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MORAL ADVERSITIES AMONG PREFERENCES AND CHOICES IN CIVIL ENGINEERING FINANCING MANAGEMENT CONTROL

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ABSTRACT

Civil engineering projects sometimes experience substantial financial losses due to suboptimal decision-making processes. These financial losses manifest as cost overruns, caused by moral adversities (MAs) arising from the ongoing disparity between optimal preferences and final project selections. This study investigates the discrepancy between preferred alternatives and final decisions in cost-driven decision-making in public sector construction projects, within the context of Small Island Developing States (SIDS). The study used a quantitative approach and a closed-ended questionnaire given to professionals in Trinidad and Tobago. It revealed four main results: irrational behavior in cost management due to moral dilemmas, the strong impact of mental accounts on decision-making, the tendency for self-interest to negatively impact mental accounting, and the link between mental accounts and preferred choices leading to cost overruns and inefficiencies in resource allocation. The study points out a shift in professional conduct in public sector construction away from axioms outlined in Prospect Theory, the present dominant theory in decision making, suggesting Preference Transition Theory (PTT) as a different paradigm. The research suggests that by seeing MAs as breaks in the Prospect Theory Utility Function, individuals may still adjust their preferences reference point, creating a rational area throughout the transitional phase described by PTT. This study adds to the discussion and body of knowledge on the duty of care and ethical dilemmas in SIDS contexts, and behavioral economics . It provides insights for academia and practice and supports the use of preference transition theory to improve decision-making processes and promote sustainability in public sector construction projects

KEYWORDS: Moral Adversities; Preferences; Choices; Decision-making; Prospect Theory; Preference Transition Theory; Public Sector Projects; Cost Control.

1. INTRODUCTION

Despite advances in forecasting approaches, cost overruns (COs) remain a persistent problem in project planning and execution [14]. Cost overrun is the norm rather than the exemption. Melaku Belay et al. (2021) [33] provided that cost overruns range from a minimum of 2% to a maximum of 248%, with an average overrun of 35% on buildings. Similar ranges were reported by Chadee et al. (2023a) [11] on housing projects and Flyvbjerg et al. (2003) [20] on roads and rails. Cost-benefit assessments are frequently employed to support these kinds of projects, but their validity is called into question by inaccurate cost reporting, exaggerated benefits, and limited inclusion of uncertainty [14]. Technological, psychological, economic, and political considerations are all major contributors to COs [19], with political influence emerging as a key element [13]. Political pressures frequently result in the distortion of cost and benefit estimates, which increases risk and creates a climate of disinformation [14]. Forecasting errors are exacerbated by this deceit as well as cognitive biases, including optimism bias and strategic misrepresentation [15].

Thus, investigations into the actual decision-making which creates these adverse outcomes are considered highly relevant and warranted.

When it comes to analyzing decision-making in cost management, it is important to consider traditional economic theories. In Behavioral Economics, Prospect Theory provided a foundation for decision making. Prospect Theory was proposed by Daniel Kahneman and Amos Tversky (1979) [27] and essentially suggests that persons do not just appreciate the final outcome of a decision (either a loss or a gain) but the outcome is actually appreciated relative to a reference point (i.e., the person's original utility). This theory also implies that generally people dislike experiencing losses more than they find pleasure in gaining [27]. Based on this implication, this research will consider how moral adversities impact decision-making and whether, as a result, professional preferences and choices are made in accordance with ethical practices.

Moral adversities refer to complex instances in which persons are not able to maintain their true sense of integrity or standard of behavior [46]. It should be recognized that morals differ from ethics. Ethics alludes to a specific code of conduct whereas morals are intuitive, following one's principle of right and wrong [16].

This research aims to determine whether preferences and choices in decision-making in cost management within the civil engineering and construction industry deviate from the internationally accepted prospect theory outcomes. Therefore, the objectives are firstly, to understand the difference between Prospect Theory and Preference Transition Theory [12] when it comes to informed decision-making in construction projects. Secondly, to determine whether professional preferences vary based on moral adversities and influence the selection of a final choice and thirdly, to decipher whether the determined choices of decision-making are rational or irrational. It essentially attempts to answer the question of what impact moral adversities have on the decision-making process in civil engineering cost management.

The benefit of this research is that it acts as a fundamental step in guaranteeing the necessary degree of confidence that professionals who are rational agents act irrationally when it comes to civil engineering cost management. Resolving theoretical inconsistencies in cost determination allows for a thorough comparison of design alternatives, aiding in the selection of the most cost-effective alternative.

2. LITERATURE REVIEW

The construction sector suffers globally from the effects of strategic misrepresentation in cost management [20]. Lv et al. (2021) [31] attributes this strategic mismanagement to rent-seeking behavior among professionals in the industry. In turn, rent-seeking behaviors hinders and reduces the safety of projects, disregards the public's interest and limits the effective use of resources. Therefore, an integral aspect of improving decision-making is reviewing the impact of moral adversities on decision making on public sector construction projects.

2.1. Theoretical Framework

Whilst preferences and choices in decision-making of construction projects and its execution should be transparent and objective, in the majority of instances, it is not actually the reality [39]. Subjectivity comes into play and decision-making does not always follow a rationale raison d'être. An individual's risk attitude and behavior actually stray from the assumed optimum behavioral patterns in traditional economic theories (i.e., expected utility theory). Prospect theory is then introduced and considers the psychological structure of the persons involved in the decision-making process [27]. However, it is recognized that this theory tests how an individual values gains

and losses.

As per Prospect Theory, incurring losses has a more negative psychological effect on a person than an equivalent gain has a positive effect. This is also referred to as loss aversion which Novemsky and Kahneman (2005) [37] describes as a cognitive bias through which a real or even potential loss is interpreted by persons as psychologically and/or emotionally more severe than an equivalent gain.

With reference to the graph below, as a person gains more, he is less likely to entertain an opportunity or gamble that threatens a loss i.e., the person becomes risk averse [27]. Whereas, when a person is already losing, he is more likely to gamble or take the chance in attempt to gain something i.e., exhibiting risk-seeking behavior.

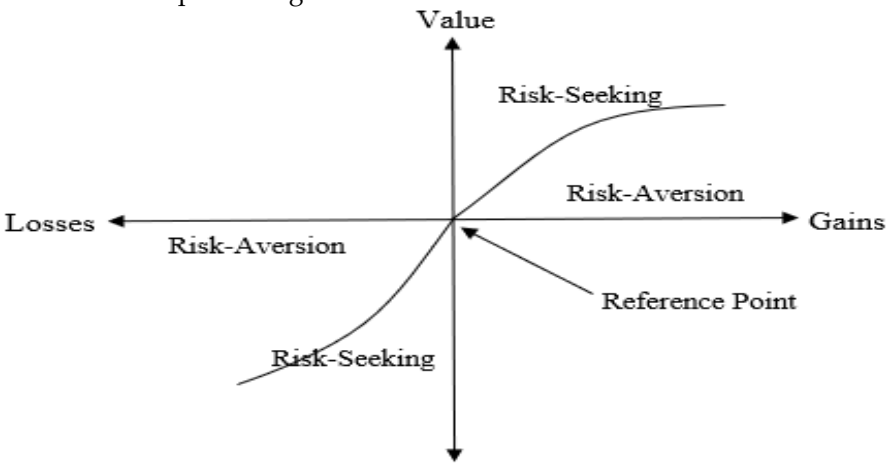


Figure 1. Prospect Theory Utility Function
Adapted: Kahneman and Tversky (1979) [27]

According to Chadee et al. (2022a) [12], the utility function that was put forward through Prospect Theory (PT) was primarily based on the fact that a discontinuity exists between gains and losses, and that there is a reference point about which individual preferences may change. That is, tendencies are based on each individual's reference point. The reference point is essentially the baseline for evaluating and comparing potential outcomes, gains, and losses and it is influenced by recent changes in one's current asset [28]. Additionally, in practice, on projects, decision makers value gains more than losses.

Hence, PT is considered to have three discrete parameters: concavity, convexity and the reference point (i.e., the theoretical disjoint between the concave and convex sections of the graph). Chadee et al. (2022a) [12] goes on to state 'There is a need to account for continuity and to resolve this violation of PT at the reference point. In so doing, an alternative preference transition theory was proposed as a solution that includes a phase change space to cojoin these three separate parameters into one continuous nonlinear model. This novel conceptual model adds new knowledge of risk and uncertainty in decision-making.'

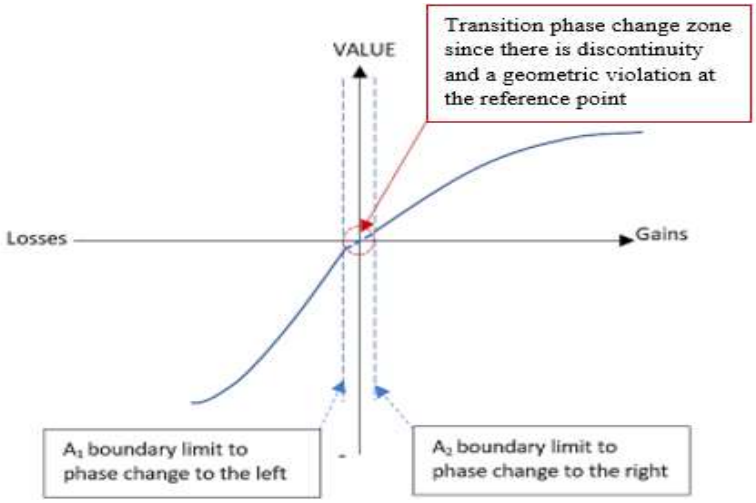


Figure 2: Transition Phase Change Model with Constant Elasticity at Reference Point
Adapted: Chadee et al. (2022a) [12]

Preference Transition Theory addresses the point of discontinuity in the curve on the utility against gains/losses graph taking into account the fact that it is possible, and of basic human nature, for a reversal or modification to an initial decision i.e., to change one's mind. The transitionary elastic zone, seen in Figure 1.1, indicates that people will act rationally and not in a risk seeking manner since rationality affects the balance of loss and gain. It is also recognized that risk averse behavior promotes the possibility of savings whereas risk seeking behavior encourages suboptimal outcomes i.e., cost overrun (Chadee 2022b, 1). For projects under risks, preferences transition to choices.

2.2. Understanding Agency Behavior

The prominence of principal-agent (P-A) related problems is recognised on public sector construction projects [21]. P-A problem refers to a conflict of interest between the owner/shareholder (principal) and the person (agent) to whom management of the asset has been transferred. The risk that the agent will act against the principal's best interest can be defined as agency costs [18]. In relation to public sector projects, though the money used for development projects is generated from taxpayers, the government is viewed as the owner/principal and management/ engineering professionals are whom control of the money is given to, also known as the agent who is supposed to act in the government's best interest. However, agency costs are high. The main reasons for this are that:

1. The money is that of the taxpayer i.e., not generated from the private sector nor the individual professional.
2. A false perception that money is in abundance.
3. There is little legal ramification when it comes to improper management of project funds in SIDs.

Hence, the agent acts with bounded rationality (i.e., within the transition phase change zone seen in Figure 1.1) but is tempted to step out of it. Bounded rationalities refer to how people make decisions when one's rationality is restricted by one's thinking capacity, the amount of access to available and relevant information, and time. Acting with bounded rationalities results in satisfactory or suboptimal choices being made [26]. When a professional steps outside of bounded rationalities, the individual is then described as being rationally irrational. This essentially means that the professional does not select the optimum choice nor one that is satisfactory but selects the option that is preferred because it is simply self-gratifying. This indicates the pristine difference between preferences and choices i.e., where one's choice may not necessarily be the option that the professional wishes for and likewise, a professional's preference may not always be the best choice for the project.

Chadee (2022b, 1) suggests that when individuals are likely to experience undesirable outcomes, they exhibit risk-seeking behavior in an attempt to ascertain maximum benefits (self-interest) first, then better outcomes for the project. Notably, this does not coincide with prospect theory as prospect theory essentially puts forward that people placed in challenging circumstances, become risk seeking to just obtain a better outcome for the project and their choices are not based solely on the level of utility but upon which produces smaller losses. It is therefore fair to say that agents sometimes create the moral adversities that plague the public sector in SIDs. Herein lies the paradox of the situation. This may be due to several factors such as culture, environment or even whether the project itself is partisan in nature e.g., social housing programmes in small island developing states, highlighted by Chadee et al. (2021a) [10], leading to reduced benefits delivered to society with increased costs to taxpayers.

2.3. Identifying Societal Impacts

The development of sustainable infrastructure is critical to strengthen economic certainty of a nation. However, in such, agents are exposed to great financial volumes and intricate processes thereby increasing the susceptibility to corruption [8]. Professional standards, ethics and unfair practices were cited as being the most influential drivers of corruption in the industry. In order to develop sustainably, a construction project relies on the favorable cooperation of all parties and the ethical code of conduct. However, unethical pro-organizational behavior underscores mutual efforts and causes dire consequences. The behavior of employees on a project is influenced by both the environment and personal characters because of issues such as asymmetric information and huge uncertainty [45].

Evidently, the repercussions of this issue are borne by the country and are particularly damning to small developing nations. Pakistan, for example, according to Khadim et al. (2021) [29], corruption is extensive in the local industry and as a result, projects and society suffer adverse outcomes. These outcomes are mainly the formation of monopoly, higher procurement and maintenance costs and poor-quality work done. Nawaz and Ikram (2013)

[35] also highlighted low-quality work as the outcome of unethical practices in the Pakistani construction industry such as corruption, bribery, bid shopping, fraud and biased conduct. Here, the crucial issue was deemed to be that professionals lacked training in ethics.

In the case of Iran, Hosseini et al. (2020) [23] highlights that corruption in the construction industry proports significant risks on construction works and, on the country's economic development. Importantly, irrational decision-making along with procedural violations in awarding contracts, improper use of contractual arrangements and the forfeiting of project management principles were noted as the ways through which the aforementioned risks were imposed. Similarly, Liu et al. (2022) [30] found that construction project violations were due to: poor cultural atmosphere, weak internal control, prior experience, moral disengagement and information asymmetry as well as the significant effect pressure and company governance.

Further inspection of strategic mismanagement within the construction industry of developing countries brings about the example of Nigeria. According to Akinrata, Ogunsemi and Akinradewo (2019) [3] and Inuwa, Usman and Dantong (2015) [25], there are several major effects of unethical practices. These effects are: construction cost overrun, unpleased clients, compensation being issued after its scheduled time as a result of delays, lack of productivity of project team, lack of professionalism, low-quality workmanship, frequent maintenance, improper project coordination, inhibited development of the economy, infrastructure and the industry, shortened life span of built structures, loss of public trust and conflicts between client and contractor. Oyewobi et al. (2011) [38] also describes corrupt construction practices as being a cancer to Nigeria because exorbitant amounts of money are wasted in resources which could have been used in developing the country's infrastructure. It is reiterated that unethical performance stunts the growth of the industry and social and economic advancement of the nation since slowed industrial growth implies that its contribution to the Gross Domestic Product (GDP) is significantly decreased. Usman, Inuwa and Iro (2012) [44] found that the causes of this strategic mismanagement in Nigeria were the lack of punishment for corruption, loss of contract money as a result of a change in government, incoherent continuation of government programmes, presence of loop holes in project monitoring, conspiracy between officials and contractors, little to no urge to support the government, job insecurity, fear that retirement will relegate status in the industry and simply because the person's needs outweigh income. These causes give insight into why irrational decision-making occurs and is therefore important to the scope of this project.

Similarly, in Ghana, ethical misconduct influences investments which in turn can cause other governmental sectors to be underfinanced resulting in the public's access to education and competent healthcare being restricted. These practices bring about the relegation of good governance and democracy and the loss of public trust [6].

According to Aigbavboa, Oke and Tyali (2016) [2], the ethical code of conduct allows for transparency and accountability within the South African construction industry however failure to abide by ethical practices jeopardises the further development of the country's economy. As with other developing countries, strategic mismanagement occurs through bribery and fraud, falsification of experience, illegal or biased award of tenders and collusive tendering. It is also recognized that, as a result of unethical performance, clients are not pleased, the quality of workmanship and therefore infrastructural development is of a low calibre and the public no longer trusts the industry. Likewise, as it pertains to the Gaza Strip, when industry professionals engage in ethical misconduct, the following is affected: long-term business dealings, project quality, time and costs [4]. In this region, unethical performance is encouraged due to the lack of strict contractual laws, absence of effective executive control, greed and delinquency.

Amoah and Steyn (2023) [5] also observe on a global scale that non-compliance with the code of conduct by construction professionals generally leads to project failure and subsequent losses to the client and the contractor. Industry professionals experience unethical issues such as inflated tender prices, overpricing the rates, tender-based kickbacks, bribes for projects, unethical methods of project execution, use of lower grade materials than specified and discrimination. This may be as a result of greediness, acceptance of corruption as normal practice, lack of knowledge about the code of conduct, the only way to get contracts, part of the process, and peer pressure. Hence, the urgency exists to sensitize professionals about the code of conduct and the potential repercussions of

involvement in corrupt practices to themselves and the associated project. Amoah and Steyn (2023) [5] suggested that in order to discourage professionals from breaching the code of conduct, the establishment and enforcement of regulations should be carried out by professional associations and commercial organisations as well as the relevant public procurement authorities. Additionally, seminars should be made compulsory to assist professionals with continuous education because ethics can evolve and there may be instances which can be interpreted as grey areas but are actually illegitimate.

Based on the societal dilemmas/consequences outlined above, it can be understood that professionals are agents of change. Hence, it is important to understand why a component and knowledgeable person would make irrational decisions and subsequently, why is prospect theory violated when it comes to professional gambles. This understanding gives way to answering the research question of what impact does moral adversities have on the decision-making process in civil engineering cost management of the public sector of Trinidad and Tobago.

According to Hu et al. (2023) [24], whilst fraud is an irrational act that can be defined by way of environmental/societal factors, it is still dependent on a person's cognition, implying that everyone has a unique standpoint on committing acts of irrationality. Hu et al. (2023) [24] specifies that an individual's own perception of threat possibility and threat severity affects his/her attitude towards fraud in a positive manner whereas, his/her attitude was adversely affected by factors like reward for compliance and response cost.

Additionally, Martin et al. (2022) [32] expresses that in public sector construction, governance within SID oil and gas economies, inadequate tender procedures and practices, reprehensible business growth strategies, unethical misconduct and the social networking context are key corruption elements, which may result from a lack of transparency in the construction supply chain. This then leads to an awareness gap between project stakeholders, creating mistrust, and also, more untraceable processes and coordination among stakeholders. This makes it even simpler for a professional to act irrationally when faced with moral dilemmas. Martin et al. (2022) [32] further comments that competing ethical choices (i.e., personal consciences and ethical pledges to professional institutions charters) associated with meeting company financial targets may result in unethical behavior. Moreover, it was determined that over-centralised government power and a lack of adequate judicial safeguards against reporting illicit activities promotes 'cutthroat' rivalry amongst firms, cronyism and injustice to win construction contracts. To resolve the industry's corruption problem, the following were suggested: to place corrupt corporations and government officials on a blacklist, enforce harsh punishments, including fines and increase accountability in state projects, the development and regulatory monitoring of an ethics scorecard, where points are assigned and removed for ethical noncompliance and a blockchain-based deployment to improve transparency by increasing supply chain connectivity. However, ultimately, to heighten ethical standards in SIDSs, professionals must first be properly informed on what is ethically required of them so that they are more inclined to rational decision-making.

Mustaffa et al. (2023) [34] states that professionals must perform their duties as per the statutes, avoid disputes, and meet the expectations of clients in evaluating interim payments by taking into consideration accuracy, impartiality, justification, and guidelines. The American Society of Civil Engineers (ASCE) is a prominent professional body that represents civil engineers worldwide and as such, it is expected that being a member of this charter ought to hold a practitioner to a higher standard. As per Hoke (2023) [22], it is stated in Section 1d of the ASCE Code of Ethics that engineers should never tolerate bribery, fraud, and corruption, and should report any violations to the relevant authorities. Engineers should therefore possess a need to avoid trouble and are obligated to take action when confronted with corruption to deter possible reprisals and perceptions of a lack of power. Likewise, Schlossberger (2015) [40] expresses that professionals ought to be mindful that their actions must be appropriate to stand as a precedent for how to be an engineer. Therefore, it is a fair assumption that a professional that is registered to an institution or charter may be less likely to act irrationally.

As aforementioned, unethical practices lead to project failure however, the successful delivery of projects promotes economic growth and the overall development of a country. Tatenda (2023) [41] explains that construction professionals encounter many challenges including obedience to authority, peer pressure, conflict of interest, time constraints, socio-economic and political pressure and breach of confidence. Additionally, Tatenda (2023) [41]

observed through the South African Council for the Project and Construction Management Professions that at registration, professionals guarantee that they will strictly adhere to and abide by the code's obligations. However, as a limitation to the assumption made previously, their conduct when they are actually executing their professional work is highly unsatisfactory. Perhaps this may be a reflection of the suggestion made by Ahmad et al. (2021) [1] that although engineering students have learnt of ethical judgement, they are not necessarily likely to act ethically. That is, some engineers' ethical awareness does not translate to their ethical behavior.

Furthermore, this research may also be used to observe Kohlberg's stages of moral development. Kohlberg's theory provides a framework for understanding how individuals progress in their reasoning about moral dilemmas (Gibbs et al. 2007, 443). It was proposed that there are six stages, grouped into three levels: pre-conventional, conventional, and post-conventional.

2.3.1. Pre-conventional

1. Stage 1 – Moral decisions are made in self-interest and/or avoidance of punishment
2. Stage 2 – Moral decisions are made to satisfy personal needs and/or to garner reward

2.3.2. Conventional

1. Stage 3 – Moral decisions made in conformance to society's expectations and with value to authority
2. Stage 4 - Moral decisions made to maintain social order and adhere to laws

2.3.3. Post-conventional

1. Stage 5 – Moral decisions made with priority given to one's individual rights and social contract
2. Stage 6 – Moral decisions are aligned with one's conscience and universal ethics

These stages offer insights into the development of moral reasoning and the complexities of decision-making. It should be noted that different persons are likely to be at different levels and stages in moral reasoning hence what may be considered rational to one person bound by a particular circumstance, may be irrational to another. According to Zhang and Zhao (2017) [47], one's moral development is heavily influenced by the social environment.

In addition, globalisation effects have proven to be a challenge for engineering professionals as, when working in several countries with discrete cultures, it may be difficult to comprehend the local and regional differences in professional ethics and integrity. Hence, it is vital that students not only learn ethical knowledge but also, how it can be applied to navigate ever-changing cultural contexts and refine their moral behavior accordingly [48]. Newberry (2004) [36] claims that within engineering education, the teaching of ethics has encountered many hurdles such as both the lack of emotional engagement with the material on the students' part and the lack of expertise and role modeling by the faculty. To alleviate this, Newberry (2004) [36] believes that there needs to be a component on ethical and societal concerns and ethical and societal context of research work should be considered.

3. METHODOLOGY

This study follows a diagnostic/explanatory research design and utilizes a mixed method or triangulation method of research i.e., it consists of both qualitative and quantitative research as well as building on previously postulated theories. According to Thurmond (2001) [43], the triangulation method allows for findings to be more readily interpreted by lessening the deficiency of utilising only a single strategy.

It is considered to be explanatory research as it tests the theoretical concept of Preference Transition Theory and builds on this as introduced in the Chadee et al. (2022a) [12] research paper on the violations of prospect theory. And diagnostic in nature, because it is gathering quantitative data via a close ended questionnaire through the idea/concept of moral adversities to test this novel theory. The questionnaire was electronically administered to civil engineering professionals across Trinidad and Tobago over a ten (10) week period and garnered a sample size of 86. It allows for an understanding of how decisions lead to moral adversities and how moral adversities affect professional preferences and choices in cost management and also, gives insight into just how far and for what reasons professionals are willing to deviate with incentivised conditions. This survey was conducted through the Delphi technique which can be described as a framework for estimating the probability and result of events in the future. It is used to acquire a collective view from persons concerning challenges which have little to no explicitly determined evidence and where opinion is significant [42]

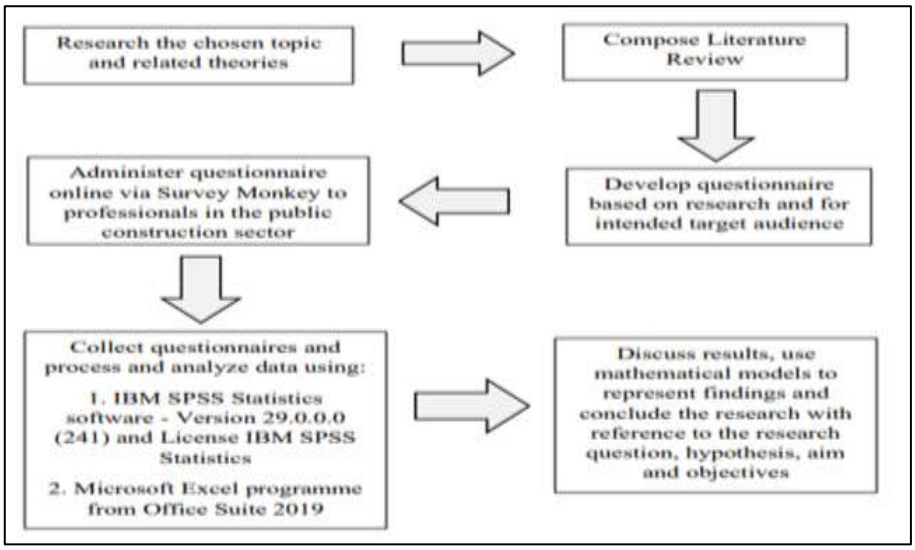


Figure 3: Flow of Steps in Research Methodology

In carrying out this research, it was assumed that the sources obtained through research for this project are all applicable to date, regardless of its respective published date and that the questionnaire respondents will be truthful and provide a proper rationale or reasoning for given responses.

In the analysis of results, two types of non-parametric statistical tests were carried out: Chi-Square Goodness of Fit Test (used for Question 1) and One-Sample Binomial Test (used for Questions 2, 3, 4 and 5).

3.1. Chi-Square Goodness of Fit Test

This test is utilized to determine whether the observed value of a particular phenomenon differs considerably from the expected value and how well the theoretical distribution fits the empirical distribution [7]. In this case, the null hypothesis is that the observed and expected are of equal frequencies, fitting a uniform distribution. The calculated Chi-Square value is found using the following formula:

$$X^2 = \sum \frac{(Observed\ Value - Expected\ Value)^2}{Expected\ Value}$$

Then, the significance level and the degrees of freedom (found using 'n-1' where n is the number of categories data is placed in) is used in the Chi-Square Table to find the critical Chi-Square value. Generally, if the calculated value is greater than the critical value, the null hypothesis is rejected. However, in IBM SPSS Statistics, a statistical significance value p is found and if this p-value is less than the significance level (0.05 or 5%), then the null hypothesis is rejected.

3.2. Binomial Test

The one-sample proportion test, commonly known as the binomial test can be used to assess if a certain proportion of cases fall into one of just two potential categories. Based on a hypothesised value, one can apply the binomial test and associated 95% Confidence Interval to evaluate whether there is a preference for one of two options/categories. One option will have a proportion greater than 0.5 if it is preferred over another.

Requirements satisfied to use this test:

1. The response variable is binary - Accept or Reject
2. Each trial has an outcome that could be defined as a 'success' or 'failure' - Accept is arbitrarily considered as the 'success' outcome
3. The probability of 'success' remains constant for each trial - Only two options implies that there is 50% chance that Accept is chosen
4. Each trial is independent - The outcome of one trial cannot affect the outcome of another
5. The sample is a fair representation of the population - As per the Central Limit Theorem, sample sizes greater than or equal to 30 tend to accurately represent a population. The sample size used in this study is 86 (> 30)

Here, statistical significance values (p-values) are also used in determining the decision. It follows the same principle, once it is less than the level of significance (0.05 or 5%), the null hypothesis is rejected.

The survey requested the participant to act in the role of a project manager on a medium size

construction project (≈ $50,000,000.00). The main functions of this project manager were to verify quality and quantity of works and approved variations to the contract sum.

The first case scenario presented was the existence of errors and omissions in the design. This case set the cost of the errors and omissions contribution to an additional 10% of the actual contract sum. Participants were then presented with several alternatives where they were given three options, that is to ignore the instructions within the alternative, follow the contract or comply with the instructions.

Table 1: Alternatives under Case Study 1

	1	2	3	Comments:
	Ignore	Follow contract	Comply	
a) Your project director requests the variation be resolved in 7 days. How do you respond?				
b) Your project director informs you that the Minister wants this variation resolved as soon as possible and requests that the variation be resolved in 5 days. How do you respond?				
c) Your project director informs you that the Minister wants this variation resolved as soon as possible, requests the variation be resolved in 5 days and your job/promotion depends on it. How do you respond?				
d) Question (c) holds. However, the contractor approaches you to increase the actual variation from $5 million dollars to $7 million dollars and you will derive a benefit of $750,000 (3 years' salary). How do you respond?				
e) Questions (d) holds. In addition, you have a close family member (spouse/parent) who is in critical need of a high-cost medical surgery and aftercare. How do you respond?				
f) Questions (d) holds. However, you will derive a benefit of $500,000 (2 years' salary), and $500,000 will go to the political party. You will be given credit for this contribution (potentially propelling your career into State Boards or executive positions). How do you respond?				

The second case study asks participants to consider that they are working on a highly politically sensitive project and are cognizant of discussions on campaign financing commitments. Though, there is a 100% job security and there are no errors and/or omission in design, the following conditions were put forward: the project manager must create and validate variations as well as sign off as approving variations. Based on this, they were asked, as seen in the table below, whether they would accept or reject the risk/gamble on creating and approving variation costs.

Table 2: Alternatives under Case Studies 2, 3 and 4

0% financial benefit to you	**Accept**	**Reject**	**10% financial benefit (principal-agent scenario)**	**Accept**	**Reject**
$10,000			$10,000 ($1,000 benefit)		
$50,000			$50,000 ($5,000 benefit)		
$100,000			$100,000 ($10,000 benefit)		
$250,000			$250,000 ($25,000 benefit)		
$500,000			$500,000 ($50,000 benefit)		
$750,000			$750,000 ($75,000 benefit)		
$1,000,000			$1,000,000 ($100,000 benefit)		
$2,500,000			$2,500,000 ($250,000 benefit)		
$5,000,000			$5,000,000 ($500,000 benefit)		
$10,000,000			$10,000,000 ($1,000,000 benefit)		
$20,000,000			$20,000,000 ($2,000,000 benefit)		

15% financial benefit to you	Accept	Reject	20% financial benefit (principal-agent scenario)	Accept	Reject
$10,000 ($1,500 benefit)			$10,000 ($2,000 benefit)		
$50,000 ($3,000 benefit)			$50,000 ($10,000 benefit)		
$100,000 ($15,000 benefit)			$100,000 ($20,000 benefit)		
$250,000 ($33,000 benefit)			$250,000 ($50,000 benefit)		
$500,000 ($75,000 benefit)			$500,000 ($100,000 benefit)		
$750,000 ($108,000 benefit)			$750,000 ($150,000 benefit)		
$1,000,000 ($150,000 benefit)			$1,000,000 ($200,000 benefit)		
$2,500,000 ($375,000 benefit)			$2,500,000 ($500,000 benefit)		
$5,000,000 ($750,000 benefit)			$5,000,000 ($1,000,000 benefit)		
$10,000,000 ($1,500,000 benefit)			$10,000,000 ($2,000,000 benefit)		
$20,000,000 ($3,000,000 benefit)			$20,000,000 ($4,000,000 benefit)		

The scenario and consideration of job security were kept the same for Case Study 3 however the condition put forward now is that though an independent construction consulting firm must create and approve 'variations', the project manager must sign off as validating the need for this 'variations'.

Participants had to indicate whether they would accept or reject the risk/gamble, on creating and approving variation costs, within a table identical to that of Case Study 2.

In Case Study 4, the scenario and considerations were consistent with that of Case Study 2 and 3 but its conditions were as follows: an independent construction consulting firm must create and approve 'variations' and the project manager must sign off as validating the need for this 'variations' but there is a 1 in 5 (20%) chance of getting caught, repaying the derived financial benefit you received, losing your job, and being reported to the Professional Association. Once more, participants were asked to either accept or reject the risk/gamble of this scenario, within a table consistent with that of Case Study 2 and 3.

The fifth and final case study invited participants to consider working on a highly politically sensitive project, within which they are privy to discussions on campaign financing commitments. In this case scenario, there is only a 50% chance of keeping the job and possible promotion based on the current political party staying in power (5-yr political cycle). Also considering that it is an election year, the project manager is tasked to 'make things happen'. If he/she does not comply, there is a 50% chance possibility that he/she will be removed from the project and replaced with another project manager who is willing to facilitate the political will. Participants had to indicate whether they would prefer a chance of the options seen in the table below.

Table 3: Alternatives under Case Study 5

0% financial benefit to you	**Accept**	**Reject**	**10% financial benefit (gamble)**	**Accept**	**Reject**
$10,000			$10,000 ($1,000 benefit)		
$50,000			$50,000 ($5,000 benefit)		
$100,000			$100,000 ($10,000 benefit)		
$250,000			$250,000 ($25,000 benefit)		
$500,000			$500,000 ($50,000 benefit)		
$750,000			$750,000 ($75,000 benefit)		
$1,000,000			$1,000,000 ($100,000 benefit)		
$2,500,000			$2,500,000 ($250,000 benefit)		
$5,000,000			$5,000,000 ($500,000 benefit)		
$10,000,000			$10,000,000 ($1,000,000 benefit)		
$20,000,000			$20,000,000 ($2,000,000 benefit)		

The data collection process for this study primarily involves the use of questionnaires to explore differences in decision-making that influence preferences and choices, particularly in the public sector construction industry. However, discussions concerning moral dilemmas can evoke strong

emotional responses, potentially leading individuals to feel defensive or opinionated, particularly regarding the protection of integrity and reputation. Consequently, there may be a conflation of the issues being examined, blurring the distinction between ethical conduct and preferences in decision-making. To mitigate this, the questionnaire emphasises the confidentiality of provided data and its intended use solely for academic purposes. Additionally, the research faces a notable gap in existing literature, especially concerning studies specific to Trinidad and Tobago, other Caribbean islands, or similar small island developing states. It should also be noted that garnering data from practicing engineers that are actually registered engineers was particularly challenging hence, the limitation exists that the data collected is not entirely from registered professionals who are held to a specific standard.

RESULTS

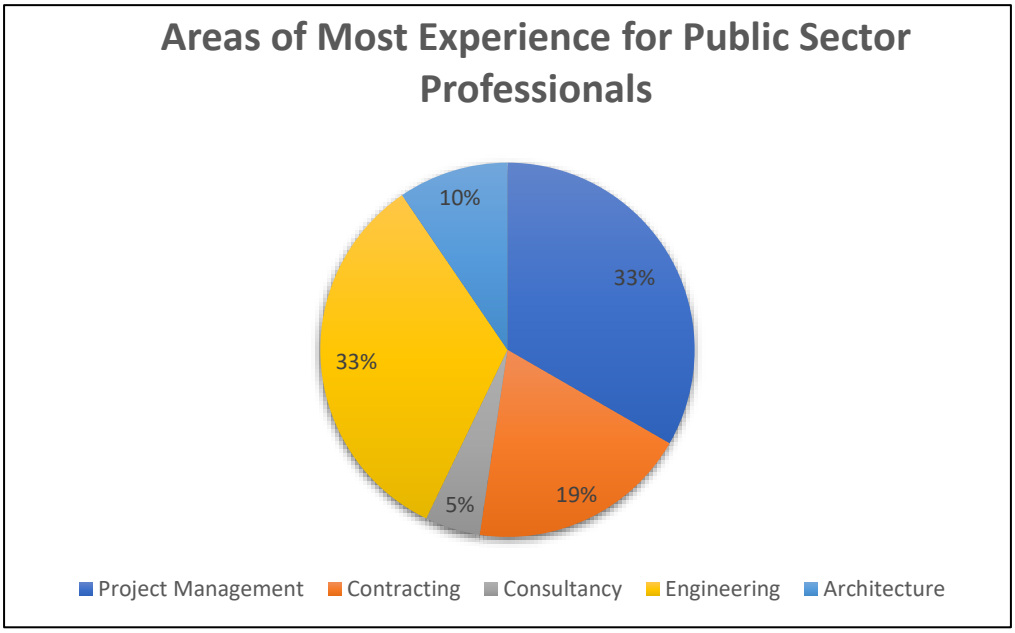


Figure 4: Amount of Public Sector Professionals and Their Respective Affiliated Area

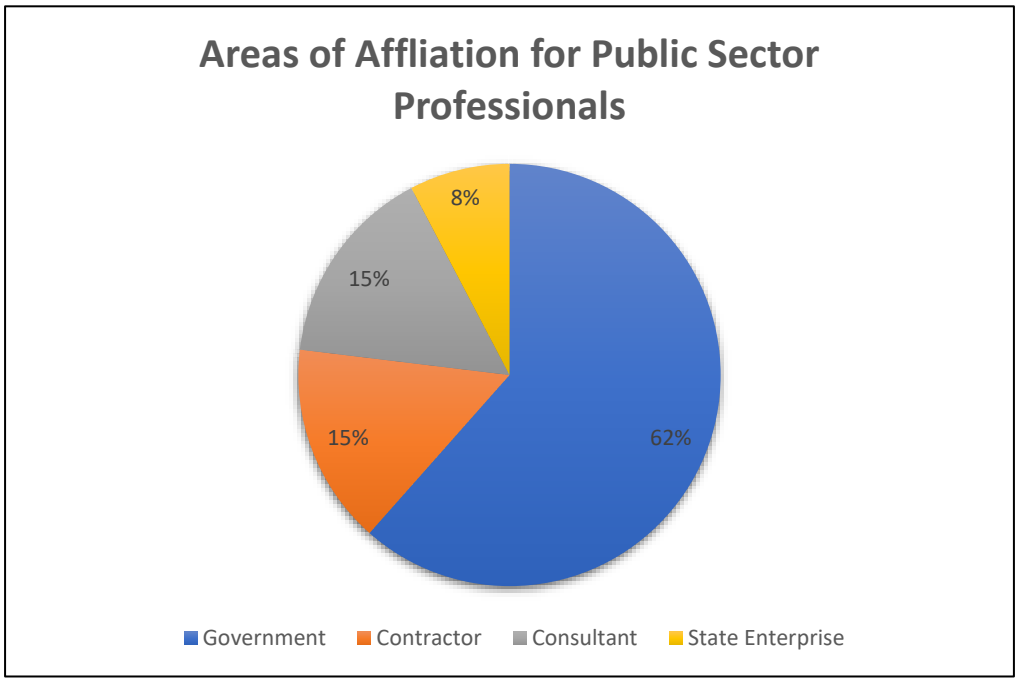


Figure 5: Areas in which Public Sector Professionals are Most Experienced

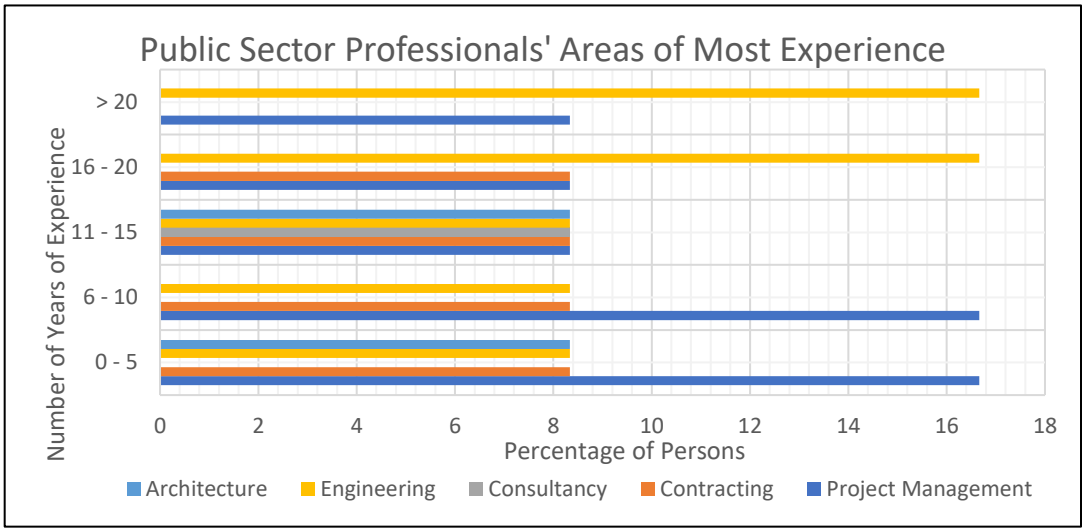


Figure 6: The level of experience of the Public Sector Professionals

Of the public sector professionals that participated in the survey, the majority indicated that they are affiliated with the Government of Trinidad and Tobago i.e., these individuals most likely work on state projects which are funded by tax-payers. This may, as aforementioned, encourage the principal-agent problem. Additionally, in general, it was observed that persons with the most working experience in the industry (more than 20 years) are based in areas of engineering and project management whilst any participating professional who is based in architecture and consultancy did not have more than 11-15 years of experience in these areas. The most experienced individuals involved in contracting have worked there for 16-20 years. Therefore, it is fair to say that the survey was well-rounded as it included responses from both junior and seasoned professionals.

In Question 1d, 1e and 1f, the situation described includes accepting personal benefit. For these instances the bar graphs (seen in Figures 3.3, 3.4 and 3.5) indicate that though rejection is the majority, not all respondents chose to ignore or follow contract. The percentage of compliance was higher for these situations than the remaining in Question 1 with the highest (25.6%) being observed in Question 1e where one's close relative was in need of urgent surgery. This keenly showcases how moral adversity influences decision-making. Question 1f had the second highest level of compliance at 15.1%. This question included the condition that a sum of money would be donated on the professional's behalf to a political party. Professionals may have therefore been inclined to comply in an attempt to gain favor of the political party which is crucial as public sector projects in Trinidad and Tobago are mostly partisan in nature.

The null hypothesis is that professionals act irrational when it comes to civil engineering cost management. Through Chi-square testing, it was determined based on that amount of professionals who chose acceptance or rejection of the risk, that the only case to not reject the hypothesis was Question 1e. The p-value was greater than 0.05 suggesting there was no statistically significant difference in the observed and expected frequencies of the options (Ignore, Follow Contract and Comply). All other cases in Question 1 obtained p-values less than 0.05 with a statistically significant difference in the observed and expected frequencies of options allowing for rejection of the null hypothesis and acceptance of the alternative, that professionals do not act irrationally in managing costs.

4.1. Question 1

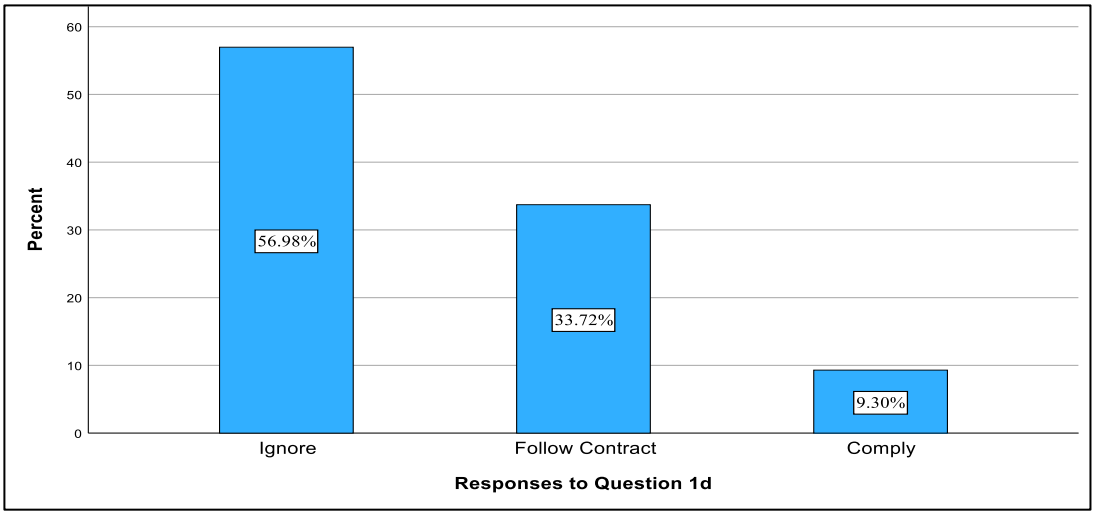


Figure 7: Bar Graph of Percentage of Respondents for Each Response Option in Question 1d

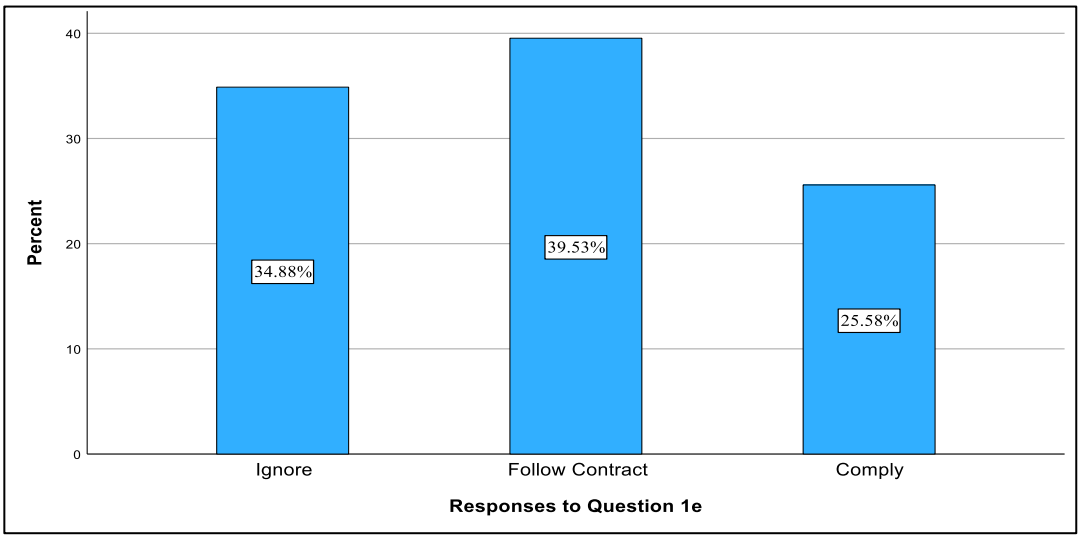


Figure 8: Bar Graph of Percentage of Respondents for Each Response Option in Question 1e

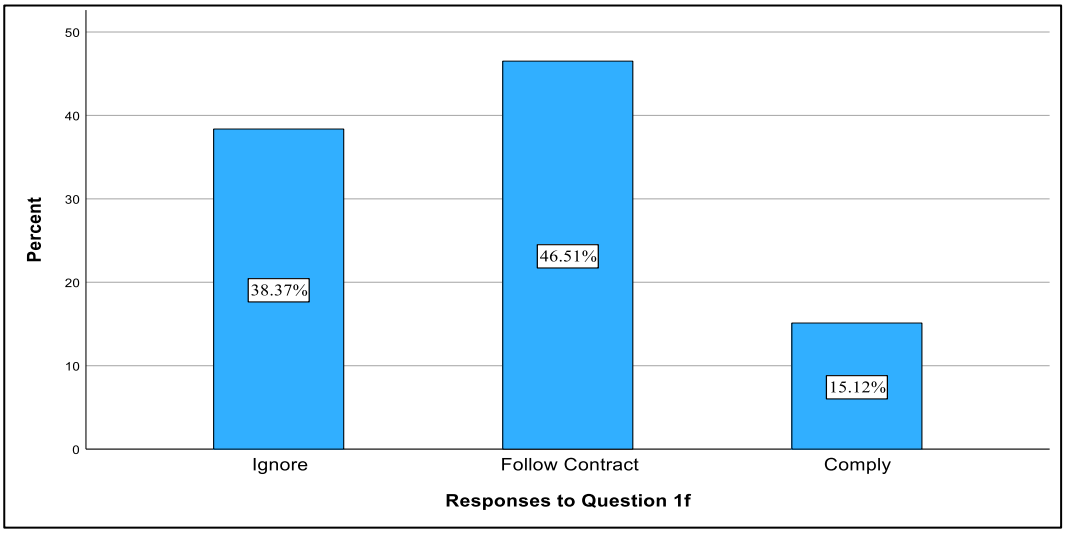


Figure 9: Bar Graph of Percentage of Respondents for Each Response Option in Question 1f

Table 4: Alternatives under Case Study 5

	Null Hypothesis	p-value	Decision
1	The categories of Responses to Question 1a occur with equal probabilities.	<.001	Reject
2	The categories of Responses to Question 1b occur with equal probabilities.	<.001	Reject
3	The categories of Responses to Question 1c occur with equal probabilities.	<.001	Reject
4	The categories of Responses to Question 1d occur with equal probabilities.	<.001	Reject
5	The categories of Responses to Question 1e occur with equal probabilities.	.272	Do Not Reject
6	The categories of Responses to Question 1f occur with equal probabilities.	.001	Reject

From One-Sample Binomial testing, in Questions 2 to Question 5, in all instances the p-value was less than 0.05 implying there was a statistically significant difference between the observed and expected frequencies of the options and that the majority of professionals rejected the gamble and hence, the decision was to reject the null hypothesis and accept the alternate.

Though the majority chose to reject the risk/game, the main takeaway lies in the fact that there were still persons who accepted it. For Question 2, the observed trendline of the graphs in Figure 3.7 and 3.8 is downward sloping (for acceptance) and upward sloping (for rejection), respectively. This implies that at 0% benefit, the likeliness that a professional will accept a gamble varies inversely with the amount of money at risk money i.e., professionals more so risk smaller sums of money as opposed to large amounts when there is no personal gain involved.

However, the opposite is recognized when it comes to Question 5 (at 10% benefit). The graph shown in Figure 3.16 includes a trendline that gradually curves upward and in Figure 3.17, the graph's trendline gradually curves downward. This suggests that when professionals have the opportunity to proportionately gain from a risk, they will be more willing to risk larger amounts of money. This observation is carried over to Question 3 and 4. Though the trendlines (observed in Figure 3.10 and 3.11) are not as distinctively curved in Question 3 as in Question 5. The gentle curvature near the right end of both graphs is still indicative of professionals being less likely to reject the gamble associated with larger sums of money, when personal gain is involved. Question 4 emphasises the same at a 20% benefit. Notably, the curvature of the trendlines in the graphs of Figure 3.13 and 3.14 are more prominent. This again stresses that as the amount to be personally gained increases, more professionals will accept gambles where large amounts of money are at risk.

4.2. Question

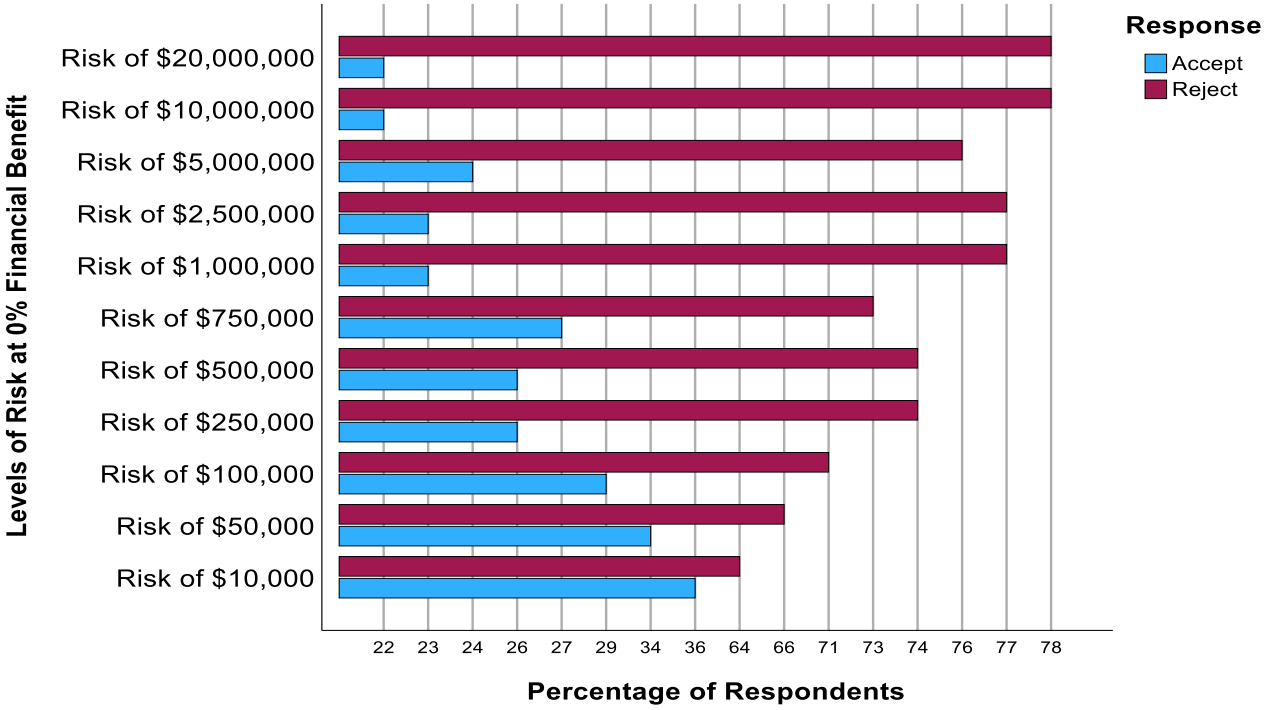
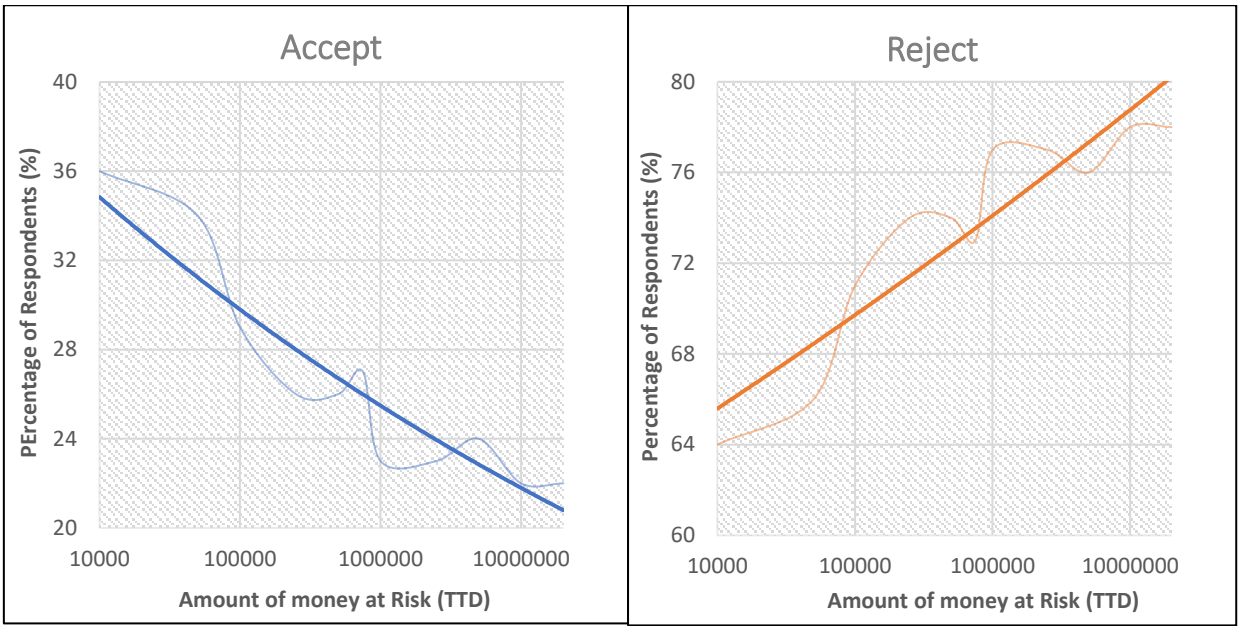


Figure 10: Clustered Bar Graph of Percentage Respondents by Levels of Risk at 0% Financial Benefit



Figures 11 and 12: Graphs of Observed Trends in Acceptance and Rejection of the Risk at 0% Financial Benefit

4.3. Question 3

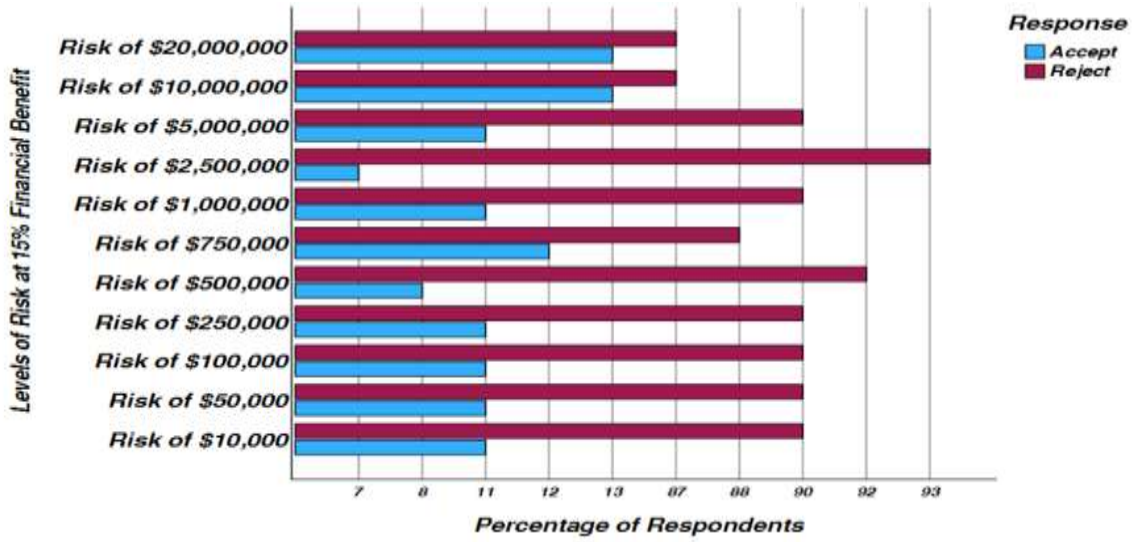
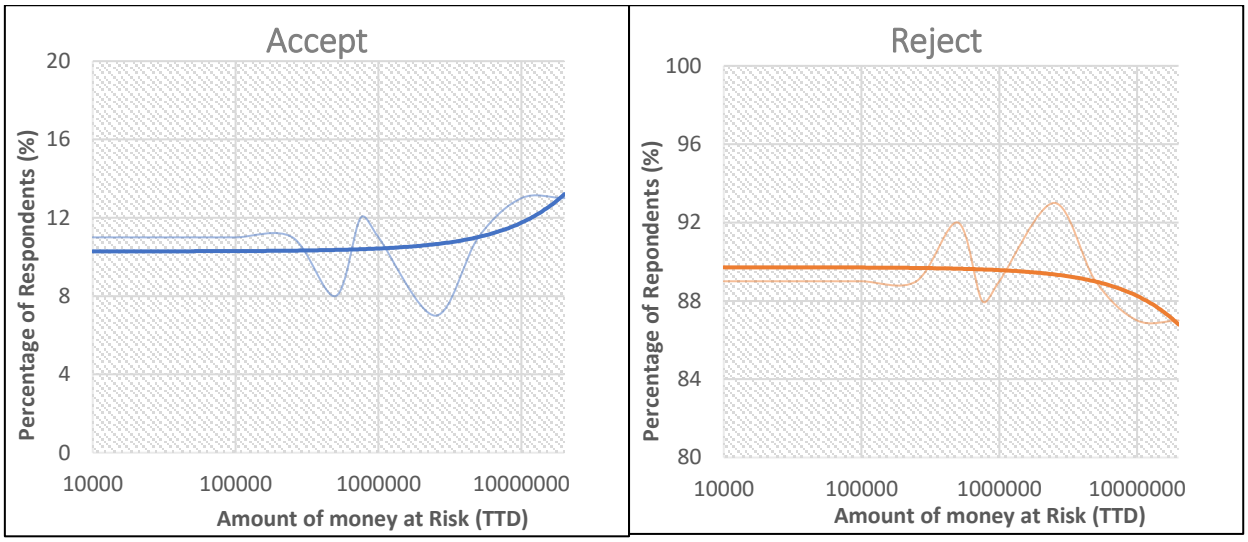


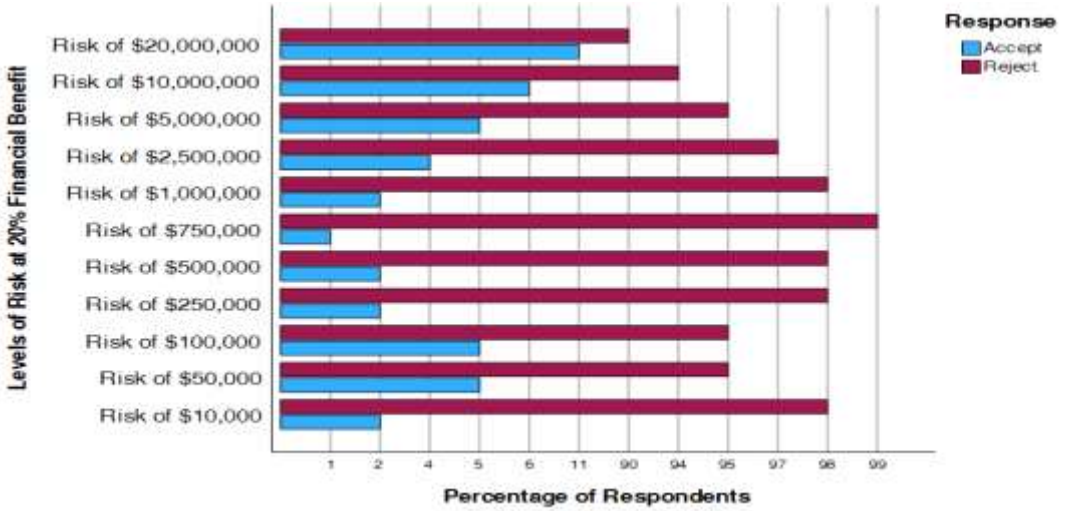
Figure 13: Clustered Bar Graph of Percentage Respondents by Levels of Risk at 15% Financial Benefit

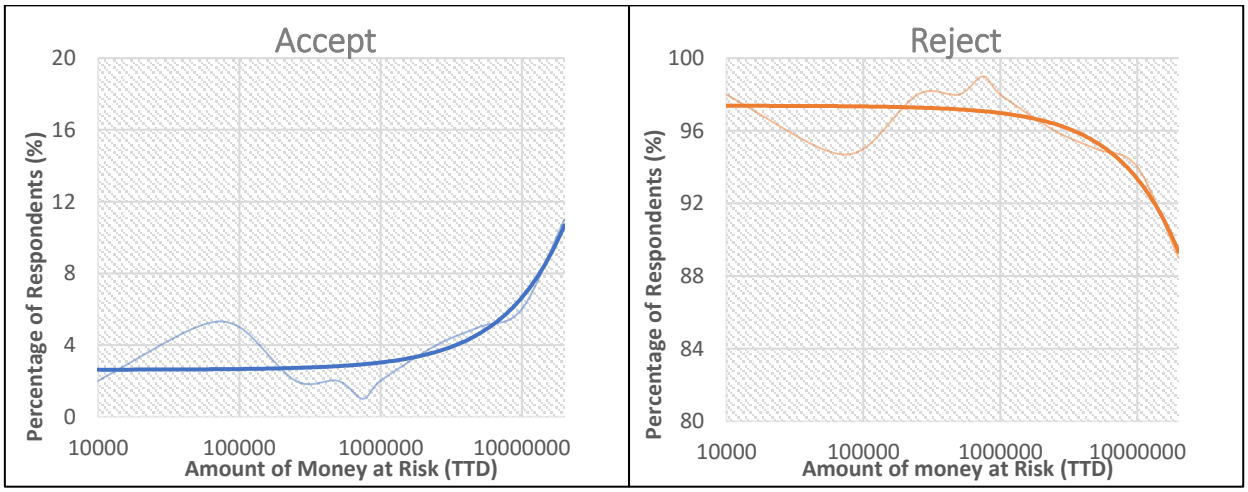


Figures 14 and 15: Graphs of Observed Trends in Acceptance and Rejection of the Risk at 15% Financial Benefit

4.4. Question 4

Figure 16: Clustered Bar Graph of Percentage Respondents by Levels of Risk at 20% Financial Benefit





Figures 17 and 18: Graphs of Observed Trends in Acceptance and Rejection of the Risk at 20% Financial Benefit

4.5. Question 5

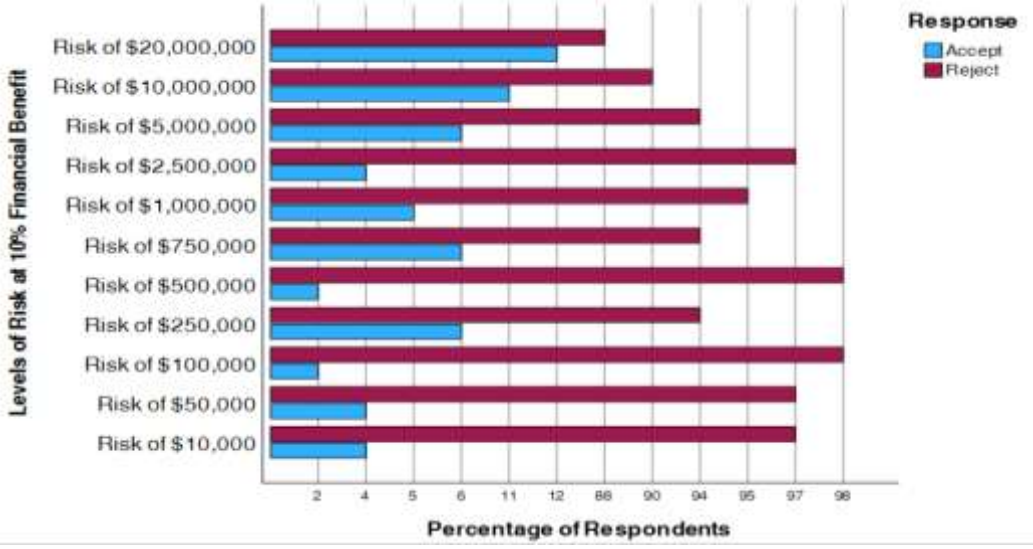
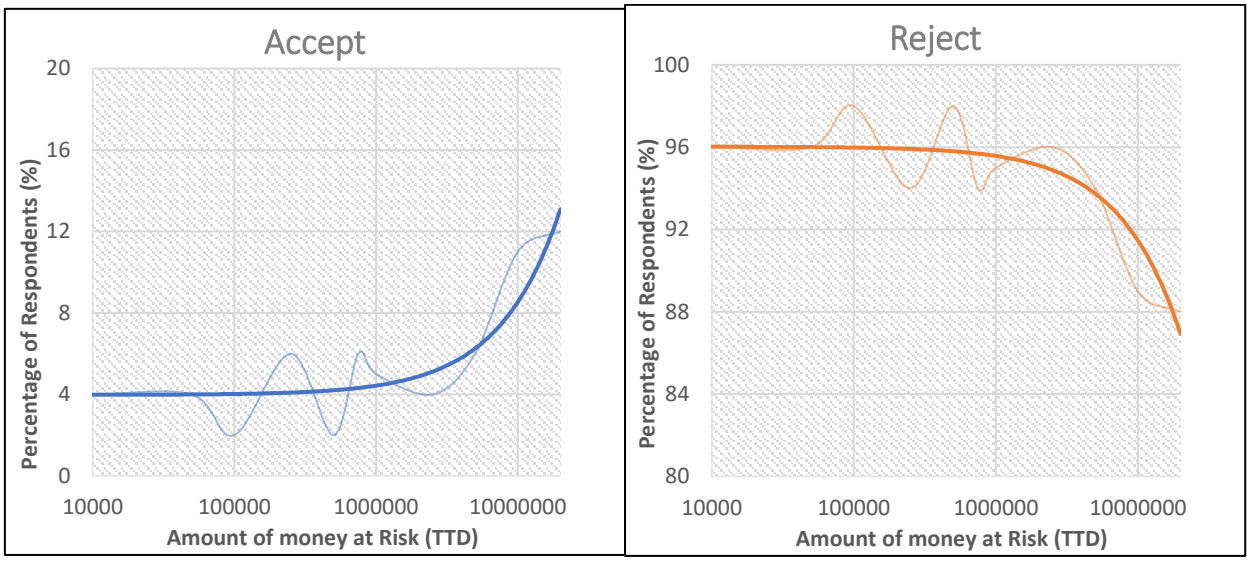


Figure 19. **Clustered Bar Graph of Percentage Respondents by Levels of Risk at 10% Financial Benefit**



Figures 20 and 21: Graphs of Observed Trends in Acceptance and Rejection of the Risk at 10% Financial Benefit

5. DISCUSSION

In all instances, there are persons who will accept, acting in their own interest. This is a crucial finding as it indicates that there is no clear-cut way in which persons in the civil engineering industry make decisions. It emphasises that which is supported by Pan (2019) [39], that subjectivity exists and based on the particular morally adverse circumstance, one's preference will trump the optimal choice for a project.

Such observation is dire for the civil engineering industry as allowing a public sector project to be carried out in self-interest encourages cost overruns, schedule delays and various other problems attributing to Parkinson's Law whereby work which can be done in a shorter period of time is 'stretched' by filling the void with problems to be resolved, resulting in a longer time period being taken up. This in turn results in disproportionate resources for other projects. Essentially, if one project takes more money and time than initially planned then the other projects will have less money and time available to be completed and may actually be disadvantaged even before commencement. In the long run, as also claimed by Khadim et al. (2021) [28], Akinrata, Ogunsemi and Akinradewo (2019) [3] and Inuwa, Usman and Dantong (2015) [25], these activities promote poor quality workmanship, affecting the integrity of built structures which will then require recurrent maintenance.

This downturn in infrastructure, paired with subsequent distrust of the industry by citizens (i.e., tax-payers who fund these projects) basically stalls the country's overall development and limits its economy. Notably, sustainable growth is also stunted through the squandering of available resources. Since Trinidad and Tobago is a small island developing state, the subsequent effects due to these issues will be more severe than if it were experienced in a developed or metropolitan nation. A good case in point is the situation in Ghana where Asamoah and Decardi-Nelson (2014) [6] stated that other governmental sectors such as education and healthcare were underfinanced and rendered incompetent. It therefore shows that a directly proportional relationship exists between preferences and choices and moral adversities as preferences and choices made in self-interest under the influence of moral adversities may actually create more moral adversities.

The results of this study align with the Pareto Principle i.e., the observation that, although a phenomenon is normally caused by many different factors, it is frequently the case that 20% of those factors account for 80% of the observation [17]. This relates to the civil engineering fraternity because though it is proven through the results that the minority (a relatively small group of professionals) chose to endure the gamble and/or accept the personal benefit, most of the construction industry is often accused of improper cost management. These further stresses the importance of understanding decision-making in civil engineering cost management.

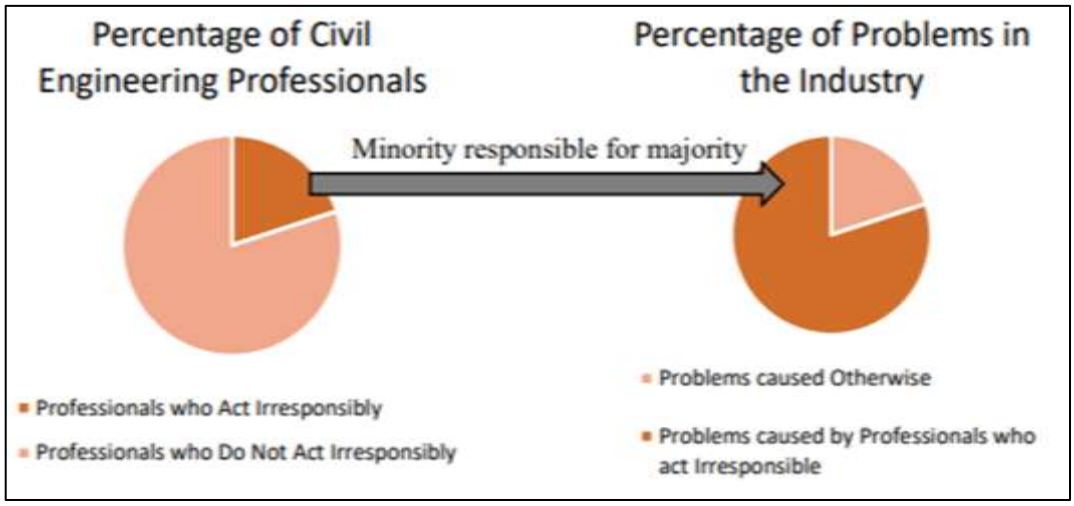


Figure 22: Application of the Pareto Principle in the Construction Industry

Based on the fact that not 100% of the responses rejected the risk/gamble, it is fair to say, in answer to the research question posed and the second objective of this study, that moral adversities play a crucial part in decision-making as it influences one's preference and hence, has the ability to alter the final choice made for a project and affect its ultimate costing. The results also indicate that rational agents act irrationally by way of their specific circumstance which justifies the hypothesis of this investigation.

With reference to Chadee et al. (2022a) [12] and Preference Transition Theory (see Figure 1.1), generally persons reside in the transition phase change zone which can be described as a domain of rationality but since a person reserves the right to change their mind, they may step out of the rational transition zone and become irrational. Crossing the boundary limit to phase change to the right may be associated with those who act irrationally with righteous intent. For example, as seen in Question 1e when a close relative's life depended on it. In keeping with the first objective, there is an interplay with ethics and morality where the professional's opinion is generally that: Though it is unethical, from the perspective of the person who made the decision, the compromise is morally just. This is also in accordance with Bouville (2008) [9], which presents that when it comes to morality, something is only right or wrong depending on how the question is framed. Bouville (2008) [9] stated, 'For instance, it depends on whether we are talking about me or someone else: I am more likely to invoke duty to my family than to grant others such a right. One can also praise deeds as moral but be unwilling to perform them oneself.' These individuals are normally risk-averse but fall prey to accepting personal benefit when faced with moral adversity. However, crossing the boundary limit to phase change to the left describes those who are

risk-seeking implying they may gamble through projects purely because of ego, greed and agency benefit.

From this it can be inferred, in relation to the study's aim, that preferences and choices in decision-making in cost management within the civil engineering and construction industry does in fact deviate from internationally accepted Prospect Theory. Considering Figure 4.1 below, this is fair to say because the more a person gambles without being caught and gains money, the more likely they are to do it again i.e., becoming risk-seeking for gains. Additionally, as supported by Usman, Inuwa and Iro (2012) [44] and Al-sweity (2013) [4], the little to no ramification that exists when it comes to strategic mismanagement of project funds encourages the 'more you gain more you gamble' behavior. In losses, risk aversion will be experienced whereby if a person experiences a loss, he would not want to continue losing through gambling or taking Question 4 into account, when the professional was given a 20% chance of being caught (from which one can lose their job), the percentage of the respondents for rejection of the risk was the highest.

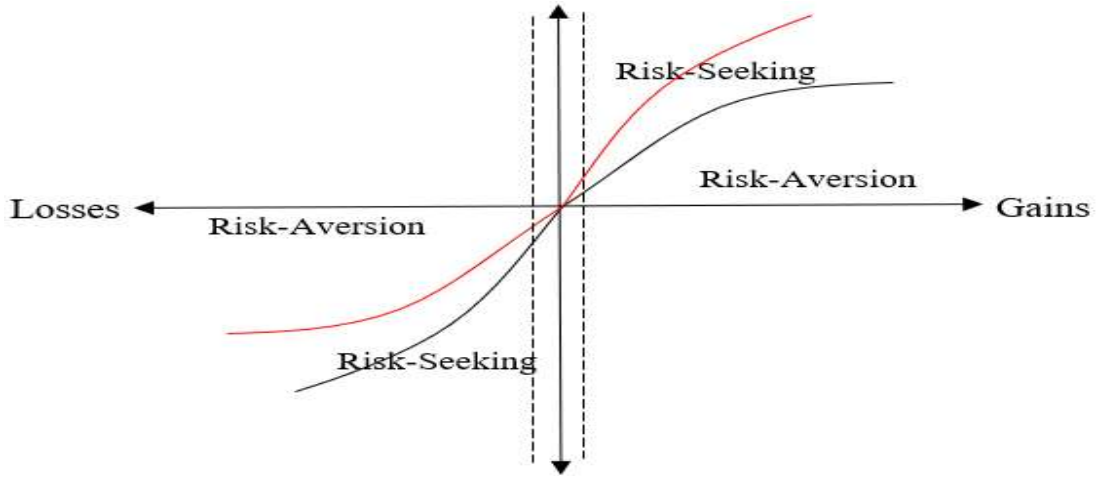


Figure 23. Deviation from Prospect Theory and Transition Phase Change Zone as per Preference Transition Theory

As such, with regard to the third objective, determined choices of decision making can be either or both rational and irrational depending on the professional's circumstance and what is morally just to them. Even though, generally, professionals who are registered and held to a specific standard are trained to be more risk conscious. This study can therefore be considered a socio-economic imperative as it brings to light how civil engineering cost management is affected by the preferences and choices of rationally irrational agents. This, as well as the fact that projects in Trinidad and Tobago are highly partisan, heightens the need for project detail transparency to the public and good governance. This is also stressed by Chadee et al. (2021a) [10] and will allow persons to become sensitized instead of being sensitive towards the topic.

Whilst the overwhelming support to reject any gamble or simply remain neutral is of significance, it must be kept in mind that in discussion of moral adversities persons are likely to become defensive when it comes to the protection of their reputation. The sensitivity of what is being tested may impact the given responses as persons may not want to have a view that is not in conformance with the masses. This may be as a result of the possible undesirable outcomes in the construction industry that include being treated differently or even being fired and subsequently blocklisted, which is a predicament that one would not want to be subjected to in today's economic climate and especially so since, there is the recurrent call to further enforce harsh penalties for breaching the code of conduct as engineer.

This study enlightens us about how money influences informed decision-making and attempts to understand the behavioral psychology of professionals but still leaves more to be explored within this topic. Future studies may also include the widening and generalization of Preference Transition Theory in other industries such as banking and finance.

6. CONCLUSION

From this study, it was determined that moral adversities impact decision-making by influencing a professional's preference, which can in turn trump the optimal choice of the project. It was found that professionals who are supposed to be

rational agents behave irrationally in civil engineering cost management due to a specific morally adverse circumstance. Determined choices of decision-making in the civil engineering and construction fraternity should be rational. Whilst most professional are rational, few instances exist in which they are irrational but considered morally just by the professional. It was then inferred that preferences and choices made in self-interest under the influence of moral adversities result in increased moral adversities i.e., a directly proportional relationship exists. Reviewed studies indicate that the reason professionals may act irresponsibly is because there is little penalty and rare instances in which it is followed through with. The repercussions of these actions are dire, as it retards the country's development.

Upon investigation, it was observed that preferences and choices in decision-making relating to cost management in the industry deviates from the internally accepted Prospect Theory whereby professionals act risk-seeking in gains and risk-averse in losses as opposed to the usual other way around.

This study also allowed for the differentiation of Prospect Theory and Preference Transition Theory. The main difference is that Preference Transition Theory attempts to account for the discontinuity of the Prospect Theory Utility Function, considering the fact that a person reserves the right to change their mind and sets a rational domain in the transition phase change zone. This theory can be further explored in other sectors such as banking and finance and research on the effects of moral adversities on preferences and choices should be expanded with consideration of population demography.

7. DECLARATIONS

7.1. Author Contributions

Conceptualization, A.C. and H.M.; methodology, A.C.; software, P.M.; validation, A.C., P.M. and H.M.; formal analysis, P.M.; investigation, A.C.; resources, A.C.; data curation, A.C. and P.M..; writing—original draft preparation, P.M.; writing—review and editing, A.C.; visualization, A.C. and P.M.; supervision, A.C. and H.M.; project administration, A.C.; funding acquisition, A.C. and P.M. All authors have read and agreed to the published version of the manuscript.

7.2. Data Availability Statement

Data available on request due to restrictions e.g. privacy or ethical: The data presented in this study are available on request from the corresponding author.

7.3. Funding

Funding information is not available.

7.4. Acknowledgements

The authors sincerely appreciate all professionals who agreed to participate in this survey. Their support and willingness to take time to fill in the questionnaires are valued.

For their insightful criticism and recommendations, the authors are grateful to the anonymous peer reviewers.

Additionally, the authors express gratitude to family and friends for their continued encouragement and moral support through this research.

7.5. Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

7.6. Conflicts of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancies have been completely observed by the authors

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