 1989), influencing followers by triggering emotional reactions and interactions with the leader (Yukl 1989). Transformational leadership is, therefore, viewed as a shared process; while charismatic leadership focuses on an individual leader (Phillips 1995). Transformational leadership comprises four components: 1) charisma or idealized influence (attributed or behavioral); 2) inspirational motivation; 3) intellectual stimulation; and 4) individualized consideration (Bass 1999). Transformational leaders inspire employees by motivation, mainly through communication of high expectation (Garcia-Morales et al. 2012). Subordinates may exert extra effort and that “... may be due, in part, to their commitment to the leader, their intrinsic work motivation, their level of development, or the sense of purpose or mission that drives them to excel beyond the standard limits” (Howell and Avolio 1993). Through intellectual stimulation, transformational leaders encourage their employees to think differently, challenge their comfort zones, and to adopt generative and exploratory thinking processes. It is found that “[t]ransformational leaders stimulate their followers to think about old problems in new ways and encourage them to challenge their own values, traditions, and beliefs” (Jung et al. 2003). They also help employees to develop long-term commitment to the organization’s goals, vision, and mission and to shift their focus from short-term and immediate results and objectives to long-term and substantial solutions and objectives (Jung et al. 2003).
Furthermore, through the intellectual stimulation of others, transformational leaders, promote employee intelligence, knowledge, and learning; thus, employees can be more innovative and creative (Garcia-Morales et al. 2012).

The literature often discusses the matter of transformational and transactional leaders when, in fact, most leaders have a profile of leadership that includes elements from both transformational and transactional skills. However, transformational leaders perform more transformational behaviors than transactional behaviors. In certain situations, and contexts, leaders are transformational. On the other hand, transactional leaders display much more transactional leadership behavior. They are more likely exerting attitudes, beliefs, and values more consistent with transactional leadership. Nonetheless, they are likely to be transformational at times (Bass and Steidlmeier 1999).

Since the rise of the transformational leadership theory and its predecessor charismatic leadership theory, research has found that charismatic/transformational leadership is positively correlated with leadership effectiveness and a number of important organizational outcomes (e.g. productivity and turnover) across various types of organizations, situations, levels of analyses, and cultures (Avolio and Bass 2004; Avolio et al. 2009). Howell and Avolio (1993) have found that transformational leadership measures were significantly and positively related to business unit performance, while transactional measures of leadership were negatively related to business-unit performance (Howell and Avolio 1993). Seltzer and Bass (1990) also detect a relationship between transformational leadership and various criteria of leaders’ effectiveness (Seltzer and Bass 1990). Similarly, Tyssen et al. (2014) explain that transformational leadership is found to have a positive effect on follower commitment and performance (Tyssen et al. 2014). Another study investigates how transformational leadership interacts with contextual factors in an international project environment and its impact on team performance (Gundersen et al. 2012). It has been found
that transformational project managers have more satisfied and better adjusted team members, thus, higher performing teams. In their meta-analysis work, Wang et al. (2011) conclude that transformational leadership:

... exhibits a positive relationship with performance across several performance criteria, including task, contextual, and creative performance”. [They also added that] ... the relationship between transformational leadership and individual performance holds across organizational type, leader level, and geographic region, [and] ... transformational leadership has positive effects on performance across levels of analysis (i.e. individual, team, and organizational levels). (Wang et al. 2011, p. 249)

This conclusion falls in line with the findings of a meta-analysis by Judge and Piccolo (2004), who present evidence from numerous studies that observe positive effects of transformational leadership on job satisfaction, supervisory satisfaction, motivation, and organizational citizenship behavior (Judge and Piccolo 2004).

Despite general consensus among researchers on the effects of transformational leadership, Northouse foregrounds a few criticisms (2016). House and Aditya (1997) question the widely accepted finding that claims the effect of transformational leadership on people. They contend that:

... there is little evidence that charismatic, transformational, or visionary leadership does indeed transform individuals, groups, large divisions of organizations, or total organizations, despite claims that they do so. It may well be that such leaders induce changes in followers’ psychological states, but that these states do not continue after the separation of leader and follower. There is no evidence demonstrating stable and long-term effects of leaders on follower self-esteem, motives, desires, preferences, or values. (House and Aditya 1997, P. 443)
Additionally, they submit that transformational leadership lacks conceptual clarity (Northouse 2016).

2.6.2 Transactional Leadership

While transformational leaders act as catalysts, mentors, facilitators, and educators in organizational changing processes (Garcia-Morales et al. 2012), transactional leaders focus on satisfying the extrinsic needs of their subordinates; their subordinates, in return, perform what the leader asks. Transactional leadership involves development exchange and corrective-avoidant leadership. Development exchange is basically defined as “... the degree to which a leader establishes a system for followers to obtain contingent rewards for meeting an agreed on expectation” (Chan et al. 2014). The relationship between a transactional leader and followers is based on, and limited to, an exchange of gains that is of mutual benefit. The exchange might be psychological, political, or economic in nature. Transactional leaders tend to satisfy employee needs in return for employee compliance and commitment to the leader’s vision and plans. A transactional leader usually tends to treat extrinsic rewards (e.g., monetary incentives, promotion, recognition, etc.) as the primary tools for increasing follower motivation (Kissi et al. 2012).

Transactional leaders operate usually within the existing organizational culture to maintain the status quo. They focus on mistakes, delay decisions, or avoid intervening until something goes wrong. Such transactions are referred to as management by exception, which can be distinguished as either an active or passive transaction between the leader and followers (Howell and Avolio 1993). Transactional leadership is likely to be common practice in stable and predictable working environments, while transformational leadership is likely to challenge the status quo, seek opportunities in the face of risk, and induce more adoption of innovative thinking. Similarly, while transformational leadership usually leads to a common ground between the leaders and their followers in terms of needs, the transactional
leader provides benefits that favor their followers in exchange for benefits the leader desires (Judge and Piccolo 2004).

The challenge is that most transactional leaders lack an understanding of what transformational leadership really is; thus, it is difficult to shift their effort and attention to more transformational behaviors (Howell and Avolio 1993). It is worth questioning whether or not a transactional leader with a relative understanding of how to utilize some transformational leadership skills, is able to perform his/her job effectively as much as a transformational leader. Although there are exceptions, transformational leaders, as Avolio (2011) substantiates, have distinguishing characteristics that give them an upper hand in the process of organizational leadership development. Besides encouraging long-term vision and goals, empowering, and supporting subordinates, challenging the status quo, and committing to the basic ethical and moral values of the organization, transformational leaders are trusted. They exhibit moral perspectives that inspire such trust. Their willingness to self-sacrifice builds tremendous trust among followers, which in turn, leads to similar patterns of self-sacrifice among their followers. Their aim is to leave behind an organization that is more successful than when they first took position (Avolio 2011). The bottom line, as pointed out by Avolio (2011), is that transformational leadership is far more effective than transactional leadership in generating higher levels of effort and in achieving organizational outcomes such as commitment, performance, satisfaction, and efficiency from subordinates. This has proven true regardless of leadership position, organizational environment, context, climate, and/or culture.

2.7 The Role of Leadership in Organizational Innovation

There are a number of internal and external factors (Kissi et al. 2012) that influence the level of innovation, directly and indirectly (Jung et al. 2003; Kissi et al. 2012; Panuwatwanich et al. 2008), in infrastructure organizations. One of the most important
factors is leadership (Aragón-Correa et al. 2007; Dess and Picken 2000; Jung et al. 2003, 2008; Kissi et al. 2010, 2012; Matzler et al. 2015; Munshi et al. 2005). Several researchers have studied this phenomena and found leadership as one of the main enablers of innovation (Ozorhon et al. 2014). Leadership has been captured as an individual skill exerting significant influence on the diffusion of organizational innovation either directly or indirectly through various organizational factors such as culture, climate, work environment and context within which leaders operate (Kissi et al. 2010). Panuwatwanich et al. (2008) found that leadership and team climate contribute to innovation indirectly through organizational culture. With the absence of culture that embraces innovation and encourages employees to produce innovative ideas, it is unlikely that creative ideas will be transformed into innovative products, processes, and services (Panuwatwanich et al. 2008). Work climate is perceived as a social psychological process that can manifest itself within an organization and is considered a determinant of motivation and behavior. Several other studies support these findings and provide evidence for organizational climate that embraces innovation as an important determinant of innovation (Jung et al. 2003).

Previous research in innovation and leadership attests to a relationship between organizations that adopt innovative practices and leadership; understanding this relationship is found to be complex (Munshi et al. 2005). The complexity is manifold and stems from several sources, such as multiple innovation stages and levels, different organizational contexts, changing work environment (Amabile et al. 2004; Kissi et al. 2012), leadership level (Kissi et al. 2012), and distinctive organizational climate (Kissi et al. 2010). The key role of leadership is the creation of an environment in which employees can reach their potential as they help achieve the organization’s goals. A growing number of leading organizations have come to realize “... that the results available in an environment based on
trust and cultural control are superior to those formerly achieved under a system of rules, regulations, and hierarchy” (Dess and Picken 2000).

Munshi et al. (2005) have distinguished two main roles of leaders who adopt and induce innovation in their organizations: First, as motivators who inspire people to extend beyond their ordinary effort and, subsequently, to innovate. Second, as “architects” who cultivate an organizational climate that enables employees to be innovative and creative. While innovation exists in multiple stages, the leadership challenges vary with different stages. Whether at an early innovative phase, motivational level, or structural stage, the challenge of leadership is to create the right organizational context, work environment, work climate, and behavioral style that facilitate a successful innovation process. Leaders usually evolve based on the innovation stage for which they are responsible (Munshi et al. 2005).

Overall, the review of relevant literature reveals that dealing with these factors (e.g., organizational culture, climate, environment, and context), in addition to how they intervene to influence innovation within ground transportation organizations is yet to be explored.

Kissi (2010) proposes a model that integrates the relationship between leadership, organizational culture, and external influences on innovation. The study investigates how these variables impact “climate for innovation” as an outcome in a sample of project managers. The combination of these influences creates a “climate for innovation” within which project managers and potential champions operate; this climate, in turn, influences their behavior and consequently their tendency to adopt innovative practices. Even though Kissi’s study focuses on design firms and innovation within projects in the construction sector, the findings can be helpful for different organizational settings and work environments within the infrastructure domain and, more specifically, within the transportation sector. Organizations within the infrastructure domain, as discussed earlier in previous sections, suffer from multiple administrative behaviors represented by several
traditional tools and techniques of management, which are designed, in large measure, to ensure organizational stability, operational efficiency, and predictable performance. Formal planning processes, centralized decision making, hierarchical organization structures, standardized procedures, and numbers-oriented control systems are still the rule in most of these organizations (Dess and Picken 2000). Deviation from such attitudes requires a “real change” effort initiated by “real change-agents” or leaders who enable climate change by "loosening up" the organization and stimulating innovation, creativity, and responsiveness, and learn to manage continuous adaptation to change. Maintaining leadership momentum and exerting leadership skills and commitment during this process is essential for successful implementation of change management. Therefore, leaders must change the mindset of traditional work structures, and focus on five key issues: “use strategic vision to motivate and inspire; empower employees at all levels; accumulate and share internal knowledge; gather and integrate external information; and challenge the status quo and enable creativity” (Dess and Picken 2000).

2.7.1 Transformational Leadership and Innovation

As Leadership is seen as one of the strongest predictors of innovation, transformational leadership has been “most strongly” related to innovation (Matzler et al. 2015). A number of studies found a positive relationship between transformational leadership and organizational innovation (Aragón-Correa et al. 2007; Chan et al. 2014; Gumusluoglu and Ilsev 2009; Howell and Avolio 1993; Howell and Higgins 1990; Jung et al. 2003; Kissi et al. 2012; Matzler et al. 2015; Munshi et al. 2005; Opoku et al. 2015a; Panuwatwanich et al. 2008; Taylor et al. 2011). Transformational leadership has been recognized as one of the most influential contemporary leadership theories (Garcia-Morales et al. 2012). These theories emphasize emotions, values, and the importance of leadership that encourage creativity and innovation (Garcia-Morales et al. 2012; Matzler et al. 2015). Transformational
leaders have significant influence on followers, “because leaders can directly decide to introduce new ideas into an organization, set specific goals, and encourage innovation initiatives from subordinates” (Aragón-Correa et al. 2007). It has not only received enormous attention in research but has also influenced leadership practice in the past three decades (Matzler et al. 2015).

Leadership styles and behaviors have accordingly become an important determinant of employee creativity (Cheung and Wong 2011; Jung et al. 2003) and organizational innovation (Chan et al. 2014; Panuwatwanich et al. 2008). Different types of leadership have various effects on innovation. Transformational leadership is recognized as a leadership style that “heightens consciousness of collective interest among the organization's members and helps them to achieve their collective goals” (Garcia-Morales et al. 2012). Creativity is defined as the “…production of novel and useful ideas, and innovation is the successful implementation of creative ideas within an organization” (Gumusluoglu and Ilsev 2009).

Thus, creativity exists and develops at the individual level, while innovation takes place at the organizational level. In line with the previous definition, “organizational innovation is the creation of valuable and useful new products and/or services within an organizational context” (Gumusluoglu and Ilsev 2009).

Organizational-level outcomes (e.g. innovation, performance, efficiency, etc.) and group processes outcomes (e.g. satisfaction, motivation, cooperation, and coordination) are achieved only when the ideas of individual employees and their creative output are employed effectively and systematically (Avolio and Bass 2004; Jung et al. 2003).

Kissi et al. (2012) argues that the effects of transformational leadership on the organizational-level output is studied mostly at the level of individual employees or organizational subunits, while less attention has been given to the key factors shaping the outcomes at an organizational-level. Thus, an organization that is ineffective in managing the
factors that shape organizational-level outputs will lack effective response to the challenges of a competitive market place. (Kissi et al. 2012). This argument implies that a high-level of coordination, cooperation, and collaboration of innovative initiatives and practices is required of an organization’s employees and operational units to achieve the overall organizational-level innovation and subsequently organizational-level outcomes.

Howell & Avolio (1993) have studied the impact of transformational and transactional leadership on performance, including the key personality characteristics of leaders and the context within which leaders and their followers operate. They examined whether transformational leadership behavior predicts consolidated-unit performance over a one-year period while considering support for innovation as a moderator (Howell and Avolio 1993). They build on the work of Bass (1985) who suggests that certain contextual factors may moderate the impact of transformational and transactional leadership on performance—e.g., the level of support for innovation in a work unit (Bass 1985). In other words, transformational leaders are likely to perform effectively in organizational units in which there is receptivity to change and a propensity for risk taking. In contrast, transformational leaders are less likely to be appreciated and fully accepted in organizational units bound by tradition, rules, and sanctions, and may be viewed as too unsettling and, therefore, inappropriate for the stability and continuity of the existing bureaucratic culture. Therefore “... units open to creative suggestions, innovation, and risk taking (i.e., units supportive of innovation) may be more conducive to transformational leadership than organizational units that are structured, stable, and orderly” (Avolio and Bass 2004; Howell and Avolio 1993).

Cultivating real leaders who genuinely exert transformational behavior is essential for the successful implementation of any innovative practice within an organization. Transformational leaders can influence employee creativity and affect organizational innovation in several different ways (Jung et al. 2003). First, they set guidelines and define
the work contexts within which employees interact to identify goals, challenges, and plans. Transformational leadership builds teams and provides them with direction, energy, and support, which in turn, leads to smooth organizational change processes and more innovative approaches, initiatives, and practices (Bass 1999; Tabassi et al. 2014). More insights about organizational change and leadership can be found in the work of Cowan-Sahadath (2010).

Second, leaders with long-term business strategies are able to improve both individual and joint efforts to innovate work processes and outcomes. Third, transformational leaders can significantly boost organizational innovation by developing and maintaining an organizational climate and culture that promotes innovative ideas and practices. Finally, leaders can always induce more creative performance through compensation and other human resource-related policies (Jung et al. 2003).

Transformational leadership is expected to improve organizational innovation due to several reasons. Transformational leaders provide decisive answers “… that link followers’ identities to the collective identity of their organization, thereby increasing followers’ intrinsic motivation (rather than just providing extrinsic motivation) to perform their job” (Jung et al. 2003). Transformational leaders focus on fostering the higher order intrinsic needs of their followers compared to the short-term ones (Chan et al. 2014). They tend to articulate clear and important vision and mission statements, which “increase followers’ understanding of the importance and values associated with desired outcomes, raise their performance expectations, and increase their willingness to transcend their self-interests for the sake of the collective entity” (Jung et al. 2003).

Overall, transformational leaders tend to create and maintain a work climate where employees feel encouraged to be involved in creative and innovative tasks to perform their jobs. Within transformational leadership frameworks, followers are likely to develop self-
management and self-development skills that allow them to perform their jobs without direct supervision or intervention (Jung et al. 2003).

Howell and Avolio (1993) provide evidence suggesting that transformational leaders do perform better in working environments that are described by followers as innovative. Past research found that transformational leadership is more fruitful in early-stage innovation, such as during research and development, while transactional leadership skills are more appropriate during commercialization (Munshi et al. 2005). Notwithstanding, transformational leaders frequently display transactional leadership behavior as well, depending on the situation, in different amounts and intensities, forming a well-balanced leadership style that combines two contradictory as well as complementing concepts (Howell and Avolio 1993). In fact, leadership theory has considered transactional and transformational leadership as two complementary points of view (Tyssen et al. 2014). It is found also in previous research that leaders who can balance transactional and transformational leadership across time, situation, and challenges are the most effective and successful (Avolio 2011).

Even within the transformational leadership behavioral components, various leaders with certain leadership styles are more suitable for different working situations. For example, within an organization seeking innovative ideas, leadership emphasizing frequent intellectual stimulation would be more beneficial to a group's effectiveness. In another situation, where it is necessary to ensure that employees’ self-interests and development are maintained, leadership exerting more individualized consideration and action would be the best choice. Further, in a situation where an organizational unit is striving for change, a leader with inspirational motivational behavior may effectively contribute to mobilizing their vision and goals. Past research has also found that a leader appropriately hired or promoted in the right time and place “… rather than making unnecessary, costly, or impossible changes [on that
particular time and place]..., can help a group or organization solve a potentially difficult problem[s]” (Avolio and Bass 2004).

The bottom line is that research suggests that the suitability of transformational leadership varies according to organizational contexts (Antonakis et al. 2003; Ensley et al. 2006; Hernandez et al. 2011; De Hoogh et al. 2005). Additionally, other authors have suggested that transformational leadership would be more prevalent and more effective when the working environment is unstable, uncertain, and turbulent (Gundersen et al. 2012).

Maintaining a work climate that supports innovation is essential to the successful implementation of innovative practices. Gumusluoglu and Ilsev (2009) examine the role of perception of support for innovation and empowerment as mediators or mechanisms underlying the effects of transformational leadership on creativity. They also investigate the relationship between transformational leadership and innovation at the organizational level. Accordingly, they propose a model in which transformational leadership is positively related to follower creativity at the individual-level, and it positively relates to organizational innovation at the organizational-level. Finally, creativity at the individual-level influences innovation at the organizational level. The authors produce evidence that supports findings proposed by other studies suggesting that transformational leaders enhance innovation within the organization and, subsequently, they increase the tendency of organizations to innovate (Gumusluoglu and Ilsev 2009).

Although many studies have found that transformational leadership is positively associated with an organization’s creative climate and innovation, empirical evidence in the literature is still scarce and inconsistent. Such is all the more true within the sector of construction and more broadly within the infrastructure domain, where studies on the associations among transformational leadership, transactional leadership, and innovation climate are still rare (Chan et al. 2014). The role of transformational leadership is not limited
only to product-oriented organizations where innovation is essential for market competency and success; it is also important for service/operation-oriented organizations such as infrastructure organizations. Employees working in service jobs that do not explicitly require them to generate new ideas and services need transformational leaders to inspire them to extend beyond their abilities to provide better service or better ways of completing their tasks effectively and efficiently (Cheung and Wong 2011).

Findings from Jung et al.’s (2003) empirical study support the literature that suggests a positive link between transformational leadership and innovation. They find that transformational leadership by top managers can improve organizational innovation directly and also indirectly by creating an organizational culture and maintaining a work climate in which employees are encouraged to express and try innovative ideas and approaches (Jung et al. 2003). Additionally, in temporary team environments, transformational leadership has both direct and indirect influences on project success (Aga et al. 2016). Transformational leadership influences innovation indirectly through communication and organizational knowledge creation and the interrelation between them (Garcia-Morales et al. 2012).

Eventually, transformational leadership becomes the “motor and transmitter” of innovative culture, where knowledge is transferred and disseminated within the organization’s members and units to ensure the best possible performance for the organization (Garcia-Morales et al. 2012). There are, of course, opposing perspectives. Still, few other studies suggest that transformational leadership has little effect on individual creativity. Jaussi & Dionne (2003) investigated the effect of leader role-modeling on individuals and group creative performance. They obtained their data from a survey of 364 students at a large northeastern (U.S.) public university, using items from the Multifactor Leadership Questionnaire (MLQ) 5x (Avolio and Bass 2004). Although they find that transformational leadership is not related to individual creative performance, they still
conclude that it is highly significantly and negatively related to group creative performance (Jaussi and Dionne 2003).

2.7.2 Leadership and Innovation Towards Sustainability and Asset Management

Much of the discussion in leadership and innovation literature focuses on the influence of leadership on innovation in general. The body of existing literature on a leader’s influence on sustainable innovation processes is limited (Bossink 2007). This research suggests that an adoption of sustainable practices within infrastructure asset management, specifically, within the ground-transportation sector, should be considered as an organizational innovation. The aim here is to investigate how leadership influences sustainable innovation practices and processes, and whether transformational leadership shares a positive relationship with those innovative practices.

The literature review revealed that the body of research on the influence of transformational leadership on sustainable innovation within infrastructure asset-management strategies within the ground-transportation sector is not yet developed. Only a handful of studies demonstrate the role of leadership in adopting sustainability and asset-management practices within the infrastructure and construction domains. A detailed discussion about these studies has already been presented in section 2.5.3.

2.8 Summary

In this chapter, infrastructure has been defined in terms of its components and sectors and the vital service that infrastructure provides to communities and cities. The common trends seen in infrastructure and the challenges facing it have been highlighted. Asset management has been introduced in this study as a solution to the challenges and problems impacting infrastructure. Asset management components and principles have been reviewed and presented. The major aim of asset management is to optimize the service level delivered
at the lowest cost possible. Several drivers contribute to the efforts to embrace and adopt asset management systems in public infrastructure organizations. One such driver is budgetary constraints; other drivers are related to legislative reforms that increase accountability and transparency. In the context of transportation, environmental issues, in addition to budgetary constraints, play a significant role in adopting asset management practices.

Sustainability, coupled with the adoption of asset management, found to be an effective solution to the challenges and risks impacting infrastructure. Principles, definitions, approaches and applications of sustainability have been presented. The aim of introducing sustainability is to help agencies to meet challenges while aligning their actions with overall strategic plans. Several examples of sustainability initiatives, across a variety of infrastructure sectors from different locations around the world, have been presented in this chapter. Sustainability initiatives from the ground-transportation sector have been presented as well.

In this study, asset management and sustainability approaches, principles and applications are assumed and proposed as “new” practices to the vast majority of organizations within ground transportation in the U.S. The efforts of adopting, embracing, and administering asset management and sustainability practices are captured as non-technological innovation. Innovation is found to have significant positive influence on several variables of organizational outcomes such as effectiveness, productivity, growth, financial outcomes, etc. In general, innovation is a complex phenomenon involving a variety of inputs and outputs affected by a number of contextual and work-related environmental factors.

As infrastructure is a domain of extreme complexity with a tremendous scale of physical components that deliver services from a wide range of facilities, the management of such complex systems requires close attention the multi-disciplinary, inter-disciplinary, and
interdependent nature of related processes. That, itself, requires promoting leaders of a high caliber. In fact, leadership is found to be the most appropriate response to calls that demand a managerial concept that can address the complexity and inter-disciplinarity of these processes. A clear distinction between management and leadership has been provided. In general, infrastructure receives very little leadership development attention. The review of relevant literature reveals a gap in studies that address the role of leadership in the development and implementation of sustainability and asset management in infrastructure. Of this limited research, a few examples of sustainability and asset management implementation have been presented. Transformational leadership theory has been found to be the best in addressing the research parameters among a diversity of leadership theories as described in this chapter. Transformational leadership is found to have a substantial influence on organizational outcomes such as effectiveness, productivity, and performance. Moreover, transformational leadership is found to be the most influential on creativity and innovation. Finally, the review of literature foregrounds a gap in studies that investigate the role of transformational leadership in innovation that promotes sustainability and asset management applications within the ground transportation sector.
Chapter 3 - Methodology

The purpose of this study is to examine the degree and extent of, or lack of, relationships between transformational, transactional and avoidance leadership styles and the climate for innovation in organizations that promote and embrace the adoption of sustainability and asset management practices. The study is undertaken using data collected from individuals working at executive levels in public and private sectors within ground transportation sectors in the United States of America. This research is based on data collected from questionnaire surveys and has been analyzed using Structural Equation Modeling and Partial Least Square (SEM-PLS) method.

3.1 Method and Design

Since empirical research provides strong evidence for explaining phenomena, selecting a proper research method based on the research questions and hypotheses is a primary commitment of researchers aiming to choose the most ideal research approach (i.e., qualitative, or quantitative, or a mix of both). Methods used to capture and record quantitative data vary widely and must be carefully aligned to the research purpose and objectives (Laycock et al. 2016). Yukl (1989) underscores this principle, noting that “the purpose of the research should dictate the methodology and choice of samples, not the other way around” (Yukl 1989). Researchers have their own views, beliefs, and interests; the work they produce in the form of research should be evaluated as a part of an integrated process involving themselves, their beliefs, and experiences. Generally, research methods fall into two general categories: quantitative and qualitative (Laycock et al. 2016). Qualitative research is exploratory in nature, and tends to deduce answers to 'how?' and 'why?' questions; whereas, quantitative research answers the questions 'how much?' or 'how many?' (Perry 1998). In other words, quantitative data are measurable and commonly numeric in nature and can be collected by surveys and questionnaires; whereas qualitative data are rich in meaning and
description that can be obtained from a number of tools such as “observations, interviews, discussions, drawings, photographs, and written text” (Laycock et al. 2016).

Toor and Ofori (2008) note that “quantitative research methods are characterized by the assumption that human behavior can be explained by social facts.” Data collection using questionnaires is a commonly employed method when studying leadership. A number of researchers refer to the questionnaire-based approach as the ‘typical leadership study’ (Bryman 2011). This is in line with the findings obtained by Lowe and Gardner (2001) who observed that 71% of empirical studies published in The Leadership Quarterly in its first decade (1990-1999) employed a quantitative research design, out of which 64% employed a questionnaire-based method for data collection. They also found that qualitative methods have been employed to a lesser extent, where only 20% of the studies used interviews and 8% used other less common methods, such as observational methods, experimental measures, and projective tests (Lowe and Gardner 2001). Such findings clearly imply that the number of quantitative studies on leadership is significantly higher than those using qualitative methods (S. Toor and Ofori 2008).

A similar conclusion can be reached when we examine research methods employed in investigating leadership in the construction industry. Toor and Ofori (2008), in their review of published empirical work on leadership in the construction industry, found that the majority of studies employed quantitative methods. Very few chose alternative methods such as qualitative and mixed methods. Questionnaire surveys were found to be the most popular method, while a few of the studies were based on interviews and case studies (S.-R. Toor and Ofori 2008).

The research design in this dissertation depends solely on the research questions/hypotheses and the literature review previously undertaken. Research investigating leadership styles that promote sustainability and asset management practices in the ground
The research questions in this study clearly define the scope, context, and parameters that need to be studied and analyzed. The main focus of this research is investigating the influence of transformational leadership on organizational innovation that creates a climate for promoting the adoption of sustainability and asset management in infrastructure organizations within the ground transportation sector. Recently, researchers are paying more attention to understanding the context in which leadership emerges and becomes embedded. Considering contextual factors while studying leadership is vital because “leadership perceptions are grounded within a larger social, cultural, task and interpersonal environment” (Lord et al. 2001). The context in which this research takes place includes both public and private organizations. Leaders in the top two levels of management from both sectors (public and private) participated in the survey to assess and measure research variables (more information on the survey development is provided in section 3.3).

Infrastructure organizations within the ground transportation sector have a wide range of business functions and working environments. The aim of this study is to examine different business functions and working environments to gain a more comprehensive picture of how leadership behavior is influencing, at higher levels, the organizational climate for innovation towards the adoption of sustainability and asset management. Such business functions are distributed across different firms and individual departments within other firms. This research focuses on a single industry (ground transportation) within the infrastructure domain so as to limit extraneous influences that might impact the reliability of data due to different industry types (Jung et al. 2008). A single organization may have one or more functions depending on its institutional characteristics. For example, a state DOT typically has several business functions such as planning, design, execution and maintenance; whereas,
a private design-firm working within the transportation sector may have only one or two functions (e.g., design and planning).

Work environment, on the other hand, is another contextual factor that should be addressed for further analysis. Most research within the domain of leadership has focused mainly on permanent organizations as a single context, while ignoring imperatives foregrounded by other scholars who stressed the need for more empirical studies on leadership in different contexts (Antonakis et al. 2003; Eberly et al. 2013). A temporary organization, on the other hand, is “characterized by discontinuous personal constellations and work contents, a lack of organizational routines, and a cross-disciplinary integration of internal and external experts” (Tyssen et al. 2014). Temporary organizations exist in real life in the form of projects and programs that “... are unique in terms of tasks and have a limited duration and a short-term orientation” (Tyssen et al. 2014). In contrast to temporary organizations, permanent organizations are those exerting stable structures and long-term setups; they are likely to maintain a specific working climate for longer periods of time. Studying various situations formulated within different working environments is helpful in recognizing variance and intensity in leadership outcomes.

Not only were those in top levels of leadership included, but middle managers (including project managers) were also included in data collection efforts to give more depth to the research purpose, while simultaneously adding a dimension to the process of analysis. This effort shifts the research from a single-level analysis to a multi-level analysis, which is found to be useful when studying leadership behavior. Such multi-dimensional analysis is expected to increase the level of complexity, which requires special attention while completing the design phase of data collection and selecting the most appropriate instruments. A literature review on leadership in the construction industry conducted by Toor and Ofori (2008) revealed that most of the studies were on project managers, site managers,
project professionals, project engineers, and building professionals. Few studies were undertaken with executive level managers and other professionals such as architects and quantity surveyors (S.-R. Toor and Ofori 2008). Focusing on the executive level of management is important due to the fact that “CEOs and top-level managers are a prime source of information about strategic processes ... and may be the only source of some information about aspects of the organization as a whole” (Cycyota and Harrison 2002). On the other hand, it is well proven that these leaders, as representatives of their organizations, have knowledge about issues internal and external to the organization and have similar duties and responsibilities, no matter the size or scope of the organization (Cycyota and Harrison 2002).

In this study, respondents were asked to provide answers to four distinctive questionnaires about their organization’s strategic plans and current efforts toward the adoption and implementation of sustainability and asset management practices, and to provide information on their leadership behavior.

### 3.2 Data Collection

Based on a review of the literature on methodological approaches applicable to the subject matter, a quantitative approach was used to determine the role of transformational leadership in promoting the adoption of sustainability and asset management practices. This quantitative approach was also selected to calculate the influence of organizational innovation as a mediator in the relationship between transformational leadership and the adoption of sustainability and asset management practices. The kind of quantitative data one collects will indicate the way in which the data should be described, analyzed, and presented (Laycock et al. 2016). Surveys and questionnaires have been used for a long time with quantitative research approaches to investigate processes in which systematic measurements are made over a series of cases that yield a set of data (Walker 1997). Thus, quantitative data
can be obtained from a number of research tools such as experimental investigations, observations, case studies, questionnaires, literature and interviews (Laycock et al. 2016). On the other hand, qualitative methods like personal interviews were found to yield rich sources of input, but they necessitate substantial output for the researcher, in terms of time and resources. Studies applying this data-collection method face considerable challenges in obtaining a sufficient sample size to determine a high enough level of statistical reliability of variables. Quantitative methods such as surveys “... can provide more extensive or directed information, they are typically less expensive, and they can reach a much larger sample” (Cycyota and Harrison 2002).

Quality data require a well-designed study using a carefully crafted questionnaire (Totten et al. 1999). The term survey describes a type of study that associates people’s responses with a researcher’s questions. Possible formats include personal interviews, telephone interviews, mailed questionnaires, emailed questionnaires and online surveys. Paper-based questionnaires used to be the most common format and they were generally familiar to both potential subjects and scientific readers. However, emailed questionnaires and online surveys have become more popular in recent years due to the wide accessibility of the internet and the convenience of electronically delivered questionnaires.

The quantitative method employed in this research requires the development and management of a questionnaire instrument to collect quantitative data for the research variables. The reason this study uses questionnaires as its data-collection tool is fourfold. First, questionnaires are among the most commonly used instruments in collecting quantitative data in many fields and areas of research including the construction industry. Second, the research sample is expected to be relatively large since it is going to cover a wide range of business functions within the transportation sector. Managing a qualitative method would be difficult for research setting such as this, in which the number of organizations and
affiliated departments is expected to be extremely high. Employing an interview method for data collection would be too impractical, tedious, and expensive. Third, using questionnaires puts less pressure on respondents for an immediate response, giving them a greater feeling of autonomy and convenience (Aragón-Correa et al. 2007). Finally, the questionnaire method is preferred because the primary target groups are likely to be scattered in different locations across the United States; so questionnaires would simplify contacting a reasonably sized sample within the designated time frame (Geoghegan and Dulewicz 2008).

Accordingly, variables are distinguished and then analyzed to check if they reveal any logical outputs and patterns of meaning. Recognizing the research variables might be a relatively easy task; however, measuring and assessing those variables using questionnaire instruments are considerably difficult. Such difficulty stems from the complexity of the process which aims to assess human behaviors, such as leadership style and behavior, over a number of contextual factors and events that tend to be synaptic and interconnected. Essentially, a leader’s behavior tends to fluctuate over time; they may exercise a different leadership behavior in any given time, situation, and/or working environment. Leadership theories suggest that different leadership styles are appropriate in various routine organizational contexts. Project management literature foregrounds a similar observation. It was found that different leadership styles are appropriate in different kinds of projects or project phases (Müller and Turner 2007). Capturing contextual factors while measuring the impact of each variable is important when assessing leadership behavior. Organizational culture and climate directly influence the way leaders interact with their followers. In other words, a leader who exerts transformational leadership in an organization with an innovative-oriented working climate may not be as successful at employing the same leadership style in a more traditional or bureaucratic organization.
In this research, a web-based survey has been distributed to participants via e-mail. The email includes an invitation letter, the purpose of the research, consent letter and a set of questionnaires. Respondents are asked to click on a distinctive link which was generated using the “invitation only” option of the survey platform. The purpose was to make sure that only those who have been invited to participate in the study receive the link. By clicking on the link, participants agree to participate in the survey; by completing it, they consent to the use of the data collected for the purposes of the study. Participants have been provided with the option of completing the survey at different times (using the same link) within a time frame of 2 weeks. Once completed, responses are transferred into a central database for further processing and analysis.

To circulate the questionnaire in the U.S., a web-based survey has been developed and distributed to a stratified sample in both the public and private sectors. The Qualtrics® platform (www.qualtrics.com) has been used to develop the research survey, as it is equipped with useful tools and features for building, distributing, managing, and analyzing a web-based survey. The survey consists of five parts; each part measures the research variables as described and discussed in the ‘Measurement Tools’ section. The survey has been uploaded and distributed to the stratified samples using the Qualtrics distribution tool. An email has been sent to both samples (i.e., participants from public and private agencies) inviting participants to complete the survey by clicking on a link. The email body has been relatively short and concise, presenting the purpose of the survey and a polite request to complete it within two weeks. The Qualtrics email-invitation feature has been used to provide a unique link for each participant, a distinctly different tool from an anonymous link that would create a single link to everyone without an invitation. After two weeks, only 3 participants completed the survey of a total of 520 (300, public sample + 220, private sample) potential respondents to whom invitations were sent, resulting in a return rate of less than 1%. Such a
low return rate caused serious challenges during the data-collection process. Multiple reminders for those who had not responded were sent for two months; still, no promising outcomes were observed. The return rate did not improve even after sending multiple reminders to those who did not complete the survey. After the first five-month distribution cycle, it became evident that the data-collection method used would not generate healthy and useful data to perform the research analysis.

Multiple research service providers have been contacted to determine alternative paths for data collection. Eventually, a contract has been signed with Qualtrics ® to administer the data collection process. Qualtrics ® is an academic research provider that includes a database of millions of business professionals throughout the world who have signed up with them to conduct studies. After providing information about the research population and scope of work, they requested screening questions to assist them in targeting only those who qualify as a research sample. After receiving a link to the survey as well as the target group, Qualtrics reaches out to research panels that may qualify. A set of screening questions was developed to form the research sample and target only those who indicated they worked in the Ground Transportation sector. Screening questions have been placed at the beginning of the survey to determine whether participants were working within the Transportation industry (Yes(Y)/No(N)), specifically, in Ground Transportation, and if they were in the top two levels of management (Y/N). If they answered N to either question, they were disqualified. Only those answering Y to both questions were included in the study.

Collecting the research data for different variables from the same source increases the risk of common method bias (Podsakoff and Organ 1986). Such bias is caused by the implicit social desirability associated with answering questions in a questionnaire in a particular way, causing the indicators to share a certain amount of common variation (Kock 2015). Common method bias, in the context of Partial Least Square – Structural Equation Modeling (PLS-
SEM), is a phenomenon that is caused by the measurement method used in an SEM study, and not by the network of causes and effects in the model being studied. This study utilized the PLS-SEM as a multivariate analytical tool to investigate the relationship between variables. More details about PLS-SEM are provided in section 3.4.3.

Podsakoff’s (2003) recommendations were followed for the procedural method. For the statistical method, the procedure that Kock (2015) suggests was followed to test for common method bias. A VIF value threshold of 3.3 is set in a full collinearity assessment when a path-based PLS-SEM algorithm is used, while a VIF value of 5 could be employed when using a factor-based PLS-SEM algorithm (Kock 2015).

To mitigate the risk of common method bias from the procedural point of view, the measurement of the predictor and criterion variables were separated when constructing the survey questionnaire. For that purpose, the survey was divided into five parts measuring each variable individually. The independent variables were separately located at the top, followed by the mediator, dependent variables, and finally the demographic variables. Another remedy of common method bias is to reduce people’s evaluation apprehension and make them less likely to edit their responses to be more socially desirable, lenient, acquiescent, and consistent with how they think the researcher wants them to respond. The ambiguity and complexity of each item’s construction was also reduced, and questions were kept as simple as possible.

3.2.1 Study Population and Sample

The purpose of this research dictated my choice in methodology; I, therefore, selected the research population and samples accordingly. This study uses surveys for the collection of data. Prior to the commencement of the survey process, I identified three main research imperatives.
First, I deemed it important to define from whom the study would collect information. Second, I identified what method to use for collecting it. Finally, I determined how to process, analyze and interpret it (Moser and Kalton 1979). This study focuses on the leadership activities of leaders in the top two levels of their departments within the Ground Transportation sector in the U.S. The target respondents in this research are those who participated in infrastructure projects and have experienced more than one infrastructure project within the ground transportation sector. The ground transportation sector includes roads, bridges, tunnels, and railroads. Executives from the top two levels of management in both the public and private sectors are the candidates selected to participate in this study. The top two levels of management are defined as follows:

- **Top-level of management**: Director, CEO, Vice president, COO, Chairperson of board, president, and corporate head
- **Middle-level of management**: Project manager, general manager, divisional manager, plant manager, regional manager, and department manager

The top level of management also includes employer representatives (i.e., top managers who represent the interests of owners.) Within this scope, four units of analysis are examined: Leadership Styles for individual leaders in Ground Transportation as independent variables; Organizational Climate for Innovation as a mediator; and Sustainability Leadership and Asset Management Leadership as outcomes (dependent variables) at the organizational level.

It is useful to distinguish between two types of populations that would become the same in an ideal situation. However, in most cases, the population for which the results are required (the target population) might not be the same as the population covered (the survey population). This happens when part of the population may be excluded for reasons that are, at times, marginal to the purpose of the survey, which can be reasonably excluded.
important point to address is that such exclusions must be deliberate and explicit to avoid any misrepresentation of the research population (Moser and Kalton 1979).

The research population are narrowed to include executive leaders and middle managers only. Managers at the middle and executive levels who represent a variety of functional areas are targeted as the research population since it is likely that they would be associated with innovation processes and would be most familiar with the behavior of leaders. Such leaders are targeted in both public and private organizations. Leaders working in the planning, design, construction, maintenance, and operations business units within the ground transportation sector have been targeted to participate in the survey. Other infrastructure divisions and business categories are excluded to control for confounding effects. Leaders at the top two levels of management represent a research term called ‘element,’ which is defined as a unit about which information is collected to form a basis for the research analysis.

The aggregation of these elements within a targeted research scope (ground transportation sector) is called the ‘population.’ A ‘study population’ refers to the aggregation of elements from which the sample is actually selected (Babbie 2011). The list from which those elements are selected is called a ‘sample frame.’ Accordingly, the research sample frame should include all top-two management-level leaders who work in organizations involved in the infrastructure domain within the ground transportation sector. Since leaders are the research ‘elements’ about which information is gathered and because information obtained from those leaders is so central to many domains of management research, it is important to understand which data collection method is the best and most applicable so that the information collected from them are the most efficient and effective (Cycyota and Harrison 2002).
Potential participating leaders originated from public and private organizations such as:

1. Public:
   - Office of the Secretary of Transportation (OST)
   - National Highway Traffic Safety Administration (NHTSA)
   - Federal Highway Administration (FHWA)
   - State Departments of Transportation (DOTs) - all 50 states
   - Surface Transportation Board
   - County Departments of Transportation - in all 50 states
   - Any other public organization within the sector

2. Private:
   - Main Contractors in SIC (1611 & 1622) - Highway and street construction & bridge, tunnel, and elevated highway in the U.S.

A single organization could have multiple leader participants coming from various related departments within the organization. A single state department of transportation, for example, has several business units such as planning, design, construction, operations, and maintenance. Hence, leaders from each department have been targeted to participate in the survey. The process of identifying the research population that would include all potential participants as described earlier, would be of great burden and a tremendous challenge. Such difficulties stem from the wide variety of business categories involved in the transportation sector. Moreover, it is widely common to have organizations that manage transportation related projects as secondary business beside other general construction activities. As a result, identifying the sample frame based on the above-mentioned criteria would be too challenging and tedious.
Consequently, the process should start with listing all organizations that fall under the predefined classification from all business categories within the transportation sector in the U.S. This list will include organizations from both public and private sectors covering a full spectrum of all business categories involved in roadway projects. Executive leaders descending from the top two levels of management in every business unit within the transportation roadway infrastructure are considered as part of the research population. Roadway infrastructure within the United States includes assets such as roads, bridges, signs, pavement markings, traffic signals, noise barrier structures and public facilities such as rest areas and other common structures (NCHRP 2013). Any organization that has business activities associated with one of the above trades has also been targeted to participate in the survey.

3.2.2 Sampling Population

A research sample is basically a specimen or part of a whole population that is selected to demonstrate what the rest of the population looks like (Naoum 2013). For investigations involving people, the members of the sample are called participants, whereas for laboratory investigations, individual items are used to derive specimens (Laycock et al. 2016). Sampling, on the other hand, is a method that estimates the population parameters from the sample data. This is always the case since it is “... relatively rare that any investigation is able to study all possible incidents over all times and in all places” (Laycock et al. 2016). Information about population size and characteristics is needed prior to defining the best strategy of deriving the research sample. The difference between the expected value and the true population value is called ‘bias’. Bias can occur at any stage of a research project and it is not limited to that which occurs during the sampling process. It is defined as “the presence of influence that can affect the study outcome” (Laycock et al. 2016). An unbiased estimator is achieved when the expected value of the estimator is equal to the population
parameter. A parameter is defined as the summary description of a given variable in a population (Babbie 2011).

Cooper and Schindler (2008) believe that the best sample design is achieved when it represents the characteristics of the population; and in measurement terms, the sample must be valid. Validity of the sample, as per the authors, depends on two factors: accuracy and precision (Cooper and Schindler 2008). Accuracy can be achieved when bias is zero or near zero. It is a process where the measurement of variables of some sample elements are either underestimating or overestimating those same variables drawn from the population causing something called ‘offsetting effect,’ by which sample values offset each other, resulting in a sample value that is close to the population value. This can be satisfied when sample size is large enough, and when selected in a way that favors neither underestimation nor overestimation. Contrarily, a biased (inaccurate) sample occurs when the under-estimators do not offset the over-estimators (or vice versa), causing an event called ‘systematic variance’ that has been defined as “the variation in measures due to some known or unknown influences that cause the scores to lean in one direction more than another” (Cooper and Schindler 2008).

The second factor which influences the validity of a sample design is precision of estimate. It is well accepted that no sample will fully represent its population in all respect. However, the aim usually is to measure how closely the sample represents the population. In general, precision is measured by the standard error of estimate, the smaller the standard error of estimate, the higher the precision of the sample is (Cooper and Schindler 2008). Stratification of the population has been found to increase the degree of the precision of the sample (Moser and Kalton 1979). Overall, analyzing the research findings properly depends on how closely the sample represents the population.
To empirically test the research’s hypotheses, an inter-industry study design is chosen in order to control for potential industry effects. The challenge in selecting the sample lies in the need to only target leaders with a substantial record of project work within the ground transportation sector. Participants are chosen on the basis of their experience and knowledge of the adoption and implementation of innovative practices that embrace sustainability and asset management, and their role in infrastructure management efforts within the transportation sector. Past research revealed that selecting a sample of organizations located in a relatively homogeneous geographic, economic, political, sociocultural, technological and legal space minimizes the impact of variables that cannot be controlled in the empirical research (Garcia-Morales et al. 2012).

The next step after identifying the targeted population is to compute the sample size. Sampling methods can be divided into two types: probability sampling and non-probability sampling. Laycock et al. (2016) define the former type as the sample that has a frame (a list of population members); each individual has an equal probability of being selected. The latter describes a sampling type that does not have a sampling frame and individuals do not have equal probability of being selected.

Another definition suggests that nonprobability sampling is “any technique in which samples are selected in some way not suggested by probability theory” (Babbie 2011). Naoum (2013) listed five types of sampling designs: non-random accidental sampling; non-random purposive sampling; simple random sampling; systematic random sampling; and stratified random sampling. On the other hand, non-probability sampling is divided into four types: reliance on available subjects; purposive or judgmental sampling; snowball sampling; and quota sampling (Babbie 2011).

The main aim of sampling is to select a set of elements from a population that represents the population as accurately as possible. Probability sampling was found to
increase the likelihood of achieving this aim by using a random-selection approach, where
elements have an equal chance of being selected in the selection process. However, this study
uses a stratified random nonprobability sampling method due to multiple reasons. First,
probability sampling is not appropriate to use in this study setup due to respondent
availability constraints. Second, this study aims to investigate a certain characteristic of a
predefined population (leaders from the top two levels of management in ground
transportation), and generalizing findings to a broader population does not fall within the
scope of the work. Third, probability sampling would entail too high a cost and extended
period of time to implement.

A larger sample does not always lead to a healthy and representative sample. A
sample is considered representative of the population from which it is selected if the
aggregate characteristics of the sample are as close to those aggregate characteristics of the
population as possible. It is worth mentioning here that samples do not need to be
representative in all aspects; only those characteristics that are relevant to the interest of the
study are of concern when seeking representativeness. However, it is quite difficult to
identify in advance which characteristics are relevant (Babbie 2011).

Moser and Kalton (1979) believe that adopting a sampling strategy that is based on a
larger sample size only, without considering a proper statistical approach, would not
necessarily lead to a representative sample, and is not sufficient to guarantee the accuracy of
the results. The authors described two major principles that underline all sample design: 1)
the desire to avoid bias in the selection procedure, and 2) to achieve maximum precision for a
given outlay of resources. Bias occurs when sampling is done by a non-random method,
when the sampling frame does not cover the population adequately, and when the non-
response rate is relatively high. Such factors are found to cause systematic and non-
compensating errors, which cannot be eliminated or rectified by just increasing sample size.
Ultimately, selecting a research sample size is largely governed by the way the results are to be analyzed. Therefore, it is important to consider the breakdown of what is going to be measured, and what numbers are needed to give the required precision, and hence what total sample size would be desirable, which might be beyond what is practicable. One more issue that needs to be taken into account is that a survey often seeks information on a number of different variables rather than focusing on a single purpose, and a sample that is quite large enough for an individual variable may not be adequate for another that requires greater precision (Moser and Kalton 1979).

There are different approaches to determining the adequate sample size of an empirical research study. In survey research, sample size can be obtained based on a fraction of the population (e.g., 15%), based on past studies, or based on the margin of error. Since the response rate is usually unknown before carrying out the survey, it can be enhanced by a number of measures that often vary based on the type of survey and the attributes of participants. Babbie (2011) suggests a number of measures that could be taken to enhance the response rate in conducting online surveys: maintaining simple and plain language throughout the questionnaire; using consistent wording between the invitation and the survey; offering to share selected results from the study with participants; planning for the date and time to email the invitation; sending reminders after some time (e.g. two weeks) for those who did not return the questionnaire; and finally, pretesting the time required to complete the full questionnaire to ensure a minimum response burden.

Many studies have also proposed other techniques to enhance the response rate for empirical studies that employ surveys as a data collection tool. Cycyota and Harrison (2002) investigate whether such techniques have any effect on enhancing the response rate for surveys mailed to executives. It has been found that “... most research on the effectiveness of response rate enhancement techniques originates in disciplines that rely heavily on
individual-level information: psychology, marketing, and political science” (Cycyota and Harrison 2002). The authors examine the effectiveness of four response rate enhancement tools, which have been presumed and shown to increase the likelihood of receiving responses to mailed surveys in particular populations. These tools include monetary incentives or gifts, advance notice, follow-up, and personalization.

While past research has found consistent enhancement of response rates when using these techniques used in other populations, Cycyota and Harrison (2002) found that none of the four techniques for enhancing response rates were effective in their carefully controlled study of a random sample of executives. Therefore, it is important to pick the most effective and efficient technique to enhance the response rate based on the survey method and population characteristics. That is, what is most effective and efficient cannot be solely based on what is convenient to the researcher, given that each one of these techniques involves a significant outlay of researcher’s resources (Cycyota and Harrison 2002). Cycyota and Harrison (2002) also suggested that any adoption of such response-rate enhancement techniques should be done with extreme caution because they may have an effect on the answers given to survey questions.

Previous research also found that self-reporting in questionnaires may influence the outputs and could form a potential source of bias (Schwarz 1999). Such bias stems from three different sources caused by an implicit interaction between the researcher (sponsor) and respondents when using response-rate enhancement techniques. First, respondents may provide answers that they feel may be favorable to the survey sponsor. They do it as a demonstration of good faith towards the sponsor by giving answers they believe the surveyor or sponsor desires. Second, participants may want to portray their organizations in the most desirable manner. This is called self-presentation bias where respondents believe the researcher or sponsor knows who they are, although anonymity is usually guaranteed, which,
in turn, leads to an inflated or overly positive assessment of the leader’s organization. Third, when using monetary incentives as a tool for response rate enhancement, the respondent may feel an obligation to provide favorable answers (Cycyota and Harrison 2002). Common method bias is another source of bias, which usually exists when the same participant provides responses to more than one variable. Results may be affected by common method bias when measures of independent and dependent variables are collected from the same source and an attempt is made to interpret any correlation among them (Podsakoff and Organ 1986).

Online surveys that can be conducted completely using emails or websites are becoming increasingly popular especially with the wide spread of internet accessibility and coverage. One limitation of such a survey method concerns the representativeness, where some potential participants may not have the opportunity to participate in the survey due to internet inaccessibility (Babbie 2011). Such disadvantage is not applicable to this study where potential participants represent high levels of management occupying executive positions in their organizations where internet availability is not an issue. In addition, online surveys were found to have response rates comparable to regular-mail surveys. Moreover, the cost of conducting online surveys is substantially lower than those conducted via the postal-service method (Babbie 2011). The advantages of using email to collect data can be summarized in two benefits. First, it’s “... much cheaper and offers significant timesaving in ease of administrative manipulation. [Second], researchers can take prompt action to ask for respondents’ clarification of responses after scrutinizing returned responses for any missing and abnormal data entries” (Chan and Chan 2005).

3.3 Operational Measures and Instrumentation

Designing a survey instrument depends solely on the research constructs, which play an important role in shaping the way data is collected. In any research measuring behavioral
elements, no device using a single metric unit can measure a phenomenon precisely. That’s why researchers tend to employ several measures to calibrate a construct or scale. Given the complexity of developing new constructs or scales of measurement, the intention of this work was to use pre-tested constructs from past empirical studies, as much as possible, to ensure their validity and reliability (Garcia-Morales et al. 2012).

Surveys are used to collect data from a sample of respondents within a limited time frame. With the survey approach, there are two types of surveys available in any given study: a descriptive survey and an analytical survey. The former aims to answer such questions as: how many, who, what, where, and when. In this survey type, respondents’ answers are counted toward a specific object for further analysis (Naoum 2013). An analytical survey, as used in this work, aims to establish relationships and associations between questionnaire attributes, by defining how often an attribute is associated with another attribute within the sample questionnaire (Naoum 2013). Subsequently, three sets of variables are introduced to form the basic research model, as illustrated in Figure 1, for further investigation and analysis. First, Leadership Styles are considered here as independent variables. Second, Organizational Innovation is selected as a mediator. And finally, dependent variables represented by Sustainability and Asset Management practices are selected as the study outcomes.

Figure 1. The Research Model
3.3.1 Transformational, Transactional Leadership and Passive/Avoidant Behaviors

In this research, leadership styles are measured using the Multi-factor Leadership Questionnaire (MLQ – Form 5x) (Avolio and Bass 2004). Since the introduction of MLQ by Bass (1985), who originally proposed a 6-factor model, several additional factors have been introduced in subsequent research (Bass 1985; Bass and Avolio 1993, 1994). Avolio and Bass (2004) claim that these revisions to the leadership factors do not conflict or contradict the integrity and legitimacy of the original 6-factor model.

The first article using MLQ as a measurement of transformational and transactional leadership was published in 1985 just after the seminal book of Bass (1985). Since then, numerous leaders and followers have completed the MLQ including “all managerial levels of Fortune 500 and 1,000 firms; a variety of government and other not-for-profit agencies; and smaller firms in manufacturing, service, and high-technology industries throughout the United States, as well as in many other countries around the globe” (Avolio and Bass 2004). MLQ has been used by numerous entities from a wide range of sectors in different countries and in several languages. In fact, “MLQ has been the subject of study and method in numerous doctoral dissertations, theses, and research investigations, many of these in Europe, Asia, Africa, and elsewhere” (Avolio and Bass 2004).

MLQ consists of two questionnaire forms: The Self Rating Form, where participants rate themselves as leaders (ratees), and the Rater Form, where other participants rate their leaders (raters). This study uses the former questionnaire form, where leaders rate themselves. The reason behind this decision stems from the logistical and operational difficulties, in which identifying the leaders’ subordinates in such data collection setup would be beyond the author’s capability and reach. MLQ (5X short) contains 45 items that identify and measure key leadership styles and effectiveness outcomes. Out of the 45 items, only 36
items represent the full range of leadership divided into 9 factors (constructs). The remaining 9 items are related to leadership outcomes such as extra effort, effectiveness, and satisfaction; they have been excluded from the study because of their irrelevance to the scope of this study. Each of the nine leadership factors is measured by four items. The four items forming each of the nine factors are highly inter-correlated with each other, and slightly correlated to other items of the other eight factors. Participant leaders who provide responses to the MLQ (5X short) are basically evaluating their perception of acting or engaging in different types of leadership behavior. This construct comprises 9 factors representing the full-range of leadership: Transformational, Transactional and Passive/Avoidant behavior. There are 20 items measuring transformational leadership and 8 items for each of the transactional and passive/avoidant behaviors. These 9 factors are classified as follows:

Transformational Leadership
- Idealized Influence (Attributes)
- Idealized Influence (Behavior)
- Inspirational Motivation
- Intellectual Stimulation
- Individual Consideration

Transactional Leadership
- Contingent Reward
- Management-by-Exception: Active

Passive/Avoidant Behavior
- Management-by-Exception: Passive
- Laissez-Faire

The MLQ (5X short) uses a five-point scale for rating the leader perception frequency of exercising different leadership behaviors, using a ratio of 4:3:2:1:0, according to a tested
list of anchors provided by Bass et al. (1974). It has been generally understood that the number of anchor points does not make much of a difference in most measurement properties of a scale. That is, whether one uses, four points or eight points does not affect the internal consistency, stability, predictive, or concurrent validity of the scale. However, it is important to pay close attention to the percentage of overlap in adjacent judgment when moving from say five points to nine, where the percentage was found to increase respectively (Bass et al. 1974). The values used to evaluate the MLQ factors range from 0 (Not at all) to 4 (Frequently, if not always) (Avolio and Bass 2004).

A number of scholars have revealed that MLQ has been extensively used to measure the leadership styles and found to be a well-validated instrument (Aga et al. 2016; Avolio and Bass 2004; Avolio et al. 1999; Awamleh and Gardner 1999; Chan et al. 2014; Jung et al. 2003; Tyssen et al. 2014). The validity of its constructs has been evaluated using Confirmatory Factor Analysis (CFA). Our literature review revealed that the MLQ instrument is a popular tool of measuring transformational and transactional leadership. Out of 44 papers studying the role of transformational leadership on a variety of organizational outcomes, 32 papers used MLQ as a measuring tool; only 12 studies used different instruments to measure the transformational/transactional leadership, that accounts for 73% and 27% respectively. The literature review also revealed that the majority of these studies have been undertaken outside the domain of infrastructure and construction. The review also shows that only 8 publications were from within the construction sector, and just one research was found in the infrastructure domain (in the water sector). Of the 8 publications within the construction sector, 5 papers used MLQ.

A review of the literature on the role of transformational leadership on a number of organizational outcomes reveals a scarcity of empirical research pertaining to the subject matter in the domain of infrastructure and more specifically within the transportation sector.
In line with this observation, Toor and Ofori (2008), in their review of the published empirical work on leadership in the construction industry, found that only two studies have employed transformational leadership using Multifactor Leadership Questionnaire (MLQ) instrument (S.-R. Toor and Ofori 2008). The objective of this study is to fill this gap by conducting empirical research that investigates the role of transformational leadership style that encourages and cultivates an organizational climate for innovation, which promotes and implements sustainability and asset management practices in infrastructure organizations within the transportation sector.

The 36 items of MLQ (5X short) that cover transformational and transactional as active leadership behaviors, and passive/avoidant behavior as passive leadership behavior, are distributed on 9 factors as described in Table 1.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Scale Name</th>
<th>Scale Abbreviation</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational</td>
<td>Idealized Attributes</td>
<td>IA</td>
<td>LS 10, 18, 21, 25</td>
</tr>
<tr>
<td>Transformational</td>
<td>Idealized Behaviors</td>
<td>IB</td>
<td>LS 6, 14, 23, 34</td>
</tr>
<tr>
<td>Transformational</td>
<td>Inspirational Motivation</td>
<td>IM</td>
<td>LS 9, 13, 26, 36</td>
</tr>
<tr>
<td>Transformational</td>
<td>Intellectual Stimulation</td>
<td>IS</td>
<td>LS 2, 8, 30, 32</td>
</tr>
<tr>
<td>Transformational</td>
<td>Individual Consideration</td>
<td>IC</td>
<td>LS 15, 19, 29, 31</td>
</tr>
<tr>
<td>Transactional</td>
<td>Contingent Reward</td>
<td>CR</td>
<td>LS 1, 11, 16, 35</td>
</tr>
<tr>
<td>Transactional</td>
<td>Management by Exception (Active)</td>
<td>MBEA</td>
<td>LS 4, 22, 24, 27</td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>Management by Exception (Passive)</td>
<td>MBEP</td>
<td>LS 3, 12, 17, 20</td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>Laissez-Faire</td>
<td>LF</td>
<td>LS 5, 7, 28, 33</td>
</tr>
</tbody>
</table>

MLQ (5X short) has a copyright protection that requires a purchase of a remote online survey license as well as a license to produce paper questionnaires. The former license allows the administration of the MLQ as an online survey via a non-Mind Garden® survey system; the latter allows the administration of the MLQ via a paper and pencil survey (Bass and
Avolio 2019). The author secured licenses for both types, which made it possible to use the MLQ instrument in the research survey. A copy of the MLQ instrument can be found in Appendix I - Sample of the MLQ-5X Instrument.

3.3.2 Climate for Innovation

The climate for innovation acts here as a mediator variable that measures the influence of organizational innovation on the relationship between transformational leadership and the research’s outcomes (sustainability and asset management practices). The mediator variable will act as an intervening variable that helps to explain the linkage between the dependent (adoption of sustainability and asset management) and independent (leadership style) variables. The mediator/intervening variable will influence the way dependent and independent variables interact and can cause the relationship between them to change (Naoum 2013). Baron and Kenny (1986) define mediator variables as the “function of a third variable, which represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest” (Baron and Kenny 1986).

The climate for innovation is measured using a 22-item innovation climate scale originally developed by Siegel and Kaemmerer (1978) and later modified by Scott and Bruce (1994). The original scale comprised three subscales: (1) support for creativity, (2) tolerance of differences, and (3) personal commitment (Siegel and Kaemmerer 1978). Scott and Bruce (1994) excluded the personal commitment construct due to what they perceived as a lack of evidence distinguishing between innovation and innovative organizations in the original Siegel and Kaemmerer (1978) study. Further, personal commitment has been considered as an outcome rather than a dimension of the climate for innovation. The climate for innovation, as presented in the work of Scott and Bruce (1994), is divided into two subscales: 1) support for innovation (16 items) that measures the degree to which individuals view the organization as open to change, supportive of new ideas from members, and tolerant of member diversity.
and 2) resource supply (6 items) that measures the degree to which resources (e.g., personnel, time) are perceived as adequate for innovation in the organization (Scott and Bruce 1994). Their data have been loaded to a factor analysis using principal-components extraction and varimax rotation. They ended up with two factors representing the above-mentioned subscales, which have been treated as a separate dimension of the climate for innovation in their model. The distribution of items among the climate for innovation construct is illustrated in Table 2.

*Table 2 – Distribution of items among Climate for Innovation subscales*

<table>
<thead>
<tr>
<th>Scale Name</th>
<th>Scale Abbreviation</th>
<th>Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support for Innovation</td>
<td>SI</td>
<td>CI 1 to 13 &amp; CI 20 to 22</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>RS</td>
<td>CI 14 to 19</td>
</tr>
</tbody>
</table>

Each of the 22 items are rated using a five-point Likert scale ranging from 0 (strongly disagree) to 4 (strongly agree). A copy of the Climate for Innovation instrument can be found in Appendix J – Sample of Climate for Innovation Instrument.

The Likert scale, developed by Rensis Likert, is the most frequently used form of the summated rating scale. Summated rating scales consist of statements that express either an agreement or disagreement position toward the object of interest. The participant is asked to respond by either agreeing or disagreeing with each statement. The statement can be either positively or negatively worded. These responses are weighted by assigning them numerical scores reflecting the attitude degree; the sum of the scores is then calculated to measure the participant’s overall attitude. A lower scale value indicates a strongly unfavorable attitude, whereas higher progressive values represent a stronger favorable attitude until it reaches the strongest favorable attitude. The Likert scale can be constructed using five, seven, and nine scale points. Although the five-point Likert scale is more popular, using seven and nine-point
scales results in a better approximation of a normal response curve and extraction of more variability among respondents. In case of a negatively worded statement, the assigned numerical values should be reversed to maintain consistency in results. In other words, the lowest value is always indicating a strongly unfavorable attitude and the highest value is always indicating a strongly favorable attitude. Each participant’s responses are then added up to find the total score (Cooper and Schindler 2008).

The climate for innovation instrument is a well-validated scale that has been used in a number of studies (Gumusluoglu and Ilsev 2009; Howell and Avolio 1993; Jung et al. 2003, 2008; Sarros et al. 2008; Scott and Bruce 1994) including those within the construction sector (Chan et al. 2014). The climate for innovation is introduced here to act as a proxy that measures the organizational non-technological innovation. Previous studies used this approach to measure the organizational innovation, knowing that obtaining direct behavioral measures of innovation across diverse organizations and industry sectors deemed to be difficult and challenging (Sarros et al. 2008). Other studies presumed that a team climate for innovation could predict the level of innovation diffusion outcomes in an organization (Panuwatwanich et al. 2008). As mentioned in previous sections, there are two types of organizational innovation (technological vs. non-technological). The scope of this research is limited to include non-technological innovations only. Technological innovations are excluded; and therefore, the proposed measurement tools for targeted organizational innovations differ from those tools for product-oriented innovations. An example of methods used to measure technological innovation can be found in the work of Jung et al. (2003), who proposed three different proxies. A permission to use and print the instrument is obtained from the author under the following conditions:

1. The surveys will be used for only research purposes; they will not be sold or used with any compensated or curriculum development activities.
2. A proper citation to the original paper (Scott & Bruce 1994) will be provided in the dissertation.

3. A copy of the completed research study will be sent to the authors’ attention upon completion of the study.

The permission to use the Climate for Innovation instrument in this research study was obtained from the author on 8/1/2018 (a copy of the permission can be found in Appendix G – Permission to Use Climate for Innovation Instrument).

3.3.3 Sustainability and Asset Management

Adoption of Sustainability and Asset Management are the study outcomes (i.e., dependent variables). Sustainability and asset management are different concepts, as adopting sustainable practices does not necessarily mean asset management is adopted in an infrastructure organization, and vice versa. The literature review on leadership, innovation, sustainability, and asset management reveals varying degrees of methodological maturity. While leadership and innovation research pay much attention to the validation of scales, studies on sustainability and asset management in construction and infrastructure industries often give less value to these methodological questions with no validated scales that represent generally accepted measurement instruments. Therefore, new measures were developed, based on the literature, to generate a different approach to measure each variable separately. Subsequently, these scales are used to assess a leader perception of adopting sustainability and asset management practices. Two instruments were developed to measure ‘Adoption of Sustainability’ and ‘Adoption of Asset Management’ as illustrated in Figure 2. The Adoption of Sustainability (AS) construct is proposed here to measure and assess a leader’s perception in terms of adopting sustainable practices, and the Adoption of Asset Management (AAM) construct is proposed to measure and assess a leader’s perception in terms of adopting asset management principles.
3.3.3.1 Adoption of Sustainability (AS)

The Sustainable Leadership Questionnaire (SLQ) presented by (Opoku et al. 2015a) is one of those measures that has been used to assess the adaption of sustainability in an organization within the construction sector. The SLQ was originally created by McCann and Holt (2010) who used it to measure the sustainable leadership behavior of selected manufacturing organizations. They defined sustainable leadership as “a focus in the present decision-making process about the importance of the long-term health, stability and existence of the organization” (McCann and Holt 2010). The instrument consists of ten questions asking subordinates to rate their perception of their leaders’ sustainability behavior (McCann and Holt 2010). While the instrument is potentially useful, it is not a self-rating survey, which makes it incompatible with this research method that uses a self-rating questionnaire completed by the leaders themselves. Nevertheless, the instrument could be utilized, after some modifications, to serve as a source of reference, among others, while creating the final instrument.
A number of sustainable leadership behaviors have been highlighted in several studies from a wide range of research areas such as business, management, construction, infrastructure, and leadership. Taylor (2008) presented a set of sustainable leadership behaviors that were found to be frequently associated with leaders emphasizing environmental aspects, which include:

... transformational leadership behaviors; scanning behaviors to gather information and ideas; framing behaviors, such as highlighting an issue’s urgency; selling behaviors, such as using rational persuasion; brokering information; managing conflict; clarifying roles and agreements between stakeholders; networking; helping to establish a new organizational culture; and running pilot projects. (Taylor 2008, P. 5)

Knight (2015) introduced a set of critical behavioral competencies of sustainability leaders. Under five competence categories, a number of sustainable leadership competencies of leaders from different sectors in different countries were identified. Those competencies were categorized into critical and not-critical behavioral competencies according to the results obtained from the study sample. The most critical behavioral competencies of leaders of sustainability are developing expertise, impressing people, establishing rapport, articulating information, interacting with people, valuing individuals, exploring possibilities, generating ideas, challenging ideas, and understanding people (Knight 2015).

Within the same context, prior research conducted by the UK Department of Trade and Industry (2003) attempted to underline the importance of identifying the skills and competencies of the Corporate Social Responsibility (CSR) specialists and managers. The report titled: ‘Changing Manager Mindsets: Report of the Working Group on the Development of Professional Skills for the Practice of Corporate Social Responsibility’ has identified a list of 27 skills and competencies a CSR leader needs or should have. The research sample participants were asked to consider the 27 skills and competencies and
evaluate how important these were for CSR specialists and for managers working in other functions. The majority agreed that many of these skills were important, and the results revealed the top six skills and competencies as: influencing without power; selling the business case (e.g., ability to communicate effectively); technical expertise; license to operate (e.g., understands the requirements of legislations, CSR standards and public opinion); building internal partnerships; and communications skills. Although CSR does not represent sustainability as a whole concept, this social dimension is one of the three elements of sustainability development in addition to dimensions of environment and economy. Therefore, these outlined skills and competencies are within the context of this research (DTI 2003).

Hind et al. (2009) proposed another set of attributes and competencies of CSR leaders. The results of their survey, which asked the respondents to assess and rate the importance of certain key attributes or characteristics of responsible leadership, revealed a number of skills and competencies that have been ordered into seven categories in descending order of importance as follows: acting with integrity; caring for people; demonstrating ethical behavior; communicating with others; taking a long-term perspective; being open-minded; and managing responsibly outside the organization (Hind et al. 2009).

There are a set of 30 attributes that are contained within these seven categories, which describe, in detail, the skills and competencies a CSR specialist should have (Hind et al. 2009). They were derived from the literature as “a mixture of both personal qualities (such as honesty and trustworthiness) and demonstrable behaviors (such as a management style of empowerment rather than control)” (Hind et al. 2009). Beside the quantitative data the study collected as described above, a qualitative approach was employed by conducting in-depth interviews with senior managers in leading European-based multinational companies. The
The major focus of the interviews was to obtain evaluative insight into the corporate responsibility competencies considered significant and critical.

The data collected from this method was categorized into three areas: knowledge, skills, and attitude. Under each category, a list of competencies and attributes were identified, which were further analyzed to propose five keys that resemble a combination of emotional and intellectual capacity (Hind et al. 2009). Results obtained from both quantitative and qualitative data represent a wide range of skills and competencies that constitute what responsible business behavior should portray.

Finally, a Sustainable Leadership Behaviors Questionnaire has been reviewed and examined for further investigation. SLBQ was originally developed by Dalati (2017) to assess the staff perception of outstanding leadership behaviors. This instrument basically examines the relationship between leadership behavior and perceived organizational trust in the field of higher education institutions in Syria. The scale consists of 10 items, which was developed based on previous leadership research (Dalati et al. 2017).

Such findings on skills, attitudes, behaviors, and competencies of sustainable leaders can establish a basis for developing a new survey instrument that would measure a leader’s perception in terms of adopting sustainable practices in an organization. The approach employed is able to assess the degree of sustainable leadership by measuring the leader’s perception towards sustainability. The skills, attitudes, behaviors, and competencies of sustainable leaders are pooled in a master list, then a process of segregation, categorization, and classification is performed. This process results in the development of a comprehensive list of competencies and behaviors that would set the stage for constructing the appropriate instrument.

The instrument was built in a form of a questionnaire survey similar to the SLQ structure as appears in the work of McCann and Holt (2010). Using a Likert scale, the
questions rate the respondent’s sustainable leadership behavior and their perception of adopting and embracing sustainability practices, which in return demonstrates the level of sustainable leadership. The rationale behind this approach stems from the fact that measuring an organization’s adoption and implementation of sustainability by assessing an organization’s activities in real life would be difficult and impractical.

The scope of this research, as mentioned earlier, comprises different business units that have their own distinctive work nature. The work conducted by a design firm, for example, is completely different from the work that a contractor usually does. In essence, the sustainability measures a design firm could adopt and implement are different than what a contractor or a supplier would be able to do. Therefore, the potential questionnaire tool will act as a proxy, in which a leader’s perception of adopting sustainable practices will be measured by the sustainable leadership construct.

Based on the literature review, this research used a self-designed instrument to measure the Sustainable Leadership variable. The instrument consists of 17 statements using a five-point Likert scale. The values used to evaluate the Sustainable Leadership range from 0 (Not at all) to 4 (Frequently, if not always). The instrument was evaluated for reliability by experts who examined the 17 statements and provided feedback based on two sets of characteristics. The first set of characteristics was about burden, sensitivity, and social desirability. The second set of characteristics was about potential failures of the response process (Olson 2010).

Based on the experts review evaluation, the instrument was modified and the statements were re-phrased to minimize the likelihood of failure. This method was found to be useful especially since a new instrument, in the form of a survey, was developed and distributed to a real population. This provided an opportunity for reviewing and modifying the instrument content to ensure that statements were written properly for the participants to
answer with minimal chance for failure. The aim was to increase the response rate and to maintain a healthy and reliable dataset. For that purpose, a separate online questionnaire was constructed, which basically consists of the same 17-item statements for the experts to review and complete.

An invitation email was sent to 32 experts for their evaluation for a duration of 3 weeks. Experts were sought based on their academic and field experience on the research materials and their background on subjects within management, engineering, and sustainability domains. Experts were asked to evaluate each of the 17 statements by rating whether the characteristic measured in the question was:

a) Burdensome—requires a great deal of cognitive work by the respondent (yes, no)

b) Sensitive—requires revealing embarrassing or private information or the topic is not discussed in everyday conversation (yes, no)

c) Socially (un)desirable—requires revealing information that may be compared against a social norm for possessing or not possessing a characteristic (yes, no).

Additionally, experts were asked to rate whether a failure of the response process is likely to occur at any stage for each statement. If any failure is likely to occur, experts were asked to rate how likely a failure was expected to occur at each stage in the response process based on the following scale:

0 = Unlikely that a failure will occur at this stage.
1 = Somewhat likely that a failure at this stage will occur.
2 = Likely that a failure at this stage will occur.
3 = Very likely that a failure at this stage will occur.

The experts also were asked to provide written comments for each statement with more detailed information about the individual types of problems they thought were likely to occur. The method employed here is based on a work done by Olson (2010) who developed
two sets of characteristics for experts to rate both cognitive and motivational characteristics of questions (Olson 2010). Permission was obtained from the author to use and print this method under the following conditions:

1. The method will be used only for research purposes, and it will not be sold or used with any compensated or curriculum development activities.
2. A proper citation to the original paper (Olson 2010) will be included in the dissertation.
3. A copy of this completed research study will be sent to the author’s attention upon completion of the study.

Permission to use the Expert Review method was obtained on 9/12/2018. A copy of this permission is found in Appendix H – Permission to Use Expert Review Method.

Out of 32 experts, only 5 responded and completed the questionnaire, three of which were members of the doctoral committee. The results indicated that some of the questions needed some modifications. Participants had an option to write a note for each question that they believed needed modifications. Some questions were re-phrased as per the remarks given by experts. The final version of the questionnaire after modification, rephrasing, and editing was used in the research survey. A copy of the Adoption of Sustainability questionnaire can be found in Appendix K – Sample of Adoption of Sustainability Questionnaire (ASQ).

3.3.3.2 Adoption of Asset Management (AAM)

A leader’s perception in terms of adopting asset management practices is measured and assessed using another instrument. The process included constructing a questionnaire that involves essential factors that cover key skills and attributes pertaining to asset management. A self-assessment instrument structured around the generic asset management planning framework developed in Australia by Mihai et al. (2010) is reviewed for potential adaptation.
The instrument measures an organization’s performance on asset management implementation (Mihai et al. 2010). It consists of 50 questions addressing seven key elements of asset management as follows (Mihai et al. 2010):

- “Agency Objectives and Stakeholder Requirements,”
- Strategy and Planning,
- Data, Information and Knowledge,
- Business Results,
- People,
- Leadership,
- Audit and Review”

The instrument uses a 6-point scale ranging from 0 to 5. The respondent rates each question by giving it a score as follows: A score of 5 is given when an action is perceived as reflecting a current practice which has been implemented across all the organization’s departments over a long period of time. A score of 4 is given when the action describes a current practice that has been implemented across all the organization’s departments but only recently. A score of 3 is given if the action reflects a current practice that has been partially implemented only in some of the organization’s divisions. A score of 2 is given when the action reflects the organization’s intention to adopt with no real implementation so far. A score of 1 is given if the action reflects the organization’s approach/intent, but not to the extent expressed in the question. A score of 0 is given when the action does not register any asset management applications in the organization’s approach, intent, or actions (Mihai et al. 2010).

Another assessment tool that was reviewed was the ‘Self-Assessment Methodology Plus (SAM+)” tool developed by the Institute of Asset Management (IAM). SAM+ tool has been developed to help infrastructure organizations assess their capabilities across the 28
elements of BSI PAS 55:2008, the 27 sub-clauses of ISO 55001:2014, or the 39 Subjects of the AM Landscape, including strengths and weaknesses, deficiencies, and areas of excellence (IAM 2015). The SAM+ tool provides two question sets; one to assess conformance with BSI PAS 55:2008 and another to assess conformance with ISO 55001:2014. The SAM+ question sheet for BSI PAS 55:2008 provides 121 questions covering each of the 28 clauses of BSI PAS 55:2008. For the other section, the SAM+ question sheet for ISO 55001:2014 provides 39 master questions and 87 sub-questions covering each of the 27 clauses and sub-clauses of ISO 55001:2014. The total number of questions for both parts is 316. Due to the response burden associated with such a long survey, this survey was deemed not suitable for implementation in its full version; however, it was decided that the tool has potential benefits and can be utilized with some refinements and modifications after obtaining the required permissions from IAM.

Both tools (Mihai et al. 2010 and IAM 2015) are designed to perform self-assessments in asset management capabilities at the organizational level, while the intention of this research is to develop a scale that is able to assess a leader’s perception in terms of adopting asset management skills, competencies, and behaviors at the individual level. The reason behind this decision stems from a conceptual principle, in which measuring an organization’s adoption and implementation of asset management practices would be difficult and impractical especially in this kind of research setup. Developing an assessment tool that is able to measure the adoption of asset management strategies at the organizational level would be complicated, and beyond the scope of this research. Therefore, the assessment scale is designed in the form of questions or statements that require responses from respondents (leaders) about their perceptions, agreements/disagreements, or personal opinions. The scale is similar in design and structure to the SLQ but with a different business focus to suit the nature of asset management concepts.
The Institute of Asset Management (IAM) introduced the “The IAM Competencies Framework” to provide a basis for recognizing, selecting, assessing, training, developing and empowering people working in asset management in an efficient, traceable and consistent manner; it describes what people working in asset management should be able to do (IAM 2014a, 2014b). The framework defines the competencies an asset manager should have from three broad measures: input measures, output measures, and behavioral measures.

This research utilized the part of this framework that focuses on the behavioral measures, which identifies personal attributes, skills, and competencies of the asset manager. The aim here, as discussed earlier, is to develop a scale that would assess leader behaviors, skills, and attitudes, as perceived by a given leader, in the adoption of asset management practices. The process of scale development is built on the IAM’s identification of such skills and attributes, which have been categorized into three broad groups as: cognitive and intellectual skills; interpersonal skills; and intrapersonal attributes (such as personality characteristics, attitudes, motivations). Further, a list of skills, attributes and behaviors that address the above-mentioned categories has been introduced, which will form the basis of the potential scale development. The list of specific skills and attributes which might be relevant to asset management and which address the above three categories is as follows (IAM 2014b, p. 12):

- **Commitment to diversity and integrity:** understands and respects diversity and adopts a fair and ethical approach to others.
- **Openness to change:** is open to change and actively seeks to support it.
- **Working with others:** works effectively with others within own organization and in the community.
- **Effective communication:** communicates clearly and effectively both orally and in writing with a wide variety of people.
• **Commitment to development**: committed to and able to develop self and others.

• **Problem solving**: understands, recalls, applies and adapts relevant information in an organized, safe and systematic way.

• **Commitment to excellence**: adopts a conscientious and proactive approach to work to achieve and maintain excellent standards.

• **Shares information**: shares information with appropriate individuals as required.

This research used a self-designed diagnostic assessment tool developed by the author, based on the available literature, that measures the Adoption of Asset Management variable. The diagnostic consists of 12 statements using a five-point Likert scale. The values used to evaluate the Asset Management Leadership range from 0 (“Not at all”) to 4 (“Frequently, if not always”). The assessment tool was evaluated for reliability by experts who examined the 12 statements and provided feedback based on two sets of characteristics. The first set of characteristics focused on burden, sensitivity, and social desirability. The second set of characteristics focused on potential failures of the response process (Olson 2010). The method used to evaluate this assessment tool by experts is the same as the one that was used for the Adoption of Sustainability. Based on the review and evaluation of experts, the assessment tool was modified, and the statements were re-phrased to minimize the likelihood of failure. This method was found to be useful especially when developing a new instrument in the form of a survey to be distributed to a real population. This provided an opportunity for reviewing and modifying the content to make sure that statements were written properly to remove any ambiguity. The aim was to increase the response rate and achieve reliability. For that purpose, a separate online questionnaire was constructed; it basically consists of the 12-item statements representing the Adoption of Asset Management (AAM) for the experts to review and complete. An invitation email was sent to 32 experts for
their evaluation for a duration of 3 weeks. Experts were asked to evaluate each of the 12 statements by rating whether the characteristic measured in the question was:

a) Burdensome—requires a great deal of cognitive work by the respondent (yes, no)

b) Sensitive—requires revealing embarrassing or private information or the topic is not discussed in everyday conversation (yes, no)

c) Socially (un)desirable—requires revealing information that may be compared against a social norm for possessing or not possessing a characteristic (yes, no).

Additionally, experts were asked to rate whether it was likely to observe any failures during the response process at any stage for each statement. Experts were also asked to rate how likely a failure at each stage in the response process was expected to occur using the following scale:

0 = Unlikely that a failure at this stage will occur.
1 = Somewhat likely that a failure at this stage will occur.
2 = Likely that a failure at this stage will occur.
3 = Very likely that a failure at this stage will occur.

The experts were also asked to provide written comments on each statement conveying detailed information about the individual types of problems they thought were likely to occur. The method employed here is based on a work done by Olson (2010) who developed two sets of characteristics for experts to rate both cognitive and motivational characteristics of questions (Olson 2010). Out of 32 experts, only 5 responded and completed the questionnaire; three were members of the researcher’s doctoral committee. The results indicated that some of the questions needed some modifications. Participants had an option to write a note for each question that needed modification. Some questions were re-phrased as per the remarks given by experts. The final version of the questionnaire (after modifications, re-phrasing, and editing) was used as the (AAM) assessment tool. A copy of the Adoption of
Asset Management questionnaire can be found in Appendix L – Sample of Adoption of Asset Management Questionnaire (AAM).

3.3.4 Moderating and Control Variables

A number of control variables that describe different contextual factors, such as organizational type, work environment, location, occupancy and other personal information (e.g., age, gender and experience), were measured by the last part of the research survey. Baron and Kenny (1986) defined moderator variables as “a qualitative (e.g., sex, race, class) or quantitative (e.g., level of reward) variable that affects the direction and/or strength of the relation between an independent or predictor variable and a dependent or criterion variable”. There is a conceptual difference between mediator and moderator variables. While a moderator “partitions a focal independent variable into subgroups that establish its domains of maximal effectiveness in regard to a given dependent variable” (Baron and Kenny 1986), a mediator “represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest” (Baron and Kenny 1986). Recognizing the distinction between the two concepts is important, and the failure to do so may have a conceptual implication. The research hypotheses included a mediator: Organization type (Public, Private).

All four instruments were combined to form a single questionnaire survey comprising all four parts as illustrated in Figure 3. The targeted sample consisted of middle and top management-level individuals in the ground transportation sector from all 50 states in the U.S.

3.4 Data Analysis

Participant data were collected using a web-based survey link administered by Qualtrics research services. Eventually, online data collected were downloaded and saved in an SPSS (Statistical Package for the Social Sciences) format. The data were examined to
ensure that all variables were complete for each participant. They were also screened for the correct range of responses to each question; incomplete data sets were removed.

**Figure 3 – The Research Measurement Constructs**

### 3.4.1 Validity and Reliability

Validity is defined as the extent to which a concept is accurately measured in a quantitative study. For example, a survey designed to assess the leadership style of executives, but which actually measures job satisfaction would not be considered valid. The second measure of quality in a quantitative study is reliability, or the accuracy of an instrument. In other words, the extent to which a research instrument consistently has the same results if it is used in the same situation on repeated trials (Heale and Twycross 2015). Reliability and validity of an instrument or a measurement in a quantitative study are not strictly examined from an all-or-none perspective. Instead, reliability as well as validity are expressed in terms of degrees. It is widely understood that the measurement of any phenomenon always contains a certain amount of chance or error. Thus, the chance of achieving a perfectly valid instrument that represents the intended, and only the intended phenomenon, is quite difficult (Carmines and Zeller 1979). Moreover, just because an indicator is quite reliable, does not mean that it is also valid; it could be measuring something other than what it should measure in the first place. On the other hand, to the extent that a
scale is unreliable, it also lacks validity (Moser and Kalton 1979). To ensure reliability and validity in this study, rigorous attention was paid in the implementation and development of instruments and interpretation of data. Rigor refers to the extent to which the researcher worked to enhance the quality of the study. Reliability must involve an acceptable and strong level of consistency; and validity must be highly representative of truthfulness.

3.4.1.1 Validity

The research data have been collected using four different instruments, two of which have been implemented based on work done by recognized authors. The other two have been developed based on a review of the literature. The Multi-Level Leadership Questionnaire (MLQ – Form 5x) (Avolio and Bass 2004) has been extensively used to measure the leadership styles and found to be a well-validated instrument (Aga et al. 2016; Avolio and Bass 2004; Avolio et al. 1999; Awamleh and Gardner 1999; Chan et al. 2014; Jung et al. 2003; Tyssen et al. 2014). The validity of MLQ’s constructs has been demonstrated by previous studies using Confirmatory Factor Analysis (CFA) (Avolio and Bass 2004).

The climate for innovation instrument, originally developed by Siegel and Kaemmerer (1978) and later modified by Scott and Bruce (1994), is a well-validated scale that has been used in a number of studies (Gumusluoglu and Ilsev 2009; Howell and Avolio 1993; Jung et al. 2003, 2008; Sarros et al. 2008; Scott and Bruce 1994) including those within the construction sector (Chan et al. 2014). On the other hand, validity of the other two instruments developed by the author (Adoption of Sustainability and Adoption of Asset Management) was attained by considering different types of research validity.

3.4.1.2 Reliability

Both The Multi-Level Leadership Questionnaire (MLQ – Form 5x) (Avolio and Bass 2004) that measures the leadership styles of managers, and the Climate for innovation instrument (Scott and Bruce 1994) that measures the climate for innovation in an
organization, have a high scale of reliability due to the extensive use of the instruments in numerous and diverse studies that showed consistency in results. On the other hand, to increase the degree of reliability of the other two instruments (Adoption of Sustainability and Adoption of Asset Management) developed by the author, an expert review technique has been adopted from the work of Olson (2010). Adoption of Sustainability (AS) and Adoption of Asset Management (AAM) instruments were evaluated for reliability by experts who examined the statements and provided feedback based on two sets of characteristics as discussed earlier in section 3.3.3.1 and 3.3.3.2. The final versions of the instruments were developed based on the feedback received from experts.

Cronbach’s alpha is another analysis tool that is used to assess the degree of reliability for all four instruments. The Cronbach’s Alpha was calculated for all instruments and its constructs, and the values are presented in the next chapter. An acceptable value for Cronbach’s Alpha is 0.7 (Nunnally 1978); however, a Cronbach’s Alpha value threshold of 0.6 is also considered sufficient in assessing the internal consistency of a construct (Oliver, Liehr-gobbers, and Krafft 2010).

3.4.2 Structural Equation Modelling (SEM)

There are different methods of analyzing the relationship between a given set of variables: (1) Multiple regression analysis (MRA), (2) Path analysis (PA), (3) Factor analysis (FA), and (4) Structural equation modeling (SEM) (Aibinu and Al-Lawati 2010). Statistical methods associated with multivariate data analysis have been classified into two segments: first-generation techniques and second-generation techniques. First-generation techniques include cluster analysis, explanatory factor analysis, multidimensional scaling, analysis of variance, logistic regression, multiple regression, and confirmatory factor analysis. The second-generation techniques involve partial least squares structural equation modeling (PLS-SEM) and covariance-based structural equation modeling (CB-SEM) (Hair et al. 2017).
Amid a broad range of analytical tools, the structural equation modelling (SEM) technique has been chosen to analyze the quantitative data in this study. SEM has been classified as a second generation data analysis technique that provides a range of cutting edge tools such as “correlation analysis, discriminant analysis, multiple regression, exploratory factor analysis, and analysis of variance tools” (Afshari 2016). It is used to simultaneously test and estimate complex causal relationships among variables, even when the relationships are hypothetical or not directly observable (Williams et al. 2009). Furthermore, SEM “… is a method for presenting, estimating, and testing a theoretical network of (mostly) linear relations between variables, where those variables may be either observables or directly unobservable, and may only be measured imperfectly” (Marcoulides 1998).

More accurate analysis of the structural model can be achieved when using SEM as the factor analysis and hypotheses assessment can be evaluated, simultaneously, in the same procedure. The structural model is used to measure the relationships between the constructs themselves (inner model), whereas the measurement model is used to measure the relationships between indicators and the constructs (outer model). SEM is a statistical multivariate method that allows simultaneous examination of the relationships among the exogenous (independent) latent variables and endogenous (dependent) latent variables within a model (Aibinu and Al-Lawati 2010). It seeks to explain the relationship among multiple variables (multivariate).

Multivariate analysis is described as a process that involves the application of statistical methods, which simultaneously analyze multiple variables (Hair et al. 2017). SEM basically examines the structure of interrelationships presented in a series of equations, similar to a series of multiple regression equations (Hair et al. 2017). These equations explain the relationship between constructs involved in the analysis. The constructs are unobservable (latent) factors represented by multiple variables.
Using SEM when dealing with multivariate analysis offers a number of advantages. First, SEM enables researchers to more effectively evaluate measurement models and structural paths, particularly when the structural model involves multiple and interrelated dependent relationships; latent constructs based on multi-item indicator variables; and multiple stages/levels of constructs in a structural model (Astrachan et al. 2014). Second, SEM recognizes and accounts for the error in each measured item while improving the accuracy of results. Third, the SEM approach is designed to consider interactive effects and complex models to find an optimal model that reduces cross-loadings and identifies the higher loadings for relevant measures. Forth, SEM facilitates the assessment of direct, indirect, and total effects. Direct effects include relationships between independent and dependent variables, while indirect effects involve relationships between independent and dependent variables that are mediated or moderated by some other variables, and total effects relate to the sum of two or more direct or indirect effects. Finally, SEM facilitates simultaneous analysis of all structural relationships and provides flexibility and functionality that leads to more accurate results (Astrachan et al. 2014; Hair et al. 2017).

The advantage of the SEM-based procedures over the first-generation methods is the greater flexibility they provide. They involve generalization and extensions of the first-generation procedures. The flexibility stems from the ability to perform a variety of techniques such as: modeling relationships among multiple predictor and criterion variables; constructing unobservable latent variables; modeling errors in measurements for observed variables; and statistically testing a priori substantive/theoretical and measurement assumptions against empirical data (Marcoulides 1998).

SEM has seen a dramatic rise in attention and use across a variety of scientific disciplines such as management, marketing, and psychology over the last two decades (Astrachan et al. 2014). It has also been widely utilized by the construction management
researchers worldwide due to its flexibility, and because it is applicable for both simple correlations between constructs and for more complex analyses of first and higher-order variables (Durdyev et al. 2018). In general, selecting an appropriate multivariate analysis method should be solely based on the underlying research questions and available data.

Structural equation modelling (SEM) can be divided into two main approaches. One is the covariance-based SEM (CB-SEM) method that is more widely used, which follows a maximum likelihood (ML) estimation procedure. The other is variance-based PLS-SEM that uses a regression-based ordinary least squares (OLS) estimation method with the goal of minimizing the residual variances of the endogenous constructs (Hair et al. 2011). PLS-SEM when compared to CB-SEM, is more robust, works fine with much smaller data samples, and works fine with formative as well as reflective constructs. Close attention should be paid while selecting the most appropriate method to use since the two multivariate approaches are conceptually different in their characteristics and features.

In general, estimation procedure differentiates the performance of these two approaches. The main difference between PLS-SEM and CB-SEM stems from the way each method deals with the latent variables. While the CB-SEM “considers the constructs as common factors that explain the covariation between its associated indicators” (Hair et al. 2017), the PLS-SEM “uses proxies to represent the constructs of interest, which are weighted composites of indicator variables for a particular construct” (Hair et al. 2017). Another main difference between the two approaches can be referred to as the research’s objective. The CB-SEM is more appropriate to use if the research objective is theory testing and confirmation. In contrast, PLS-SEM is more appropriate to utilize when the research objective is theory development and prediction (Hair et al. 2011).

The PLS-SEM is an analytical process where ordinary least-square regression is applied to estimate the path relationships between variables while minimizing the error terms
CB-SEM, however, applies a maximum likelihood estimation to check the overall fit of an observed covariance matrix with the hypothesized model. The process of estimating the complex models that encapsulate multiple latent variables is often less fortunate when applying the CB-SEM approaches.

The CB-SEM method has been adopted in a growing number of papers in national and international journals, which indicates its popularity among other methods used to estimate structural equation models. However, the application of CB-SEM is subject to various criteria concerning data, theory, and the operationalization of latent variables (Oliver et al. 2010). The application of CB-SEM analysis generates efficient and unbiased estimates only when the assumption of multivariate normality is met. Sample size is another criterion that should be taken into account when maximum likelihood estimation is used in the CB-SEM approach (Hair et al. 2017). Generally, when the properties of measurement model restrict the use of CB-SEM or when the emphasis is more on theory exploration than confirmation, PLS-SEM is a more attractive alternative compared to CB-SEM and is often more appropriate. Finally, high efficiency in parameter estimation is more likely occurred in PLS-SEM, and that is due to the method’s greater statistical power than that of CB-SEM (Hair et al. 2017; Hair et al. 2011).

3.4.3 Partial Least Squares (PLS)

The origins of PLS can be traced back to 1966 when Herman Wold presented two iterative procedures using Least Squares estimation for single and multicomponent models for canonical correlation. Then in 1971, upon the development of the LISREL approach to latent variable path modeling, the basic PLS design was developed in 1977 and has subsequently been extended and modified in various ways (Marcoulides 1998). The Partial Least Squares (PLS) method has seen widespread application in various business and engineering disciplines such as management, leadership, marketing and construction.
management (Aibinu and Al-Lawati 2010; Astrachan et al. 2014; Brunetto et al. 2014; Durdyev et al. 2018; Durdyev et al. 2018; Jung et al. 2003, 2008; Jung and Sosik 2002; Lee et al. 2014; Matzler et al. 2015; Tyssen et al. 2014). Hair et al. (2012) reviewed studies published in 8 leading journals in management for a 30-year period from 1981 through 2010. They found that the cumulative number of studies employing PLS in data analysis between 1985 and 2010 has significantly increased (Hair et al. 2012). PLS-SEM has seen a rise in its popularity in marketing and other business disciplines with more than 100 published studies featuring PLS-SEM in the top 20 marketing journals (Hair et al. 2011). The PLS approach gained considerable popularity among applied researchers after its initial introduction and subsequent application. Simultaneously, software packages used to analyze structural equation models with PLS have become more readily available (e.g. LVPLS, PLS-Graph, PLS-GUI, SmartPLS, SPAD PLS) (Oliver et al. 2010).

The PLS-SEM approach provides flexibility to perform complex analyses with multivariate formative and reflective constructs, which may not be available in other statistical approaches. The PLS method “generates estimates of standardized regression coefficients (i.e., path coefficients) for the model paths, which can then be used to measure the relationships between latent variables” (Jung et al. 2008). PLS-SEM is a causal modeling approach aimed at maximizing the explained variance of the dependent latent constructs. As mentioned, PLS-SEM is more applicable when the research objective is theory development, rather than theory testing that investigates how well the model fits observed data, which is the norm for the CB-SEM method. PLS-SEM estimates the indicator loadings for the independent constructs based on their prediction of the dependent constructs, not their shared variance among indicator variables on the same construct. Thus, the indicator loadings in PLS-SEM are, represent their contribution to the path coefficients (Hair et al. 2011).
PLS-SEM can address a broader range of problems due to its ability to work efficiently with small sample sizes, its increased model complexity, and its less restrictive assumptions about the data, in terms of data normality and regression using sum scores. Additionally, because the measurement properties of the constructs are less restrictive with PLS-SEM, constructs with fewer items (e.g., one or two) can be used. Further, PLS-SEM can deal with both reflective and formative measurement models. The distinction between reflective/formative constructs is discussed in more detail in the coming section.

While PLS-SEM can be applied to a wider range of situations, interpretation of the results varies based on construct measurement properties. The application of PLS-SEM relies on various requirements that need to be taken into account on one hand; on the other hand, several considerations need to be noted when deciding whether or not to use PLS-SEM (Hair et al. 2011). Hair et al. (2017) presented four critical issues relevant to the application of PLS-SEM that need to be taken into consideration: (1) the data characteristics, (2) model properties, (3) the PLS-SEM algorithm, and (4) model evaluation issues (Hair et al. 2017). A detailed summary of the key characteristics of PLS-SEM can be found in the work of Hair et al. (2017, p.20).

3.4.3.1 Reflective and Formative Construct Identification

There are two broad types of measurement specifications that should be considered when developing constructs, namely reflective and formative measurement models. The former is widely used and found to be common in the majority of scales in business and related methodological texts on scale development (Coltman et al. 2008). It is directly based on the classical true-score test theory (Hair et al. 2017) and factor analysis models (Marcoulides 1998). Reflective indicators are created with an intention to measure the same underlying latent variable (LV). In case of any change in the actual level of an LV, then all corresponding indicators would also change in the same direction. Therefore, the causality
path is directed from the construct to its measurements. The magnitude of that change in which each indicator shifts relative to the shift in the underlying LV is based on how well the indicator reflects the LV. This can be determined by the loading that is proportional to the amount of variance in that indicator for which the LV is able to account (Marcoulides 1998).

The loading score should be inspected for determining the appropriateness of the indicators. Each loading represents the correlation between the indicator and the component score. The magnitude of such loading is indicative of the relationship intensity as that intensity relates to shared variance between the indicators and the latent variable component score. In other words, indicators with low loadings essentially imply that they have little relationship with their associated LV (Marcoulides 1998). Considering this description of the conceptual relationship between the LV and its corresponding indicators and the fact that a reflective measure dictates the causality effect between all indicator items and the construct, inter-correlation between indicators should be closely observed. Moreover, individual reflective indicators should be interchangeable, that means any indicator can be abolished without affecting the construct’s integrity and legitimacy, subject to maintaining sufficient reliability (Hair et al. 2017). The causality path direction in the reflective model that flows from the construct to its indicators implies that the variation in any given variable is linked to the variation in its latent variable. In other words, if any change occurs in the latent variable evaluation for any reason, all indicators will change simultaneously (Coltman et al. 2008).

On the other hand, in the formative measurement model, indicators are not assumed to be correlated nor do they measure the same underlying phenomenon (Marcoulides 1998). More importantly, formative indicators are not interchangeable, as is the case with reflective indicators. Moreover, “... they are viewed as the cause variables that provide the condition under which the LV they are connected to is formed” (Marcoulides 1998). In a construct formed by formative indicators, each component of the construct is captured by each
indicator separately. This implies that any change in the construct’s form, whether by the deletion or addition of an indicator(s), would significantly modify the conceptual domain of the construct (Coltman et al. 2008). The indicator items ultimately define the construct’s function and purpose, thus, an appropriate method of selecting the number and type of indicators should be followed (Hair et al. 2017).

Differentiating the characteristics between reflective and formative concepts has broad implications when evaluating formatively measured constructs. As such, they are essentially evaluated using different methods compared to the evaluation of reflective constructs (Hair et al. 2017). An incorrect identification of the construct, either reflective or formative would, in turn, affect the estimation of the relationships between the latent variable and its associated indicators. This effect on estimates would, consequently, result in the misrepresentation of conclusions and deformation of the construct’s conceptual parameters (O’Cass and Carlson 2012). It is critical to pay close attention to the identification of underlying constructs and to assess their content validity by determining how well the associated indicators explain the construct’s conceptual domain. Failure of differentiation between reflective and formative constructs in any given model can lead to severely biased results (Jarvis et al. 2003). Hair et al. (2017) discussed this critical issue in their pioneering book and questioned whether the selection of constructs and its associated indicators are influenced by certain factors, and whether or not to measure a construct reflectively, formatively, or a combination of both. The answer to such question is arguably indefinite “... since constructs are not inherently reflective or formative. Instead, the specification depends on the construct conceptualization and the objective of the study” (Hair et al. 2017).

Generally speaking, the decision as to whether a construct is being specified as formative and/or reflective should be based on theoretical considerations only (Oliver et al. 2010). Therefore, the correct identification of the nature of a construct (i.e., whether
formative or reflective) is regarded as essential to building the conceptual research model. A proper differentiation between formative and reflective constructs would ultimately ensure selecting the best analytical methods and tools, while also specifying the appropriate criteria in evaluating the measurement and structural models as well.

3.4.3.2 Evaluation of Measurement Model for Reflective Constructs

Model estimation is needed to measure the relationships between the indicators and the constructs (measurement models), as well as between the constructs themselves (structural model). These empirical measures are used to compare the theoretically established measurement and structural models with reality, as represented by the sample data (Hair et al. 2017). The main goal of the PLS-SEM approach is to maximize the explained variance (i.e., the $R^2$ value) of the endogenous latent variables. Therefore, the evaluation of the quality of the PLS-SEM measurement model relies on metrics that estimate the model’s predictive capabilities such as reliability, convergent validity, and discriminant validity.

As a research model can either include reflective or formative indicators exclusively, or can include a combination of both reflective and formative indicators, depending on the observed construct, the evaluation criteria of measurement (outer) and structural (inner) models need to be addressed and highlighted properly. The literature discusses several criteria for evaluating the constructs’ validity and reliability. Four basic evaluation types for a reflective construct can be differentiated as follows:

*Internal Consistency*: can be assessed by calculating the Cronbach’s alpha, a well-known and the most commonly used reliability coefficient by researchers and scholars (Oliver et al. 2010). It is a generalized measure for the internal consistency of a unidimensional, multi-item scale. Cronbach’s alpha estimates the reliability of a construct by
evaluating the intercorrelations of the associated indicators (Hair, Hult, et al. 2017). This statistic is defined as follows:

\[
cronbach's \, \alpha = \left( \frac{M}{M - 1} \right) \cdot \left( 1 - \frac{\sum_{i=1}^{M} s_i^2}{s_{total}^2} \right) \tag{3.1}
\]

In formula (3.1), \( s_i^2 \) represents the variance of the indicator variable \( i \) of a specific construct, measured with \( M \) indicators (\( i = 1, \ldots, M \)); \( s_{total}^2 \) is the variance of the sum of all \( M \) indicators of that construct. The method by which the Cronbach’s alpha is calculated assumes that all indicators forming any given construct are equally reliable. Moreover, Cronbach’s alpha is used as a more conservative measure of internal consistency reliability. That stems from the fact that it tends to underestimate the internal consistency reliability due to its sensitivity to the number of indicators in the construct. Cronbach’s alpha value varies between 0 and 1, with a threshold of 0.6 considered sufficient in assessing the internal consistency of a construct (Oliver et al. 2010).

**Convergent Validity:** the average variance extracted (AVE) is a common measure used to examine convergent validity of a reflective construct, which is formally defined as:

\[
AVE = \frac{\sum_{i=1}^{M} l_i^2}{M} \tag{3.2}
\]

where \( l_i \) as shown in Equation ((3.2) is the outer loading of the indicator \( i \) of a specific construct formed by \( M \) indicators. AVE is defined as “... the grand mean value of the squared loadings of the indicators associated with the construct” (Oliver et al. 2010). An acceptable AVE value should range between 0.5 and 1.0. Higher AVE values indicate that the construct explains more than half of the variance of its indicators. In contrast, an AVE value below the threshold of 0.5 is considered insufficient, and indicative of a lack of convergent validity (Hair, Hult, et al. 2017; Oliver et al. 2010).

**Indicator Reliability** is evaluated by the outer loading of the indicator of a specific construct formed by a number of indicators. Indicator reliability specifies which part of an
indicator’s variance can be explained by the underlying latent variable. A common threshold criterion is that more than 50% of the indicator’s variance should be explained by the latent variable. This means that an indicator’s outer loading should be above 0.708 since the square of it equals 0.50 (i.e., $0.708^2 = 0.5$). Indicators with outer-loading values larger than 0.7 are acceptable, and below 0.4 are to be eliminated. On the other hand, any outer loading value of an indicator between 0.40 and 0.70 could be a subject for removal only if it leads to an increase in the AVE value above the suggested threshold value (i.e., $AVE \geq 0.5$) (Hair et al. 2017).

_Discriminant Validity_ is a measure to examine whether a construct is truly distinct from other constructs in any given model (Hair et al. 2017). Oliver et al. (2010) define it as: “the dissimilarity in a measurement tool’s measurement of different constructs.” Discriminant validity can be obtained only when each construct formed by a number of indicators is exclusively capturing a phenomena not explained by other constructs in the model (Hair et al. 2017). To assess discriminant validity, two sets of analysis need to be undertaken. The first one is the analysis of cross-loadings and the other is the Fornell-Larcker criterion. The cross-loading procedure can be obtained by comparing an indicator’s outer loading on the associated construct with its other cross-loading (i.e., its correlation) on other constructs. If an indicator’s load is higher with other LVs than the one with which it is associated, this means the indicator is not appropriately reflecting the underlying construct (Marcoulides 1998). Analysis of cross-loadings can be represented by creating a table with rows for the indicators and columns for the latent variable. In this table, the loading of an indicator on its associated construct should always exceed the cross-loading with other constructs in the model.

The other analysis approach to assess the discriminant validity for a reflective multi-item construct is the Fornell-Larcker criterion. It is a process in which the square root of the
AVE values is compared with the latent variable correlations. For the discriminant validity to be established, the square root of each construct’s AVE should be greater than its highest correlation with any other construct in the model (Hair et al. 2017).

If the results obtained by these two tests (Fornell-Larcker and Cross-loadings) reveal a lack of discriminant validity, further assessment is needed to examine whether the research model’s constructs are distinct or not. In this dissertation, the procedure suggested by Henseler et al. (2015) is followed in assessing the heterotrait-monotrait ratio (HTMT) of the correlations. HTMT is the average of the heterotrait-heteromethod correlations (i.e., the correlations of indicators across constructs measuring different phenomena), relative to the average of the monotrait-heteromethod correlations (i.e., the correlations of indicators within the same construct) (Henseler 2015). Using SmartPLS, the Discriminant Validity is calculated, and the results are shown in the report section that includes the Heterotrait-Monotrait Ratio (HTMT). The HTMT values are presented in pairs of constructs in a matrix format. Henseler et al. (2015) suggests a threshold value of 0.9 for establishing the discriminant validity. In case any HTMT values between any pair of constructs exceeds the threshold of 0.9, a further step of HTMT assessment, which uses the bootstrapping procedure, is needed (Hair et al. 2017). This process can be performed using SmartPLS in order to derive a bootstrap confidence interval. The range into which the true HTMT values will likely fall is called confidence interval. Any value of 1 within this range (i.e., confidence interval) indicates a lack of discriminant validity. In case discriminant validity is not established after all, a remedial procedure is needed. Hair et al. (2017) suggested a number of steps in handling discriminant validity problems as follows:

- Retain the constructs that cause discriminant validity problems in the model.

This process is performed in an attempt to increase the average monotrait-
heteromethod correlations and/or decrease the average heteromethod-
heterotrait correlations.

- Delete indicators that have lower correlations with other indicators in the same construct.
- Split into homogenous subconstructs by using a higher-order construct, if theoretically accepted.
- Delete indicators that are strongly correlated with indicators in the opposing construct.
- Reassign the indicators that are strongly correlated with the opposing construct to it, if theoretically applicable.

3.4.3.3 Evaluation of Measurement Model for Formative Constructs

Reflective measurement models differ in their characteristics from the formative measurement models, as formative indicators are assumed to be error free. Therefore, the concept of reliability for internal consistency is not appropriate. As described earlier, the causality path of the formative measurement models reverses the direction seen in reflective measurement models, and indicators form or constitute the latent variable. This causality reversal demands a different evaluation approach for the formative measurement model. Consequently, the statistical evaluation criteria for reflective measurement models cannot be directly transferred to formative measurement models (Oliver et al. 2010). The literature suggests two assessment procedures to test the reliability and validity of a formative measurement model. These are collinearity between indicators and significance of the outer weights (Hair et al. 2017; Oliver et al. 2010). Two basic evaluation types for a formative construct can be differentiated as follows:

Assessing Collinearity Issues. Due to the nature of any formative indicators construct, a high correlation between indicators is not expected since they are not interchangeable,
unlike the nature of reflective indicators where indicators are highly correlated and interchangeable. A high correlation between any pair of constructs with formative indicators is indicative of collinearity, which suggests methodological and interpretational problems. Collinearity, if occurring between formative indicators, affects the estimation of weights and their statistical significance, which, in turn, affects the results and analysis output.

A formative indicator’s weights should not be evaluated in the same way that a reflective indicators’ loadings are evaluated. In general, formative indicators’ weights are relatively smaller than reflective indicator loadings. This is true because the SEM-PLS approach tends to optimize the indicators’ weights to maximize the explained variance of the dependent variables in the model. Therefore, a lower indicator weight of a formatively measured indicator should not be considered as a poor measurement model. While indicators with very small loadings are frequently eliminated within reflective measurement models, this procedure should not be applied in formative measurement models, as theoretical and conceptual considerations lead to indicators being assigned to the construct. Furthermore, since formative indicators are not highly correlated, as described earlier in this section, any indicator with lower weight than potentially set for elimination should be evaluated with extreme caution since it might affect the latent construct estimation (Oliver et al. 2010).

Elimination of a problematic indicator(s) from a formative construct is recommended only if substantial multicollinearity occurs. The Variance Inflation Factor (VIF) is used to measure collinearity between formative indicators. A VIF value of 5 and higher respectively indicate a potential problem of collinearity (Hair et al. 2017). While Oliver et al. (2010) indicated that as a rule of thumb, VIF should not exceed a value of 10; in general, the critical value should be defined individually and should be based on practical considerations with respect to each analysis.
Assessing the Significance and Relevance of the Formative Indicators. A formative indicator’s outer weight is used to evaluate its significance and relevance and, thereby, its contribution to forming the construct. The outer weight is the result of a multiple regression with the latent variable scores as the dependent variable and the formative indicators as independent variables (Hair et al. 2017). The outer weights demonstrate the relative contribution of each indicator to the affiliated construct, or its relative significance in forming it. Unlike reflective measurement models, only a limited number of indicators can retain a statistically significant weight in a formative measurement model. In other words, the maximum possible outer weight of an uncorrelated indicator is $\frac{1}{\sqrt{n}}$, where $n$ is the number of indicators. That means with a construct of 5 uncorrelated formative indicators, the maximum possible outer weight of a formative indicator would be $\frac{1}{\sqrt{5}} = 0.447$.

Basically, in a formatively measured construct, the maximum possible outer weights and their average value significantly declines with a larger number of indicators (Hair, et al. 2017). One more thing needs to be considered when evaluating the measurement model with formative indicators; that is the absolute contribution to its construct, which is given by the outer loading along with the outer weight. A relatively lower weight of a formative indicator with high outer loading (i.e., $> 0.5$), should be interpreted as absolutely important but not as relatively important, and hence can be retained in the model. In contrast, a nonsignificant outer weight of a formative indicator with a low outer loading (i.e., $< 0.5$) should be interpreted as not important and, hence, can be eliminated from the model after examining its theoretical relevance (Hair et al. 2017).

3.4.3.4 Evaluation of the Structural Model

The structural model is the (inner) part of the conceptual model that encapsulates the relationships among hypothetical constructs. Evaluating the structural model is the next step after confirming the reliability and validity of the measurement model. This involves
examining the model’s predictive capabilities and the relationships between the constructs (Hair et al. 2017). The most important evaluation metrics for the structural model are $R^2$ (explained variance), $f^2$ (effect size), $Q^2$ (predictive relevance), and the size and statistical significance of the structural path coefficients (Hair et al. 2017). A number of assessments for the structural model are listed below.

**Structural Model Path Coefficients** are the estimates obtained for the structural model relationships in which the hypothesized relationships among the constructs are defined. The path coefficients’ values vary between -1 and +1. A strong positive relationship occurs between any pair of constructs when the path coefficient is close to +1. Whereas a strong negative relationship occurs between any pair of constructs when the path coefficient is close to -1. A strong relationship between constructs is mostly indicative of a statistically significant relationship. However, estimating the significance of a relationship between constructs requires further statistical measures, which can be obtained using a SmartPLS algorithm and bootstrapping.

The closer the estimated coefficients are to 0, the weaker are their relationships (Hair et al. 2017). The assessment of a path coefficient’s significance level as well as the relevance of the significant relationship, need to be taken into consideration. A path coefficient has direct and indirect effects on a latent variable within the structural model. The sum of direct and indirect effects is called total effect. While direct and indirect effects are used to estimate the relationship among the constructs, total effects are used when the aim is to explore the impact of independent variable(s) on a dependent variable(s) via one or more mediating variables (Hair et al. 2017).

**Coefficient of Determination ($R^2$)** is used to measure the model’s predictive power and is calculated as the squared correlation between a specific endogenous construct’s actual and predicted values. The coefficient of determination value represents the amount of
variance in the endogenous constructs explained by all of the exogenous constructs linked to it. There is no generalized rule of thumb that can be made about acceptable threshold values of $R^2$ (Hair et al. 2017; Oliver et al. 2010). Acceptable $R^2$ values depend on the model complexity and the individual study. Thus, higher values of $R^2$ is indicative of a higher percentage of variance explained. $R^2$ value ranges from 0 to 1, with higher values indicating higher levels of predictive accuracy.

Effect Size ($f^2$) is the change in the $R^2$ value when a certain independent construct is omitted from the model, which can be used to evaluate whether the omitted construct has a substantive impact on the dependent constructs (Hair et al. 2017). The effect size ($f^2$) can be calculated as:

$$f^2 = \frac{R^2_{\text{included}} - R^2_{\text{excluded}}}{1 - R^2_{\text{included}}}$$  \hspace{1cm} (3.3)

In Equation (3.3), $R^2_{\text{included}}$ and $R^2_{\text{excluded}}$ are $R^2$ values of the dependent variable when selected independent variables are included and excluded from the model, respectively. $f^2$ Values of 0.02, 0.15, or 0.35 indicate weak, moderate or substantial influence of the latent exogenous variable on the particular latent endogenous variable, respectively (Cohen 1988). Effect size values of less than 0.02 indicate that there is no effect (Hair et al. 2017).

Mediation occurs when a third mediator variable intervenes between two other related constructs. It is basically a change in the exogenous construct that causes a change in the mediator variable, which, in turn, results in a change in the endogenous construct in the PLS path model (Hair et al. 2017). Mediation is defined as the “function of a third variable, which represents the generative mechanism through which the focal independent variable is able to influence the dependent variable of interest” (Baron and Kenny 1986). Measuring the mediating effect can be described using a three-variable casual model as illustrated in Figure
4. A mediation effect is evaluated based on the relationship between the variables in terms of direct and indirect effects.

Direct effects are explained as the relationship linking two constructs directly with a single arrow. In contrast, indirect effects are represented by a sequence of relationships with at least one intervening construct involved (Hair et al. 2017). The direct effect in Figure 4 is represented by \( c \) between variables \( X \) and \( Y \), while the indirect effect of \( X \) on \( Y \) is represented in the form of an \( X \rightarrow M \rightarrow Y \) sequence. The indirect effect of \( a \cdot b \) represents the mediating effect of the construct \( M \) on the relationship between \( X \) and \( Y \).

![Figure 4 – General Mediation Model](image)

Baron and Kenny’s (1986) approach to testing the mediation effect is well known and has been used extensively by many scholars from different disciplines for the past three decades. The Baron and Kenny approach is based on a two-step procedure. In the first step, a significant relationship between the independent \( X \) and dependent \( Y \) variables should exist at a simple zero-order model without the presence of the mediator variable. However, in contrast to regression analysis, this step-wise approach is not necessary as PLS is able to test mediating effects in a single model at once (Nitzl et al. 2016). Baron and Kenny (1986) asserted that the evidence for mediation is strongest when there is an indirect effect but no direct effect, which they call “full mediation.” When there are both indirect and direct effects, they call it “partial mediation.” Other authors argue that such conditions should not be required for the existence of mediation (Hair et al. 2017; Nitzl et al. 2016; Zhao et al. 2010).
They believe that it is not required to have a significant zero-order effect of $X$ on $Y$ to establish mediation. Zhao et al. (2010) built their argument on the concept of full and partial mediation presented by Baron and Kenny’s (1986) approach, where they identified two types of non-mediation:

*Direct-only non-mediation*: The direct effect is significant but the indirect effect is not.

*No-effect non-mediation*: Neither the direct nor indirect effects are significant.

In addition, they identify three types of mediation:

*Complementary mediation*: The indirect effect and the direct effect are both significant and point in the same direction.

*Competitive mediation*: The indirect effect and the direct effect are both significant and point in opposite directions.

*Indirect-only mediation (full mediation)*: The indirect effect is significant but the direct effect is not.

Figure 5 illustrates the mediation analysis procedure to distinguish between all types of mediation as described above. First, the significance of the indirect effect ($a \cdot b$) is investigated via the mediator variable ($M$). If the indirect effect is not significant, it is concluded that ($M$) has no mediation effect in the tested relationship. While non-presence of an indirect effect might be indicative of unpromising results, as it opposes any form of mediation relationship, further analysis might unveil undiscovered mediators. Subsequently, if the direct effect ($c$) is significant, there could be a possible omitted mediator, which explains the relationship between $X$ and $Y$ (direct-only non-mediation), accordingly. If the direct effect is also nonsignificant (no-effect non-mediation), that would be indicative of a flawed theoretical framework. If this situation occurs, despite a significant total effect of $X$ on $Y$, close attention should be given to the theoretical structure, which may require a modification to the path model setup.
While going through the decision tree as illustrated in Figure 5, it is important to keep in mind that mediation can occur only when indirect effect $(a \cdot b)$ is significant. Insignificant indirect effect suggests that no mediation relationship is found in the model. Next, the aim is to assess the significance of the direct effect $(c)$. Nonsignificant direct effect implies that the relationship is identified as an indirect-only mediation; that represents the best-case scenario as it suggests that the mediator fully complies with the theoretical requirements. Contrarily, a significant direct effect $(c)$ between two variables indicates that a hypothesized mediating relationship might exist in the model. Nevertheless, “... this result may point to a potentially incomplete theoretical framework as there is likely another mediator, which potentially explains a greater share of the relationship between $X$ on $Y$” (Hair et al. 2017). In case both the direct and indirect effects are significant, two types of partial mediation occur in the model; one is complementary mediation and the other is competitive mediation. The former basically describes a situation in which the direct effect $(c)$ and the indirect effect $(a \cdot b)$ have the same signs, while the latter represents a situation where the direct effect $(c)$ and
indirect effect paths (a or b) have opposite signs. Complementary mediation, when it exists, suggests that another mediator may have been omitted; the indirect path and the direct effect of that mediator have the same sign. In contrast, competitive mediation suggests that another mediator may be present somewhere in the model (could be any other variable) where the indirect effect and the direct effect have the same sign. In this situation, when competitive mediation occurs, it is worth reconsidering the research model structure and carefully analyzing the theoretical substantiation of all effects involved (Hair et al. 2017).

3.4.3.6 Moderating Effect

Moderation is a situation that occurs when the relationship between two constructs is affected by a third variable. The moderator variable changes the strength or even the direction of a relationship between two constructs in the model. Moderators can be present in structural models in different forms. They can be categorical-qualitative (e.g., gender, race, class) or metric-quantitative (e.g., level of satisfaction) variables that affect the direction and/or strength of the relationship between an independent or predictor variable and a dependent or criterion variable (Baron and Kenny 1986; Hair et al. 2017). One useful application of categorical moderation is multigroup analysis that enables the identification of the model estimation between the groups (group comparison) (Hair et al. 2017; Henseler and Fassott 2010). Moderators can be measured with a construct of single item or multiple items using reflective or formative indicators.

In a model that includes a theoretically hypothesized moderator, and while assessing reflective measurement models, all relevant criteria (e.g., internal consistency reliability, convergent validity, and discriminant validity) must be met. Similarly, when assessing a formative measurement model, all relevant criteria should be investigated and met (Hair et al. 2017). However, such relevant criteria do not apply in the case of the interaction term. The interaction term is presented in the model as an additional latent variable covering the
product of the independent latent variable $X$ and the moderator $M$, as illustrated in Figure 6. The interaction term can be operationalized by three prominent approaches: (1) the product indicator approach, (2) the orthogonalizing approach, and (3) the two-stage approach (Hair et al. 2017). All three approaches are available in SmartPLS 3 as options to automatically include in an interaction term.

![Figure 6 – Moderating Effect (d)](image)

### 3.4.3.7 Hierarchical Component Model (HCM)

A hierarchical component model in the context of SEM-PLS can be defined as constructs involving more than one dimension. It often involves testing higher-order models that contain constructs and sub-constructs (Hair et al. 2017; Wetzels et al. 2009). As such, they can be distinguished from unidimensional constructs, which are characterized by a single underlying dimension. The application of hierarchical construct models is based on a number of theoretical and empirical grounds (Wetzels et al. 2009).

The application of HCM in a PLS path model is useful for multiple reasons. First, it minimizes the complexity of the path model by reducing the number of relationships in the structural model. (Hair et al. 2017; Wetzels et al. 2009). Second, hierarchical latent variable models allow matching the level of abstraction for predictor and criterion variables in conceptual models (Wetzels et al. 2009). Finally, HCM can minimize collinearity issues and
may solve construct reliability and discriminant validity problems (Hair et al. 2017; Wetzels et al. 2009).

There are four different possible combinations in a model that uses higher-order constructs. The four main combinations are derived from the fact that (a) a first-order construct can have either formative or reflective indicators, and (b) those first-order constructs can, themselves, be either formative or reflective indicators of an underlying second-order construct (Jarvis et al. 2003). The combination of these possibilities is shown in Figure 7. Selecting the proper combination of higher-order and lower-order constructs in the SEM-PLS model should be based solely on theory, not based on personal preferences.

Subsequently, a two-stage HCM analysis is used by combining the repeated indicators approach and the use of latent variable scores. In the first stage, the latent variable scores for the first-order constructs are obtained by using the repeated indicator approach. In the second stage, the first-order construct scores serve as manifest variables in the second-order construct measurement model (Becker 2012; Hair et al. 2017; Wetzels et al. 2009).
Figure 7 – Higher-Order/Lower-Order construct Combinations
Chapter 4 – Survey Results

Participant data was collected online using the Qualtrics platform, sent via email, which included an invitation link for the survey. Data collection efforts produced a total of 150 responses. They were saved and organized in an SPSS data file.

Preliminary analyses were performed on the data set to determine how the data conformed to the assumptions required for Partial Least Square – Structure Equation Modeling (PLS-SEM). The following analyses were performed: response rate, participant characteristics, descriptive statistics, and a reliability analysis.

4.1 Response Rate

Participants were recruited from different states within the U.S. using Qualtrics ® research services. To ensure that respondents fell within the desired research sample domain they were identified using multiple screening questions. A total of 150 complete responses from a stratified sample were collected over the internet by Qualtrics ® with a qualifying rate of 27%.

4.2 Participants’ Characteristics

A wide variety of data on professional qualifications and organizational characteristics were collected. Table 3 provides a summary of all the data collected from participants, however, not all of these variables were used in this study. Organization type was the only moderator used for further analysis.

The majority of participants were male (66%); nearly a third were female (30.67%); and the remaining did not disclose their gender. The percentage of participants between the ages of 46 and 55 constituted the leading group (29.33%). The percentages of participants aged 18 to 25 and 65 and over were lower (1.33% and 6.67% respectively) in comparison to other age ranges as shown in Figure 8. The majority of participants worked in permanent
Table 3 – Demographic information

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<td>Middle level</td>
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<tr>
<td>Chairperson of Board</td>
<td>2</td>
<td>3.45%</td>
</tr>
<tr>
<td>Other</td>
<td>8</td>
<td>13.79%</td>
</tr>
<tr>
<td>Middle-level of Management</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Manager</td>
<td>5</td>
<td>5.43%</td>
</tr>
<tr>
<td>General Manager</td>
<td>26</td>
<td>28.26%</td>
</tr>
<tr>
<td>Divisional Manager</td>
<td>12</td>
<td>13.04%</td>
</tr>
<tr>
<td>Plant Manager</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Regional Manager</td>
<td>2</td>
<td>2.17%</td>
</tr>
<tr>
<td>Department Manager</td>
<td>40</td>
<td>43.48%</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>7.61%</td>
</tr>
<tr>
<td>Tenure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 3</td>
<td>30</td>
<td>20.00%</td>
</tr>
<tr>
<td>4 to 7</td>
<td>31</td>
<td>20.70%</td>
</tr>
<tr>
<td>8 to 11</td>
<td>21</td>
<td>14.00%</td>
</tr>
<tr>
<td>12 to 15</td>
<td>17</td>
<td>11.30%</td>
</tr>
<tr>
<td>More than 15</td>
<td>51</td>
<td>34.00%</td>
</tr>
<tr>
<td>Organization Size (Number of Employees)</td>
<td>Count</td>
<td>Percentage</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>1 to 50</td>
<td>42</td>
<td>28.00%</td>
</tr>
<tr>
<td>51 - 100</td>
<td>13</td>
<td>8.70%</td>
</tr>
<tr>
<td>101 - 150</td>
<td>8</td>
<td>5.30%</td>
</tr>
<tr>
<td>151 - 250</td>
<td>9</td>
<td>6.00%</td>
</tr>
<tr>
<td>251 - 350</td>
<td>9</td>
<td>6.00%</td>
</tr>
<tr>
<td>351 - 500</td>
<td>16</td>
<td>10.70%</td>
</tr>
<tr>
<td>More than 500</td>
<td>53</td>
<td>35.30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Subordinates</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 20</td>
<td>88</td>
<td>58.70%</td>
</tr>
<tr>
<td>21 - 50</td>
<td>29</td>
<td>19.30%</td>
</tr>
<tr>
<td>51 - 80</td>
<td>11</td>
<td>7.30%</td>
</tr>
<tr>
<td>81 - 100</td>
<td>8</td>
<td>5.30%</td>
</tr>
<tr>
<td>101 - 150</td>
<td>3</td>
<td>2.00%</td>
</tr>
<tr>
<td>More than 150</td>
<td>11</td>
<td>7.30%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Organization Type</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>63</td>
<td>42.00%</td>
</tr>
<tr>
<td>Private</td>
<td>87</td>
<td>58.00%</td>
</tr>
</tbody>
</table>

occupational environments (93.30%) compared to less than a tenth (6.70%) that worked in temporary work environments (project site office) as shown in Figure 9. Participants who were holding positions at the top level of management in their organizations account for 38.70% of the dataset, compared to 61.30% of executives at the middle-level of management, as shown in Figure 10. The majority of executives at the top-level of management were directors (27.59%), followed by presidents (17.24%), vice presidents (15.52%), CEO’s (13.79%), COO’s (8.62%), chairs of boards (3.45%), and other top-level positions (13.79%).

On the other hand, the majority of executives at the middle-level of management were department managers (43.48%), followed by general managers (28.26%), divisional managers (13.04%), project managers (5.43%), regional managers (2.17%), and other middle-level executives (7.61%).
As far as the participants’ educational background was concerned, nearly half held a 4-year bachelor’s degree (48%), followed by 2-year college degree holders (22%), master’s degree holders (12%), Ph.D. holders (1.3%); and finally, all other education levels including high school graduates represented 16.70% of the respondents. The majority of participants had a tenure of more than 15 years at the executive position (34%). Next was a tenure of 4 to 7 years (20.70%), followed by 0 to 3 (20%), 8 to 11 (14%), and finally 12 to 15 years.
(11.30%). Participants came from a diverse pool of organizations within the ground transportation sector in terms of size. The majority were from organizations with more than 500 employees (35.30%), followed by executives running smaller organizations of 1 to 50 employees (28%). Those who run organizations of 351 to 500 employees corresponded to 10.70% of respondents. Finally, all other leaders working in organization with employee numbers between 50 and 350 accounted for 26% of the respondents.

For a majority of participants, the number of subordinates fell within the lowest range given in the question (1 to 20), with a total of 88 executives representing 58.70% of the sample. Participants with 21 to 50 subordinates represented 19.30% of the sample; executives with more than 150 subordinates represented 7.30% of the sample; and finally, participants with a number of subordinates that fell outside these ranges represented 14.60% of the sample. Participants working in the private sector represented 58% of the sample and the remaining participants (42% of the sample) were from the public sector, as shown in Figure 11.

![Figure 10 – Level of Management](image-url)
Participants were from 36 different states, with California leading at 10% of the sample (N=150). Texas and Illinois comprised the next largest sample at 8.7% each. The distribution of the other states represented is illustrated in Figure 12.

4.3 Summary of Survey Responses

The data used to measure the study variables were collected using a survey that consisted of four instruments, two of which were adapted from standard and well-validated
instruments. First was the Multi-Level Leadership Questionnaire (MLQ – Form 5x) (Avolio and Bass 2004), which organized leadership styles into three distinctive themes comprising 9 factors that represent the full-range of leadership: transformational, transactional, and passive/avoidance behavior. Transformational leadership was measured by five factors that comprised 20 items. Transactional and passive/avoidant behaviors were measured by four factors (two for each), with a total of 16 items. Second, was the climate for innovation instrument, a 22-item scale originally developed by Siegel and Kaemmerer (1978), later modified by Scott and Bruce (1994). The other two instruments were developed by the author to measure the adoption of sustainability and asset management. The former comprised 17 items and the latter 12 items.

4.3.1 Leadership Styles

Participants’ leadership styles were assessed using the Multi-Level Leadership Questionnaire (MLQ – Form 5x) (Avolio and Bass 2004) by classifying them into three distinctive characteristics of leadership. Transformational, transactional, and passive/avoidant leadership scales comprised 9 sub-scales to measure (1) idealized attributes, (2) idealized behaviors, (3) inspirational motivation, (4) intellectual stimulation, (5) individual consideration, (6) contingent reward, (7) management by exception (active), (8) management by exception (passive), and (9) laissez-faire. Sub-scales 1 to 5 were used to assess the participants’ transformational leadership style, sub-scales 6 and 7 were used to assess the participants’ transactional leadership style and sub-scales 8 and 9 were used to assess the participants’ passive/avoidant style. These 9 sub-scale factors represent the independent variables that are used to test hypotheses 1 to 4. Table 4 highlights the Cronbach’s alpha test results of internal consistency for the MLQ 5X leadership styles and subscales. The Alpha coefficient values of transformational, transactional, and passive/avoidant scales were higher than 0.70, which indicate a high level of internal consistency. Typically, thresholds of 0.9,
0.80, and 0.70 are used for “high,” “very good,” “good,” and “adequate” levels of internal consistency (Salkind 2010). However, a Cronbach’s Alpha value threshold of 0.6 is considered sufficient in assessing the internal consistency of a construct (Oliver et al. 2010).

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>( \alpha )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>20</td>
<td>0.944</td>
</tr>
<tr>
<td>Idealized Attributes</td>
<td>4</td>
<td>0.798</td>
</tr>
<tr>
<td>Idealized Behaviors</td>
<td>4</td>
<td>0.765</td>
</tr>
<tr>
<td>Inspirational Motivation</td>
<td>4</td>
<td>0.832</td>
</tr>
<tr>
<td>Intellectual Stimulation</td>
<td>4</td>
<td>0.78</td>
</tr>
<tr>
<td>Individual Consideration</td>
<td>4</td>
<td>0.74</td>
</tr>
<tr>
<td>Transactional Leadership</td>
<td>8</td>
<td>0.777</td>
</tr>
<tr>
<td>Contingent Reward</td>
<td>4</td>
<td>0.753</td>
</tr>
<tr>
<td>Management by Exception (Active)</td>
<td>4</td>
<td>0.735</td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>8</td>
<td>0.839</td>
</tr>
<tr>
<td>Management by Exception (Passive)</td>
<td>4</td>
<td>0.72</td>
</tr>
<tr>
<td>Laissez-Faire</td>
<td>4</td>
<td>0.698</td>
</tr>
</tbody>
</table>

4.3.1.1 Transformational Leadership

The transformational leadership style was assessed using 5 sub-scales, each comprising 4 items that were used to measure the participants’ (1) idealized attributes, (2) idealized behaviors, (3) inspirational motivation, (4) intellectual stimulation, and (5) individual consideration. Questions featured a 5-point Likert scale, in which 0 represented the lowest category (“not at all”) and 4 represented the highest category (“frequently, if not always”). The data collected is presented in the following sections to demonstrate the distribution of responses.
The idealized attributes subscale is one of five subscales to assess the transformational leadership style among leaders. Leaders with such skills can influence their subordinates who view them in an idealistic way. Leaders exert great power over their followers, which is determined by the way that their followers view them (Avolio and Bass 2004). Leaders with idealized attributes arouse and inspire others with a vision of what can be accomplished through extra personal effort.

The data as described in Table 5 shows a tendency towards idealized attributes responses, where participants indicated the likelihood of taking actions that fall within this category of transformational leadership. Further analysis is required to investigate the relationship with other variables in order to answer the research questions. Figure 13 illustrates the distributions of participant responses to the 4 questions representing the idealized attributes subscale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS10</td>
<td>9</td>
<td>7</td>
<td>25</td>
<td>64</td>
<td>45</td>
</tr>
<tr>
<td>LS18</td>
<td>5</td>
<td>5</td>
<td>16</td>
<td>76</td>
<td>48</td>
</tr>
<tr>
<td>LS21</td>
<td>2</td>
<td>6</td>
<td>15</td>
<td>75</td>
<td>52</td>
</tr>
<tr>
<td>LS25</td>
<td>5</td>
<td>11</td>
<td>39</td>
<td>66</td>
<td>29</td>
</tr>
</tbody>
</table>

Table 5 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Transformational Leadership Style (Idealized Attributes)
Idealized behavior is another subscale that was used to assess the transformational leadership style. Leaders who are perceived as transformational by their idealized behavior tend to obtain their influence over their subordinates by exercising social skills and regulating their use of power. By developing a higher level of autonomy and achievement, they usually end up with long-term performance among their subordinates. Leaders with idealized behavior encourage development, changes in their mission and vision, and, most importantly, achievement of each subordinate’s full potential (Avolio and Bass 2004). The data represented in Table 6 shows a tendency towards idealized behavior responses, where the majority of participants indicated the likelihood of taking actions that fall within this category of transformational leadership. Figure 14 illustrates the distribution of participant responses to the 4 questions representing the idealized behavior subscale. Further analysis is required to investigate the relationship to other variables in order to answer the research questions.
The Inspirational motivation subscale consists of 4 questions (items) to assess the transformational leadership style. Leaders who are perceived by their subordinates as inspirational motivators are those who authentically articulate shared goals and mutual understanding of what is right and important (Avolio and Bass 2004). Leaders with high scores on the inspirational motivation scale tend to enhance the quality of their work.
environment by promoting positive expectations about what and how tasks need to be performed.

Participant responses are summarized in Table 7. Participants scored high on the 4 questions that represent the inspirational motivation subscale. Most of the respondents picked “fairly often” and “frequently if not always” when asked questions like: “I talk optimistically about the future” and “I articulate a compelling vision of the future”. Figure 15 illustrates the distribution of participant responses to the 4 questions representing the inspirational motivation subscale. Further analysis is needed to investigate the relationship between this subscale to the other transformational leadership subscales and to other variables to answer the research questions.

Table 7 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Transformational Leadership Style (Inspirational Motivation)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS9</td>
<td>5</td>
<td>6</td>
<td>20</td>
<td>73</td>
<td>46</td>
</tr>
<tr>
<td>LS13</td>
<td>2</td>
<td>5</td>
<td>22</td>
<td>68</td>
<td>53</td>
</tr>
<tr>
<td>LS26</td>
<td>3</td>
<td>12</td>
<td>36</td>
<td>63</td>
<td>36</td>
</tr>
<tr>
<td>LS36</td>
<td>3</td>
<td>1</td>
<td>14</td>
<td>67</td>
<td>65</td>
</tr>
<tr>
<td>N=150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The intellectual stimulation subscale consists of 4 items that were used along with other subscales to assess the participants’ transformational leadership (Avolio and Bass 2004). Leaders with such skills help others to deal with problems differently and to think outside the box. Leaders with intellectually stimulating traits tend to intensify in others the sense of problems, awareness of their own thoughts and imagination, and recognition of their beliefs and values. Table 8 shows the distribution of participant responses to these 4 questions.

Participants responded with high scores to the 4 questions that represent the intellectual stimulation subscale. The majority of respondents answered “fairly often” when asked to scale their frequency of actions like: “I seek differing perspectives when solving problems” and “I get others to look at problems from many different angles”.

Figure 16 illustrates the distribution of participant responses to the 4 questions representing the intellectual stimulation subscale. Further analysis is needed to investigate the
relationship between this subscale with the other transformational leadership subscales, and with other variables, to answer the research questions.

Table 8 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Transformational Leadership Style (Intellectual Stimulation)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS2</td>
<td>12</td>
<td>12</td>
<td>28</td>
<td>68</td>
<td>30</td>
</tr>
<tr>
<td>LS8</td>
<td>5</td>
<td>7</td>
<td>33</td>
<td>64</td>
<td>41</td>
</tr>
<tr>
<td>LS30</td>
<td>3</td>
<td>9</td>
<td>29</td>
<td>74</td>
<td>35</td>
</tr>
<tr>
<td>LS32</td>
<td>4</td>
<td>7</td>
<td>25</td>
<td>67</td>
<td>47</td>
</tr>
</tbody>
</table>

The individual consideration subscale consists of 4 items that are used along with other subscales to assess the level of a participants’ transformational leadership style. Intellectual consideration behaviors can be characterized by the ability to passionately listen, understand others’ concerns and needs, and treat each individual optimally (Avolio and Bass...
Leaders with individual consideration skills tend to recognize and attend to their associates' current needs, while also providing support to meet those needs to maximize and develop their full potential. Participant responses to the 4 questions are summarized in Table 9. In general, participants responded with high scores to the 4 questions addressing individual consideration. The majority answered, “Fairly often” and “Frequently if not Always” to questions probing the scale of actions like, “I treat others as individuals rather than just a member of a group” and “I help others to develop their strength”.

Further analysis is needed to investigate the relationship between this subscale with the other transformational leadership subscales and with other variables to answer the research questions. Figure 17 illustrates the distribution of participant responses to the 4 questions representing the individual consideration subscale.

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N=150</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS15</td>
<td>9</td>
<td>7</td>
<td>27</td>
<td>67</td>
<td>40</td>
</tr>
<tr>
<td>LS19</td>
<td>3</td>
<td>2</td>
<td>19</td>
<td>47</td>
<td>79</td>
</tr>
<tr>
<td>LS29</td>
<td>6</td>
<td>6</td>
<td>31</td>
<td>68</td>
<td>39</td>
</tr>
<tr>
<td>LS31</td>
<td>4</td>
<td>5</td>
<td>21</td>
<td>70</td>
<td>50</td>
</tr>
</tbody>
</table>

Table 9 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Transformational Leadership Style (Individual Consideration)
4.3.1.2 Transactional Leadership

The transactional leadership style was assessed using 2 subscales, each comprising 4 items that measured (1) contingent reward and (2) management by exception (active). Each question featured a 5-point Likert scale, in which 0 represented the lowest category (“Not at all”) and 4 represented the highest category (“frequently, if not always”). The data collected is presented in the following sections to demonstrate the distribution of responses.

The “Contingent Reward” subscale consists of 4 questions (items). The relationship between a transactional leader and his/her subordinates is based on, and limited to, an exchange of gains that is of mutual benefit. In this leadership style, leaders tend to satisfy employee needs in exchange for compliance and commitment to the leader’s vision and plans. Past research found that “This leadership style tends to emphasize extrinsic rewards, such as monetary incentives and promotion, as a means to increase followers’ motivation” (Kissi et al. 2012). Table 10 illustrates the distribution of participant responses to the 4 questions.
Participant responses indicated that the majority of leaders express transactional leadership styles in certain situations. Figure 18 illustrates an increase in tendency towards questions favoring high levels of performance. The majority of participants responded favorably (i.e., “fairly often” and “frequently if not always”) to questions that assessed the level to which they performed actions such as: “I discuss in specific terms who is responsible for achieving performance targets” and “I express satisfaction when others meet expectations.” Further analysis is needed to investigate the relationship between this subscale and other transactional leadership subscales, along with other variables, to answer the research questions. Figure 18 illustrates the distributions of participant responses to the 4 questions representing the contingent reward subscale.

<table>
<thead>
<tr>
<th>Item</th>
<th>N=150</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS1</td>
<td>10 15 31 62 32</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS11</td>
<td>7 7 23 73 40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS16</td>
<td>4 4 24 68 50</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>LS35</td>
<td>2 0 16 55 77</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The “Management by Exception (Active)” subscale consists of 4 questions (items). Leaders with such skills tend to focus on mistakes, delay decisions, or avoid intervening until something has gone wrong. They tend to monitor task execution for any problems that may arise while correcting those problems to maintain current performance levels (Avolio and Bass 2004). Table 11 illustrates the distributions of participant responses. In general,
participants responded with moderate scores to the 4 questions that represent the management by exception (active) subscale. That means that leaders less frequently take transactional leadership approaches that focus on mistakes, delaying decisions, or avoiding intervening until something has gone wrong.

Further analysis is needed to investigate the relationship between this subscale and the other transactional leadership subscale, in addition to other variables, to answer the research questions. Figure 19 illustrate the distributions for participant responses to the 4 questions representing the management by exception (active) subscale.

Table 11 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Transactional Leadership Style (Management by Exception Active)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All</th>
<th>Once in a While</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Frequently if Not Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS4</td>
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<td>46</td>
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</tr>
<tr>
<td>LS27</td>
<td>28</td>
<td>42</td>
<td>40</td>
<td>28</td>
<td>12</td>
</tr>
</tbody>
</table>

N=150
4.3.1.3 Passive/Avoidant

Passive/Avoidant style was assessed using 2 subscales, each comprising of 4 indicators to measure the level of each participant’s (1) management by exception (passive) and (2) laissez-fair styles. Each question featured a 5-point Likert scale, in which 0 (“Not at all”) represented the lowest degree of the corresponding leadership style and 4 (“frequently, if not always”) represented the highest degree. The data collected is presented in the following sections to demonstrate distributions for responses.

The “management by exception (passive)” subscale consists of 4 indicators. This subscale does not measure or assess any leadership style; rather, it assesses passive/avoidant attitudes and behavior. Participants who score higher in this subscale lack the fundamentals of leadership and require extensive training to gain active and positive leadership skills.

Table 12 illustrates the frequencies of participant responses to the 4 indicators that form this subscale. The majority of participants responded with lower scores to the indicators within
the management by exception (passive) attitude category. The consistency of the scores indicates that leaders who demonstrate transformational and transactional leadership styles are less likely to exhibit passive/avoidant behaviors while running their organizations. A high percentage (68.48%) of participants responded with “Not at All” to subscale indicators like “I wait for things to go wrong before taking action.”

Further analysis is needed to investigate the relationship between this subscale and the other passive/avoidant subscale, in addition to other variables, to answer the research questions. Figure 20 illustrates the distributions of participant responses to the 4 indicators (items) representing the management by exception (passive) subscale.

Table 12 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Passive/Avoidant (Management by Exception Passive)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS3</td>
<td>63</td>
<td>32</td>
<td>38</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>LS12</td>
<td>102</td>
<td>24</td>
<td>10</td>
<td>9</td>
<td>5</td>
</tr>
<tr>
<td>LS17</td>
<td>32</td>
<td>34</td>
<td>49</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>LS20</td>
<td>90</td>
<td>21</td>
<td>17</td>
<td>15</td>
<td>7</td>
</tr>
</tbody>
</table>

N=150
The “laissez-faire” subscale consists of 4 indicators. This subscale does not measure or assess any leadership style, rather, it assesses the passive/avoidant attitude and behavior. Participants who score higher in this subscale lack the fundamentals of leadership and require extensive training to gain active and positive leadership skills. Table 13 illustrates the frequency of participant responses to the 4 indicators that form this subscale. The majority of participants responded with lower scores to the 4 items within the laissez-faire attitude subscale. The consistency of the scores indicates that leaders who demonstrate transformational and transactional leadership styles are less likely to exhibit passive/avoidant behaviors while running their organizations. A high percentage (74.67%) of participants responded with “Not at All” to subscale indicators like “I’m absent when needed.”

Further analysis is needed to investigate the relationship between this subscale and the other passive/avoidant subscale, in addition to other variables, to answer the research questions. Figure 21 illustrates the distributions of participant responses to the 4 questions representing the Laissez-Faire subscale.
### Table 13 - Multifactor Leadership Questionnaire (MLQ 5X) Data for Passive/Avoidant (Laissez-Faire)

<table>
<thead>
<tr>
<th>Items</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS5</td>
<td>96</td>
<td>20</td>
<td>13</td>
<td>14</td>
<td>7</td>
</tr>
<tr>
<td>LS7</td>
<td>112</td>
<td>18</td>
<td>9</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>LS28</td>
<td>95</td>
<td>27</td>
<td>17</td>
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<td>3</td>
</tr>
<tr>
<td>LS33</td>
<td>97</td>
<td>21</td>
<td>15</td>
<td>13</td>
<td>4</td>
</tr>
</tbody>
</table>

N=150

4.3.2 Climate for Innovation (CI)

The organizational climate for innovation was measured using a 22-item innovation climate scale originally developed by Siegel and Kaemmerer (1978), later modified by Scott and Bruce (1994). Each of these 22 items was rated using a five-point Likert scale ranging from 0 (“strongly disagree”) to 4 (“strongly agree”). The climate for innovation scale
measures the non-technological innovation of an organization. This approach is used when it is difficult to measure innovative behaviors across diverse organizations and industry sectors (Sarros et al. 2008). Internal consistency is assessed by calculating Cronbach’s alpha for the 22-item climate for Innovation scale, as shown in Table 14. The value of the coefficient alpha (0.909) indicates high reliability, which means internal consistency of the scale is high. The climate for innovation measure consists of two subscales as presented by Scott and Bruce (1994). The first subscale, “Support for Innovation,” comprised 16 items measuring the degree to which individuals viewed the organization as open to change, supportive of new ideas from members, and tolerant of member diversity (Scott and Bruce 1994). The other subscale, “resource supply,” consisted of 6 items, which measured the degree to which resources (i.e., personnel, funding, time) were perceived as adequate within the organization.

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate for Innovation</td>
<td>22</td>
<td>0.909</td>
</tr>
<tr>
<td>Support for Innovation</td>
<td>16</td>
<td>0.885</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>6</td>
<td>0.78</td>
</tr>
</tbody>
</table>

The climate for innovation scale represents the mediator variable that is used to test the research hypotheses H6 and H7. The mediator variable in this research study acts as a proxy for the independent and dependent variables. Table 15 illustrates the distribution for participant responses to the 16 indicators forming the Support for Innovation (SI) subscale. Participants who scored high on this subscale suggest that their organizations support innovation. Figure 22 illustrates participant responses for the SI subscale. The distribution of responses indicates a tendency towards high scores, which suggests a presence of support for innovation.
Table 15 – Climate for Innovation – Support for Innovation data (N=150)

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree (0)</th>
<th>Disagree (1)</th>
<th>Neutral (2)</th>
<th>Agree (3)</th>
<th>Strongly Agree (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI1</td>
<td>3</td>
<td>12</td>
<td>24</td>
<td>67</td>
<td>44</td>
</tr>
<tr>
<td>CI2</td>
<td>1</td>
<td>9</td>
<td>29</td>
<td>68</td>
<td>43</td>
</tr>
<tr>
<td>CI3</td>
<td>1</td>
<td>5</td>
<td>28</td>
<td>76</td>
<td>40</td>
</tr>
<tr>
<td>CI4</td>
<td>16</td>
<td>46</td>
<td>50</td>
<td>26</td>
<td>12</td>
</tr>
<tr>
<td>CI5</td>
<td>11</td>
<td>16</td>
<td>20</td>
<td>47</td>
<td>56</td>
</tr>
<tr>
<td>CI6</td>
<td>6</td>
<td>13</td>
<td>26</td>
<td>65</td>
<td>40</td>
</tr>
<tr>
<td>CI7</td>
<td>8</td>
<td>21</td>
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<td>49</td>
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<tr>
<td>CI8</td>
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<td>26</td>
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<td>44</td>
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</tr>
<tr>
<td>CI9</td>
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<td>21</td>
<td>44</td>
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<tr>
<td>CI10</td>
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<tr>
<td>CI11</td>
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<td>26</td>
<td>35</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>CI12</td>
<td>11</td>
<td>47</td>
<td>62</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>CI13</td>
<td>10</td>
<td>22</td>
<td>39</td>
<td>52</td>
<td>27</td>
</tr>
<tr>
<td>CI20</td>
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<td>14</td>
<td>40</td>
<td>56</td>
<td>28</td>
</tr>
<tr>
<td>CI21</td>
<td>9</td>
<td>16</td>
<td>35</td>
<td>58</td>
<td>32</td>
</tr>
<tr>
<td>CI22</td>
<td>10</td>
<td>26</td>
<td>28</td>
<td>50</td>
<td>36</td>
</tr>
</tbody>
</table>

Support for Innovation (SI)

CI 1  Creativity is encouraged here
CI 2  Our ability to function creatively is respected by the leadership
CI 3  Around here, people are allowed to try to solve the same problems in different ways
CI_4  The main function of members in this organization is to follow orders which come down through channels
CI 5  Around here, a person can get in a lot of trouble by being different
CI 6  This organization can be described as flexible and continually adapting to change
CI 7  A person can’t do things that are too different around here without provoking anger
CI_8  The best way to get along in this organization is to think the way the rest of the group does
CI 9  People around here are expected to deal with problems in the same way
CI 10 This organization is open and responsive to change
CI 11 The people in charge around here usually get credit for others’ ideas
CI 12 In this organization, we tend to stick to tried and true ways
CI 13 This place seems to be more concerned with the status quo than with change
CI 20 The reward system here encourages innovation
CI 21 This organization publicly recognizes those who are innovative
CI_22 The reward system here benefits mainly those who don't rock the boat
Table 16 illustrates the distribution of participant responses to the 6 indicators forming the “Resource Supply (RS)” subscale. Participants who scored high on this subscale indicate that their organizations supply resources that support innovation. Figure 23 illustrates the distribution of participant responses. There is a tendency towards high scores, indicating a presence of support for innovation.

Table 16 – Climate for Innovation – Resource Supply (N=150)

<table>
<thead>
<tr>
<th>Item</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI14</td>
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</tr>
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<tr>
<td>CI16</td>
<td>7</td>
<td>19</td>
<td>32</td>
<td>69</td>
<td>23</td>
</tr>
<tr>
<td>CI17</td>
<td>10</td>
<td>35</td>
<td>41</td>
<td>36</td>
<td>28</td>
</tr>
<tr>
<td>CI18</td>
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<td>46</td>
<td>30</td>
<td>24</td>
</tr>
<tr>
<td>CI19</td>
<td>10</td>
<td>15</td>
<td>38</td>
<td>66</td>
<td>21</td>
</tr>
</tbody>
</table>
4.3.3 Adoption of Sustainability (AS)

A 17-item scale developed by the author was used to measure the adoption of sustainability. This instrument consists of 17 statements on a 5-point Likert scale. The values used to assess the level of sustainability adoption ranged from 0 (“Not at all”) to 4 (“Frequently, if not always”). The instrument has been evaluated for reliability by experts who examined the 17 statements and provided feedback based on two sets of characteristics. Internal consistency was measured by calculating Cronbach’s alpha value for the 17-item adoption of sustainability scale, as shown in Table 17. The value of coefficient alpha (0.858) is indicative of a “very good” reliability coefficient. (Salkind 2010).

The “adoption of sustainability” category represents the dependent variable, which is used to test the hypotheses H1a, H1b, H1c, H4, H6 and H8a. Table 18 shows participant ratings for the 17 statements which formed the scale. Their responses trend towards high scores as illustrated in Figure 24. Such a trend is indicative of leaders who embrace and adopt sustainability practices in their organizations.
Table 17 - Cronbach’s Alpha for the Adoption of Sustainability scale

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption of Sustainability</td>
<td>17</td>
<td>0.858</td>
</tr>
</tbody>
</table>

Table 18 – Adoption of Sustainability Data (N=150)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL1</td>
<td>7</td>
<td>15</td>
<td>35</td>
<td>77</td>
<td>36</td>
</tr>
<tr>
<td>SL2</td>
<td>19</td>
<td>9</td>
<td>62</td>
<td>52</td>
<td>27</td>
</tr>
<tr>
<td>SL3</td>
<td>32</td>
<td>66</td>
<td>37</td>
<td>16</td>
<td>19</td>
</tr>
<tr>
<td>SL4</td>
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</tr>
<tr>
<td>SL5</td>
<td>9</td>
<td>15</td>
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<td>60</td>
<td>46</td>
</tr>
<tr>
<td>SL6</td>
<td>9</td>
<td>9</td>
<td>40</td>
<td>61</td>
<td>50</td>
</tr>
<tr>
<td>SL7</td>
<td>19</td>
<td>14</td>
<td>45</td>
<td>62</td>
<td>30</td>
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<tr>
<td>SL8</td>
<td>16</td>
<td>14</td>
<td>53</td>
<td>67</td>
<td>20</td>
</tr>
<tr>
<td>SL9</td>
<td>8</td>
<td>14</td>
<td>34</td>
<td>79</td>
<td>35</td>
</tr>
<tr>
<td>SL10</td>
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<td>9</td>
<td>42</td>
<td>65</td>
<td>36</td>
</tr>
<tr>
<td>SL11</td>
<td>28</td>
<td>43</td>
<td>55</td>
<td>23</td>
<td>20</td>
</tr>
<tr>
<td>SL12</td>
<td>13</td>
<td>21</td>
<td>56</td>
<td>52</td>
<td>27</td>
</tr>
<tr>
<td>SL13</td>
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<td>46</td>
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<td>32</td>
</tr>
<tr>
<td>SL14</td>
<td>7</td>
<td>12</td>
<td>57</td>
<td>66</td>
<td>27</td>
</tr>
<tr>
<td>SL15</td>
<td>41</td>
<td>21</td>
<td>38</td>
<td>51</td>
<td>19</td>
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<tr>
<td>SL16</td>
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<td>67</td>
<td>34</td>
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<tr>
<td>SL17</td>
<td>11</td>
<td>19</td>
<td>45</td>
<td>65</td>
<td>29</td>
</tr>
</tbody>
</table>

Adoption of Sustainability (AS)

<p>| SL_1 | My actions take into consideration the impact of social aspects of sustainability (e.g., Equity, Equal opportunities, Health, Safety, Accessibility, and Distribution of cost and benefits) |
| SL_2 | My actions take into consideration the impact of environmental aspects of sustainability (e.g., Ecosystem services, GHG emissions, Global warming, Noise, Heat island effect, Land consumption, Waste, Ecological damage, and Climate change) |
| SL_3 | I make decisions based on my experience, knowledge and technical skills regardless of any possible impact on other departments or stakeholders’ interests. |</p>
<table>
<thead>
<tr>
<th>SL_4</th>
<th>My decisions take into consideration the entire organization's performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>SL_5</td>
<td>I take necessary measures when actions are negatively affecting sustainability</td>
</tr>
<tr>
<td>SL_6</td>
<td>I match decisions I make with the organization's vision and objectives towards sustainability</td>
</tr>
<tr>
<td>SL_7</td>
<td>I use Change Management tools to induce organizational movement towards sustainability.</td>
</tr>
<tr>
<td>SL_8</td>
<td>I attempt to confront the old and traditional culture that undermines the efforts toward sustainability</td>
</tr>
<tr>
<td>SL_9</td>
<td>I encourage adopting new ideas and innovative methods while addressing sustainability issues</td>
</tr>
<tr>
<td>SL_10</td>
<td>I seek opportunities through sustainable efforts</td>
</tr>
<tr>
<td>SL_11</td>
<td>I maintain healthy profit and create wealth regardless of sustainability concept</td>
</tr>
<tr>
<td>SL_12</td>
<td>I put purpose before profit</td>
</tr>
<tr>
<td>SL_13</td>
<td>I implement Corporate Social Responsibility (CSR) only if it does not affect profit.</td>
</tr>
<tr>
<td>SL_14</td>
<td>I demonstrate sustainability by persevering through all types of change</td>
</tr>
<tr>
<td>SL_15</td>
<td>I use social networking when communicating Sustainability decisions with all involved.</td>
</tr>
<tr>
<td>SL_16</td>
<td>I attempt to build a culture of sustainability by effective communication and networking</td>
</tr>
<tr>
<td>SL_17</td>
<td>I promote sustainability principles when hiring, promoting employees and replacing leaders</td>
</tr>
</tbody>
</table>

### 4.3.4 Adoption of Asset Management (AAM)

A 12-item scale developed by the author was used to measure the level of adoption of asset management. The instrument consists of 12 statements featuring a 5-point Likert scale. The values used to evaluate the (AAM) ranged from 0 (“Not at all”) to 4 (“Frequently, if not always”). The instrument was evaluated for reliability by experts, who examined the 12 statements and provided feedback based on two sets of characteristics. Internal consistency was measured by calculating Cronbach’s alpha value for the 12-item (AAM) scale, as shown in Table 19. The value of coefficient alpha (0.941) is indicative of a high reliability coefficient (Salkind 2010).
Table 19 - Cronbach’s Alpha for the Asset Management Leadership scale

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>(\alpha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption of Asset</td>
<td>12</td>
<td>0.941</td>
</tr>
<tr>
<td>Management</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The “adoption of asset management” subscale represents the dependent variable, which is used to test the hypotheses H2a, H2b, H2c, H5, H7 and H8b.

Table 20 illustrates participant responses to the 12 statements forming the scale. Their responses trend towards high scores as illustrated in Figure 25. This trend is indicative of leaders who embrace and adopt asset management practices in their organizations.
Table 20 – Adoption of Asset Management Data (N=150)

<table>
<thead>
<tr>
<th>Item</th>
<th>Not at All (0)</th>
<th>Once in a While (1)</th>
<th>Sometimes (2)</th>
<th>Fairly Often (3)</th>
<th>Frequently if Not Always (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AL1</td>
<td>13</td>
<td>17</td>
<td>37</td>
<td>57</td>
<td>26</td>
</tr>
<tr>
<td>AL2</td>
<td>14</td>
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<tr>
<td>AL3</td>
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<td>AL4</td>
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<tr>
<td>AL5</td>
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<td>46</td>
<td>34</td>
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<tr>
<td>AL6</td>
<td>16</td>
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<td>AL7</td>
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<td>AL8</td>
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<td>AL9</td>
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<tr>
<td>AL11</td>
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<tr>
<td>AL12</td>
<td>11</td>
<td>12</td>
<td>32</td>
<td>47</td>
<td>48</td>
</tr>
</tbody>
</table>

Adoption of Asset Management (AAM)

| AL_1 | I identify Asset Management as one of the core processes in my organization |
| AL_2 | I recognize that stakeholders' requirements may not align with my objectives. I endeavor to balance these requirements within an Asset Management framework |
| AL_3 | I use consistent and systematic processes for identifying Asset requirements and developing an investment plan |
| AL_4 | I recognize the term "level of service" that is used to describe the quality of services provided by the asset under consideration. I link the level of service of each asset to the transportation network needs |
| AL_5 | I encourage forming teams of diversity while dealing with Asset Management issues where professionals other than engineers are recruited from a diverse background, education, gender and ethnicity |
| AL_6 | I use change management tools to induce transformational movement towards the adoption of Asset Management practices |
| AL_7 | Effective communication and social networking are two main tools I use to promote more adoption of Asset Management practices |
| AL_8 | I focus on fostering a learning environment for employees by encouraging them to participate various activities such as seminars, conferences and inter-organization partnership on Asset Management |
| AL_9 | I use mentoring and training programs that enable employees to acquire the required Asset Management competences |
| AL_10 | I evaluate my organization's performance on the basis of compliance to predefined KPIs and Asset Management guidelines |
| AL_11 | I delegate responsibilities to leaders across the organization with full authority for process development, documentation, deployment, improvement, hiring and replacing staff and audit and review |
| AL_12 | I make relevant information available across the organization for better understanding, analysis and problem solving |
Figure 25 – Adoption of Asset Management Scale Responses (N=150)
Chapter 5 – SEM-PLS Analysis Results

The primary purpose of this study is to empirically evaluate the transformational, transactional, and passive/avoidant (laissez-faire) leadership styles among executives at the top level of management within the ground transportation industry as well as investigate the relationship between these leadership styles and organizational innovation, sustainability, and asset management adoption. The main objectives of the study are: (1) to identify which of the two leadership styles (transformational and transactional) is best able to predict outcomes of “Sustainability,” and “Asset Management” practices; (2) to examine the mediation effect of “Climate for Innovation” between “Transformational Leadership” and the research outcomes of “Sustainability” and “Asset Management”; and (3) to study the effects of contextual factors such as what impact an organization type may have on leadership styles and research outcomes.

This chapter provides the results for the data analysis efforts on fulfilling these research objectives. The leadership style presented by transformational, transactional, and passive/avoidant acted as independent variables (predictor variables). The organizational climate for innovation served as the mediator variable, while sustainability and asset management adoption acted as dependent variables (criterion variables). Finally, the demographics of respondents were included as moderators to measure a number of effects on multiple contextual factors, including cultural and environmental factors. Additionally, organization type was considered within the sample population from different areas of business (planning, construction, operations, and maintenance) in both the private and public sectors.

The following were the research questions and their corresponding hypotheses:

1. Is there a relationship between leadership styles and adopting (embracing) sustainability?
2. Is there a relationship between leadership styles and adopting (embracing) asset management?
3. Is there a relationship between leadership styles and organizational climate of innovation?
4. Is there a relationship between climate for innovations and adopting (embracing) sustainability?
5. Is there a relationship between climate for innovations and adopting (embracing) asset management?
6. Is there any mediation influence of climate for innovation on transformational leadership style and adopting (embracing) sustainability?
7. Is there any mediation influence of climate for innovation on transformational leadership style and adopting (embracing) asset management?
8. What are the prominent leadership styles of leaders who promote sustainability and asset management practices?
9. To what extent is an executive leadership style (transformational and transactional) predicted by contextual factors such as organizational culture (organizational type)?

Based on the research questions listed above and a comprehensive literature review, the following research hypotheses were generated for further investigation:

Hypothesis 1a: Transformational leadership is significantly related to sustainability.
Hypothesis 1b: Transactional leadership is positively related to sustainability.
Hypothesis 1c: Passive/avoidant behavior is negatively related to sustainability.
Hypothesis 2a: Transformational leadership is significantly related to asset management.
Hypothesis 2b: Transactional leadership is positively related to asset management.
Hypothesis 2c: Passive/avoidant behavior is negatively related to asset management.
Hypothesis 3: Transformational leadership is positively related to climate for innovation.
Hypothesis 4: Climate for innovation is positively related to sustainability.

Hypothesis 5: Climate for innovation is positively related to asset management.

Hypothesis 6: Climate for innovation mediates the relationship between transformational leadership and sustainability.

Hypothesis 7: Climate for innovation mediates the relationship between transformational leadership and asset management.

Hypothesis 8a: When using organizational type as a moderator, the positive relationship between transformational leadership and sustainability is stronger in the private sector than in public sector.

Hypothesis 8b: When using organizational type as a moderator, the positive relationship between transformational leadership and asset management is stronger in the private sector.

A combined consolidated survey questionnaire was designed using four instruments, two of which are survey questions from the following survey instruments: (a) the MLQ form 5x short (Avolio and Bass 2004), (b) the Scott and Bruce 22-item innovation climate scale (Scott and Bruce 1994). The other two instruments were developed by the author and have been tested, modified and edited to attain validity using an expert review technique (Olson 2010): (c) adoption of sustainability questionnaire (ASQ), and (d) adoption of asset management questionnaire (AAMQ). Figure 26 represents the 1st order constructs model; Figure 27 illustrates the 2nd order constructs model.
In addition, a number of demographic questions relating to gender, age, job title, management level, education, and work environment were also included.

The relationship between the research’s independent variables and dependent variables was investigated. Using SmartPLS ® 3.2.8, the PLS-SEM model was evaluated by
estimating the measurement model and structural model. Results were obtained and are presented herein.

5.1 Estimating the Measurement Model

The first step in evaluating a PLS-SEM model is to examine the outer model to validate the measurement model. The process includes obtaining the reliability and validity of the constructs, then estimating the structural model. After establishing the reliability and validity of reflective and formative measurement models, the structural model (inner model) estimates are evaluated (Hair et al. 2017). To examine the reliability and validity of the study’s outer model, the reliability of the construct indicator is examined where individual indicators are checked and all reflective indicators with a factor loading greater than 0.70 are retained. Indicators with outer loadings between 0.40 and 0.70 are considered for removal from the scale only when deleting the indicator leads to an increase in the internal consistency coefficient (e.g. AVE) above the suggested threshold value (i.e. 0.5) (Hair et al. 2017), while loadings below 0.4 are deleted.

In this study, factor loadings of the 1st order model ranged from -0.496 to 0.89, after the first run using SmartPLS 3.2.8 as presented in Table 21. To date, SmartPLS 3 (Ringle et al. 2015) is the most comprehensive and advanced program in the field when SEM-PLS analysis is considered (Hair et al. 2017). SmartPLS ® has been used in numerous studies by scholars across the globe (Astrachan et al. 2014; Brunetto et al. 2014; Cheng 2017; Matzler et al. 2015; Tyssen et al. 2014). The original 1st order reflective constructs and 2nd order formative constructs model is shown in Figure 28.

After several PLS algorithm runs, a number of construct indicators were removed based on the previously mentioned criteria for indicator reliability. All retained indicators can be observed in Table 25. Reflective indicators with outer loadings below 0.7 can be deleted without affecting the construct reliability and validity because they are interchangeable and
Table 21 – Outer Loadings of the 1st order model (N=150)

<table>
<thead>
<tr>
<th>Transformational Leadership</th>
<th>IA</th>
<th>LS_10</th>
<th>LS_18</th>
<th>LS_21</th>
<th>LS_25</th>
<th>0.734</th>
<th>0.822</th>
<th>0.849</th>
<th>0.746</th>
</tr>
</thead>
<tbody>
<tr>
<td>IB</td>
<td>LS_6</td>
<td>LS_14</td>
<td>LS_23</td>
<td>LS_34</td>
<td>0.627</td>
<td>0.808</td>
<td>0.8</td>
<td>0.819</td>
<td></td>
</tr>
<tr>
<td>IM</td>
<td>LS_9</td>
<td>LS_13</td>
<td>LS_26</td>
<td>LS_36</td>
<td>0.726</td>
<td>0.829</td>
<td>0.876</td>
<td>0.83</td>
<td></td>
</tr>
<tr>
<td>IS</td>
<td>LS_2</td>
<td>LS_8</td>
<td>LS_30</td>
<td>LS_32</td>
<td>0.69</td>
<td>0.799</td>
<td>0.814</td>
<td>0.798</td>
<td></td>
</tr>
<tr>
<td>IC</td>
<td>LS_15</td>
<td>LS_19</td>
<td>LS_29</td>
<td>LS_31</td>
<td>0.808</td>
<td>0.611</td>
<td>0.742</td>
<td>0.823</td>
<td></td>
</tr>
</tbody>
</table>

20-items

<table>
<thead>
<tr>
<th>Transactional Leadership</th>
<th>CR</th>
<th>LS1</th>
<th>LS_11</th>
<th>LS_16</th>
<th>LS_35</th>
<th>0.56</th>
<th>0.827</th>
<th>0.856</th>
<th>0.772</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEA</td>
<td>LS_4</td>
<td>LS_22</td>
<td>LS_24</td>
<td>LS_27</td>
<td>0.734</td>
<td>0.756</td>
<td>0.774</td>
<td>0.706</td>
<td></td>
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</tbody>
</table>

8-items

<table>
<thead>
<tr>
<th>Passive/Avoidant</th>
<th>MEP</th>
<th>LS_3</th>
<th>LS_12</th>
<th>LS_17</th>
<th>LS_20</th>
<th>0.637</th>
<th>0.874</th>
<th>0.581</th>
<th>0.845</th>
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<tbody>
<tr>
<td>LF</td>
<td>LS_5</td>
<td>LS_7</td>
<td>LS_28</td>
<td>LS_33</td>
<td>0.776</td>
<td>0.698</td>
<td>0.617</td>
<td>0.802</td>
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8-items

<table>
<thead>
<tr>
<th>Climate for Innovation</th>
<th>SI</th>
<th>CI_1</th>
<th>CI_2</th>
<th>CI_3</th>
<th>CI_4</th>
<th>CI_5</th>
<th>CI_6</th>
<th>CI_7</th>
<th>CI_8</th>
<th>CI_9</th>
<th>CI_10</th>
<th>CI_11</th>
<th>CI_12</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>0.742</td>
<td>0.733</td>
<td>0.579</td>
<td>0.234</td>
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<td>0.709</td>
<td>0.537</td>
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<tr>
<td></td>
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<td>0.583</td>
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<td>0.667</td>
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</tr>
<tr>
<td>RS</td>
<td>CI_14</td>
<td>CI_15</td>
<td>CI_16</td>
<td>CI_17</td>
<td>CI_18</td>
<td>CI_19</td>
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<td>0.842</td>
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**22-items**

**Adoption of Sustainability**

<table>
<thead>
<tr>
<th></th>
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<th>SL_3</th>
<th>SL_4</th>
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<tbody>
<tr>
<td></td>
<td>0.732</td>
<td>0.664</td>
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<table>
<thead>
<tr>
<th></th>
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<th>SL_8</th>
<th>SL_9</th>
<th>SL_10</th>
<th>SL_11</th>
<th>SL_12</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>0.776</td>
<td>0.672</td>
<td>0.826</td>
<td>0.737</td>
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<td>0.625</td>
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<table>
<thead>
<tr>
<th></th>
<th>SL_13</th>
<th>SL_14</th>
<th>SL_15</th>
<th>SL_16</th>
<th>SL_17</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>-0.356</td>
<td>0.705</td>
<td>0.641</td>
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**17-items**

**Adoption of Asset Management**

<table>
<thead>
<tr>
<th></th>
<th>AL_1</th>
<th>AL_2</th>
<th>AL_3</th>
<th>AL_4</th>
<th>AL_5</th>
<th>AL_6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.704</td>
<td>0.792</td>
<td>0.822</td>
<td>0.806</td>
<td>0.751</td>
<td>0.789</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AL_7</th>
<th>AL_8</th>
<th>AL_9</th>
<th>AL_10</th>
<th>AL_11</th>
<th>AL_12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.81</td>
<td>0.757</td>
<td>0.77</td>
<td>0.792</td>
<td>0.805</td>
<td>0.748</td>
</tr>
</tbody>
</table>

**12-items**

<table>
<thead>
<tr>
<th></th>
<th>AL_1</th>
<th>AL_2</th>
<th>AL_3</th>
<th>AL_4</th>
<th>AL_5</th>
<th>AL_6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.704</td>
<td>0.792</td>
<td>0.822</td>
<td>0.806</td>
<td>0.751</td>
<td>0.789</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>AL_7</th>
<th>AL_8</th>
<th>AL_9</th>
<th>AL_10</th>
<th>AL_11</th>
<th>AL_12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.81</td>
<td>0.757</td>
<td>0.77</td>
<td>0.792</td>
<td>0.805</td>
<td>0.748</td>
</tr>
</tbody>
</table>

**IA**: Idealized Attributes, **IB**: Idealized Behavior, **IM**: Inspirational Motivation, **IS**: Intellectual Stimulation, **IC**: Individual Consideration, **CR**: Contingent Reward, **MEA**: Management by Exception (Active), **MEP**: Management by Exception (Passive), **LF**: Laissez-Faire, **SI**: Support for Innovation, and **RS**: Resources Supply

Highly correlated since they measure the same construct (Hair et al. 2017). This process was performed gradually as illustrated in Figure 29, where indicators with outer loadings of < 0.4 were deleted first, then indicators with outer loadings of 0.4 < x < 0.7 were checked for deletion potential if the construct’s AVE was enhanced and reached the acceptable threshold (i.e., = 0.5).

The evaluation of the reflective measurement model was performed as illustrated in Figure 30. First, internal consistency was evaluated by obtaining Cronbach’s Alpha. Next, convergent validity was evaluated by investigating the indicator reliability and obtaining AVE. Finally, discriminant validity was evaluated by performing multiple tests as described in Figure 30.
The process of evaluating the reflective measurement model entails consecutive runs of PLS algorithm using SmartPLS®. In each run, the same procedure was used as described in Figure 30 until evidence of reliability and validity was obtained. The procedure performed to develop the final model after several runs can be found in Appendix N – Evaluation of Measurement Model. The final 1st order reflective constructs and 2nd order formative constructs model is illustrated in Figure 31.
Figure 29 – Outer Loading Relevance Testing – Adapted from Hair et al. (2017)
Figure 30 – The Process of Evaluating Reflective Measurement Model

**Evaluation of Reflective Measurement Model**

1. **Internal Consistency**
   - Yes
   - Cronbach’s Alpha ≥ 0.6
   - Revise the construct’s indicators content
   - No
   - Internal consistency achieved

2. **Convergent Validity**
   - Indicator Reliability
   - AVE ≥ 0.5
   - Convergent validity achieved
   - No
   - Delete problematic indicator(s)
   - Follow the process as illustrated in Figure 26

3. **Discriminant Validity**
   - Cross-Loading
   - HTMT test
   - HTMT test by Bootstrapping
   - Yes
   - Discriminant validity achieved
   - No
   - Fornell and Lacker’s

**Discriminant Validity Remedial Steps**

1. Retain the constructs that cause discriminant validity problems in the model and attempt to increasing the average MT correlations and/or decreasing the average HT correlations of the constructs’ measures.

2. Eliminate items that have low correlations with other items measuring the same construct.

3. Split into homogenous subconstructs by using a higher-order construct, if the measurement theory supports this step.

4. Eliminate items that are strongly correlated with items in the opposing construct.

5. Reassign these indicators to the other construct, if theoretically applicable.
### Table 22 – The study’s original constructs and their corresponding indicators

<table>
<thead>
<tr>
<th>Transformational Leadership</th>
<th>Idealized Attributes (IA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 10</td>
<td></td>
</tr>
<tr>
<td>LS 18</td>
<td></td>
</tr>
<tr>
<td>LS 21</td>
<td></td>
</tr>
<tr>
<td>LS 25</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Idealized Behaviors (IB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 6</td>
</tr>
<tr>
<td>LS 14</td>
</tr>
<tr>
<td>LS 23</td>
</tr>
<tr>
<td>LS 34</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Inspirational Motivation (IM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 9</td>
</tr>
<tr>
<td>LS 13</td>
</tr>
<tr>
<td>LS 26</td>
</tr>
<tr>
<td>LS 36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Intellectual Stimulation (IS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 2</td>
</tr>
<tr>
<td>LS 8</td>
</tr>
<tr>
<td>LS 30</td>
</tr>
<tr>
<td>LS 32</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Individual Consideration (IC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 15</td>
</tr>
<tr>
<td>LS 19</td>
</tr>
<tr>
<td>LS 29</td>
</tr>
<tr>
<td>LS 31</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transactional Leadership</th>
<th>Contingent Reward (CR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 1</td>
<td></td>
</tr>
<tr>
<td>LS 11</td>
<td></td>
</tr>
<tr>
<td>LS 16</td>
<td></td>
</tr>
<tr>
<td>LS 35</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management by Exception-Active (MEA)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 4</td>
</tr>
<tr>
<td>LS 22</td>
</tr>
<tr>
<td>LS 24</td>
</tr>
<tr>
<td>LS 27</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Passive/Avoidant</th>
<th>Management by Exception-Passive (MEP)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 3</td>
<td></td>
</tr>
<tr>
<td>LS 12</td>
<td></td>
</tr>
<tr>
<td>LS 17</td>
<td></td>
</tr>
<tr>
<td>LS 20</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Laissez-Faire (LF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 5</td>
</tr>
<tr>
<td>LS 7</td>
</tr>
<tr>
<td>LS 28</td>
</tr>
<tr>
<td>LS 33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Climate for Innovation</th>
<th>Support for Innovation (SI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 1</td>
<td>Creativity is encouraged here</td>
</tr>
<tr>
<td>CI_2</td>
<td>Our ability to function creatively is respected by the leadership</td>
</tr>
<tr>
<td>CI_3</td>
<td>Around here, people are allowed to try to solve the same problems in different ways</td>
</tr>
<tr>
<td>CI_4</td>
<td>The main function of members in this organization is to follow orders which come down through channels</td>
</tr>
<tr>
<td>CI_5</td>
<td>Around here, a person can get in a lot of trouble by being different</td>
</tr>
<tr>
<td>CI_6</td>
<td>This organization can be described as flexible and continually adapting to change</td>
</tr>
<tr>
<td>CI_7</td>
<td>A person can't do things that are too different around here without provoking anger</td>
</tr>
<tr>
<td>CI_8</td>
<td>The best way to get along in this organization is to think the way the rest of the group does</td>
</tr>
<tr>
<td>CI_9</td>
<td>People around here are expected to deal with problems in the same way</td>
</tr>
<tr>
<td>CI_10</td>
<td>This organization is open and responsive to change</td>
</tr>
<tr>
<td>CI_11</td>
<td>The people in charge around here usually get credit for others' ideas</td>
</tr>
<tr>
<td>CI_12</td>
<td>In this organization, we tend to stick to tried and true ways</td>
</tr>
<tr>
<td>CI_13</td>
<td>This place seems to be more concerned with the status quo than with change</td>
</tr>
<tr>
<td>CI_20</td>
<td>The reward system here encourages innovation</td>
</tr>
<tr>
<td>CI_21</td>
<td>This organization publicly recognizes those who are innovative</td>
</tr>
<tr>
<td>CI_22</td>
<td>The reward system here benefits mainly those who don't rock the boat</td>
</tr>
</tbody>
</table>

**Resource Supply (SR)**

| CI_14 | Assistance in developing new ideas is readily available |
| CI_15 | There are adequate resources devoted to innovation in this organization |
| CI_16 | There is adequate time available to pursue creative ideas here |
| CI_17 | Lack of funding to investigate creative ideas is a problem in this organization |
| CI_18 | Personnel shortage inhibit innovation in this organization |
| CI_19 | This organization gives me free time to pursue creative ideas during the workday |

**Adoption of Sustainability (AS)**

| SL_1 | My actions take into consideration the impact of social aspects of sustainability (e.g., Equity, Equal opportunities, Health, Safety, Accessibility, and Distribution of cost and benefits) |
| SL_2 | My actions take into consideration the impact of environmental aspects of sustainability (e.g., Ecosystem services, GHG emissions, Global warming, Noise, Heat island effect, Land consumption, Waste, Ecological damage, and Climate change) |
| SL_3 | I make decisions based on my experience, knowledge and technical skills regardless of any possible impact on other departments or stakeholders’ interests. |
| SL_4 | My decisions take into consideration the entire organization's performance |
| SL_5 | I take necessary measures when actions are negatively affecting sustainability |
| SL_6 | I match decisions I make with the organization's vision and objectives towards sustainability |
| SL_7 | I use Change Management tools to induce organizational movement towards sustainability. |
| SL_8 | I attempt to confront the old and traditional culture that undermines the efforts toward sustainability |
| SL_9 | I encourage adopting new ideas and innovative methods while addressing sustainability issues |
| SL_10 | I seek opportunities through sustainable efforts |
| SL_11 | I maintain healthy profit and create wealth regardless of sustainability concept |
| SL_12 | I put purpose before profit |
| SL_13 | I implement Corporate Social Responsibility (CSR) only if it does not affect profit. |
| SL_14 | I demonstrate sustainability by persevering through all types of change |
| SL_15 | I use social networking when communicating Sustainability decisions with all involved. |
| SL_16 | I attempt to build a culture of sustainability by effective communication and networking |
| SL_17 | I promote sustainability principles when hiring, promoting employees and replacing leaders |

**Adoption of Asset Management (AAM)**

| AL_1 | I identify Asset Management as one of the core processes in my organization |
| AL_2 | I recognize that stakeholders' requirements may not align with my objectives. I endeavor to balance these requirements within an Asset Management framework |
| AL_3 | I use consistent and systematic processes for identifying Asset requirements and developing an investment plan |
| AL_4 | I recognize the term "level of service" that is used to describe the quality of services provided by the asset under consideration. I link the level of service of each asset to the transportation network needs |
I encourage forming teams of diversity while dealing with Asset Management issues where professionals other than engineers are recruited from a diverse background, education, gender and ethnicity.

I use change management tools to induce transformational movement towards the adoption of Asset Management practices.

Effective communication and social networking are two main tools I use to promote more adoption of Asset Management practices.

I focus on fostering a learning environment for employees by encouraging them to participate in seminars, conferences and inter-organization partnership on Asset Management

I use mentoring and training programs that enable employees to acquire the required Asset Management competences.

I evaluate my organization's performance on the basis of compliance to predefined KPI's and Asset Management guidelines.

I delegate responsibilities to leaders across the organization with full authority for process development, documentation, deployment, improvement, hiring and replacing staff and audit and review.

I make relevant information available across the organization for better understanding, analysis and problem solving.

To examine the internal consistency of the constructs, Cronbach’s alpha was calculated for all constructs; their values are shown in Table 23. To examine convergent validity of the constructs, the average variance extracted (AVE) was calculated, as shown in Table 23. All first-order constructs have an AVE of 0.517 or greater.

**Table 23 - Revised Cronbach’s Alpha and AVE Values for first-order constructs (outer model), N=150**

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>α</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>15</td>
<td>0.939</td>
<td>0.542</td>
</tr>
<tr>
<td>Transactional Leadership</td>
<td>7</td>
<td>0.756</td>
<td></td>
</tr>
<tr>
<td>Contingent Reward</td>
<td>1</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Management by Exception (Active)</td>
<td>4</td>
<td>0.735</td>
<td>0.555</td>
</tr>
<tr>
<td>Passive/Avoidant</td>
<td>3</td>
<td>0.669</td>
<td>0.517</td>
</tr>
<tr>
<td>Climate for Innovation</td>
<td>10</td>
<td>0.926</td>
<td></td>
</tr>
<tr>
<td>Support for Innovation</td>
<td>6</td>
<td>0.855</td>
<td>0.7</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>4</td>
<td>0.879</td>
<td>0.624</td>
</tr>
<tr>
<td>Adoption of Sustainability</td>
<td>12</td>
<td>0.928</td>
<td>0.56</td>
</tr>
<tr>
<td>Adoption of Asset Management</td>
<td>12</td>
<td>0.941</td>
<td>0.608</td>
</tr>
</tbody>
</table>
Table 24 – Retained outer loading of the 1st order model (N=150)

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items (before)</th>
<th># of Items (after)</th>
<th>Items removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>20</td>
<td>15</td>
<td>LS_6, 36, 2, 19 &amp; 29</td>
</tr>
<tr>
<td>Transactional Leadership</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Contingent Reward</td>
<td>4</td>
<td>1</td>
<td>LS-1, 11 &amp; 16</td>
</tr>
<tr>
<td>Management by Exception</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>8</td>
<td>3</td>
<td>LS_3, 12, 17, 20 and 5</td>
</tr>
<tr>
<td>Climate for Innovation</td>
<td>22</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Support for Innovation</td>
<td>16</td>
<td>6</td>
<td>CI-3, 4, 5, 7, 8, 9, 11, 12, 13 and CI-22</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>6</td>
<td>4</td>
<td>C_17 and 18</td>
</tr>
<tr>
<td>Adoption of Sustainability</td>
<td>17</td>
<td>12</td>
<td>SL-3, 4, 11, 12 and 13</td>
</tr>
<tr>
<td>Adoption of Asset Management</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

To re-evaluate the discriminant validity of the constructs for the revised model, Fornell and Larcker’s approach was applied; the results are shown in Table 26. In this test, the AVE should be higher than their correlations with other constructs. The results indicated that out of 8 constructs, only one construct did not match this criterion for the Adoption of Asset Management (AAM). The cross-loading approach was used also to examine the outer loadings of the indicators on other constructs. Loadings of the indicators have the highest values on their constructs, except for two (adoption of sustainability and transformational leadership), where there were loadings with higher values on other constructs (adoption of asset management and contingent reward respectively). The results showed a lack in discriminant validity. And hence, an additional statistical step was required to investigate the discriminant validity of the constructs.
Table 25 – Retained indicators of the 1st order model

<table>
<thead>
<tr>
<th>Transformational Leadership</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 10</td>
<td>I talk optimistically about the future</td>
</tr>
<tr>
<td>LS 18</td>
<td></td>
</tr>
<tr>
<td>LS 21</td>
<td></td>
</tr>
<tr>
<td>LS 25</td>
<td></td>
</tr>
<tr>
<td>LS 14</td>
<td></td>
</tr>
<tr>
<td>LS 23</td>
<td></td>
</tr>
<tr>
<td>LS 9</td>
<td>I spend time teaching and coaching</td>
</tr>
<tr>
<td>LS 13</td>
<td></td>
</tr>
<tr>
<td>LS 26</td>
<td></td>
</tr>
<tr>
<td>LS 8</td>
<td></td>
</tr>
<tr>
<td>LS 30</td>
<td></td>
</tr>
<tr>
<td>LS 32</td>
<td></td>
</tr>
<tr>
<td>LS 15</td>
<td></td>
</tr>
<tr>
<td>LS 31</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Transactional Leadership</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 35</td>
<td>Contingent Reward (CR)</td>
</tr>
<tr>
<td>LS 4</td>
<td>Management by Exception – Active (MEA)</td>
</tr>
<tr>
<td>LS 22</td>
<td></td>
</tr>
<tr>
<td>LS 24</td>
<td></td>
</tr>
<tr>
<td>LS 27</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Passive/Avoidant</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LS 7</td>
<td>I avoid making decisions</td>
</tr>
<tr>
<td>LS 28</td>
<td></td>
</tr>
<tr>
<td>LS 33</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Climate for Innovation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 1</td>
<td>Creativity is encouraged here</td>
</tr>
<tr>
<td>CI 2</td>
<td>Our ability to function creatively is respected by the leadership</td>
</tr>
<tr>
<td>CI 6</td>
<td>This organization can be described as flexible and continually adapting to change</td>
</tr>
<tr>
<td>CI 10</td>
<td>This organization is open and responsive to change</td>
</tr>
<tr>
<td>CI 20</td>
<td>The reward system here encourages innovation</td>
</tr>
<tr>
<td>CI 21</td>
<td>This organization publicly recognizes those who are innovative</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Support for Innovation (SI)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 14</td>
<td>Assistance in developing new ideas is readily available</td>
</tr>
<tr>
<td>CI 15</td>
<td>There are adequate resources devoted to innovation in this organization</td>
</tr>
<tr>
<td>CI 16</td>
<td>There is adequate time available to pursue creative ideas here</td>
</tr>
<tr>
<td>CI 19</td>
<td>This organization gives me free time to pursue creative ideas during the workday</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Resource Supply (RS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>CI 14</td>
<td>Assistance in developing new ideas is readily available</td>
</tr>
<tr>
<td>CI 15</td>
<td>There are adequate resources devoted to innovation in this organization</td>
</tr>
<tr>
<td>CI 16</td>
<td>There is adequate time available to pursue creative ideas here</td>
</tr>
<tr>
<td>CI 19</td>
<td>This organization gives me free time to pursue creative ideas during the workday</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Adoption of Sustainability (AS)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>SL_1</td>
<td>My actions take into consideration the impact of social aspects of sustainability (e.g., Equity, Equal opportunities, Health, Safety, Accessibility, and Distribution of cost and benefits)</td>
</tr>
<tr>
<td>SL_2</td>
<td>My actions take into consideration the impact of environmental aspects of sustainability (e.g., Ecosystem services, GHG emissions, Global warming, Noise, Heat island effect, Land consumption, Waste, Ecological damage, and Climate change)</td>
</tr>
<tr>
<td>SL 5</td>
<td>I take necessary measures when actions are negatively affecting sustainability</td>
</tr>
<tr>
<td>SL 6</td>
<td>I match decisions I make with the organization's vision and objectives towards sustainability</td>
</tr>
<tr>
<td>SL 7</td>
<td>I use Change Management tools to induce organizational movement towards sustainability.</td>
</tr>
<tr>
<td>SL_8</td>
<td>I attempt to confront the old and traditional culture that undermines the efforts toward sustainability</td>
</tr>
<tr>
<td>SL 9</td>
<td>I encourage adopting new ideas and innovative methods while addressing sustainability issues</td>
</tr>
<tr>
<td>SL 10</td>
<td>I seek opportunities through sustainable efforts</td>
</tr>
<tr>
<td>SL_14</td>
<td>I demonstrate sustainability by persevering through all types of change</td>
</tr>
<tr>
<td>SL_15</td>
<td>I use social networking when communicating Sustainability decisions with all involved.</td>
</tr>
<tr>
<td>SL_16</td>
<td>I attempt to build a culture of sustainability by effective communication and networking</td>
</tr>
<tr>
<td>SL_17</td>
<td>I promote sustainability principles when hiring, promoting employees and replacing leaders</td>
</tr>
</tbody>
</table>

**Adoption of Asset Management (AAM)**

| AL_1  | I identify Asset Management as one of the core processes in my organization |
| AL_2  | I recognize that stakeholders' requirements may not align with my objectives. I endeavor to balance these requirements within an Asset Management framework |
| AL_3  | I use consistent and systematic processes for identifying Asset requirements and developing an investment plan |
| AL_4  | I recognize the term "level of service" that is used to describe the quality of services provided by the asset under consideration. I link the level of service of each asset to the transportation network needs |
| AL_5  | I encourage forming teams of diversity while dealing with Asset Management issues where professionals other than engineers are recruited from a diverse background, education, gender and ethnicity |
| AL_6  | I use change management tools to induce transformational movement towards the adoption of Asset Management practices |
| AL_7  | Effective communication and social networking are two main tools I use to promote more adoption of Asset Management practices |
| AL_8  | I focus on fostering a learning environment for employees by encouraging them to participate in various activities such as seminars, conferences and inter-organization partnership on Asset Management |
| AL_9  | I use mentoring and training programs that enable employees to acquire the required Asset Management competences |
| AL_10 | I evaluate my organization's performance on the basis of compliance to predefined KPI's and Asset Management guidelines |
| AL_11 | I delegate responsibilities to leaders across the organization with full authority for process development, documentation, deployment, improvement, hiring and replacing staff and audit and review |
| AL_12 | I make relevant information available across the organization for better understanding, analysis and problem solving |

Heterotrait-Monotrait ratio (HTMT) approach was used and the results are shown in Table 27, where the pairwise correlations between variables should not exceed the threshold of 0.9. The results indicated a lack of discriminant validity since a single correlation value was beyond 0.9, especially between the climate for innovation subconstructs (i.e., RS and SI). Similar to Fornell and Larcker’s test and cross-loadings assessment, no sign of a lack of discriminant validity was detected between AAM and AS or between TRANS and CR. To further investigate the problem causing the lack of discriminant validity, an HTMT test was generated using bootstrapping in SmartPLS. The results are shown in Table 28. Subsamples of 5000 were used along with a bias-corrected, two-tailed method with a confidence interval of 95%. A confidence interval containing an HTMT value of 1 generally indicates a lack of
### Table 26 – Fornell and Larcker’s results (N=150)

<table>
<thead>
<tr>
<th></th>
<th>AAM</th>
<th>CR</th>
<th>MEA</th>
<th>P/A</th>
<th>RS</th>
<th>SI</th>
<th>AS</th>
<th>TRANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAM</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.399</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEA</td>
<td>0.356</td>
<td>0.19</td>
<td>0.745</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P/A</td>
<td>-0.201</td>
<td>-0.368</td>
<td>0.004</td>
<td>0.719</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td>0.506</td>
<td>0.278</td>
<td>0.199</td>
<td>-0.144</td>
<td>0.837</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>0.563</td>
<td>0.381</td>
<td>0.222</td>
<td>-0.189</td>
<td>0.792</td>
<td>0.79</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS</td>
<td>0.81</td>
<td>0.447</td>
<td>0.233</td>
<td>-0.16</td>
<td>0.492</td>
<td>0.528</td>
<td>0.749</td>
<td></td>
</tr>
<tr>
<td>TRANS</td>
<td>0.671</td>
<td>0.649</td>
<td>0.391</td>
<td>-0.314</td>
<td>0.382</td>
<td>0.514</td>
<td>0.688</td>
<td>0.736</td>
</tr>
</tbody>
</table>

**AAM:** Adoption of Asset Management, **CR:** Contingent Reward, **MEA:** Management by Exception (Active), **P/A:** Passive/Avoidant, **RS:** Resources Supply, **SI:** Support for Innovation, **AS:** Adoption of Sustainability and **TRANS:** Transformational Leadership

### Table 27 – HTMT Ratio Results (N=150)

<table>
<thead>
<tr>
<th></th>
<th>AAM</th>
<th>CR</th>
<th>MEA</th>
<th>P/A</th>
<th>RS</th>
<th>SI</th>
<th>AS</th>
<th>TRANS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAM</td>
<td>0.409</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.412</td>
<td>0.22</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEA</td>
<td>0.204</td>
<td>0.417</td>
<td>0.301</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P/A</td>
<td>0.554</td>
<td>0.299</td>
<td>0.24</td>
<td>0.185</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td>0.614</td>
<td>0.407</td>
<td>0.271</td>
<td>0.194</td>
<td>0.912</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>0.864</td>
<td>0.456</td>
<td>0.29</td>
<td>0.184</td>
<td>0.539</td>
<td>0.577</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AS</td>
<td>0.703</td>
<td>0.665</td>
<td>0.457</td>
<td>0.319</td>
<td>0.414</td>
<td>0.553</td>
<td>0.722</td>
<td></td>
</tr>
<tr>
<td>TRANS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

### Table 28 – Bootstrapping Confidence Interval HTMT Ratio Results (N=150)

<table>
<thead>
<tr>
<th>Path</th>
<th>2.50%</th>
<th>97.50%</th>
<th>Path</th>
<th>2.50%</th>
<th>97.50%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR -&gt; AML</td>
<td>0.208</td>
<td>0.569</td>
<td>SI -&gt; RS</td>
<td>0.832</td>
<td>0.971</td>
</tr>
<tr>
<td>MEA -&gt; AML</td>
<td>0.247</td>
<td>0.576</td>
<td>SL -&gt; AML</td>
<td>0.787</td>
<td>0.92</td>
</tr>
<tr>
<td>MEA -&gt; CR</td>
<td>0.066</td>
<td>0.424</td>
<td>SL -&gt; CR</td>
<td>0.271</td>
<td>0.601</td>
</tr>
<tr>
<td>P/A -&gt; AML</td>
<td>0.106</td>
<td>0.294</td>
<td>SL -&gt; MEA</td>
<td>0.172</td>
<td>0.419</td>
</tr>
<tr>
<td>P/A -&gt; MEA</td>
<td>0.215</td>
<td>0.601</td>
<td>SL -&gt; P/A</td>
<td>0.096</td>
<td>0.245</td>
</tr>
<tr>
<td>P/A -&gt; CR</td>
<td>0.165</td>
<td>0.424</td>
<td>SL -&gt; RS</td>
<td>0.379</td>
<td>0.668</td>
</tr>
<tr>
<td>RS -&gt; AML</td>
<td>0.42</td>
<td>0.678</td>
<td>SL -&gt; SI</td>
<td>0.424</td>
<td>0.693</td>
</tr>
<tr>
<td>RS -&gt; CR</td>
<td>0.112</td>
<td>0.486</td>
<td>TRANS -&gt; AML</td>
<td>0.586</td>
<td>0.788</td>
</tr>
<tr>
<td>RS -&gt; MEA</td>
<td>0.113</td>
<td>0.391</td>
<td>TRANS -&gt; CR</td>
<td>0.489</td>
<td>0.789</td>
</tr>
<tr>
<td>RS -&gt; P/A</td>
<td>0.075</td>
<td>0.249</td>
<td>TRANS -&gt; P/A</td>
<td>0.291</td>
<td>0.611</td>
</tr>
<tr>
<td>SI -&gt; AML</td>
<td>0.486</td>
<td>0.72</td>
<td>TRANS -&gt; MEA</td>
<td>0.166</td>
<td>0.459</td>
</tr>
<tr>
<td>SI -&gt; CR</td>
<td>0.22</td>
<td>0.586</td>
<td>TRANS -&gt; RS</td>
<td>0.245</td>
<td>0.589</td>
</tr>
<tr>
<td>SI -&gt; MEA</td>
<td>0.134</td>
<td>0.429</td>
<td>TRANS -&gt; SI</td>
<td>0.387</td>
<td>0.697</td>
</tr>
<tr>
<td>SI -&gt; P/A</td>
<td>0.089</td>
<td>0.299</td>
<td>TRANS -&gt; SL</td>
<td>0.6</td>
<td>0.809</td>
</tr>
</tbody>
</table>
discriminant validity. The results indicated no values of 1, as shown in Table 28, providing evidence of construct discriminant validity.

5.2 Estimating the Structural Model

The model consisted of a single higher-order exogenous construct: transactional leadership. This higher-order construct was formed from the two first-order constructs of contingent reward (CR) and management by exception – active (MEA). In addition, the model consisted of a higher-order mediating construct, that is climate for innovation. The construct was formed by the two first-order constructs of support for innovation (SI) and resources supply (RS). The research model was designed to have a combination of reflective/formative indicator measurements. This decision was based on criteria established by Jarvis et al. (2003) for the appropriate measurement model to use. Therefore, the model was set as a reflective-formative format with reflective first-order constructs and formative second-order constructs, as illustrated in Figure 31. This is known as the hierarchical component model (HCM), which often involves testing a higher-order structure that contains two layers of constructs (Hair et al. 2017).

To represent the measurement model of the higher-order component, a repeated-indicator approach was used, in which the higher-order component uses all of its underlying lower-order component’s indicators in the measurement model. Following the recommendation by Becker et al. (2012), the repeated indicator approach, with mode B on the higher-order construct and inner path weighting scheme, is used for reflective-formative hierarchical latent variables (Becker et al. 2012). Furthermore, a two-stage higher-order component analysis using standardized latent variable scores was applied as recommended by Hair et al. (2017). In the first stage, the repeated indicator approach was used to obtain the latent variable scores for the lower-order components. In the second stage, standardized latent scores of the first order constructs were saved and copied into the PLS data as the observed
variables, which served as manifest variables in the higher-order components measurement model for the first order constructs in the structural model for further analysis (Becker et al. 2012; Cheng 2017; Hair et al. 2017; Wilson 2010). Figure 32 illustrates the final research model of higher order components at the second stage where latent scores of the lower order constructs were used as formative indicators.

A PLS algorithm was executed using SmartPLS 3.2.8 with factor weighting scheme and 5000 iterations to calculate the outer weights/loadings, path coefficients, $R^2$ and Variance Inflation Factor (VIF). As the research model of the higher order constructs at the second stage includes two formative exogenous constructs (i.e., transactional leadership and climate for innovation) evaluation of the measurement model validity and reliability can be achieved by assessing collinearity issues between formative items and the significance and relevance of the formative indicators. Collinearity between formative items can be measured by calculating VIF. Table 29 presents the VIF values for all four formative constructs. The results were indicative of no collinearity issues between the formative factors since all values are below 5.0. To check the significance and relevance of the formative indicators, outer loadings and weights were obtained, as presented in Table 30.

According to Hair et al. (2017), a formative indicator with insignificant outer weight should be removed only if the outer loading is also insignificant and below 0.5. All formative indicators passed this criterion since all outer weight values are significant and no outer loading values are below 0.5. The model is illustrated in Figure 31 and Figure 32 for both first order and second order models, respectively. Subsequently, the structural model of the higher order constructs at the second stage was evaluated by assessing the coefficient of determination $R^2$ to measure the structural model’s predictive validity. High coefficient of determination values were detected for the target constructs of the model (0.491 for Adoption.
of Asset Management and 0.51 for Adoption of Sustainability), which confirms the model’s predictive validity. The $R^2$ for Climate for Innovation was relatively lower at 0.209.

Figure 31 – Final Reflective 1st-order constructs and formative 2nd-order constructs model (N=150)
Figure 32 – Final Research Model of 2nd Order Constructs (N=150)

Table 29 – VIF values for formative items of the higher order model (N=150)

<table>
<thead>
<tr>
<th>Item</th>
<th>VIF</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td>1.038</td>
</tr>
<tr>
<td>MEA</td>
<td>1.038</td>
</tr>
<tr>
<td>RS</td>
<td>2.685</td>
</tr>
<tr>
<td>SI</td>
<td>2.685</td>
</tr>
</tbody>
</table>
Table 30 – Formative Indicators’ Outer Weights and Loadings at the higher order model (N=150)

<table>
<thead>
<tr>
<th>Items</th>
<th>Climate for Innovation</th>
<th>Transactional</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.798</td>
<td>0.888</td>
</tr>
<tr>
<td>Loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.469</td>
<td>0.621</td>
</tr>
<tr>
<td>Loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.19</td>
<td>0.858</td>
</tr>
<tr>
<td>Loading</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.843</td>
<td></td>
</tr>
<tr>
<td>Loading</td>
<td></td>
<td>0.993</td>
</tr>
</tbody>
</table>

5.3 Testing Hypotheses H1a, H1b, H1c, H2a, H2b and H2c

The following hypotheses were tested by investigating the relationship between the leadership styles (transformational, transactional and passive/avoidant) and the adoption of sustainability and asset management.

H1a: Transformational leadership is significantly related to sustainability.

H1b: Transactional leadership is positively related to sustainability.

H1c: Passive/Avoidant behavior is negatively related to sustainability.

H2a: Transformational leadership is significantly related to asset management.

H2b: Transactional leadership is positively related to asset management.

H2c: Passive/Avoidant behavior is negatively related to asset management.

Another assessment criterion for the structural model is the path coefficient that evaluates the hypothesized relationship between the constructs. In order to test research hypothesis H1a, the effect of a transformational leadership style on the adoption of sustainability was examined by measuring the total effect. A statistically significant effect of 0.743 ($t = 9.652, p < 0.001$) support the hypothesis of H1a. The results, as presented in
Table 31, also revealed a statistically insignificant negative effect (-0.049) \((t = 0.604, p = 0.546)\) of a transactional leadership style on the adoption of sustainability, which does not support hypothesis H1b. A statistically insignificant positive relationship \((t = 1.374, p = 0.17)\) was observed between the passive/avoidant style and adoption of sustainability \((0.066)\). This result does not support hypothesis H1c.

Table 31 – Statistics for the 2nd order constructs \((N=150)\)

<table>
<thead>
<tr>
<th>Total Effects</th>
<th>Path Coefficient</th>
<th>t</th>
<th>P Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate for Innovation -&gt; Adoption of Asset Management</td>
<td>0.311</td>
<td>5.281</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Climate for Innovation -&gt; Adoption of Sustainability</td>
<td>0.262</td>
<td>3.926</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Passive/Avoidant -&gt; Adoption of Asset Management</td>
<td>0.02</td>
<td>0.368</td>
<td>0.713</td>
</tr>
<tr>
<td>Passive/Avoidant -&gt; Adoption of Sustainability</td>
<td>0.066</td>
<td>1.374</td>
<td>0.17</td>
</tr>
<tr>
<td>Transactional -&gt; Adoption of Asset Management</td>
<td>0.001</td>
<td>0.013</td>
<td>0.989</td>
</tr>
<tr>
<td>Transactional -&gt; Adoption of Sustainability</td>
<td>-0.049</td>
<td>0.604</td>
<td>0.546</td>
</tr>
<tr>
<td>Transformational -&gt; Adoption of Asset Management</td>
<td>0.677</td>
<td>7.928</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transformational -&gt; Climate for Innovation</td>
<td>0.506</td>
<td>6.495</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transformational -&gt; Adoption of Sustainability</td>
<td>0.743</td>
<td>9.652</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

Similarly, after examining the effect of transformational leadership on the adoption of asset management, a statistically significant total effect of 0.677 \((t = 7.928, p < 0.001)\) was observed. This finding supports hypothesis H2a. Transactional leadership style was found to have a positive \((0.001)\) and statistically insignificant relationship \((t = 0.013, p = 0.989)\) to the adoption of asset management. This finding does not support hypothesis H2b. Finally, the path coefficient between a passive/avoidant style and the adoption of asset management was found to be statistically insignificant \((0.02)\) \((t = 0.368, p = 0.713)\), which indicates an insignificant positive effect, not supporting hypothesis (H2c).

Finally, to assess for common method bias, the procedure suggested by Kock (2015) was followed. As a comprehensive procedure for the simultaneous assessment of both vertical and lateral collinearity, a full collinearity test was performed. Using SmartPLS,
variance inflation factors (VIFs) were generated for all latent variables in the 2\textsuperscript{nd} order construct model using a factor-based algorithm. A VIF value of 5 and greater is an indication of pathological collinearity, and subsequently considered as an indication of a common method bias. Therefore, if all VIFs resulting from a full collinearity test are equal to or lower than 5, the model can be considered free of common method bias. After performing a full collinearity test, the results presented in Table 32 were obtained. VIF values of 3.366 or less provide justification for no common method bias.

Table 32 – VIF Values When Using Full Collinearity Test

<table>
<thead>
<tr>
<th></th>
<th>AAM</th>
<th>CI</th>
<th>P/A</th>
<th>AS</th>
<th>Transactional</th>
<th>Transformational</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.293</td>
<td>3.206</td>
</tr>
<tr>
<td>CI</td>
<td>1.496</td>
<td>1.553</td>
<td>1.545</td>
<td>1.542</td>
<td>1.524</td>
<td></td>
</tr>
<tr>
<td>P/A</td>
<td>1.124</td>
<td>1.139</td>
<td>1.138</td>
<td>1.122</td>
<td>1.116</td>
<td></td>
</tr>
<tr>
<td>AS</td>
<td>2.134</td>
<td>3.299</td>
<td>3.312</td>
<td>3.316</td>
<td>3.032</td>
<td></td>
</tr>
<tr>
<td>Transactional</td>
<td>1.916</td>
<td>2.018</td>
<td>1.551</td>
<td>2.032</td>
<td>1.46</td>
<td></td>
</tr>
<tr>
<td>Transformational</td>
<td>3.022</td>
<td>3.119</td>
<td>2.665</td>
<td>2.86</td>
<td>2.268</td>
<td></td>
</tr>
</tbody>
</table>

AAM: Adoption of Asset Management, P/A: Passive/Avoidant, AS: Adoption of Sustainability and CI: Climate for Innovation

5.4 Testing Hypotheses H3, H4 and H5

In this section, the relationships between the independent variable (Transformational Leadership) and the mediator (Climate for Innovation) and the mediator and dependent variables are investigated. Using SmartPLS ® 3.2.8, the PLS-SEM model was evaluated by estimating the measurement model and structural model as illustrated in Figure 31 and Figure 32, respectively. The same measurement model was used since the mediator variable was included from the beginning and has been evaluated during the original and subsequent revisions. The results obtained from the previous section (5.3), as shown in Table 31, were utilized to investigate hypotheses 3, 4, and 5.

H3: Transformational leadership is positively related to climate for innovation.

H4: Climate for Innovation is positively related to sustainability.
H5: Climate for Innovation is positively related to asset management.

To test research hypothesis H3, the effect of a transformational leadership style on the Climate for Innovation was examined by measuring the path coefficient of the higher order constructs model. This resulted in a statistically significant direct effect of 0.506 ($t = 6.495$, $p < 0.001$), thereby, supporting hypothesis H3. The results, as presented in Table 31, also revealed a statistically significant relationship (0.262) between the climate for innovation and adoption of sustainability ($t = 3.926$, $p < 0.001$), thereby, supporting the research hypothesis H4. Similarly, a significant effect of a Climate for Innovation was detected on the Adoption of Asset Management (0.311). This statistically significant result ($t = 5.281$, $p < 0.001$) supports hypothesis H5.

5.5 Testing Hypotheses H6 & H7

In this section, the relationship between the independent (transformational leadership) and dependent variables via a mediator was investigated. Using SmartPLS ® 3.2.8, the PLS-SEM model was evaluated by estimating the measurement model and structural model as illustrated in Figure 31 and Figure 32, respectively. The same measurement model was used since the mediator variable was included from the beginning and was evaluated during the original and subsequent revisions. The results obtained from the previous section (5.3) as shown in Table 31, were utilized to investigate hypotheses 6 and 7.

H6: Climate for innovation mediates the relationship between transformational leadership and sustainability.

H7: Climate for innovation mediates the relationship between transformational leadership and asset management.

To test whether a climate of innovation mediates the relationship between a transformational leadership style and the two endogenous variables (sustainability and asset management), the procedure of mediation analysis developed by Zhao et al. (2010) was
followed. First, the significance of the indirect effect of transformational leadership on sustainability (H6) and asset management (H7) via the climate for innovation were tested. The indirect effect from transformational leadership via climate for innovation to sustainability is the product of path coefficients from transformational leadership to climate for innovation and from climate for innovation to sustainability. Similarly, the indirect effect from transformational leadership via climate for innovation to asset management is the product of path coefficients from transformational leadership to climate for innovation and from climate for innovation to asset management. To test the significance of the products of these path coefficients, the bootstrap routine was executed using SmartPLS. The basic setting was adjusted to the complete bootstrapping option. In the advanced settings, Bias-Corrected and Accelerated (BCa) Bootstrap, two-tailed testing, and a significance level of 0.05 were selected.

The results shown in Table 33 indicate that the indirect effect from transformational leadership via climate for innovation to adoption of sustainability is significant since the 95% confidence interval does not include zero [0.063, 0.22]. The empirical $t$ value of the indirect effect (0.132) for the transformational leadership $\rightarrow$ adoption of sustainability relationship is 3.238, yielding a $p$ value of 0.001.

Similarly, the indirect effect from transformational leadership via climate for innovation to adoption of asset management was found to be significant since the 95% confidence interval does not include zero [0.091, 0.244]. The empirical $t$ value of the indirect effect (0.157) for the transformational leadership $\rightarrow$ adoption of asset management relationship is 3.981, yielding a $p$ value of < 0.001.

In the next step, the significance of the direct effect from transformational leadership $\rightarrow$ adoption of sustainability was tested. A strong and statistically significant relationship (0.61) and ($t = 7.098, p < 0.001$) was found. Similarly, the direct effect from
transformational leadership → adoption of asset management revealed a strong relationship (0.52) that was statistically significant ($t = 6.003, p < 0.001$). Therefore, it was concluded that climate for innovation partially mediates the relationship between transformational leadership and the two endogenous variables (adoption of sustainability and asset management) since both the direct and indirect effects are significant (Hair et al. 2017; Zhao et al. 2010).

To further substantiate the type of partial mediation, the product of the direct effect and the indirect effect for both paths were calculated. Since the direct and indirect effects are both positive, the sign of their product is also positive. Hence, it was concluded that climate for innovation has a complementary mediation effect on transformational leadership to adoption of sustainability and on transformational leadership to adoption of asset management. These findings partially support research hypotheses (H6 and H7).

<table>
<thead>
<tr>
<th></th>
<th>Direct Effect</th>
<th>95% Confidence Interval of the Direct Effect</th>
<th>t Value</th>
<th>Significance (p Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational -&gt; AAM</td>
<td>0.52</td>
<td>[0.363, 0.699]</td>
<td>6.003</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transformational -&gt; AS</td>
<td>0.61</td>
<td>[0.451, 0.791]</td>
<td>7.098</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Indirect Effect</th>
<th>95% Confidence Interval of the Indirect Effect</th>
<th>t Value</th>
<th>Significance (p Value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational -&gt; AAM</td>
<td>0.157</td>
<td>[0.091, 0.244]</td>
<td>3.981</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Transformational -&gt; AS</td>
<td>0.132</td>
<td>[0.063, 0.22]</td>
<td>3.238</td>
<td>0.001</td>
</tr>
</tbody>
</table>
5.6 Testing Hypothesis (H8)

In this section, the relationship between the independent variable (transformational leadership) and dependent variables via a moderator is investigated. Using SmartPLS ® 3.2.8, the PLS-SEM model was evaluated by estimating the measurement model and structural model. An extended measurement model that includes the moderator and the interaction term was used as shown in Figure 33. The same structural model, as discussed in section 5.2, was used since the results pertaining to outer loadings and weights were almost identical after including the moderator variable.

**H8a:** When using an organization type as a moderator, the positive relationship between transformational leadership and sustainability is stronger in the private sector than in the public sector.

**H8b:** When using an organization type as a moderator, the positive relationship between transformational leadership and asset management is stronger in the private sector than in the public sector.

To test hypotheses H8a and H8b, the final 1st order constructs model is extended first by including the moderator variable. Organization type is expressed using a nominal scale with only two values: 1 for the public sector and 2 for the private sector. The moderator in this case has only one factor (Q11) assigned to it, which has been connected by a path to the two endogenous variables (sustainability and asset management). Figure 33 illustrates the extended 1st order model that includes the moderator and the interaction term.

5.6.1 Evaluation of the Measurement Model

A two-stage approach is used for the interaction term and standardized product term generation as well as automatic weighing mode under advanced settings. Using the same procedure followed earlier for estimating the measurement model, a PLS-SEM algorithm was executed (using the factor weighting scheme and mean value replacement for missing
values). Since the moderator variable has only one factor, the evaluation of the moderator variable’s measurement model is not required. After all, a construct with only one factor will yield an outer loading of 1.0 and an AVE of 1.0 too, indicating internal consistency reliability and validity. No major changes were found in the measurement model values; therefore, no
further investigation is required to evaluate the measurement model in terms of convergent and discriminant validity.

5.6.2 Evaluation of the Structural Model

In order to estimate the structural model with the moderator included, the repeated indicator approach, with mode B on the higher-order construct and inner path weighting scheme, was used for reflective-formative hierarchical latent variables. Furthermore, a two-stage higher-order component analysis, using standardized latent variable scores, was applied as recommended by Hair et al. (2017).

In the first stage, the repeated indicator approach was used to obtain the latent variable scores for the lower-order components. In the second stage, standardized latent scores of the first order constructs were saved and copied into the PLS data as the observed variables, which served as manifest variables in the higher-order components measurement model for the first order constructs in the structural model for further analysis (Becker et al. 2012; Cheng 2017; Hair et al. 2017; Wilson 2010).

A PLS algorithm was executed using SmartPLS 3.2.8 with path weighting scheme and 5000 iterations to calculate the outer weights/loadings, path coefficients, $R^2$ and Variance Inflation Factor (VIF). As the research model of higher order at the second stage includes four formative exogenous constructs, evaluation of measurement-model validity and reliability can be achieved by assessing the significance and relevance of the formative indicators and collinearity issues between formative items. To check the significance and relevance of the formative indicators after the inclusion of additional constructs in the path model (i.e., organization type and the interaction terms), outer loadings and weights were obtained, as presented in Table 34.
The results indicate that no major changes were found in the measurement properties of all other constructs in the path model that might affect the reliability and validity of the constructs. Therefore, no further investigation is required to assess the significance and relevance of the formative indicators as well as the collinearity (VIF) and $R^2$.

Table 34 – Outer Loadings and weight for the 2nd Order Model After Including the Moderator, (N=150)

<table>
<thead>
<tr>
<th>Items</th>
<th>Original Model</th>
<th>After Including a Moderator</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Climate for Innovation</td>
<td>Transactional</td>
</tr>
<tr>
<td>CR</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.798</td>
<td>0.798</td>
</tr>
<tr>
<td>Loading</td>
<td>0.888</td>
<td>0.887</td>
</tr>
<tr>
<td>MEA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.469</td>
<td>0.469</td>
</tr>
<tr>
<td>Loading</td>
<td>0.621</td>
<td>0.621</td>
</tr>
<tr>
<td>RS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.19</td>
<td>0.19</td>
</tr>
<tr>
<td>Loading</td>
<td>0.858</td>
<td>0.858</td>
</tr>
<tr>
<td>SI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>0.843</td>
<td>0.842</td>
</tr>
<tr>
<td>Loading</td>
<td>0.993</td>
<td>0.993</td>
</tr>
</tbody>
</table>

A structural model was estimated to assess whether the interaction terms were significant. For this purpose, the bootstrapping procedure was run with 5,000 bootstrap samples, using the No Sign Changes option, BCa bootstrap, two-tailed testing, and the standard settings for the PLS-SEM algorithm and the missing value treatment.

The results shown in Table 35 indicate that the moderating effects of an organization type on the relationship between a transformational leadership style and sustainability and between transformational leadership and asset management were insignificant. The analysis yields a $p$ value of 0.299 for the path linking the interaction term and adoption of sustainability, and a $p$ value of 0.808 for the path linking the interaction term and adoption of asset management. Similarly, the 95% bias-corrected bootstrap confidence interval of the
interaction term’s effect linked to sustainability is [-0.057, 0.189] and [-0.118, 0.097] for asset management.

As both confidence intervals include zero, it is concluded that the moderating effect was insignificant. Overall, these results do not support research hypotheses 8a and 8b, which state that organization type exerts a significant and positive effect on the relationship between transformational leadership and adoption of sustainability (H8a) and between transformational leadership and adoption of asset management (H8b).

Table 35 – Statistics for Moderating Effect of Organization’s Type

<table>
<thead>
<tr>
<th>Path</th>
<th>(n=150)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Moderating Effect → Adoption of Asset Management</strong></td>
<td></td>
</tr>
<tr>
<td>T Statistics</td>
<td>0.243</td>
</tr>
<tr>
<td>P Values</td>
<td>0.808</td>
</tr>
<tr>
<td>95 % Confidence Interval</td>
<td>[-0.118, 0.097]</td>
</tr>
<tr>
<td><strong>Moderating Effect → Adoption of Sustainability</strong></td>
<td></td>
</tr>
<tr>
<td>T Statistics</td>
<td>1.039</td>
</tr>
<tr>
<td>P Values</td>
<td>0.299</td>
</tr>
<tr>
<td>95 % Confidence Interval</td>
<td>[-0.057, 0.189]</td>
</tr>
</tbody>
</table>

A positive and significant effect of an organization type on the relationship between transformational leadership and the dependent variables, if existed, would have been indicative of a stronger relationship between transformational leadership and sustainability and/or asset management in the private sector than in the public sector. Contrarily, a negative and significant effect of an organization type on the relationship between transformational leadership and the dependent variables, if existed, would have been indicative of a stronger relationship between transformational leadership and adoption of sustainability and/or adoption of asset management in the public sector than in the private sector.
CHAPTER 6 – DISCUSSION

This chapter provides a discussion on the findings presented in the previous chapter. This discussion revolves around leadership styles that enable the manifestation of organizational innovation, which in turn influence the decision of embracing and adopting sustainability and asset management practices in ground transportation organizations in the U.S. The study investigated the role of transformational leadership in embracing sustainability and asset management practices, and whether organizational innovation has a mediating influence on the relationship between transformational leadership and the research outcomes (sustainability and asset management). The relationship between other leadership styles (transactional and passive/avoidant) and sustainability and asset management adoption was examined as well. Moreover, the study investigated whether organizational type established any moderating effect on the relationship between transformational leadership and the research’s outcomes. The following sections discuss the interpretation of the statistical analyses. Practical and theoretical implications are discussed as well. Overall conclusions, limitations, and the potential for future research are discussed in the subsequent chapter (Chapter 7 - Conclusions).

6.1 Theoretical and Practical Implications

Based on the author’s best knowledge, no existing research investigated the relationship between transformational leadership and leaders’ perceptions on embracing and adopting sustainability and asset management practices within the ground transportation infrastructure sector in the U.S. This study’s aim was to investigate the potential relationship between leadership style of executives at the top and middle levels of management in infrastructure organizations within the ground transportation sector and organizational climate for innovation, which eventually lead to the adoption of non-technological innovation initiatives such as sustainability and asset management.
The results presented in Chapter 5 revealed a positive and significant relationship between transformational leadership and the adoption of asset management and sustainability practices within the ground transportation sector. Moreover, the results supported the mediation influence (partial mediation) of climate for innovation on the relationship between transformational leadership and sustainability and asset management.

The results demonstrated the prominent leadership style that embraces sustainability and asset management concepts in their business units. The results indicate that no moderation effect was detected of organization type (public vs. private) on the relationship between transformational leadership and the leader’s perception of embracing and adopting sustainability and asset management practices. These findings are limited by the use of the self-report instruments that were used to measure the research variables: leadership styles, organizational innovation, and perception of adopting sustainability and asset management practices. Nevertheless, because of the emphasis placed on innovation, sustainability, asset management, and leadership styles in this study, and due to a number of practical and methodical constraints, self-report measures were deemed appropriate.

This research aims to address concerns raised by a number of scholars who recommended a more integrated approach while studying leadership. This is achieved by including different contextual factors (organization type), promoting a more holistic overview and in-depth analysis. Finally, this study’s findings demonstrated the role of leadership in achieving organizational outcomes such as cultivating a climate of innovation in which transformational leadership would influence higher levels of the adoption and implementation of sustainability and asset management practices within the ground transportation sector. Given that the infrastructure sector is facing unprecedented issues such as climate change, natural resource consumption and depletion, urbanization, population growth/decline, new regulations, and considerable pressure on ecosystem services, it is
crucial that highly effective leaders are recognized, evaluated, groomed, and promoted in order to deal with the aforementioned challenges effectively and efficiently. The findings of this study revealed that transformational leaders are capable of dealing with those challenges properly and effectively. This is supported by the significant positive relationships obtained between transformational leadership and leader perceptions of adopting sustainability and asset management practices.

6.1.1 Transformational Leadership and Sustainability

Transformational leadership as a process results when leaders raise follower aspirations and mobilize their higher-order values (Avolio et al. 2009) to share and pursue the leader’s mission/vision. This process of leadership motivates followers to perform more than simple transactions and to do more than simply meet common expectations. They are encouraged to not just act in their own self-interest in exchange for rewards (Tekleab et al. 2008). Transformational leadership, as viewed by Bass (1985), is centered around how a leader affects and influences followers. Transformational leadership comprises four components: charisma or idealized influence (attributed or behavioral), inspirational motivation, intellectual stimulation, and individualized consideration. Considerable research has found that transformational leadership was positively correlated with leadership effectiveness and a number of important organizational outcomes (e.g. productivity and turnover) across various types of organizations, situations, levels of analyses, and cultures (Avolio and Bass 2004; Avolio et al. 2009).

The role of leadership in promoting and adopting sustainability practices in the infrastructure domain has received very little attention. Only a small number of studies have addressed the role of leadership in promoting and adopting sustainable practices within the infrastructure sector. Few more focused on sustainable practices in the construction industry. The literature review provided in Chapter 2 revealed research on the influence of
transformational leadership (in particular) on sustainability in ground transportation sector is underdeveloped. Only a handful of studies demonstrated the role of leadership (in general) in adopting sustainable practices within the infrastructure/construction domain.

The results obtained in this study indicate a positive and statistically significant relationship between transformational leadership and the perception of adopting sustainability practices. This finding is supportive of few studies, from the infrastructure domain, that found a similar result but in different setups. One study that found a positive impact of leadership on implementing successful sustainable practices in infrastructure organizations is the work of Taylor (2011) who studied the role of leadership in promoting sustainable practices in the Australian water industry (Taylor et al. 2011). Other studies found similar results on the influence of leadership on sustainability; however, none of them studied the role of transformational leadership, in particular, on the adoption of sustainability.

6.1.2 Transactional Leadership and Sustainability

Transactional leadership refers to leaders who focus on satisfying the extrinsic needs of their subordinates; in return, subordinates perform what the leader asks. This style of leadership involves development exchange and corrective avoidant leadership. “Development exchange refers to the degree to which a leader establishes a system for followers to obtain contingent rewards for meeting an agreed on expectation” (Chan et al. 2014). The relationship between transactional leaders and followers is based on, and limited to, an exchange of gains that is of mutual benefit. To the author’s best knowledge, previous leadership studies have not investigated the relationship between transactional leadership styles and leader perceptions of embracing and adopting sustainability and asset management practices in ground transportation organizations within the infrastructure domain. However, among the leadership studies conducted, a number of them have detected a positive relationship between transactional leadership and certain organizational outcomes such as job
satisfaction (Gumusluoglu and Ilsev 2009) and success at work (Riaz and Haider 2010). Importantly, some of these studies suggest that transformational leadership styles result in higher job satisfaction than transactional leadership styles (Laohavichien et al. 2009). In fact, some studies have determined that transformational leadership has the strongest and most positive influence whether outcomes have been measured subjectively or objectively.

According to these studies, although transactional leadership has had more of a positive impact on organizational outcomes than passive and non-transactional leadership (Avolio and Bass 2004), it is transformational leadership that has had a greater influence on the widest range of organizational outcomes (e.g. effectiveness, satisfaction, performance, etc.). Granted, transformational leaders can be transactional sometimes; still, transactional leadership has been found to have lower influence on performance. Further, transactional-leadership influence is detected in less significant organizational change (Avolio and Bass 2004).

Still, leadership theory posits that transactional and transformational leadership constitute two complementary points of view (Tyssen et al. 2014). In fact, previous research has uncovered that leaders who can balance transactional and transformational leadership across time, situation, and various challenges are the most effective and successful (Avolio 2011). The challenge is that many transactional leaders may not fully conceive of what transformational leadership really is and/or what it requires to produce more transformational behavior.

It is worth exploring whether or not a transactional leader who employs some transformational leadership approaches is able to perform their job effectively as a transformational leader. Afterall, this has been true in some cases. Still, transformational leaders, as pointed out by Avolio (2011), have distinguishing characteristics that give them an upper hand in the process of organizational leadership development. The bottom line is that
transactional leadership often fails to perform effectively because leaders usually lack the necessary reputation or resources to consistently deliver rewards most of the time. Transactional leaders only gain and maintain a reputation when they are able to fulfill the self-interest expectations (e.g., pay, promotions, recognition, etc.) of their subordinates. Those who fail to deliver expected rewards lose their leverage, compromising their reputation. Therefore, their effectiveness as leaders is diminished (Avolio and Bass 2004; Tsui 1984).

The results of this study showed a low negative and statistically insignificant relationship between transactional leadership and adoption of sustainability. Hypothesis 1b is not supported due to insignificance of the results and the direction of the relationship. This finding does not support the results obtained in other studies that found a significant positive relationship between transactional leadership and some organizational and contextual outcomes. Drawing from contingency theory, Larsson et al. (2015) investigated the suitability of certain leadership styles in specific kinds of situations in the context of civil engineering projects. They detected a positive relationship between a set of contingency factors, in terms of four project characteristics: complexity, burn rate, duration, and type of contract (Larsson et al. 2015).

Similar results reported by Voon et al. (2011) who investigated the relationship between leadership styles of Malaysian executives and their subordinates' job satisfaction working in public sector. Their findings are indicative of a positive and statistically significant relationship between both constructs forming the transactional leadership style (e.g., contingent reward and management by exception – active) and the two dimensions of subordinates' job satisfaction (e.g., job assignment and working condition). They used MLQ-5X instrument to measure the leadership styles including transactional leadership style (Voon et al. 2011).
Another study detected mixed results when assessing the leadership styles of senior managers, middle managers, and first-line supervisors who work for diverse for-profit businesses in Florida (USA). They found a positive and significant correlation between transactional contingent reward (CR) leadership of business managers and job satisfaction (Febres 2017). As described earlier in Chapter 2, transactional leadership style comprises two components: contingent reward (CR) and management by exception active (MBEA). However, the same study found a negative and statistically significant relationship between management by exception-active (MEA) transactional leadership and job satisfaction (Febres 2017). They used both forms of MLQ-5X instrument (leader’s self-rating and rater forms) to measure the leadership styles including the transactional style.

Similarly, Barling et al. (2000) found a significant positive relationship between the transactional contingent reward leadership and leader’s emotional intelligence, and in contrast, a significant negative relationship between transactional management by exception – active and the leader’s emotional intelligence (Barling, et al. 2000). They used MLQ-5X instrument (self-rating form) to measure the leadership styles of vice presidents, general managers, middle managers and supervisors of a large pulp and paper organization. These results are consistent with the findings reported by Lowe et al. (1996) in their meta-analysis who found that the transactional management by exception construct provides mixed results with effectiveness (Lowe, et al. 1996). They suggest that this construct could be considered as representing non-leader behaviors that have zero or negative-effect relationships with effectiveness. This might be due to the aggregated scale they used by merging both active and passive management by exception constructs.

Mixed results were also reported in a Ph.D. dissertation study in which a significant positive relationship was found between the transactional contingent reward leadership style and emotional intelligence. In contrast, an insignificant negative relationship was found
between the transactional management by exception (active) leadership style and emotional intelligence (Legier Jr. 2007). In this work, MLQ self-rating form and rater form were used to measure the leadership styles of leaders in an automotive parts manufacturing firm. Furthermore, in a study conducted on a public agency in the Netherlands, a negative relationship was found between transactional leadership and followers innovative behavior (Pieterse et al. 2010). They used MLQ 5X short instrument to measure the leadership styles including transactional leadership. Similar findings were detected by Howell and Avolio (1993), who revealed a negative relationship between transactional leadership and performance. They used MLQ 5X short to measure the leadership styles of leaders from the top 4 level of management in a large Canadian financial institution (Howell and Avolio 1993). In another Ph.D. dissertation study in which the relationship between leadership styles and the company’s shareholder value was investigated, mixed results were reported (Ives-Lozinski 2016). While a significant positive relationship was found between contingent reward and shareholder value, management by exception (active) was found to be insignificantly related to shareholder value.

While our results are consistent with previous research that found a negative and statistically insignificant relationship between transactional leadership style (particularly the management by exception – active construct) and different organizational outcomes, the studies investigating the relationship between transactional leadership style and the leaders’ perception of adopting sustainability practices in the ground transportation sector is either not yet developed or unavailable. Lack of empirical studies investigating the relationship between transactional leadership style and adopting sustainability practices in the ground transportation organizations, hinders the ability to make definitive statements. At the same time, inconsistency of the results reported in previous research work investigating the
relationship between transactional leadership and different organizational outcomes precludes meaningful interpretation.

The findings of our current study indicate an insignificant relationship between transactional leadership style and leaders perception of adopting and embracing sustainability practices in their organizations within the ground transportation sector. The results obtained here imply that leaders who exercise transactional leadership styles in a ground transportation firm, have no significant impact on perception nor in inspiring a willingness to embrace the adoption of sustainability measures. Similarly, Howell and Avolio (1993) claim that, in their study, transformational leadership measures were significantly and positively related to business unit’s performance while transactional measures of leadership were negatively related to business unit’s performance.

6.1.3 Passive/Avoidant Behavior and Sustainability

Passive/avoidant leaders are those who avoid attempting to influence their subordinates and who generally evade their supervisory duties. They tend to be inactive and have no confidence in their ability to perform leadership. They passively delegate most responsibilities to subordinates, set no clear goals, and do not aid their teams in making decisions. They avoid getting involved in decision making and facing challenges and problems (Bass 2008). Passive/avoidant leaders have been observed to focus merely on mistakes, which impacts associate development and performance. This leadership behavior comprises two components: Management by Exception-Passive (MEP) and Laissez-Fair. When leaders were rated as “frequently,” using a Laissez-Faire style of leadership or passive Management-by-Exception (Avolio and Bass 2004; Bass 2008), a strong negative relationship between a passive/avoidant leadership style and a number of organizational outcomes such as effectiveness and satisfaction were found.
Although the passive/avoidant style consists of (MEP) and Laissez-Fair, the two constructs were merged into one single construct due to a lack of discriminant validity among its constructs. Further, multiple problematic items and those with lower outer loadings were eliminated, resulting in three items representing the Passive/Avoidance construct. According to Hair et al. (2017), a formative indicator with an insignificant outer weight should be removed only if the outer loading is also insignificant and below 0.5.

The results of this study showed a low positive and statistically insignificant relationship between passive/avoidant leadership and sustainability. While hypothesis 1c is not supported due to insignificance of the results and the direction of the relationship, this finding does not support the results obtained in other studies that found a significant negative relationship between passive/avoidant leadership and a number of organizational and contextual outcomes. Based on colleagues’ ratings of leaders, strong negative relationships were found with effectiveness and satisfaction when leaders were rated as frequently using passive/avoidant style (Avolio and Bass 2004). In the construction sector, Chan and Chan (2005) found that passive/avoidant style is seldom used by building professionals. Their study revealed a very low negative and statistically significant relationship between passive/avoidant style and a number of employees work outcomes such as extra effort, leader effectiveness, and satisfaction with leader. They used MLQ (5x short) to measure the leadership styles of building professionals including architects, structural engineers, and surveyors throughout Australia, Hong Kong, Singapore, and the UK (Chan and Chan 2005).

In a Ph.D. dissertation study, Davis (2008) revealed similar results indicating that passive avoidant style affects the extra effort exerted by subordinates, job satisfaction, and perception of leader’s effectiveness negatively. In this work, MLQ (5x short) was utilized to measure the leadership styles of project managers who are members of Project Management Institute located in the U.S. (Davis 2008).
The results obtained in previous research work using MLQ instrument to measure the leadership styles including passive/avoidant on a number of organizational outcomes were found to be inconsistent. In a meta-analysis work that includes studies that used MLQ to measure leadership styles from the perspective of the subordinates, Lowe et al. (1996) found that passive/avoidant style has either no relationship or is negatively related to leader effectiveness (Lowe, et al. 1996). The results obtained by a Ph.D. dissertation study revealed a negative and statistically insignificant relationship between passive/avoidant style and subordinate perception of their leader performance in an automotive parts manufacturing firm (Legier Jr. 2007). In this work, MLQ self-rating form and rater form were used to measure the leadership styles. The results suggest that passive/avoidant style is not perceived by subordinates as a common leader’s practice in their organization.

Mixed results were also reported in another research, where a significant and weak positive relationship was found between passive/avoidant leadership style and work assignment, which is one of the two dimensions of job satisfaction (Voon et al. 2011). The significant and weak negative relationship between passive/avoidant style and the other dimension of the job satisfaction (working condition), suggests that the reason behind such weak relationship might be either because leaders practice passive/avoidant style seldomly, or due to the presence of a moderating variable, which could influence the relationship between variables. They used MLQ instrument to measure the leadership styles including passive/avoidant of Malaysian executives working in the public sector.

While our results are consistent with previous research that found very weak positive and statistically insignificant relationship between passive/avoidant style and different organizational outcomes, the studies investigating the relationship between passive/avoidant style and the leaders’ perception of adopting sustainability practices in the ground transportation sector is either not yet developed or unavailable. Overall, the results of this
study implies that leaders who exert laissez-fair behavior in a ground transportation firms have no significant impact on adopting sustainability practices.

6.1.4 Transformational Leadership and Asset Management

The role of leadership in promoting and adopting asset management practices in ground transportation received very little attention. Merely a small number of studies addressed the role of leadership in promoting and adopting asset management practices in the infrastructure domain. The literature review provided in Chapter 2 reveals that the body of research studying the influence of transformational leadership (in particular) on asset management in ground transportation is underdeveloped. Only a handful of studies demonstrated the role of leadership (in general) in adopting asset management practices within the infrastructure domain.

Edwards (2010) underscored the link between leadership and organizational culture as an enabler for successful implementation of asset management. Developing an asset management culture in an organization is recognized as increasingly important to helping transition from a ‘silo’ view of its departments to a more integrated view of asset management (Edwards 2010). A survey of experts in asset management, undertaken by Kellick (2014), revealed that leadership is the most important success factor in the adoption of asset management practices in infrastructure organizations (Kellick 2014). Among ten other factors, ‘executive support’ was top ranked, which indicates the significant role of leadership in the adoption and implementation of asset management practices. Kellick (2010) also recommends that asset management be integrated into the decision-making process, suggesting the important role of senior management support for the adoption and implementation of asset management practices. Asset-management researchers agree that even though asset management does not start in the boardroom, it definitely ends there. This conclusion is in line with what those reached across the industry and the literature.
The results of this study reveal a positive and statistically significant relationship between transformational leadership and asset management, supporting the few studies that found similar results in differing setups. What research is available on the link between leadership and adoption of asset management focuses on either other styles of leadership or leadership in general. To the author’s knowledge, no other empirical research exists investigating the relationship between transformational leadership and perception and a willingness to adopt asset management practices in ground-transportation firms. The results imply that transformational leaders working in ground transportation organizations are well aware of the importance of implementing asset management practices and that they are most likely the best candidates to adopt asset management practices where they work.

6.1.5 Transactional Leadership and Asset Management

The results of this study show a very weak positive and statistically insignificant relationship between transactional leadership and asset management. Hypothesis 2b is not supported due to insignificance of the results. This result does not support those obtained in other studies that found a positive and significant relationship between transactional leadership and some organizational and contextual outcomes. One of those studies is the work of Tyssen et al. (2014) who detected a significant positive relationship between transactional leadership and project success and project commitment. They used MLQ 5X short instrument to measure the leadership styles of the International Project Management Association (IPMA) members located in Austria, Switzerland, and Germany (Tyssen et al. 2014). They utilized SEM-PLS technique to analyze the data collected from IPMA members who worked in temporary work environments in diverse industries and project types. Similar findings were detected by Jung and Avolio (2000) who found a significant positive relationship between transactional leadership and trust in the leader, value congruence, and satisfaction. They partially used MLQ 5X to measure transformational and transactional
leadership of students from upper business courses at a public university in Northeastern US (Jung and Avolio 2000).

The results obtained in this study are in line with the findings reported by other research work in which an insignificant relationship was found between transactional leadership and a number of organizational outcomes. In a Ph.D. dissertation study, Ives-Lozinski (2016) detected an insignificant relationship between transactional leadership and the company’s shareholder value. This was highlighted particularly in the relationship between management by exception (active) construct and the company’s shareholder value. MLQ 5X instrument was used to measure the leadership style of high-level executives in Canadian oil and gas industry (Ives-Lozinski 2016). Similar findings were also found in a Ph.D. dissertation study in which an insignificant negative relationship was reported between the transactional management by exception (active) leadership style and emotional intelligence (Legier Jr. 2007). In this work, MLQ self-rating form and rater form were used to measure the leadership styles of leaders in an automotive parts manufacturing firm. Further evidence supporting the results obtained by this study were found in another Ph.D. dissertation study in which the relationship between transactional leadership style of project managers as perceived by subordinates and subordinates willingness to exert extra effort was investigated (Davis 2008). An insignificant relationship was reported between transactional leadership and willingness to exert extra effort and job satisfaction. MLQ 5X instrument rater form was used to measure the leadership styles of project managers throughout the U.S. who are members of the Project Management Institute (PMI).

While our results are consistent with previous research that found statistically insignificant relationship between transactional leadership style and different organizational outcomes, the studies investigating the relationship between transactional leadership style and the leaders’ perception of adopting asset management practices in the ground transportation
sector is either not yet developed or unavailable. Lack of empirical studies investigating the relationship between transactional leadership style and adopting asset management practices in the ground transportation organizations, hinders the ability to make definitive statements. At the same time, inconsistency of the results obtained in previous research work investigating the relationship between transactional leadership and different organizational outcomes precludes meaningful interpretations.

The results obtained here imply that leaders who exercise a transactional leadership style in a ground transportation firm have no significant impact on the perception and willingness to embrace and adopt asset management practices. This finding is consistent with previous research that substantiates that transactional leadership provides a basis for effective leadership but that greater effort, effectiveness, and satisfaction are achieved when transactional leadership is integrated with transformational leadership (Bass 1985). In other words, transactional leaders are able to perform well in adopting asset management practices only when they exert transformational leadership skills. Furthermore, the very weak and insignificant results indicate that transactional leadership style is seldomly used by top and middle leaders who are perceived to willingly adopt asset management practices in the U.S. ground transportation sector.

6.1.6 Passive/Avoidant behavior and Asset Management

The results of this study show a very low positive and statistically insignificant relationship between passive/avoidant style and the adoption of asset management. Hypothesis 2c is not supported due to insignificance of the results and the direction of the relationship. This finding does not support the results obtained in other studies that found a significant negative relationship between passive/avoidant leadership and a number of organizational and contextual outcomes. As described in section (6.1.3), previous research revealed mixed results on the relationship between passive/avoidant leadership style and a
number of organizational outcomes in terms of significance and the relationship direction. In a Ph.D. dissertation study, Johnson (2012) found weak negative and statistically insignificant relationship between passive/avoidant style and job satisfaction of virtual team members across the NSEO Contract Management Office. In this work, MLQ instrument was used to measure the leadership styles including passive/avoidant style (Johnson 2012). Similarly, Ives-Lozinski (2016) found an insignificant relationship between passive/avoidant style and the company’s shareholder value. MLQ 5X instrument was used in their study to measure the leadership styles of high level executives in Canadian oil and gas industry.

Lack of empirical studies investigating the relationship between passive/avoidant style and adopting asset management practices in the ground transportation organizations, hinders the ability to make definitive statement. Inconsistency of the results reported in previous research along with the lack of empirical studies investigating the relationship between passive/avoidant and asset management, preclude meaningful interpretations. Overall, our results imply that leaders who exercise passive/avoidant behavior in a ground transportation firm have no significant impact on adopting asset management practices. Clearly, this provides strong support to the pivotal assertion of this study that transformational leadership have strong effect on the adoption of asset management practices.

6.1.7 Transformational Leadership and Climate for Innovation

In the literature, transformational leadership has been “most strongly” related to innovation (Matzler et al. 2015). A number of studies found a positive relationship between transformational leadership and organizational innovation (Aragón-Correa et al. 2007; Chan et al. 2014; Gumusluoglu and Ilsev 2009; Howell and Avolio 1993; Howell and Higgins 1990; Jung et al. 2003; Kissi et al. 2012; Matzler et al. 2015; Munshi et al. 2005; Opoku et al. 2015b; Panuwatwanich et al. 2008; Taylor et al. 2011). Transformational leadership has been recognized as one of the most influential contemporary leadership theories. In general,
transformational leadership theories emphasize emotions, values, and the importance of leadership that encourages creativity and innovation (Garcia-Morales et al. 2012; Matzler et al. 2015). In this study, organizational innovation was estimated by the Climate for Innovation measure as described in Chapter 3. This measure assesses the degree to which an organization enables the employees to attempt creative ideas and adopt innovative practices. Therefore, it measures a climate for innovation at the organizational level, not at the individual level. Basically, a leader provides information about their perception of the actual climate in the organization in which they, themselves, work. A positive and significant result, in this manner, indicates that transformational leaders perceive their organizations as places that create a climate of innovation.

The results obtained in this study indicate a strong positive and statistically significant relationship between transformational leadership and climate for innovation. This finding is supportive of a number of studies that found similar results. Jung et al. (2003) found that transformational leaders can influence employees’ creativity and affect organizational innovation in several different ways. The significance of the results obtained implies that leaders with transformational leadership skills are able to create a climate of innovation where new and innovative ideas can be embraced and adopted.

Transformational leadership is able to improve organizational innovation due to several reasons. First, it provides decisive answers “that link followers’ identities to the collective identity of their organization, thereby increasing followers’ intrinsic motivation (rather than just providing extrinsic motivation) to perform their job” (Chan et al. 2014). Second, Transformational leaders focus on fostering the higher order intrinsic needs of their followers compared to the short-term ones (Chan et al. 2014). They tend to articulate a clear and important vision and mission, which “increase followers’ understanding of the importance and values associated with desired outcomes, raise their performance
expectations, and increase their willingness to transcend their self-interests for the sake of the collective entity” (Jung et al. 2003). Third, transformational leaders inspire employees through motivation, mainly by communication, while seeking performance beyond expectation (Garcia-Morales et al. 2012). Howell and Avolio (1993) refer to the performance beyond expectation as “Followers' level of extra effort” that “… may be due, in part, to their commitment to the leader, their intrinsic work motivation, their level of development, or the sense of purpose or mission that drives them to excel beyond the standard limits” (Howell and Avolio 1993). Fourth, by providing intellectual stimulation, transformational leaders encourage their employees to think differently, challenge their comfort zones, and to adopt generative and exploratory thought processes. “Transformational leaders stimulate their followers to think about old problems in new ways and encourage them to challenge their own values, traditions, and beliefs (Jung et al. 2003).” Finally, by adopting intellectual stimulation skills, transformational leaders promote employee learning and overall intelligence, ultimately leading to their innovation and creativity (Garcia-Morales et al. 2012). Overall, transformational leaders tend to create and maintain a climate in which employees feel encouraged to engage in creative and innovative tasks to perform their jobs.

6.1.8 Climate for Innovation and Sustainability

In this study, adoption of sustainability is presented as a solution for the challenges facing the infrastructure domain and, more specifically, within the ground transportation sector. Sustainability involves a set of methods, approaches, and practices that may be perceived as “new” to some organizations in this field. As mentioned in Chapter 2, the body of literature on a leader’s influence on sustainable innovation processes is limited; much of the discussion in leadership and innovation studies focus on the influence of leadership on innovation in general (Bossink 2007). Chapter 2 revealed that the body of research on the relationship between sustainability and innovation within the ground transportation sector is
underdeveloped. Much of the available research found that innovation is essential to society as a whole as well as several aspects of organizational performance, such as operational effectiveness, financial outcomes, market competitiveness, and organization growth (Chan et al. 2014).

Slaughter (1998) foregrounds a number of benefits attributable to innovation in the construction industry, which include economic growth, improvement in productivity, an increase in market share, social benefits (equity and equality), improved quality of life, reducing environmental impacts, higher technical feasibility, and other intangible benefits (Slaughter 1998). At the project-level, innovative practices have been found to expectedly increase the efficiency and effectiveness of construction site operations (Dulaimi et al. 2005). Yet, only a handful of studies demonstrate the positive impact of innovation in adopting sustainable practices within the infrastructure/construction domain.

The results of this study indicate a positive and statistically significant relationship between Climate for Innovation and Adoption of Sustainability. These findings are supportive of a few studies that found similar results. One of the few studies that investigates the link between innovation and implementing sustainable practices in infrastructure organizations is the work of Taylor (2011) who studies the role of “champions” in promoting sustainable practices in the Australian water industry (Taylor et al. 2011). It has been found that champion leaders facilitate a safe environment for innovation leading to the adoption of sustainable practices. A positive and significant relationship between climate for innovation and sustainability suggests that sustainability is a trending approach and an outcome of innovation as a movement.

6.1.9 Climate for Innovation and Asset Management

The adoption of asset management, in this study, is presented as a solution for the challenges facing the infrastructure domain and, more specifically, the ground transportation
sector. Asset Management involves a set of methods, approaches, and practices that may be perceived as “new” to some organizations in the field. As leadership has a positive and significant influence on various organizational outcomes, it can impact the organizational inertia preventing individual departments from working together on initiatives. Leaders with the right skills can typically disrupt the status quo and encourage the adoption of new practices previously uncommon to the organization (FHWA 2010).

The results indicate a positive and statistically significant relationship between Climate for Innovation and Asset Management. These findings are supportive of a few studies with similar results. Findings from an International Scan published as a TRB report (TRB 2008) revealed that “the evolution in the use of asset management was viewed as changing the culture of the organization.” Cultivating an asset management culture in an organization has been stressed as it is found to be one of the most important components of asset management programs. A positive and significant relationship between climate of innovation and asset management suggests that organizational innovation influences the adoption of asset management.

6.1.10 Climate for Innovation as a Mediator Between Transformational Leadership and Sustainability

A number of studies found a strong relationship between transformational leadership and organizational innovation (Aragón-Correa et al. 2007; Chan et al. 2014; Gumusluoglu and Ilsev 2009; Howell and Avolio 1993; Howell and Higgins 1990; Jung et al. 2003; Kissi et al. 2012; Matzler et al. 2015; Munshi et al. 2005; Opoku et al. 2015b; Panuwatwanich et al. 2008; Taylor et al. 2011), investigating a mediation effect of climates for innovation in the relationship between transformational leadership and creativity (Gumusluoglu and Ilsev 2009). However, available research does not examine the mediating effect of a climate for innovation in the relationship between transformational leadership and sustainability. This
study proposes that leader perceptions of innovative climates in their organizations are the mechanism underlying the effects of transformational leadership on adopting and embracing sustainability practices.

The results indicate a positive and significant relationship between transformational leadership and climate for innovation, on the one hand, and a positive and significant relationship between climate for innovation and sustainability, on the other. The results also reveal that climate for innovation has a partial mediation effect on the relationship between transformational leadership and sustainability. Following the procedure presented by Zhao et al. (2010) for mediation analysis, the results obtained in Chapter 5 are indicative of a complementary mediation effect. Complementary mediation also reveals that another mediator may have been omitted whose indirect path has the same direction as the direct effect (Hair et al. 2017). This also indicates that climate for innovation mediates a portion of the effect of transformational leadership on sustainability, whereas transformational leadership still explains a portion of sustainability that is independent of climates for innovation (Nitzl et al. 2016).

6.1.11 Climate for Innovation as a Mediator Between Transformational Leadership and Asset Management

Despite a number of studies that found a strong relationship between transformational leadership and organizational innovation, available research does not examine the mediating roles of climate for innovation in the relationship between transformational leadership and adoption of asset management. This study proposes that leader perceptions of the organizational climate for innovation is the mechanism underlying the effects of transformational leadership on adopting and embracing asset management practices.

The results indicate a positive and significant relationship between transformational leadership and climate for innovation, on the one hand, and a positive and significant
relationship between climate for innovation and adoption of asset management, on the other. The results also reveal a partial mediation effect of climate for innovation on the relationship between transformational leadership and asset management. Following the procedure presented by Zhao et al. (2010) for mediation analysis, the results obtained in Chapter 5 are indicative of a complementary mediation effect. Complementary mediation, as mentioned in the previous section, provides a cue that another mediator may have been omitted when the cue’s indirect path has the same direction as the direct effect (Hair et al. 2017). This also indicates that a portion of the effect of Transformational Leadership on Asset Management is mediated through Climate for Innovation, whereas Transformational Leadership still explains a portion of Asset Management that is independent of Climate for Innovation (Nitzl et al. 2016).

6.1.12 Organization Type as a Moderator Between Transformational Leadership and Sustainability

This research examined and evaluated the influence of contextual factors on the development of leadership style for leaders working in different contextual situations comprising internal and external contexts, which include organization type. The study covered multiple-level leadership (middle and top management), different organization type (public and private), as well as different infrastructure departments (planning, design, construction, operations and maintenance).

The results of the study indicate that the moderating effect of organization type on the relationship between transformational leadership style and sustainability is insignificant. The results suggest no moderation effect of organization type on the relationship between transformational leadership and sustainability. A positive and significant effect of organization type on the relationship between transformational leadership and sustainability, if existed, would have been indicative of a stronger relationship between transformational
leadership and sustainability in the private sector than in the public sector. Contrarily, a negative and significant effect of organization type on the relationship between transformational leadership and the dependent variables, if existed, would have been indicative of a stronger relationship between transformational leadership and sustainability in the public sector than in the private sector. Since the results of the study reveal an insignificant effect of organization type as a moderator, neither the private nor the public sector have a positive/negative effect on the intensity and magnitude of the influence of transformational leadership style on the perception of embracing and adopting sustainability practices. To the author’s knowledge, there is no other research investigating the role of organization type as a moderator on the relationship between transformational leadership style and the leader’s perception of embracing and adopting sustainability practices.

6.1.13 Organization Type as a Moderator between Transformational Leadership and Asset Management

The results of the study indicate that the moderating effect of organizational type on the relationship between transformational leadership style and asset management is insignificant. The results are indicative of no moderation effect of organization type on the relationship between transformational leadership and asset management. A positive and significant effect of organization type on the relationship of transformational leadership and asset management, if existed, would have been indicative of a stronger relationship between transformational leadership and asset management in the private sector than in the public sector. Contrarily, a negative and significant effect of organization type on the relationship between transformational leadership and asset management, if existed, would have been indicative of a stronger relationship between transformational leadership and asset management in the public sector than in the private sector. Since the results of the study reveal an insignificant effect of organization type as a moderator, neither the private nor the
public sector have a positive/negative effect on the intensity and magnitude of the influence of transformational leadership style on the perception of embracing and adopting asset management practices. To the author’s knowledge, there is no other research that investigates the role of organization type as a moderator of the relationship between transformational leadership style and the leader’s perception of embracing and adopting asset management practices.
Chapter 7 - Conclusions

The purpose of this study was fourfold. First, the objective was to examine the multivariate relationships between leadership styles (transformational, transactional and passive/avoidant) and the leader’s perception of embracing and adopting sustainability and asset management practices in civil infrastructure organizations and, more specifically, within the ground transportation sector. Second, the goal was to identify the prominent leadership styles of individuals who promote and adopt innovation in sustainability and asset management methods and practices. Additionally, the aim was to investigate whether organizational innovation mediates the relationship between transformational leadership and sustainability/asset management. Third, the other objective of this study was to examine and evaluate the influence of contextual factors on the development of leadership style of leaders working in different contextual situations, internal and external, which include organizational characteristics. For that purpose, a multi-dimensional assessment was performed to include different organization types (public and private). Finally, the aim was to investigate whether the relationship between transformational leadership and the leader’s perception of adopting sustainability and asset management practices was influenced (moderated) by an organization type (public and private).

The findings from this study revealed the predictive role of leadership styles and organizational innovation on the adoption of sustainability and asset management practices, within the ground transportation sector. In addition, the results indicate a partial mediation effect of organizational innovation on the relationship between transformational leadership and the leader’s perception of adopting sustainability and asset management practices. Finally, a multi-dimensional analysis revealed the absence of a significant influence when organization type (public and private) was used as a moderator. Overall, the findings
demonstrated a positive and statistically significant relationship between transformational leadership and perception of adopting sustainability and asset management practices.

The results obtained from this study also showed a negatively low and statistically insignificant relationship between transactional leadership and the leader’s perception of adopting sustainability and asset management practices. Moreover, the findings revealed a positively low and statistically insignificant relationship between passive/avoidant and the leader’s perception of adopting sustainability and asset management practices. The findings of this study revealed a partial mediation effect of organizational innovation on the relationship between transformational leadership style and the leader’s perception of embracing and adopting sustainability and asset management practices and methods in ground transportation.

Finally, no moderation effect was detected of the organization type (public vs. private) on the relationship between transformational leadership and the leader’s perception of adopting sustainability and asset management practices.

The findings presented in this study are consistent with previous research that has found a strong and significant relationship between leadership and a number of organizational and business management outcomes. However, the research on the influence of transformational leadership on sustainability and asset management in the ground transportation sector received very little attention, if any. This study’s findings have contributed to the body of knowledge by filling a gap in the existing literature. The findings of this study reveal that the prominent leadership style (transformational) facilitates a climate for innovation. Transformational leadership style was found to be significantly related to the leader’s perception of adopting and embracing sustainability and asset management practices. The findings are also indicative of insignificant negative influences of transactional leadership style on the leader’s perception of adopting sustainability and asset management.
practices, while passive/avoidant style has an insignificantly low positive relationship with the leader’s perception of adopting sustainability and asset management practices.

The findings presented in this study also provide important insight for both researchers and practitioners alike. The theoretical contribution of the study’s findings includes a better understanding of the association of leadership styles on the adoption of sustainability and asset management practices, and the role of organizational innovation in that relationship. Additionally, this study presented a multi-dimensional analysis by investigating a moderation effect of organization type (public and private). The findings from this research study offer empirical evidence that ground transportation organizations need to develop programs that are able to distinguish, identify, cultivate, promote, and empower leaders with transformational leadership skills. Sustainability and asset management implementation requires a certain caliber of leaders who are able to effectively change the status quo into more innovative environments in response to the unprecedented challenges the ground transportation sector is facing. The findings also suggest that transactional leaders do not represent the best candidates to hire or promote when the organization objectives include the implementation of sustainability and asset management practices.

This research underscores the importance of contextual factors when investigating the role of leadership styles in relation to innovation and adoption of sustainability and asset management. Organization type (Public vs. Private) does not exert any significant impact on the results obtained from the study. The results also confirmed the partial mediation effect of organizational innovation on the relationship between transformational leadership and the leader’s perception of adopting sustainability and asset management. The findings imply that only leaders with transformational leadership skills are able to create a climate for innovation in their organizations when implementing sustainability and asset management in response to the major challenges facing the infrastructure domain within ground transportation.
7.1 Limitations

The limitations of this study can be listed as follows:

1. A potential for bias in self-selected participants: Respondent answers may be significantly different from the overall population that chose not to participate in the survey. This could happen due to the mechanism used for data collection. The data collected from participants located in the U.S. was administered by Qualtrics ® research services contract, in which participants were reached via email with a link to the survey. Participants were mainly accessed through a pool of registered professionals in return for a reward. That means that the research sample was limited to leaders who registered with Qualtrics only. Although participants were screened for certain criteria related to the research population in terms of the business sector (ground transportation), level of management (top two levels of management), and location (USA, all states), entire data collection procedure was performed by Qualtrics ®; the data was automatically saved in the researcher’s account for further analysis.

2. Self-reporting is a limitation of this study, in which participant responses may vary due to the respondent's self-reported measures. Common source method is another limitation since participants have to rate themselves on their leadership styles as well as their perception of adopting and embracing sustainability and asset management practices in the organizations where they work. After all, they may rate themselves differently from others. Ideally, observing the behavior characteristics of leaders through their associates’ rating would have been a more accurate method but this was not possible due to research constraints.
3. The study’s generalizability may have suffered due to these reasons: The scarcity of executives in the top two managerial levels, along with the weak response rate, posed considerable obstacles to collecting data. Moreover, the study is limited to the top two level of management working within the ground transportation (roads, bridges, tunnels, and railroads) sector only. Finally, the study is based solely on a sample from the ground transportation sector located in the U.S. only.

The implications of this study should be evaluated based on the context of its limitations and delimitations. This was the first study to investigate the relationship between leadership styles as predictors of adopting sustainability and asset management practices, in addition to organizational innovation as a mediator on the relationship between transformational leadership and the leader’s perception of adopting sustainability and asset management practices within the civil infrastructure domain and, specifically, in U.S. ground transportation.

7.2 Future Research

The two dependent variables (research outcomes) of this study were leader perceptions on adoption of sustainability and asset management practices. Measuring sustainability and asset management implementation at the organizational level was not pursued due to practical constraints. Future research needs to include a method for measuring the implementation of sustainability and asset management practices by setting up predefined performance indicators and systematic evaluation criteria. Future research could focus more on qualitative approaches to obtain more comprehensive results. Future research is also needed to examine other leadership styles (e.g., authentic leadership, servant leadership, etc.), and the relationships between these leadership styles and sustainability and asset management implementation.
Future studies may also investigate multiple demographics, professional, and contextual factors such as age, gender, tenure, work environment, income, organization size, etc. to determine if a relationship exists between leadership and the implementation of sustainability and asset management based on these factors in the context of organizational innovation.

A larger sample would support a better representation of the research findings by reaching more participants and, subsequently, generating larger datasets for more comprehensive analysis. Therefore, future research could find different results with a different sample profile. Future researchers may shift the focus from ground transportation to examine findings from different organization types and industries to enhance the generalizability of the research.

This research measured leadership style based on the leadership “full range” theory presented by Bass (1985). The MLQ (5X short) instrument was used to identify and measure key leadership behaviors among participating leaders. MLQ consists of two questionnaire forms: the Self Rating Form, where executives rate themselves as leaders (ratees), and the Rater Form, where associates rate their leaders (raters). This research used the self-rating form only where leaders evaluated how frequently, or to what extent, they believe they engage in the same types of leadership behavior toward their associates. Rater form has not been used due to logistical and operational difficulties since the identification of participating leaders’ subordinates was beyond the author’s capabilities and reach. Future research may focus on smaller group of organizations within common geographic characteristics to make the use of both forms more feasible and possible.

MLQ comprises 9 factors representing the full range of leadership: Transformational (5 factors), Transactional (two factors) and Passive/Avoidance Behavior (2 factors). This study used an aggregate method to measure each of the leadership styles at higher-order
analysis. Future research can focus on expanding the method into a lower order factor analysis to include each of the 9 factors as individual leadership styles. Finally, future research may investigate the relationship between sustainability and asset management. Previous research found that adoption of asset management would be an enabler and act as a vehicle for sustainability in an organization.

The data used in this study was collected just before the COVID-19 pandemic hit the world. Future research may investigate the impacts of extreme circumstances caused by the global pandemic on the operation of the ground transportation sector. As many other industries suffered from the implications caused by COVID-19, transportation organizations witnessed considerable changes in their operating environments due to remote working conditions, pause or delays in design and construction of projects, and disruptions to revenue sources. Increase in e-shopping and decrease in passenger trips resulted in shifts in traffic compositions of several major corridors. While these dramatic changes urged agencies and decision makers to face unprecedented challenges, they also represented opportunities for innovation. Many agencies and private firms also realized the importance of resilience to such extreme events. As such, future research may investigate whether the pandemic resulted in any significant changes on the findings of this work.
Appendices

Appendix A – Invitation to Participate in Survey (web-based)

CIVIL & ENVIRONMENTAL ENGINEERING
COLLEGE OF ENGINEERING AND COMPUTER SCIENCE
(351 Link Hall, Syracuse, NY 13244. Tel.: 315.443.2558)

Research Title: Transformational Leadership and Adoption of Sustainability and Asset Management: The Role of Transformational Leadership in Creating Climate for Innovation that Promotes Sustainability and Asset Management Practices in Transportation Sector in UK and Kuwait

Dear Sir or Madam,

As a professional leader in the domain of Infrastructure and specifically within Ground Transportation sector, you undoubtedly have remarkable ways, in terms of skills and behavior, in which you influence others to challenge the status quo and change the mindset from business-as-usual to innovative ways of doing business. Leadership style that promotes adoption of Sustainability and Asset Management practices should be identified in order to help distinguish professional development, competency and commitment to the field. Your response to this survey will enhance our awareness and understanding to this important subject matter.

I’m conducting this research to investigate the distinctive leadership behaviors that leaders display while running their organization’s business units. Leadership style that advocates more adoption of Sustainability and Asset Management is the main variable this research is trying to explore and hopefully to unfold. I attempt to identify the link between leadership behavior and skills in creating a climate for innovation that promotes Sustainability and Asset Management in the Transportation sector. I attempt also to measure how leaders influence their employees in different contextual factors such as organizational environment and culture. The targeted research population consists of leaders from the first two levels of management in Ground Transportation organizations in the United States. Leaders of age 18 and older are invited to participate in this survey.

Please click on the link given in this email and follow the instructions to complete the online survey. The survey consists of five parts; each part measures a certain research variable. Please take the time to respond to all questions since they are inter-dependent and inter-connected. The estimated burden for this survey is approximately 15-20 minutes. Please complete the survey within two weeks. You will be able to complete the survey in stages; please use the same link as given to resume your work. As an incentive, you will receive a gift card or cash for completing the survey. You will be compensated the amount you agreed to prior to opening this survey. For partial completions, participants may receive partial compensation or a raffle entry into a sweepstakes. For participants who do not complete the survey or skip questions, the dedicated research team member maintains communication to take appropriate action.

For further information or in case you have any questions or concerns about this research and/or the survey, please do not hesitate to contact me via mmnbushhab@syu.edu

Thank you for your interest and participation in this study. I genuinely appreciate your valuable time.

Sincerely,

Mohammad Bushabini
Ph.D. Student
Department of Civil and Environmental Engineering
Syracuse University
351 Link Hall, Syracuse, NY, 13244
mmnbushab@syu.edu
Appendix B – Consent Letter

CIVIL & ENVIRONMENTAL ENGINEERING

COLLEGE OF ENGINEERING AND COMPUTER SCIENCE

(151 Link Hall, Syracuse, NY 13244. Tel.: 315.443.2558)

Research Title: Transformational Leadership and Adoption of Sustainability and Asset Management: The Role of Transformational Leadership in Creating Climate for Innovation that Promotes Sustainability and Asset Management Practices in Transportation Sector in US and Kuwait

My name is Mohammad Bushahri, and I am a graduate student at Syracuse University. I am inviting you to participate in a research study. Involvement in the study is voluntary, so you may choose to participate or not. This sheet will explain the study to you and please feel free to ask questions about the research if you have any. I will be happy to explain anything in detail if you wish. This research is being administered and supervised by my academic advisor Dr. Baris Salman.

I am interested in learning more about the distinctive leadership behavior that leaders display while running their organization’s business units. Leadership style that advocates more adoption of Sustainability and Asset Management is the main variable this research is trying to explore and hopefully to unfold. I attempt to identify the link between leadership behavior and skills in creating a climate for innovation that promotes Sustainability and Asset Management in Transportation sector. I attempt also to measure how leaders influence their employees in different contextual factors such as organizational environment and culture. The research population would be leaders who are 18 years or older from the first two levels of management in Transportation organizations, mainly within federal, state and city agencies as well as main contractors working in Transportation projects in the United States and Kuwait. You will be asked to answer all questions/statements in the attached papers and follow the instructions to complete the questionnaire. The questionnaire consists of five parts, each part measures a certain research variable. Make sure you respond to all questions since they are inter-dependent and inter-connected. This will take approximately 15-20 min. of your time.

All information will be kept confidential. Your participation in this research is voluntary and your confidentiality is assured. As an incentive, you will receive a gift card or cash for completing the survey. You will be compensated the amount you agreed to prior to opening this survey. Return of this survey after completing it is your consent for your responses to be compiled with others. Please note that the use of this data will be limited to this research only, as authorized by the Syracuse University – IRB Office, although results may ultimately be presented in formats other than the dissertation, such
as journal articles or conference presentations. You may contact me directly with any concerns related to this survey or the research in general at my below mentioned email.

Contact Information:
If you have any questions, concerns, complaints about the research, contact my faculty advisor at lesalman@syr.edu or contact me at mnbushsh@syr.edu. If you have any questions about your rights as a research participant, if you have questions, concerns, or complaints that you wish to address to someone other than the investigator, if you cannot reach the investigator, contact the Syracuse University Institutional Review Board at 315-443-3013.

Please note that whenever one works with email or the internet there is always the risk of compromising privacy, confidentiality, and/or anonymity. Your confidentiality will be maintained to the degree permitted by the technology being used. It is important for you to understand that no guarantees can be made regarding the interception of data sent via the internet by third party. Also note that you may encounter social risks when responding to some of the questions in the survey, especially to those related to your organization’s performance and overall business outcomes. By participating in this research, you will be able to assess your leadership style and identify strengths and weaknesses in your leadership.

Please print a copy of this consent letter for your record

By completing and returning the survey, I agree to participate in this research study.
### Appendix C – IRB Approval

**SYRACUSE UNIVERSITY**

**INSTITUTIONAL REVIEW BOARD**  
**MEMORANDUM**

**TO:** Baris Salman  
**DATE:** May 31, 2018  
**SUBJECT:** Expedited Protocol Review - Approval of Human Participants  
**IRB #:** 18-143  
**TITLE:** Transformational Leadership and the Adoption of Sustainability and Asset Management: The Role of Leadership Style in Creating a Climate for Innovation that Promote the Adoption of Sustainability and Asset Management Practices in Transportation Sector in USA and Kuwait

The above referenced protocol was reviewed by the Syracuse University Institutional Review Board for the Protection of Human Subjects (IRB) and has been given **expedited approval**. The protocol has been determined to be of no more than minimal risk and has been evaluated for the following:

1. the rights and welfare of the individual(s) under investigation;
2. appropriate methods to secure informed consent; and
3. risks and potential benefits of the investigation.

The approval period is May 31, 2018 through May 30, 2019. A continuing review of this protocol must be conducted before the end of this approval period. Although you will receive a request for a continuing renewal approximately 60 days before that date, it is your responsibility to submit the information in sufficient time to allow for review before the approval period ends.

Enclosed are the IRB approved date stamped consent and/or assent document/s related to this study that expire on **May 30, 2019**. The IRB approved date stamped copy must be duplicated and used when enrolling new participants during the approval period (may not be applicable for electronic consent or research projects conducted solely for data analysis). Federal regulations require that each participant indicate their willingness to participate through the informed consent process and be provided with a copy of the consent form. Regulations also require that you keep a copy of this document for a minimum of three years after your study is closed.

Any changes to the protocol during the approval period cannot be initiated prior to IRB review and approval, except when such changes are essential to eliminate apparent immediate harm to the participants. In this instance, changes must be reported to the IRB within five days. Protocol changes must be submitted on an amendment request form available on the IRB web site. Any unanticipated problems involving risks to subjects or others must be reported to the IRB within 10 working days of occurrence.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Katherine McDonald  
IRB Chair

**DEPT:** Civil and Environmental Engineering, 151 Link Hall  
**STUDENT:** Mohammad Bushahri
Appendix D – IRB Amendment Approval

SYRACUSE UNIVERSITY

INSTITUTIONAL REVIEW BOARD
MEMORANDUM

TO: Baris Salman
DATE: December 12, 2018
SUBJECT: Amendment Approval - Use of Human Participants
IRB#: 15-143
AMENDMENT#: 1 – A) Consent Form Changes (Revised);
B) Change in Methods;
C) Change in Recruitment Materials/Methods (New)
TITLE: Transformational Leadership and the Adoption of Sustainability and Asset Management: The Role of Leadership Style in Creating a Climate for Innovation that Promotes the Adoption of Sustainability and Asset Management Practices in Transportation Sector in USA and Kuwait

The amendment(s) submitted to the above referenced human participants protocol for review by the Institutional Review Board (IRB) is approved.

This protocol must still be renewed based on the expiration date of May 30, 2019. If applicable, attached is the protocol's approved, amended informed consent document, date-stamped with the expiration date. This amended document replaces the original approved document and is to be used in your informed consent process. If you are using written consent, Federal regulations require that each participant indicate their willingness to participate by signing the informed consent document and be provided with a copy of the signed consent form. Regulations also require that you keep a copy of this document for a minimum of three years.

CHANGES TO APPROVED PROTOCOL: Any additional proposed changes to this protocol during the period for which IRB approval has already been given, cannot be initiated without IRB review and approval, except when such changes are essential to eliminate apparent immediate harm to the participants. Changes in approved research initiated without IRB review and approval to eliminate apparent immediate hazards to the participant must be reported to the IRB within five days. Protocol changes are requested on an amendment application available on the IRB website; please reference your IRB number and attach any documents that are being amended.

CONTINUATION BEYOND APPROVAL PERIOD: To continue this research project beyond May 30, 2019, you must submit a renewal application for review and approval. A renewal reminder will be sent to you approximately 60 days prior to the expiration date. (If the researcher will be traveling out of the country when the protocol is due to be renewed, please renew the protocol before leaving the country.)

UNANTICIPATED PROBLEMS INVOLVING RISKS: You must report any unanticipated problems involving risks to subjects or others within 10 working days of occurrence to the IRB at 315.443.3013 or crp@syr.edu.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Katherine McDonald
IRB Chair

DEPT: Civil and Environmental Engineering, 151 Link Hall
STUDENT: Mohammed Buahah

Research Integrity and Protections | 214 Lyman Hall | Syracuse, NY 13244-1200 | 315.443.3013 | oirp.syr.edu

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Appendix E – IRB Second Amendment Approval

INSTITUTIONAL REVIEW BOARD
MEMORANDUM

TO: Baris Salman
DATE: October 17, 2019
SUBJECT: Amendment Approval - Use of Human Participants
IRB#: 18-143
AMENDMENT#: 2 – A) Change in Methods;
B) Change in Recruitment Materials/Methods (New)
TITLE: Transformational Leadership and the Adoption of Sustainability and Asset Management: The Role of Leadership Style in Creating a Climate for Innovation that Promote the Adoption of Sustainability and Asset Management Practices in Transportation Sector in USA and Kuwait

The amendment(s) submitted to the above referenced human participants protocol for review by the Institutional Review Board (IRB) is approved.

This protocol must still be renewed based on the expiration date of May 29, 2020. If applicable, attached is the protocol’s approved, amended informed consent document, date-stamped with the expiration date. This amended document replaces the original approved document and is to be used in your informed consent process. If you are using written consent, Federal regulations require that each participant indicate their willingness to participate by signing the informed consent document and be provided with a copy of the signed consent form. Regulations also require that you keep a copy of this document for a minimum of three years.

CHANGES TO APPROVED PROTOCOL: Any additional proposed changes to this protocol during the period for which IRB approval has already been given, cannot be initiated without IRB review and approval, except when such changes are essential to eliminate apparent immediate harm to the participants. Changes in approved research initiated without IRB review and approval to eliminate apparent immediate hazards to the participant must be reported to the IRB within five days. Protocol changes are requested on an amendment application available on the IRB web site; please reference your IRB number and attach any documents that are being amended.

CONTINUATION BEYOND APPROVAL PERIOD: To continue this research project beyond May 29, 2020, you must submit a renewal application for review and approval. A renewal reminder will be sent to you approximately 60 days prior to the expiration date. (If the researcher will be traveling out of the country when the protocol is due to be renewed, please renew the protocol before leaving the country.)

UNANTICIPATED PROBLEMS INVOLVING RISKS: You must report any unanticipated problems involving risks to subjects or others within 10 working days of occurrence to the IRB at 315.443.3013 or orip@syr.edu.

Thank you for your cooperation in our shared efforts to assure that the rights and welfare of people participating in research are protected.

Katherine McDonald
IRB Chair

DEPT: Civil & Environmental Engineering, 151 Link Hall
STUDENT: Mohammad Bushahri

Research Integrity and Protections | 214 Lyman Hall | Syracuse, NY 13244-1200 | 315.443.3013 | orip.syr.edu
Appendix F - Permission to Use the MLQ-5X Instrument

Approval for Remote Online Use of a Mind Garden Instrument

Effective date is March 12, 2019 for:

Mohammad Bushahri
Remote online use of the Mind Garden instrument stated below is approved for the person on the title page of this document.

Your name:
Mohammad Bushahri

Email address:
mmbushah@syr.edu

Company/institution:
Syracuse University

Mind Garden Sales Order or Invoice number for your license purchase:
LZYMNAYHA

The name of the Mind Garden instrument you will be using:
Multifactor Leadership Questionnaire™ - Remote Online Survey License - Translation : English (default)

Please specify the name of and web address for the remote online survey website you will be using and describe how you will be putting this instrument online:
I'm using Qualtrics (qualtrics.com) platform to publish my survey, which include 3 other instrument as well. I’m using 36 items only.

The Remote Online Survey License is a data license for research purposes only. This license grants one permission to collect and disclose (a) item scores and scale scores, (b) statistical analyses of those scores (such as group averaging, group standard deviation, T-scores, etc.) and (c) pre-authorized sample items only, as provided by Mind Garden, for results write-up and publication.

The instrument items, directions, manual, individual report, group report, and any other descriptive information available through Mind Garden is the intellectual property of the copyright holder and can be used only with purchase or written permission from Mind Garden.

added 13 September 2018
Appendix G – Permission to Use Climate for Innovation Instrument

Dear Mohammad:

You have my permission to use the Climate for Innovation survey for your dissertation. Good luck with your work.

Susanne G. Scott, Ph.D.
Associate Dean of the Koppelman School of Business
Brooklyn College, City University of New York
2900 Bedford Avenue
Brooklyn, NY 11210
718-951-5000 EXT 3374; sscott@brooklyn.cuny.edu

From: Mohammad Mahdi Bushahri [mailto:mmbushah@syru.edu]
Sent: Tuesday, July 31, 2018 4:14 PM
To: Susanne G. Scott
Subject: Permission to use the Climate for Innovation measure
Importance: High

Dear Dr. Scott,

My Name is Mohammad Bushahri, I’m a Doctoral student from Syracuse University writing my dissertation titled “Transformational Leadership and Adoption of Sustainability and Asset Management: The Role of Transformational Leadership in Creating Climate for Innovation that Promotes Sustainability and Asset Management Practices in Transportation Sector in US and Kuwait” under the direction of my dissertation advisor Dr. Baris Salman, who can be reached at bsalman@syru.edu. I would like your permission to use the Climate for Innovation questionnaire instrument in my research study. I would like to use and print your survey under the following conditions:

- I will use the surveys only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will indicate a proper citation to your original paper (Scott & Bruce 1994) in my dissertation.
- I will send a copy of my completed research study to your attention upon completion of the study.

If these are acceptable terms and conditions, please indicate so by replying to me through e-mail mmbushah@syru.edu

Sincerely,

Mohammad Bushahri
PhD Candidate in Civil Engineering
Civil & Environment Engineering
Syracuse University
Appendix H – Permission to Use Expert Review Method

Hi Mohammad,

This is fine with me.

Kristen

From: Kristen Olson <kolson5@uni.edu>
Subject: RE: Permission to use the expert review method
Date: September 12, 2018 at 5:08 PM
To: Mohammad Mahdi Bushahri <mmbushah@sy.edu>

From: Mohammad Mahdi Bushahri [mailto:mmbushah@sy.edu]
Sent: Monday, September 10, 2018 1:54 PM
To: Kristen Olson <kolson5@uni.edu>
Subject: Permission to use the expert review method

Dear Dr. Olson,

My Name is Mohammad Bushahri, I’m a Doctoral student from Syracuse University writing my dissertation titled “Transformational Leadership and Adaption of Sustainability and Asset Management: The Role of Transformational Leadership in Creating Climate for Innovation that Promotes Sustainability and Asset Management Practices in Transportation Sector in US and Kuwait” under the direction of my dissertation advisor Dr. Baris Salman, who can be reached at bsalman@sy.edu. I would like your permission to use the expert review method you used in your paper: “An Examination of Questionnaire Evaluation by Expert Reviewers” (Olson 2010) in my research study. I would like to use and print your method under the following conditions:

- I will use the method only for my research study and will not sell or use it with any compensated or curriculum development activities.
- I will indicate a proper citation to your original paper (Olson 2010) in my dissertation.
- I will send a copy of my completed research study to your attention upon completion of the study.

If these are acceptable terms and conditions, please indicate so by replying to me through e-mail mmbushah@sy.edu

Sincerely,

Mohammad Bushahri
PhD Candidate in Civil Engineering
Civil & Environment Engineering
Appendix I - Sample of the MLQ-5X Instrument

For use by Mohammad Bushahri only. Received from Mind Garden, Inc. on March 11, 2019

To Whom It May Concern,

The above-named person has made a license purchase from Mind Garden, Inc. and has permission to administer the following copyrighted instrument up to that quantity purchased:

Multifactor Leadership Questionnaire

The three sample items only from this instrument as specified below may be included in your thesis or dissertation. Any other use must receive prior written permission from Mind Garden. The entire instrument may not be included or reproduced at any time in any other published material. Please understand that disclosing more than we have authorized will compromise the integrity and value of the test.

Citation of the instrument must include the applicable copyright statement listed below.

Sample Items:

As a leader …
   I talk optimistically about the future.
   I spend time teaching and coaching.
   I avoid making decisions.

The person I am rating…
   Talks optimistically about the future.
   Spends time teaching and coaching.
   Avoids making decisions

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Sincerely,

Robert Most
Mind Garden, Inc.
www.mindgarden.com

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Appendix J – Sample of Climate for Innovation Instrument

<table>
<thead>
<tr>
<th>Part II: Organization Climate for Innovation</th>
</tr>
</thead>
<tbody>
<tr>
<td>This questionnaire is to measure your perception on the organizational climate for innovation and to what extend your organization encourages innovation and creativity. Please answer all items in this questionnaire. If an item is irrelevant, or if you are unsure or do not know the answer, leave the answer blank. 22-item descriptive statements are listed herein. Judge to what extend you agree or disagree on each statement.</td>
</tr>
<tr>
<td><strong>Put (✓) at the appropriate answer</strong></td>
</tr>
<tr>
<td>Creativity is encouraged here</td>
</tr>
<tr>
<td>Our ability to function creatively is respected by the leadership</td>
</tr>
<tr>
<td>Around here, people are allowed to try to solve the same problems in different ways</td>
</tr>
<tr>
<td>The main function of members in this organization is to follow orders which come down through channels</td>
</tr>
<tr>
<td>Around here, a person can get in a lot of trouble by being different</td>
</tr>
<tr>
<td>This organization can be described as flexible and continually adapting to change</td>
</tr>
<tr>
<td>A person can’t do things that are too different around here without provoking anger</td>
</tr>
<tr>
<td>The best way to get along in this organization is to think the way the rest of the group does</td>
</tr>
<tr>
<td>People around here are expected to deal with problems in the same way</td>
</tr>
<tr>
<td>This organization is open and responsive to change</td>
</tr>
<tr>
<td>The people in charge around here usually get credit for others’ ideas</td>
</tr>
<tr>
<td>In this organization, we tend to stick to tried and true ways</td>
</tr>
<tr>
<td>This place seems to be more concerned with the status quo than with change</td>
</tr>
<tr>
<td>Assistance in developing new ideas is readily available</td>
</tr>
<tr>
<td>There are adequate resources devoted to innovation in this organization</td>
</tr>
<tr>
<td>There is adequate time available to pursue creative ideas here</td>
</tr>
<tr>
<td>Lack of funding to investigate creative ideas is a problem in this organization</td>
</tr>
<tr>
<td>Personnel shortage inhibit innovation in this organization</td>
</tr>
<tr>
<td>This organization gives me free time to pursue creative ideas during the workday</td>
</tr>
<tr>
<td>The reward system here encourages innovation</td>
</tr>
<tr>
<td>This organization publicly recognizes those who are innovative</td>
</tr>
<tr>
<td>The reward system here benefits mainly those who don’t rock the boat</td>
</tr>
</tbody>
</table>

* Item was reverse-coded
Appendix K – Sample of Adoption of Sustainability Questionnaire (ASQ)

Part III: Sustainable Leadership

This questionnaire is to describe your views on Sustainability as you perceive it. Sustainability is defined as ‘meeting the needs of the present without compromising the ability of future generation to meet their own needs’. Please answer all items in this questionnaire. If an item is irrelevant, or if you are unsure or do not know the answer, leave the answer blank. Seventeen descriptive statements are listed herein. Judge how frequently each statement fits you.

<table>
<thead>
<tr>
<th>Put (✓) at the appropriate answer</th>
<th>Not at All</th>
<th>Once in a While</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Frequently</th>
<th>if not Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>My actions take into consideration the impact of social aspects of sustainability (e.g. Equity, Equal opportunities, Health, Safety, Accessibility, and Distribution of cost and benefits)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My actions take into consideration the impact of environmental aspects of sustainability (e.g. Ecosystem services, GHG emissions, Global warming, Noise, Heat Island effect, Land consumption, Waste, Ecological damage, and Climate change)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I make decisions based on my experience, knowledge and technical skills regardless of any possible impact on other departments or stakeholders interests. We define Stakeholders as: individuals or groups that are, or could be, influenced by or could be themselves influence an organization objectives and decisions (von Meding et al. 2013)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My decisions take into consideration the entire organization's performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I take necessary measures when actions are negatively affecting sustainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I match decisions I make with the organization’s vision and objectives towards sustainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I use Change Management tools to induce organizational movement towards sustainability. We define Change Management as: “the process of continually reviewing the organization’s direction, structure and capabilities to serve the ever-changing needs of the marketplace, the organization and employee” (Ahn et al. 2004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I attempt to confront the old and traditional culture that undermines the efforts toward sustainability</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I encourage adopting new ideas and innovative methods while addressing sustainability issues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I seek opportunities through sustainable efforts</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I maintain healthy profit and create wealth regardless of sustainability concept</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I put purpose before profit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I implement Corporate Social Responsibility (CSR) only if it does not affect profit. We define CSR as: “the integrity with which a company governs itself, fulfills its mission, lives by its values, engage with its stakeholders and measures its impacts and publicly report on its activities” (BTI 2003).</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I demonstrate sustainability by persevering through all types of change</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I use social networking when communicating Sustainability decisions with all involved. We define Social Networking as: the interpersonal skills a leader use to develop and maintain relationship with others (Basselier and Denibosat 2004)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I attempt to build a culture of sustainability by effective communication and networking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I promote sustainability principles when hiring, promoting employees and replacing leaders</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Item was revers-coded
Appendix L – Sample of Adoption of Asset Management Questionnaire (AAM)

Part VI: Asset Management

This questionnaire is to describe your views on Asset Management as you perceive it. Asset Management is defined as “the systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan.” Please answer all items in this questionnaire. If an item is irrelevant, or if you are unsure or do not know the answer, leave the answer blank. Twelve descriptive statements are listed herein. Judge how frequently each statement fits you.

Put (√) at the appropriate answer

<table>
<thead>
<tr>
<th></th>
<th>Not at All</th>
<th>Once in a While</th>
<th>Sometimes</th>
<th>Fairly Often</th>
<th>Frequently if not Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>I identify Asset Management as one of the core processes in my organization</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_1</td>
</tr>
<tr>
<td>I recognize that stakeholders’ requirements may not align with my objectives. I endeavor to balance these requirements within an Asset Management framework</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_2</td>
</tr>
<tr>
<td>I use consistent and systematic processes for identifying Asset requirements and developing an investment plan</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_3</td>
</tr>
<tr>
<td>I recognize the term “level of service” that is used to describe the quality of services provided by the asset under consideration. I link the level of service of each asset to the transportation network needs</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_4</td>
</tr>
<tr>
<td>I encourage forming teams of diversity while dealing with Asset Management issues where professionals other than engineers are recruited from a diverse background, education, gender and ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_5</td>
</tr>
<tr>
<td>I use change management tools to induce transformational movement towards the adoption of Asset Management practices (see above for Change Management definition)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_6</td>
</tr>
<tr>
<td>Effective communication and social networking are two main tools I use to promote more adoption of Asset Management practices. (See above for Social Networking definition)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_7</td>
</tr>
<tr>
<td>I focus on fostering a learning environment for employees by encouraging them to participate various activities such as seminars, conferences and inter-organization partnership on Asset Management</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_8</td>
</tr>
<tr>
<td>I use mentoring and training programs that enable employees to acquire the required Asset Management competences</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_9</td>
</tr>
<tr>
<td>I evaluate my organization’s performance on the basis of compliance to predefined KPI’s and Asset Management guidelines</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_10</td>
</tr>
<tr>
<td>I delegate responsibilities to leaders across the organization with full authority for process development, documentation, deployment, improvement, hiring and replacing staff and audit and review</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_11</td>
</tr>
<tr>
<td>I make relevant information available across the organization for better understanding, analysis and problem solving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>AL_12</td>
</tr>
</tbody>
</table>
## Appendix M – Sample of Demographics Questionnaire

### Part V: Demographics and Professional Practice

*Put [✓] at the appropriate answer*

We define two levels of Management as follows:
- Top-level of management (e.g., CEO, COO, Director, President, etc.)
- Middle-Level of management (Project Manager, General Manager, Department Manager, etc.)

<table>
<thead>
<tr>
<th>Based on this definition, how would you define your current status?</th>
<th>Top level</th>
<th>Middle level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Director of Operations</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>President</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>CEO</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Vice President</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>COO</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Chairman of board</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>Other</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your job title if you are in the top level?

<table>
<thead>
<tr>
<th>What is your job title if you are in the top level?</th>
<th>Director of Operations</th>
<th>General Manager</th>
<th>Divisional Manager</th>
<th>Project Manager</th>
<th>Start Manager</th>
<th>Deputy Manager</th>
<th>Department Manager</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your job title if you are in the middle level?

<table>
<thead>
<tr>
<th>What is your job title if you are in the middle level?</th>
<th>1 to 3</th>
<th>4 to 7</th>
<th>8 to 11</th>
<th>12 to 15</th>
<th>16 to 20</th>
<th>More than 20</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

How many years of employment in executive position?

<table>
<thead>
<tr>
<th>How many years of employment in executive position?</th>
<th>USA</th>
<th>Kuwait</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

Where is Work Location?

If USA, Which State?

<table>
<thead>
<tr>
<th>What is your Organization's type?</th>
<th>Public</th>
<th>Private</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

How many subordinates you have?

<table>
<thead>
<tr>
<th>How many subordinates you have?</th>
<th>1 to 20</th>
<th>21 to 50</th>
<th>51 to 100</th>
<th>101 to 150</th>
<th>151 to 250</th>
<th>251 to 500</th>
<th>More than 500</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is the size of your Organization?

<table>
<thead>
<tr>
<th>What is the size of your Organization?</th>
<th>Permanent (office)</th>
<th>Temporarily (projects)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 to 50</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>51 to 100</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>101 to 150</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>151 to 250</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>251 to 500</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
<tr>
<td>More than 500</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your Work Environment?

<table>
<thead>
<tr>
<th>What is your Work Environment?</th>
<th>18 to 25</th>
<th>26 to 35</th>
<th>36 to 45</th>
<th>46 to 55</th>
<th>56 to 65</th>
<th>More than 65</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your Age?

<table>
<thead>
<tr>
<th>What is your Age?</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

What is your Gender?

<table>
<thead>
<tr>
<th>What is the highest degree completed?</th>
<th>2 year college</th>
<th>Bachelor's degree</th>
<th>Master</th>
<th>PhD</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
<td>[ ]</td>
</tr>
</tbody>
</table>

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Page 6 of 6
Appendix N – Evaluation of Measurement Model

In this section, the work done for the measurement evaluation process is presented. Multiple runs have been performed to end up with the final model as presented in section (5.1). The work presented here is for informative purposes and has been placed in the appendix chapter for brevity purposes.

After the first run, a number of outer indicators were removed from the model due to their impact on the construct’s convergent validity. The revised first-order constructs model is illustrated in Figure 34. Out of 20 indicators forming the Transformational leadership scale, 2 indicators were removed from two different constructs, namely Idealized Behavior (IB) and Individual Consideration (IC). Transactional leadership scale of 8 indicators was reduced down to 7 indicators, after removing one indicator from the Contingent Reward (CR) construct. One indicator was removed from Passive/Avoidant scale resulting in 7 indicators after removing one indicator from the Management by Exception (Passive) construct. Climate for Innovation scale that consisted of 22 indicators was reduced down to 10 indicators only, after removing 12 indicators from both its constructs. Finally, the 17-item Adoption of Sustainability scale was reduced down to 12 indicators, after removing 5 items. Asset Management Leadership scale remained unchanged since all indicator’s outer loadings were above 0.7. Figure 34 shows the final scale indicators after removing the items with lower loading values. Table 21, as presented in section 5.1), shows the outer loadings for all items forming the first-order constructs.

To examine the constructs’ Internal Consistency, Cronbach’s alpha is calculated for all constructs and the values are shown in Table 37. The alpha (α) values ranged between 0.698 to 0.944. Alpha value for Transformational Leadership scale was (α = 0.944), Transactional Leadership scale was (α = 0.772), and alpha value for Passive/Avoidant scale was (α = 0.839), which are indicative of a high level of internal consistency for MLQ
instrument. Cronbach’s alpha for the Climate for Innovation instrument was ($\alpha = 0.922$), while alpha value for Adoption of Sustainability (AS) was ($\alpha = 0.928$), and finally alpha value for Adoption of Asset Management (AAM) was ($\alpha = 0.941$).

To examine convergent validity of the constructs, average variance extracted ($AVE$) were calculated, as presented in Table 37. All first-order constructs have an Average Variance Extracted of 0.525 or greater. To evaluate the discriminant validity of the constructs, Fornell and Larcker’s approach was applied and the results are shown in Table 38, where the square roots of Average Variance Extracted should be higher than their correlations with other constructs.
Figure 34 – Revised Reflective 1st-order constructs and formative 2nd-order constructs model (N=150)
<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items (before)</th>
<th># of Items (after)</th>
<th>Items removed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>20</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Idealized Attributes</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Idealized Behaviors</td>
<td>4</td>
<td>3</td>
<td>LS-6</td>
</tr>
<tr>
<td>Inspirational Motivation</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Intellectual Stimulation</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Individual Consideration</td>
<td>4</td>
<td>3</td>
<td>LS-19</td>
</tr>
<tr>
<td>Transactional Leadership</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Contingent Reward</td>
<td>4</td>
<td>3</td>
<td>LS-6</td>
</tr>
<tr>
<td>Management by Exception (Active)</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>8</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Management by Exception (Passive)</td>
<td>4</td>
<td>3</td>
<td>LS-17</td>
</tr>
<tr>
<td>Laissez-Faire</td>
<td>4</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Climate for Innovation</td>
<td>22</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Support for Innovation</td>
<td>16</td>
<td>6</td>
<td>CI-3, 4, 5, 7, 8, 9, 11, 12, 13 and CI-22</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>6</td>
<td>4</td>
<td>C_17 and 18</td>
</tr>
<tr>
<td>Adoption of Sustainability</td>
<td>17</td>
<td>12</td>
<td>SL-3, 4, 11, 12 and 13</td>
</tr>
<tr>
<td>Adoption of Asset Management</td>
<td>12</td>
<td>12</td>
<td></td>
</tr>
</tbody>
</table>

The results indicate that out of 13 constructs, only 3 constructs did not match this criterion: Laissez-Faire, Idealized Attributes and Adoption of Asset Management. The cross-loading approach was used also to examine the outer loadings of the indicators on other constructs. Loadings of the indicators have the highest values on their constructs except for two constructs (Adoption of Sustainability and Resource Supply) where there were loadings with higher values on other construct (Adoption of Asset Management and Support for Innovation respectively). Results of these evaluations did not provide evidence for the discriminant validity of the constructs.
Table 37 - Cronbach’s Alpha and AVE Values for first-order constructs (outer model), N=150

<table>
<thead>
<tr>
<th>Scale</th>
<th># of Items</th>
<th>$\alpha$</th>
<th>AVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformational Leadership</td>
<td>18</td>
<td>0.944</td>
<td></td>
</tr>
<tr>
<td>Idealized Attributes</td>
<td>4</td>
<td>0.798</td>
<td>0.622</td>
</tr>
<tr>
<td>Idealized Behaviors</td>
<td>3</td>
<td>0.772</td>
<td>0.686</td>
</tr>
<tr>
<td>Inspirational Motivation</td>
<td>4</td>
<td>0.832</td>
<td>0.668</td>
</tr>
<tr>
<td>Intellectual Stimulation</td>
<td>4</td>
<td>0.78</td>
<td>0.603</td>
</tr>
<tr>
<td>Individual Consideration</td>
<td>3</td>
<td>0.744</td>
<td>0.659</td>
</tr>
<tr>
<td>Transactional Leadership</td>
<td>7</td>
<td>0.772</td>
<td></td>
</tr>
<tr>
<td>Contingent Reward</td>
<td>3</td>
<td>0.789</td>
<td>0.703</td>
</tr>
<tr>
<td>Management by Exception (Active)</td>
<td>4</td>
<td>0.735</td>
<td>0.547</td>
</tr>
<tr>
<td>Passive Avoidant</td>
<td>7</td>
<td>0.839</td>
<td></td>
</tr>
<tr>
<td>Management by Exception (Passive)</td>
<td>3</td>
<td>0.747</td>
<td>0.668</td>
</tr>
<tr>
<td>Laissez-Faire</td>
<td>4</td>
<td>0.698</td>
<td>0.525</td>
</tr>
<tr>
<td>Climate for Innovation</td>
<td>10</td>
<td>0.922</td>
<td></td>
</tr>
<tr>
<td>Support for Innovation</td>
<td>6</td>
<td>0.879</td>
<td>0.624</td>
</tr>
<tr>
<td>Resource Supply</td>
<td>4</td>
<td>0.855</td>
<td>0.7</td>
</tr>
<tr>
<td>Adoption of Sustainability</td>
<td>12</td>
<td>0.928</td>
<td>0.56</td>
</tr>
<tr>
<td>Adoption of Asset Management</td>
<td>12</td>
<td>0.941</td>
<td>0.608</td>
</tr>
</tbody>
</table>

Therefore, an additional statistical step is required to investigate the discriminant validity of the constructs. Heterotrait-Monotrait ratio (HTMT) approach was used, and the results are shown in Table 39, where the pairwise correlations between variables should not exceed the threshold of 0.9. The results obtained are indicative of a lack in discriminant validity since multiple correlation values were beyond 0.9 especially among the constructs forming the transformational leadership instrument (IA, IB, IM and IC), Passive/Avoidant (MEP & LF), and climate for innovation (SI & RS).

To further investigate the problem causing the lack of discriminant validity, HTMT test was generated using bootstrapping in SmartPLS and the results are shown in Table 40. We used 5000 subsamples and bias corrected two tailed method with a confidence
A confidence interval containing HTMT value of 1 indicates a lack of discriminant validity. The results shown in Table 38 indicating multiple values of 1, which is indicative of a lack of discriminant validity that requires a modification in the research model.

As a remedy, we followed a remedial procedure recommended by Hair et al. (2017) (Hair, et al. 2017). We first opted to decrease the HTMT correlation values among the problematic constructs by eliminating items that are strongly correlated with items in the opposing constructs. After several trials of deleting problematic items from the transformational leadership constructs (IA, IB, IC, IM and IS), running PLS algorithm and bootstrapping after each modification and generating HTMT results; no sign of discriminant validity was apparent. Accordingly, we followed the recommendation suggested by Hair et al. (2017) and merged the transformational leadership constructs into a single broad construct. Subsequently, we deleted multiple items with lower outer loadings from that single

Table 38 - Fornell and Larcker’s results (N=150)

<table>
<thead>
<tr>
<th></th>
<th>AAM</th>
<th>CR</th>
<th>IA</th>
<th>IB</th>
<th>IC</th>
<th>IM</th>
<th>IS</th>
<th>LF</th>
<th>MEA</th>
<th>MEP</th>
<th>RS</th>
<th>SI</th>
<th>AS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAM</td>
<td>0.78</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR</td>
<td>0.548</td>
<td>0.839</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IA</td>
<td>0.583</td>
<td>0.767</td>
<td>0.789</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>IB</td>
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<td>0.73</td>
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<td>0.803</td>
<td>0.798</td>
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<td>IS</td>
<td>0.601</td>
<td>0.693</td>
<td>0.757</td>
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<td>0.752</td>
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<td>0.375</td>
<td>0.387</td>
<td>0.41</td>
<td>0.386</td>
<td>0.327</td>
<td>0.379</td>
<td>0.336</td>
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<td>0.371</td>
<td>0.324</td>
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<td>0.522</td>
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<td>0.227</td>
<td>-0.03</td>
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<td>-0.02</td>
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<td>0.528</td>
<td>0.749</td>
</tr>
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</table>

**Key:**
- **AAM:** Adoption of Asset Management
- **CR:** Contingent Reward
- **IA:** Idealized Attributes
- **IB:** Idealized Behavior
- **IC:** Individual Consideration
- **IM:** Inspirational Motivation
- **IS:** Intellectual Stimulation
- **LF:** Laissez-Faire
- **MEA:** Management by Exception (Active)
- **MEP:** Management by Exception (Passive)
- **RS:** Resources Supply
- **SI:** Support for Innovation
- **AS:** Adoption of Sustainability

Interval of 95%.
construct after several PLS algorithm runs to end up with a revised model as shown in Figure 31 presented in page 203.

Table 39 - HTMT Ratio Results (N=150)

<table>
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<tr>
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<th>AAM</th>
<th>CR</th>
<th>IA</th>
<th>IB</th>
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<th>IM</th>
<th>IS</th>
<th>LF</th>
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<th>MEP</th>
<th>RS</th>
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<td>0.978</td>
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<td>0.913</td>
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<td>0.369</td>
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<td>0.326</td>
<td>0.337</td>
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<td>0.427</td>
<td>0.406</td>
<td>0.431</td>
<td>0.386</td>
<td>0.179</td>
<td>0.24</td>
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<tr>
<td>SI</td>
<td>0.614</td>
<td>0.593</td>
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<td>0.597</td>
<td>0.606</td>
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<td>0.271</td>
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<td>0.29</td>
<td>0.12</td>
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</table>

The revised research model suggests that transformational leadership subconstructs did not maintain their integrity as a distinct individual constructs measuring five different transformational leadership traits (i.e., IA, IB, IC, IM and IS). Hence, the transformational leadership style is evaluated as a broad construct with no subconstruct classifications.

Similarly, the two constructs forming passive/avoidant style were merged into one single construct due to lack in discriminant validity among its constructs. Further, we eliminated multiple problematic items and those with lower outer loadings to end up with three items representing the passive/avoidance construct. Generally, this modification to the research model did not affect the theoretical and conceptual basics since we hypothesized transformational leadership style as a broad general construct and did not emphasize (conceptually) on the five subscales. This is also true for passive/avoidant style where we hypothesized passive/avoidant as a broad and general style, and did not emphasize on its
two subcategories. Next, we ran a PLS algorithm using SmartPLS with 5000 iterations and factor weighting scheme and followed the same procedure to estimate the measurement and structure models.
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EXPERIENCE

Mar. 2017 - Mar. 2022  
Head of Technical Services Department, Ministry of Communications, Kuwait
- Run and manage the operation and maintenance project of the telecommunications complex and liberation tower
- Provide all technical services to clients in the telecommunications complex and liberation tower
- Control and manage the major systems such as BMS, CCTV, fire alarm, access control, and fire fighting
- Perform a preventive planned maintenance (PPM) program for all electromechanical systems
- Prepare and print term of references (TOR) for new projects
- Prepare and manage tender documentation
- Maintain high level of performance and quality of services
- Adopt cutting edge technologies to manage the project’s tasks and work orders
- Embrace asset management concept while setting KPI’s and quality references

Manager, Projects Department, Hassan Abul Co. for Building Materials W.L.L
- Manage, control, and monitor all related projects activities during the project’s life cycle starting from the design stage passing by tendering stage ending up with the execution stage, by applying all necessary tools and skills to achieve the project’s targets and objectives.
- Assign annual budget to the profit center (Projects Dept.) by analyzing the potential projects which going to be
tendered and monitor closely the market trend and movement to access proper plans and actions.

· Manage the sales activities by assigning number of potential projects to each sales executive for proper and professional approach.

· Manage the daily sales activities by analyzing all business visits, technical and financial offers, and progress meetings at sites in data base pool for future review and analysis.

· Manage and control the marketing activities by assigning number of consultant offices and client to each sales executive for proper and professional approach.

· Manage and supervise the daily operation process on site during the execution stage by getting site reports from site engineers and attending progress meeting at site.

· Study and manage the procurement plan for each project and order and prepare procurement schedule accordingly.

· Establish and modify the internal and external procedure of all related activities in the entire project cycle (i.e., pre-design, design, tendering and execution stages).

· Study and review the projects time schedule (CPM) for all on hand projects for proper follow up and control.

· Study, review and authorize all outgoing offers and proposals to the customers for all trades.

· Maintain professional and personal relationship with the clients and establish long term relationship based on trust and mutual understanding.

· Prepare all required managerial reports using the latest construction management tools.

· Visit International fares for building materials

· Negotiate with manufacturers, suppliers, and agencies from all around the world for better deals and prices.

· Inspection visits to the manufacturers and suppliers in the origin to ensure quality and time control.


**Project Engineer, KEO International Consultants, Kuwait**

· Study, review and authorize shop drawings for all structural and architectural elements.

· Study, review and authorize all civil & architectural material submittals.

· Supervise the daily site activities for all civil and architectural works.

· Maintain the safety standards level at site.

· Attend progress meetings at site.
· Study and authorize pre-qualification submittals for all sub-contractors.

· Study, review and authorize the structural calculations submitted by the main contractor.

Projects involved in:

- Al-Manar Residential Complex at Benaid Al-Gar, Kuwait 2000 - 2002


Head of Technical Specifications & Contracts, Ministry of Communication, Kuwait

- Prepare and develop the projects specifications for the ministry projects.
- Maintain the technical specification updated to the latest material classifications.
- Develop and update the previous technical specifications using the latest systems like CSI divisions.
- Assign daily tasks to the section engineers.
- Coordinate with design offices during the design stage for any coming project.


Civil Engineer, Design & Construction Dept., Ministry of Communications, Kuwait

- Study, review and authorize the shop drawings for all structural and architectural components.
- Study, review and authorize all material submittals.
- Supervise the daily site activities for all civil and architectural works.
- Maintain the safety level standards at site.
- Attend the periodically progress meeting at site.
EDUCATION

**Ph.D. in Civil Engineering** (Public Infrastructure Management and Leadership) *Syracuse University*, Syracuse, NY (May 2022)

**Master of Science in Civil Engineering** (Construction Engineering and Management) *Kuwait University*, Kuwait (November 2001)

**Bachelor of Science in Civil Engineering** (Structural Design) *Kuwait University*, Kuwait (January 1997)

**Related Coursework:**

RESEARCH INTERESTS

Asset Management, Sustainability, Public Infrastructure Management, Leadership, Project Management, Construction Management, Organizational Innovation, and Green Infrastructure

Computer Skills

- Primavera, MS Project, Minitab Statistical Software, SmartPLS, and MS Office Suite

Professional Membership

- The Institute of Asset Management (USA), *member* (since 2015)
- LEED Green Associate – USA, *member* (since 2014)
- The American Society of Civil Engineers (ASCE), *member* (since 2011)
· Project Management Professional (PMP) Certification Preparation Seminar from Project Management Institute (PMI), participant, 2006

· Professional Engineer Certificate (PEC) - Kuwait Society of Engineers, certified 2006

· The Projects Management Institute (PMI) – USA, member (since 2005)

· The Kuwait Society of Engineers, member (since 2002)