MITIGATION OF BIAS IN DECISION MAKING IN THE CONSTRUCTION SECTOR DISPUTE RESOLUTION

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ABSTRACT

Construction projects are complex and involve a large number of stakeholders, thus disputes are very common throughout the life of the project. These disputes lead to cost and time overruns and thus need to be resolved in the most efficient manner. In the past only a few traditional methods were used for dispute resolution, such as litigation and arbitration, but these methods take a lot of time and money to lead to a decision. Thus, to resolve disputes more efficiently alternative dispute resolution (ADR) methods were introduced, such as negotiation, mediation, med/arb, dispute boards, minitrial etc the main aim for these methods is to reduce the time and cost expenses in resolving disputes. In most research dealing with construction project dispute resolution (CPDR) it is assumed that the decision-making parties involved in the process are neutral and will make rational decisions, which is not always the case. Judgment errors are very common, and bias is one of the major judgment errors according to past research, bias may creep into the decision making process in CPDR subconsciously, which will lead to decisions that are not accurate, rational or just, if the parties fail to reach an acceptable decision in a timely manner then the dispute may be moved forward towards arbitration or litigation, thus defeating the purpose of ADR techniques which are meant to reduce the time and cost for the dispute resolution process. This study aims to develop a framework to better incorporate the factors that lead to bias in the dispute resolution process. Based on detailed literature review and primary survey of industry professionals, 15 top factor that lead to bias were identified. A secondary questionnaire survey was conducted to rank the bias mitigation strategies which were identified by through the relevant literature. Based on the results of the secondary survey the best remedial practices were identified and incorporated into a framework to deal with bias effects in CPDR process. This research will help in adding more information bias and paving way for future research on the topic of bias in regards to the construction sector.

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Chapter 1

Introduction

1.1 Background

Bias in decision making is reviewed in a lot of studies in the past. It depends on a number of factors which influence a person's decision making ability, human judgment and decision making is distorted by an array of cognitive, perceptual and motivational biases (Pronin, 2007). Bias in decision making means that the decisions made by certain individuals are skewed away from a predefined objective standard, or become irrational, which may be due to a number of the factors. People make many decisions on a daily basis, but how does one get to a right or wrong answer and also, what constitutes a right answer. Every situation is unique and has a number of variables that go into that decision-making process some decisions are easy to make and have no effect on anyone other than the person involved, while some decisions are affecting a large number of people. Such as in construction projects because of the large number of variables involved, decision making process is susceptible to bias. According to (Chira, Adams, & Thornton, 2008) bias is a prejudice or a propensity to make decisions while already being influenced by an underlying belief. The past several decades of research have unveiled a lot of biases in human judgment. These biases have received much attention because of their potential for compromising human decision making and exacerbating misunderstanding among people and groups (Pronin, 2007). Thus, studies have been conducted to identify the effects of bias in the decision-making process.

This concept has only recently been studied in regards to the dispute resolution process in the construction sector, as construction projects are unique, complex and have long durations spanning over many years, also many stakeholders are invsolved in each construction project so many key decisions have to be made on a daily basis to keep the project running smoothly

and withing the given time frame. Disputes arise as the result of non-acceptance of a rejection of a claim, a claim has to be made which is rejected to which a dispute can arise between the two parties (Semple, Hartman, & Jergeas, 1994). Disputes lead to cost and time overruns as they have a direct and indirect costs associated with their resolution, the direct cost is the amount spent in dealing with lawyers, claim consultants and the costs associated with the delays of project. The indirect costs are the mistrust and poor work quality which deteriorate project success (Zubair, Gabriel, & Thaheem, 2017). Thus when a dispute arises, a set of dispute resolution methods need to be used to resolve it, ranging from traditional methods such as litigation to different alternative methods such as, negotiation, mediation, dispute boards, arbitration, minitrial etc. As more and more research is being carried out on the dispute resolution process, alternative dispute resolution (ADR) techniques are being promoted as to keep the cost and time overruns to a minimum, thus either the dispute may be resolved between the disputing parties through negotiation or a 3rd party neutral may be employed to carry out the dispute resolution process.

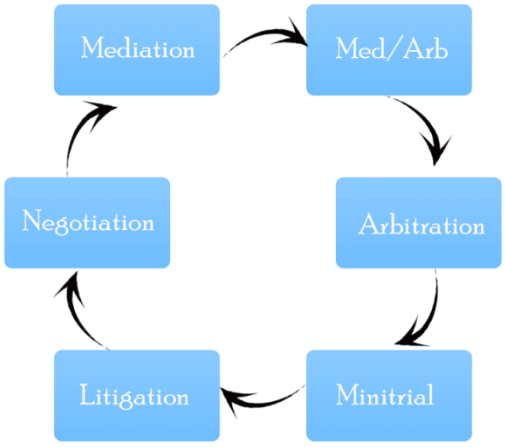

Figure 1.1 Dispute Resolution Techniques

The main aim of the parties involved in the dispute resolution process is to keep the loss of time and cost to a minimum while getting a fair decision to the dispute. This 3rd party in some

cases may be employed at the beginning of the project so that it is able interact with all the stakeholders, and also be aware of the conditions of the project throughout its life cycle. As multiple parties are involved with varying interests thus it is expected of the dispute resolution parties to be rational and impartial while making their decisions towards the said dispute. Mediators must meticulously avoid even the appearance of partiality or prejudice throughout the mediation process (Izumi, 2010). But this is not always the case and according to previous research bias may still creep into the dispute resolution process knowingly or unknowingly (Bhattacharya & Jasper, 2018). Bias affects our decisions and skews it away from the correct or just decision, and in the case of construction disputes more often than not it leads to prolonged decision-making processes which adds to the costs associated with the dispute.

1.2 Problem Statement

Decision making is a process of receiving, extracting and communicating information in which people have to exercise judgments (Li & Cheung, 2016). On construction projects decisions have to be made on a daily basis to keep the project running smoothly and within the time and cost constraints. A large number of stakeholders are involved in construction projects having varying interests, thus given the complex nature of construction projects and the number of stakeholders involved, disputes are very common throughout the life of the project. Disputes lead to cost and time overruns if not resolved in a timely manner, thus it is very important to get to a rational decision as soon as possible to better resolve the disputes. Thus, various ADR techniques are being promoted as they have lower costs and are resolved more quickly as compared to traditional methods. But as evident for the research in the last few decades, judgment errors are very common in the decision-making process, bias being one of the judgment errors also affects the decisions.

In the dispute resolution process we need timely and rational decisions to resolve disputes for that ADR is promoted in which the disputing parties expect the third party neutrals to be just

and rational in the decision making process, but that is not always the case as bias may still creep into the dispute resolution process unknowingly (Cheung, Li, & Levina, 2019). Due to the effects of bias in the decision making the disputes remain unresolved and eventually end up in litigation defeating the purpose of using ADR. Thus the factors affecting bias in construction sector dispute resolution (CPDR) need to be identified so as to employ remedial measures in the earlier stages of the decision making to resolve disputes in a more efficient manner.

1.3 Research Objectives

- To identify the major biases that occur in decision making of dispute resolution.
- To assess the biases that occur in the construction sector dispute resolution.
- To identify and suggest remedial measures for the different types of bias effects.
- To develop a bias mitigation framework for dispute resolution leading to performance improvement.

Chapter 2

Literature Review

2.1 Bias in decision making

Humans make decisions daily based on several factors and information available to them. Decision making ability varies across persons and within person across the lifespan (Morewedge et al., 2015). People are susceptible to judgment errors during the decision-making process depending on several different factors. Previous studies have shown that bias is one of the major judgment errors that occurs in human decision. Some decisions however may not be affected by the bias factors such as decisions where there is no significant loss, but some important decisions where faulty and irrational decisions may lead to major losses have to be protected from judgment errors. The phenomenon of bias in decision making has been discussed in numerous research papers throughout the last few decades, ranging from its effects in day to day lives as well as professional cases dealing with decisions in legal trials, medical fields etc. Only recently has bias been discussed regarding the disputes in the construction sector (Cheung & Li, 2019).

2.4 Disputes in construction sector

Construction industry is getting complex day by day. It is riddled with dynamism and uncertainties owing to multidisciplinary nature of projects and stakeholders. Owing to the diversity, differences of opinion are bound to occur which may escalate to conflict (Zubair et al., 2017). There may be many different causes of a dispute arising as every project is unique but according to (Zubair et al., 2017) the top five causes of disputes according to literature are, delays in payments, change orders, quality of works, delays in works, contractual anomalies.

Most construction contracts have mentioned a clause for dispute resolution in case if any arise in the future, including methods such as arbitration or dispute boards which comprise of member from both the contractor and client side and come into action when and if a dispute arises, but these methods are more so based on the historical practices of the company rather than on the practical aspect of the process. There is a cost associated with each dispute, it can either be visible such as the cost of the dispute resolution process, attorneys etc or less visible costs such as the opportunity costs and resources assigned to dispute resolution, other than these costs there are also some costs that are more difficult to quantify such as business relationships (Bvumbwe & Thwala, 2011). (Farooqui et al., 2014) Talks about the most frequently occurring causes of disputes in the construction industry of Pakistan which according to him are "Unrealistic information expectations", "Unclear Risk Allocation" and "Unfair Risk Allocation", where as "Unrealistic Tender Pricing", other issues can arise on projects as well, as disputes vary from project to project given the unique nature of our construction industry. Thus, these disputes need to be resolved in the most efficient and rational manner. Traditional methods such as litigation or alternative dispute resolution methods such as arbitration, mediation or negotiation may be used to resolve disputes between the parties. Litigation used to always be the go to method for dispute resolution but it requires a lot of time and large direct and indirect costs, so as the main goal of both disputing parties is to conserve the economic and time losses thus more attention is being given to the ADR techniques. The most efficient method would be that a dispute is resolved through negotiation between the disputing parties as it saves more time and cost because no third party has to be employed. But if the parties are not on good terms or in case of not getting to a mutual agreement from negotiation, a third party may be involved as a mediator having experience in dispute resolution to further facilitate the process. According to (Chan, Suen, & Chan, 2006) mediation was the

most preferred ADR technique, in context of international projects and litigation was the least preferred.

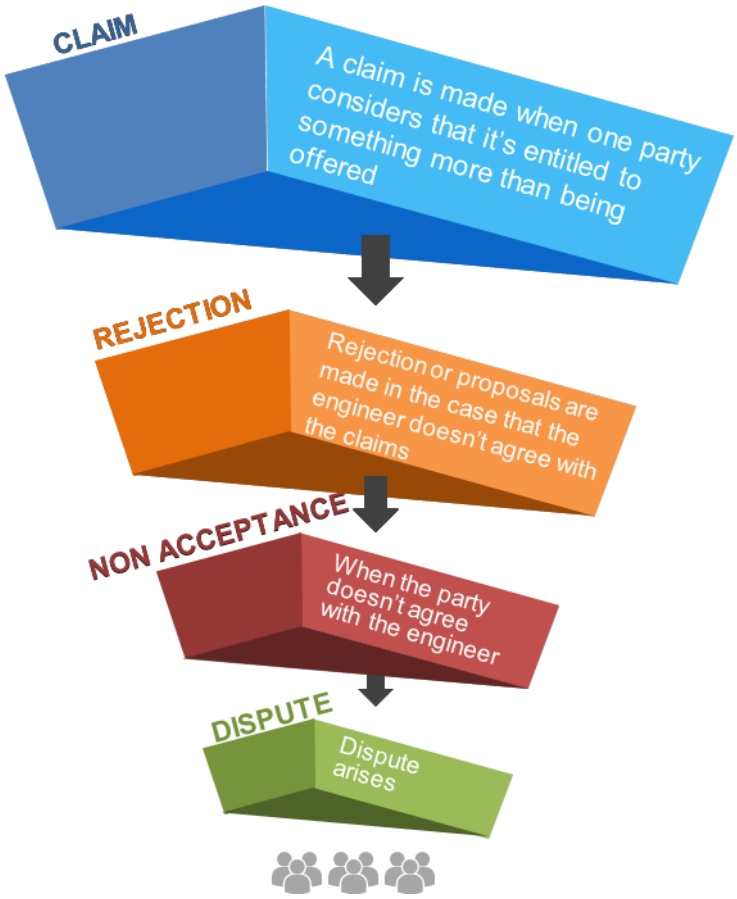

Figure 2.1 Process of Raising a dispute

2.3 Bias and mediator neutrality in dispute resolution

Mediation is a process in which an impartial third party facilitates communication and negotiation and promotes voluntary decision making by the parties to the dispute (Izumi, 2010). It is necessary to remind that the role of a mediator is pretty passive, the goal of his activity is to build a constructive dialogue between conflicting parties (Yaskova & Zaitseva, 2017). In mediation, the neutral mediator assists parties in reaching a settlement, however it does not have the authority to make a binding decision (Korobko, Radaeva, Rozanova, Rubanov, &

Treskov, 2019). Regardless of what techniques are used it is expected that the dispute resolution parties would be rational and are impartial so that a correct decision can be made, impartiality as we define the term, means that the mediator does not favor any one party in a mediation over any other party (Izumi, 2010). Other than that Neutrality is critical to the role of the mediator. Mediators must meticulously avoid even the appearance of partiality or prejudice throughout the mediation process (Izumi, 2010). But this isn't always the case and bias may creep into the CPDR process due to a number of factors (Cheung et al., 2019). A lot of research has been conducted on the topic of judgment errors in the past few decades, of which bias has been identified as a major form of judgment error. It is generally believed that rational evaluation underpins quality decisions. Most negotiation studies assume that decision makers are rational and able to make sense of the available information and select the most appropriate options, however humans are not always rational (Cheung & Li, 2019). Only recently bias and its effects are being explored in the construction project dispute resolution (CPDR). Construction projects are complex and involve a lot of moving parts that go into making the project a success, thus disputes are sure to arise throughout the life of the project, and these disputes lead to large cost and time overruns if not resolved in an efficient manner. Heuristics are commonly applied by decision makers to simplify problems so that quick decisions can be made, due to which systemic and predictable errors arise (Cheung & Li, 2019). Bias in decision making leads to irrational decisions and thus may lead to unresolved disputes causing more time and financial losses. These biases need to be avoided to lead to a smooth resolution process to increase the chances of success of a project. Thus, to lessen the amount of bias in the CPDR process, first the factors that cause bias need to be identified through the study of the available literature on decision making.

2.4 Factors effecting bias in decision making

Correct decision making is very important on construction projects, as delayed or unresolved disputes lead to cost and time overruns, due to the complex nature of construction projects disputer are very common and apart from disputes important decisions need to be made on a daily bases, one would believe the these decisions are made with a lot of care and after thorough information gathering, though even construction projects are not free from the effects of bias. Notably, identifying bias in CPDR is considered the first step to alleviate biased behaviors and thereby enhance the possibility of achieving successful dispute settlement (Cheung & Li, 2019). The main focus of this study was to identify the factors that lead to bias in decision making so a study of the available literature over the past few decades was carried out, a total of 60 papers related to decision making, disputes, bias and factors related to bias were selected as an initial overview, out of which 30 papers were selected for a detailed review based on their relevance to the topic. A detailed study of these 30 research papers was carried out and a total of 40 factors were identified which lead to bias and judgment errors in decision making regardless of the field and importance of the decisions being made.

Table 2.1 Factors affecting bias

Sr.	Factors Leading to Bias in Decision Making	Frequency	Sr.	Factors Leading to Bias in Decision Making	Frequency
1	**Over Confidence**	15	21	**Desirability/Undesirability of an outcome**	1
2	**Anchoring**	15	22	**Insider Bias**	1
3	**Confirmation**	13	23	**Selective Perception**	1
4	**Hindsight**	13	24	**Conservatism**	4
5	**Self-Serving**	11	25	**Recollection of original information (hindsight)**	4
6	**Insufficient adjustment**	8	26	**Re-Constructing Information (hindsight)**	4
7	**Sunk Cost**	4	27	**Equalizing**	1
8	**Motivation**	5	28	**Splitting Bias**	1

9	**Group Pressure**	4	29	**Expertise**	3
10	**Excessive Optimism**	4	30	**Incentive**	1
11	**Omission of Important Variables**	2	31	**Explanation**	1
12	**Illusion of Control**	2	32	**Information Processing Bias**	1
13	**Ambiguity**	3	33	**Heuristic**	3
14	**Making Sense**	3	34	**Knowledge Accessibility**	3
15	**Ethnic Bias**	3	35	**Loss aversion**	1
16	**Sub-addivity of probability**	2	36	**Exaggeration**	1
17	**Ignoring data**	2	37	**Hard-Easy**	1
18	**Self-Other Placement**	2	38	**Illusory Correlation**	1
19	**Certainty Effect**	1	39	**Mood**	1
20	**Proxy Weightage more than fundamental units**	1	40	**Recency**	1

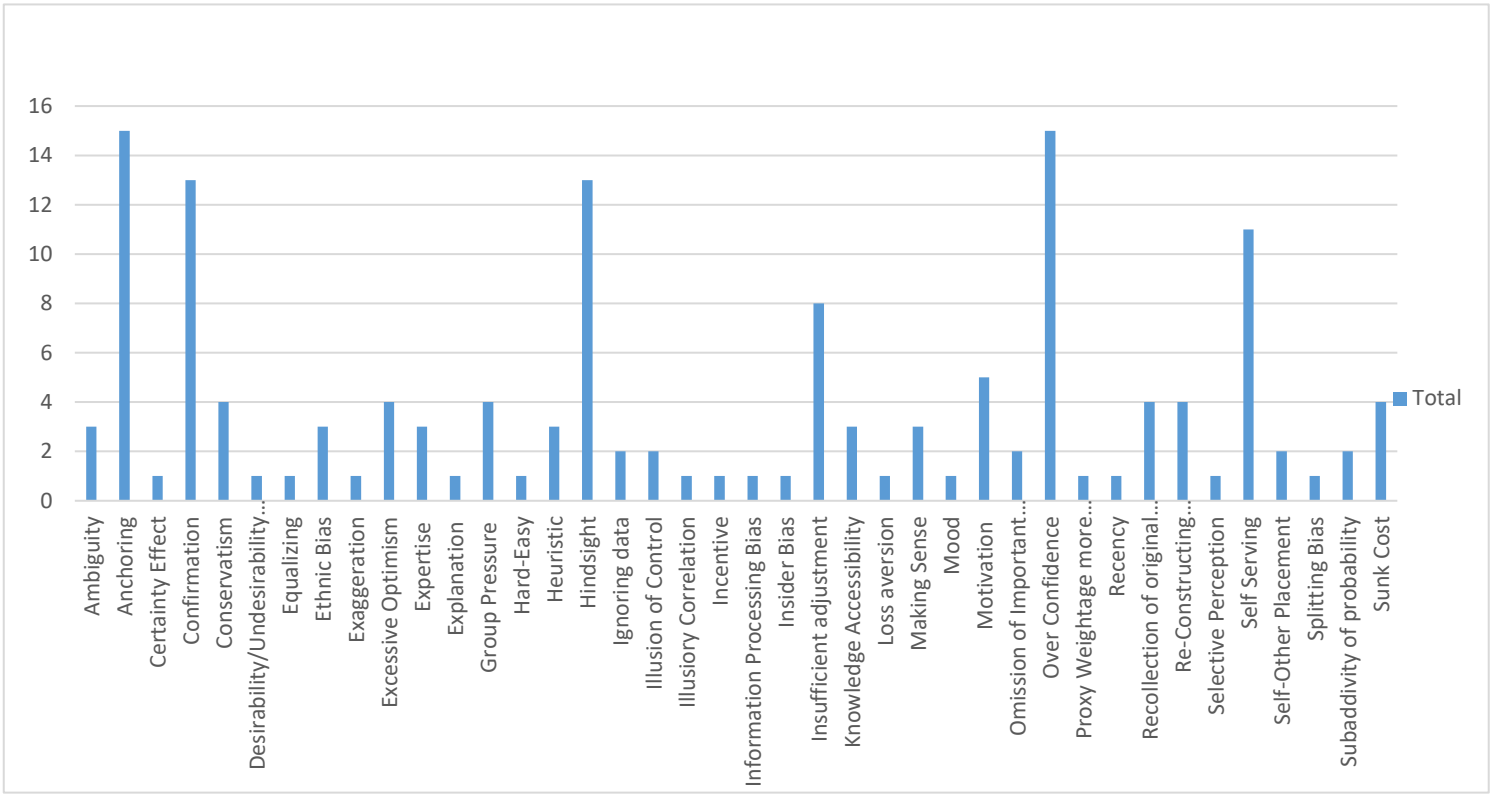

Figure 2.2 Frequency bar chart of factors affecting bias

- **Over-Confidence**

Overconfidence bias occurs when people exaggerate the accuracy of their decisions and thus are prone to biased decisions in this regard. People tend to take things out of proportion when they are confident about a certain outcome or their decisions. Sometimes the confidence is misplaced due to preexisting ideas in the mediators' mind, these ideas and experiences make their decisions biased towards their own views rather than towards an accurate and rational decision. Although having more experience may give rise to more accurate decision making but it also may add to the overconfidence bias in decision making (Montibeller & Von Winterfeldt, 2015). The literature has defined overconfidence in three distinct ways.

- Overestimation of one's actual performance.
- Over placement of one's performance relative to others.
- Excessive precision in one's beliefs. (Moore & Healy, 2008) cited by (Cheung & Li, 2019)

- **Anchoring**

As the name implies anchoring effect on the decision making refers to the impression derived from the first set of information received. The decision-making parties rely too much on the initial set of information received, people make decisions with reference to the previously available information. During the dispute resolution process even from the beginning people start making a decision based on the initial set of information received, as they may form their own idea of what happened that gave rise to the dispute and thus they make certain decisions from the beginning even if the initial set of information received may not be accurate or may be incomplete, and throughout the process they fail to fully adjust their decisions away from the initial anchor even when new information that keeps on adding throughout the decision making process.

Experiments conducted by (Mussweiler, Englich, & Strack, 2004) found that anchors derived from previously received information could, however, be irrelevant, uninformative, implausibly extreme or even self-generated and still they would have an effect on the accuracy of the decisions made, the same was mentioned by (Bennett, 2014).

- **Confirmation**

Confirmation bias occurs when people selectively focus upon evidence that supports their beliefs or what they believe to be true, while ignoring evidence that serves to disconfirm those ideas (Pines, 2006). People generate different ideas about a certain situation based on the incomplete set of information or based on their personal experiences, after they form a general idea about a situation and reach rough conclusion then they subconsciously only look at the information that supports their previous claims while disregard the information that goes against those ideas, giving rise to confirmation bias. Confirmation and anchoring bias go hand in hand and both are directly related to each other. According to literature they are one of the top causes of bias in decision making.

- **Hindsight**

Hindsight bias is defined as the belief that an event is more predictable after it becomes known than it was before it became known (Roese & Vohs, 2012). Once an outcome has occurred it starts to seem more predictable than it actually was at the time it hadn't occurred yet. Before the outcome has occurred, people are unable to fully predict what is going to happen as there is more uncertainty about what may happen due to the said phenomenon. Before the event has occurred there may be a lot of other scenarios that may seem equally plausible, as a lot of varying factors are involved in the process, but

after an outcome has occurred then it seems more clear and predictable than it actually was before, people get affected by the "knew it all along" effect as they disregard all the other outcomes that were there in their mind before the outcome occurred.

- **Self-Serving**

  Self-serving bias means that a person's decision may be influenced in a way that profits him more as compared to others. Also another form of self-serving bias may be that people tend to take credit for success but deny responsibility for failure, people see their success as a result of their quality and hard work, but in case of failures they blame it on other people's failure or blame it on unfavorable conditions, like unreasonable work requirements or inadequate instruction (Pronin, Lin, & Ross, 2002). They take credit for positive outcomes and transfer the blame to others in case of negative outcomes, thus this way they are affected by a bias that only looks at the outcomes that favor their cause.

- **Insufficient adjustment**

  Insufficient adjustment is a major cause of a lot of other biases, mainly confirmation and anchoring bias. As in anchoring bias when the decision makers decide based on the initial set of information received and fail to adjust their initial assumption as new and up dated information keeps on adding throughout the process this leads to biased decisions. This type of bias is more of a sub part of anchoring bias, that if people fail to adjust for the correct information, then their decisions will be affected by bias. Heuristics or thumb rules are used as a method to save up time but are more so shortcuts rather than being tested and accurate processes, thus such heuristics lead us to form an initial decision based on an incomplete set of information which if not adjusted properly leads to bias (Furnham & Boo, 2011).

- **Sunk Cost**

  Sunk cost is basically the cost that has already been lost in a certain project or product, and the future decisions are influence towards the attempts to minimize or recover these losses. The inability to accept that costs incurred earlier can no longer be recovered and should not be considered a factor in future decisions (Shore, 2008), but sunk cost influences our future decisions as people don't let go of losses easily and they keep trying to invest more into the failed project to try to recover some of the losses.

- **Motivation**

  Motivation bias can be of multiple types, an example of a motivational bias is the deliberate attempt of experts to provide optimistic forecasts for a preferred action or outcome (Montibeller & Von Winterfeldt, 2015). Another type of motivational bias may be the motivation of the decision makers to resolve the dispute or to get a certain outcome. The motivation of the dispute resolution parties, may it be to a motivation to resolve the dispute or to not be motivated to resolve it, or that being too motivated can lead to over optimistic forecasts than in reality and that also leads to faulty decisions.

- **Group Pressure**

  Decisions may be influenced by the pressure from other people around you such as in high profile cases there is a lot of pressure from the higher ups to get a quick decision, as is in many political scenarios. Also, another type of group pressure is when a decision is made in a group, so people tend to be influenced by the majority decision. Groups pressure leads to biased decisions in a team as the decision more often than not leans towards the majority of the people and the minority are change their decisions to be in line with the other people thus leading to biased decisions.

- **Excessive Optimism**

  Excessive optimism is related to the overestimation of the number of favorable outcomes in comparison to unfavorable ones (Chira et al., 2008). Excessive optimism and overconfidence go hand in hand as being effected by either of these may lead to faulty decision making. (Libby & Rennekamp, 2012) indicated that forecasts are much more likely to be issued when managers are either more optimistic about future earnings, or more confident in their ability to predict the firm's future.

- **Omission of Important Variables**

  As indicated by the name, such a bias occurs when important variables are overlooked (Montibeller & Von Winterfeldt, 2015). During a decision-making process if the parties involved miss important variables which can be due to several reasons such as if the information processing phase was not in detail and heuristics are used thus leading to missed variables. Also, other reasons may be as mentioned above due to other bias effects such as confirmation or anchoring, in which the dispute resolving parties only give importance to the variables that are in line with their initial assumptions and due to this they are unable to give due importance to opposing variables.

- **Illusion of Control**

  Illusion of control is defined as the "tendency of people to believe they can control and/or influence outcomes that in reality they have no influence over" giving people the wrong idea that outcome can be influenced by involvement for example picking a lottery ticket (Shore, 2008). Some outcomes are fully based on chance and are not in the control of any party, but subconsciously people believe that the outcome can be changed with their personal involvement giving us an illusion of control over a

situation. This leads to biased decisions making as people have a false idea about how a certain situation could have been changed with a person's involvement.

- **Ambiguity**

  Such a bias may occur when there is an ambiguity in the given data, thus the decision is not fully based on the facts and rather on the interpretation of the data by the decision maker. And thus, the decision may not necessarily be the correct decision in the situation and would be based on the experience of the dispute resolution party and their assumptions about what may have happened.

- **Making Sense**

  Making sense bias is the type of bias that occurs when one tries to make sense of a situation in case of missing or missing information, so the judgment is based on what we might think must have happened rather than what actually happened. In case of hindsight bias with outcome knowledge available the decision makers would try to make sense of the outcome based on the amount of information available to them at present which would not have been so clear before the certain outcome had occurred thus giving rise to a biased decision. (Blank & Nestler, 2007)

- **Ethnic Bias**

  Bias against a certain group or race of people. As Richard Delgado and his colleagues warned, "ADR might foster racial or ethnic bias in dispute resolution. Because formal adjudication explicitly manifests ―societal norms of fairness and even-handedness " through symbols (flag, black robe), ritual, and rules, the adversarial process counteracts bias among legal decision makers and disputants (Izumi, 2010)

- **Subaddivity of probability**

Estimate of a likelihood is less than the sum of its (more than two) mutually exclusive components (Hilbert, 2012)

- **Ignoring data**

  This bias occurs when people selectively focus on data that supports their own assumptions about the situation, such as in medical field, looking at a symptom of a particular disease people ignore the possibility of that symptom being there even when it's not the same disease (Pines, 2006)

- **Self-Other Placement**

  Self-Other placement is a type of self-serving bias, in which the estimates about one's own self is better than for others. People place their abilities to be higher than others or that other people are more likely to make a mistake than themselves.

- **Certainty Effect**

  People prefer sure things to gambles with similar expected utilities; they discount the utility of sure things dramatically when they are no longer certain (Montibeller & Von Winterfeldt, 2015). This type of bias occurs when people have to choose between different outcomes thus in such situations, they prefer what-ever sure thing is being given to them rather than gamble on chance where they may be able to get a better outcome or maybe not.

- **Proxy Weightage more than fundamental units**

  Proxy or unimportant attributes receive larger weights than the respective fundamental objectives (Montibeller & Von Winterfeldt, 2015). Such a bias effect occurs when unimportant or misleading variables are being fed to the disputing parties thus the proxy

units if given more important than they actually require will lead to faulty decision making.

- **Desirability/Undesirability of an outcome**

  This bias is dependent on the decision maker's desirability to achieve a certain outcome or to avoid a certain type of outcome. Wanting a certain outcome to occur leads to being irrational during the decision-making process as our decisions are subconsciously leaning towards what our personal desires are regarding the said issues.

- **Insider Bias**

  Bias may creep into the process if the dispute resolution member or party has relations to or is being financed by either of the disputants (Izumi, 2010). Even if it is expected that the third party remains neutral towards both the disputants, still a subconscious bias may creep into the process if the neutral party has better relations with one of the disputants more than the other party.

- **Selective Perception**

  Every person has their own thought process and they perceive things differently thus, the situation where several people perceive the same circumstances differently; varies with the ambiguity of the problem or task (Shore, 2008). Thus a bias may exist in the CPDR process depending on the dispute resolution parties and their previous experience in dealing with disputes.

- **Conservatism**

  "Conservatism" refers to the experimental finding that people tend to underestimate high values and high likelihoods/probabilities/frequencies and overestimate low ones" (Shore, 2008). Wrongly estimating the variables is defined as conservatism bias.

- **Recollection of original information**

  Bias may occur when the decision-making process involved a lot of information and then there is an issue with accurately being able to recall the original information. Or in case of hindsight bias after the event has occurred if we fail to recall all the details of the event so our decision may be based on what we understand after knowing the outcome (Bernstein, Erdfelder, Meltzoff, Peria, & Loftus, 2011).

- **Re-Constructing Information**

  Re-construction the whole scenario after it has occurred may lead to bias if we fail to reconstruct the data accurately.

- **Equalizing**

  This bias occurs when decision makers allocate similar weights to all objectives or similar probabilities to all events (Montibeller & Von Winterfeldt, 2015)

- **Splitting Bias**

  This bias relies on the method, which is used to group the variables, if different variables are grouped in such a way that it affects their weightage then splitting bias may occur.

- **Expertise**

  This type of bias relies on the person's experience level, the more the person's experience in dispute resolution, the lesser will be the bias and vice versa. Although higher experience may lead to overconfidence in some cases too.

- **Incentive**

  Incentives may be monetary or avoidance of a punishment and can also be in the form of prospects. None the less, Incentives to make a rational decision can lessen the bias (Arkes, 1991).

- **Explanation**

  The bias occurs when the individuals are asked to explain a certain scenario although they know the outcome has occurred but their decisions are effected by the hypothetical explanations regardless (Arkes, 1991).

- **Information Processing Bias**

  The lesser the amount of information being processed to get to a decision, the more would be the bias. Individuals' information processing has the potential to be skewed by an array of heuristics, or simple judgment rules, that can systematically bias cognitive processing and lead to erroneous decisions (Adame, 2016), thus instead of relying on heuristics and assumptions, more information needs to be processed to lower the amount of bias in decision making.

- **Heuristic**

  As mentioned above, heuristics or thumb rules lead to biased or flawed decision making as they are not accurate enough to lead to a rational decision in each case.

- **Knowledge Accessibility**

  The knowledge accessibility suggests that peoples' ability to see events as likely to happen depends on how easily they can recall specific past information associated with that event (Mussweiler et al., 2004).

- **Loss aversion**

  Loss aversion or "prospect theory" is related to individual's stronger desire to avoid losses than experience comparable gains (Chira et al., 2008). For example, people are more likely to choose an outcome that avoids a loss rather than an item that has a chance of loss occurring even if there is a chance of higher gain as well.

- **Exaggeration**

  Based on the estimates, real-world evidence turns out to be less extreme than our expectations (conditionally inverse of the conservatism bias) (Hilbert, 2012).

- **Hard-Easy**

  Hard-easy bias relates to the bias effect based on the difficulty of the task at hand, the harder the task the lesser the confidence, and the easier the task the higher will be the confidence level.

- **Illusory Correlation**

  Illusory correlation is a bias in which one's judgments are based on a relation one expects to see even when no such relationship exists (Hilbert, 2012).

- **Mood**

  The decision-making process may also be affected by the decision maker's mood during the CPDR process.

- **Recency**

  Recent information is given more preference over the older data. And thus, depending on the sequence of information given during the process, the final decision may be biased.

2.5 Selecting top factors

All the identified factors were not of equal importance, so a content analysis was carried out to assess each factor both quantitatively and qualitatively. This technique in coordination with the preliminary survey was used to identify the top factors and eliminate the less important ones so as to target the more important factors only for the future study. By conducting a detailed study of the above-mentioned literature in combination with the respondents score against each factor, top 15 factors that lead to bias were identified.

Table 2.2 Top Bias Factors

Rank	Factor	Reference
1	**Anchoring**	(Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Arkes, 1991) (Roese & Vohs, 2012) (Adame, 2016) (Pronin, 2007) (Cheung & Li, 2019) (Cheung et al., 2019) (Mussweiler et al., 2004) (Li & Cheung, 2016) (Epley & Gilovich, 2006) (Epley & Gilovich, 2001) (Blank, Nestler, von Collani, & Fischer, 2008) (Pines, 2006) (Blank & Nestler, 2007)
2	**Confirmation**	(Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Arkes, 1991) (Chira et al., 2008) (Cook & Smallman, 2008) (Kassin, Dror, & Kukucka, 2013) (Cheung et al., 2019) (Li & Cheung, 2016) (Tsai, Klayman, & Hastie, 2008) (Shore, 2008) (Blank & Nestler, 2007) (Pines, 2006) (Tschan et al., 2009)
3	**Hindsight**	(Montibeller & Von Winterfeldt, 2015) (Roese & Vohs, 2012) (Bernstein et al., 2011) (Bhattacharya & Jasper, 2018) (Arkes, 1991) (Pronin, 2007) (Cheung et al., 2019) (Cheung & Li, 2019) (Mussweiler et al., 2004) (Li & Cheung, 2016) (Epley & Gilovich, 2006) (Blank & Nestler, 2007) (Blank et al., 2008)
4	**Over Confidence**	(Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Roese & Vohs, 2012) (Arkes, 1991) (Chira et al., 2008) (Hilbert, 2012) (Kassin et al., 2013) (Cheung & Li, 2019) (Cheung et al., 2019) (Li & Cheung, 2016) (Moore & Healy, 2008) (Tsai et al., 2008) (Shore, 2008) (Libby & Rennekamp, 2012) (Hoffmann & Post, 2014)
5	**Self-Serving**	(Roese & Vohs, 2012) (Arkes, 1991) (Izumi, 2010) (Pronin et al., 2002) (Pronin, 2007) (Cheung & Li, 2019) (Cheung et al., 2019) (Li & Cheung, 2016) (Newey, 2016) (Libby & Rennekamp, 2012) (Hoffmann & Post, 2014)
6	**Insufficient adjustment**	(Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Adame, 2016) (Cheung & Li, 2019) (Mussweiler et al., 2004) (Li & Cheung, 2016) (Epley & Gilovich, 2001) (Epley & Gilovich, 2006)
7	**Motivation**	(Montibeller & Von Winterfeldt, 2015) (Roese & Vohs, 2012) (Kassin et al., 2013) (Cheung & Li, 2019) (Epley & Gilovich, 2006)
8	**Group Pressure**	(Montibeller & Von Winterfeldt, 2015) (Arkes, 1991) (Kassin et al., 2013) (Shore, 2008)
9	**Sunk Cost**	(Montibeller & Von Winterfeldt, 2015) (Arkes, 1991) (Chira et al., 2008) (Shore, 2008)
10	**Omission of Important Variables**	(Montibeller & Von Winterfeldt, 2015) (Cheung & Li, 2019)
11	**Ambiguity**	(Furnham & Boo, 2011) (Kassin et al., 2013) (Cheung et al., 2019)
12	**Self-Other Placement**	(Hilbert, 2012) (Moore & Healy, 2008)

13	**Certainty Effect**	(Montibeller & Von Winterfeldt, 2015)
14	**Insider Bias**	(Izumi, 2010)
15	**Selective Perception**	(Shore, 2008)

2.5 Mitigation Strategies

Vast research has been conducted on bias in decision making and by studying the relevant literature we identified the top factors that lead to bias in decision making, side by side with the research on the factors that lead to bias, research has also been conducted on ways to reduce the effects of bias on decision making. Judgment errors are common in the decision-making process and given how complex construction projects are that makes the need for accurate and rational decision making more important, thus to lead to a rational decision the effects of bias need to be reduced or diminished completely if that is possible. Bias has been discussed in research articles over the past few decades, it has only recently been discussed in context with the CPDR process, but in majority research bias has been discussed in general relation with the decision-making process. Bias being one of the top judgment errors needs to be dealt with to lead to accurate decisions, especially in complex construction projects. Thus, alongside bias research some remedies have also been proposed in the past research, conducting a detailed review of literature based on the top factors identified previously, a number of remedial strategies were identified which are told to reduce the effects of bias in decision making to a certain extent. Bias being a subconscious effect is not that easy to deal with and in most cases it's not possible to fully remove the effects of bias in decision making, but these techniques listed below do deal with bias effects to a certain extent according to the literature, even if not fully able to deal with it. A few remedial strategies are proposed for each of the top factors

identified in the previous review, each remedy is said to deal with the effects of bias to a certain extent.

Table 2.3 Bias Mitigation Strategies

Sr No	Factor	Remedies	Code
1	**Anchoring**	Remedy1:Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decision (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**AR1**
		Remedy2:Looking at the general guidelines of the case initially before looking at numeric information (Monetary expense, losses etc) (Bennett, 2014; Montibeller & Von Winterfeldt, 2015)	**AR2**
		Remedy3:Giving the decision makers incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless, Bolstad, Nakstad, Andreassen, & Jensen, 2013)	**AR3**
		Remedy4:Employing more experienced mediators (Furnham & Boo, 2011)	**AR4**
2	**Confirmation**	Remedy1: Observing the data on our own without initially being exposed to extraneous information (Kassin et al., 2013)	**CR1**
		Remedy2: Working with contributing analyst's/team members to assess how evidence supports or conflicts the hypothesis (Cook & Smallman, 2008)	**CR2**
		Remedy3: Adopting a linear approach of decision making process, rather than comparing data to preconceived ideas (Kassin et al., 2013)	**CR3**
		Remedy4: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**CR4**
3	**Insufficient Adjustment**	Remedy1: Giving incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless et al., 2013)	**IAR1**
		Remedy2: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011 (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**IAR2**
		Remedy3: Employing more experienced mediators (Furnham & Boo, 2011)	**IAR3**
		Remedy4: Forewarning about anchors and insufficient adjustment so that intentional precautions are taken (Furnham & Boo, 2011)	**IAR4**
4	**Hindsight**	Remedy1: Refocus the questions to ask about current state because this reduces the effort required for retrieval of previous information (MacKenzie & Podsakoff, 2012)	**HSR1**

		Remedy2: Increase the respondent's motivation to expend the effort required to retrieve the information necessary to make the decision accurately (MacKenzie & Podsakoff, 2012)	**HSR2**
		Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**HSR3**
		Remedy4: Forewarning about anchors and insufficient adjustment bias (Furnham & Boo, 2011)	**HSR4**
5	**Motivation**	Remedy1: Telling the respondents the importance of the task at hand to motivate them to get to a rational and correct decision (MacKenzie & Podsakoff, 2012)	**MR1**
		Remedy2: Holding the decision makers accountable and providing feedback for every decision made (Novicevic, Buckley, Harvey, & Fung, 2008) (MacKenzie & Podsakoff, 2012)	**MR2**
		Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**MR3**
		Remedy4: Giving incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless et al., 2013) (MacKenzie & Podsakoff, 2012)	**MR4**
6	**Ambiguity**	Remedy1: Using clear and concise language; avoiding complicated syntax; defining ambiguous or unfamiliar terms; and labeling all response options rather than just the end points (MacKenzie & Podsakoff, 2012)	**AmbR1**
		Remedy2: Increase the respondent's motivation to expend the effort required to retrieve the information necessary to make a decision accurately (MacKenzie & Podsakoff, 2012)	**AmbR2**
		Remedy3: Employing more experienced mediators (Furnham & Boo, 2011)	**AmbR3**
7	**Self-Serving**	Remedy1: Holding the decision makers accountable and providing feedback for every decision made (Novicevic et al., 2008) (MacKenzie & Podsakoff, 2012)	**SSR1**
		Remedy2: Keep the identity of the parties hidden so as to avoid any favoritism (Kriss, Loewenstein, Wang, & Weber, 2011) (Deffains, Espinosa, & Thöni, 2016)	**SSR2**
		Remedy3: Mediators should manifest external neutrality by eliminating conflicts of interest, and abstaining from pressing for particular outcomes (Izumi, 2010)	**SSR3**
		Remedy4: Having multiple decision makers from each of the party (Izumi, 2010)	**SSR4**
		Remedy5: Project Relationship management/Trust building between the stakeholders and the project management team (Meng & Boyd, 2017)	**SSR5**
8	**Sunk Cost**	Remedy1: Cultivating awareness of the present moment. It consists of focusing on present experience and clearing one's mind of other thoughts (Hafenbrack, Kinias, & Barsade, 2014)	**SCR1**
		Remedy2: Prior warnings of sunk cost effect so as to promote more focus on the available evidence rather than on the past (Braverman & Blumenthal-Barby, 2012)	**SCR2**
		Remedy3: Providing the parties with more options if they are able to let go of unpromising projects (Braverman & Blumenthal-Barby, 2012)	**SCR3**

		Remedy4: Employing more experienced mediators (Furnham & Boo, 2011)	**SCR4**
9	**Insider Bias**	Remedy1: Keep the identity of the parties hidden so as to avoid any favoritism (Kriss et al., 2011) (Deffains et al., 2016)	**IBR1**
		Remedy2: Having multiple decision makers rather than one (Izumi, 2010)	**IBR2**
		Remedy3: Mediators should manifest external neutrality by eliminating conflicts of interest, and abstaining from pressing for particular outcomes (Izumi, 2010)	**IBR3**
10	**Over Confidence**	Remedy1: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**OCR1**
		Remedy2: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**OCR2**
		Remedy3: Training of the team on how to think over divergent ideas that go against the normal heuristics applied (Smith & Agate, 2004)	**OCR3**
		Remedy4: Looking at the strong cues first rather than weaker cues so that there is less requirement to update one's decisions later on as more information is received (Tsai et al., 2008)	**OCR4**
		Remedy5: Making other peers skill set and experience known so as each member is informed and knows about others capabilities (Moore & Healy, 2008)	**OCR5**
11	**Group Pressure**	Remedy1: Each member should be given a group task and sufficient time to think about it before entering the core group (Rogelberg, Barnes-Farrell, & Lowe, 1992)	**GPR1**
		Remedy2: Team building training that leads to improved team performance and identifying issues such as group pressure and conformity etc (Kaba, Wishart, Fraser, Coderre, & McLaughlin, 2016)	**GPR2**
		Remedy3: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**GPR3**
12	**Certainty Effect**	Remedy1: Adding delay to certain outcomes adds a certain uncertainty to the outcome (Weber & Chapman, 2005)	**CER1**
		Remedy2: Adding risk to immediate options, by telling the parties of the losses they'll incur due to choosing the certain outcome (Weber & Chapman, 2005)	**CER2**
		Remedy3: Looking at the pros and cons of each item separate to its value (Montibeller & Von Winterfeldt, 2015)	**CER3**
		Remedy4: Employing more experienced mediators (Saito, 2011) (Tormala & Petty, 2004)	**CER4**
13	**Ommision of Important Variables**	Remedy1: Having multiple people in the dispute resolution process so as to capture varying aspects (Montibeller & Von Winterfeldt, 2015)	**OVR1**
		Remedy2: Ask for unusual and extreme scenarios so as to better incorporate all the data available (Montibeller & Von Winterfeldt, 2015)	**OVR2**
		Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011)	**OVR3**

		(Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	
14	**Selective Perception**	Remedy1: Making teams comprising of individuals from varying disciplines (Shore, 2008)	**SPR1**
		Remedy2: Creating a culture that reduces the fear of failure, so as to motivate every member of the team to pitch in their ideas (Shore, 2008)	**SPR2**
		Remedy3: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**SPR3**
15	**Self-Other Placement**	Remedy1: Avoiding thumb rules and heuristics and following a set of rules and guidelines while making the decisions (Hilbert, 2012)	**SOPR1**
		Remedy2: Should use simple data to make decisions easier and more accurate (Hilbert, 2012)	**SOPR2**
		Remedy3: Making other peers skill set and experience known so as each member is informed and knows about others capabilities (Pronin et al., 2002)	**SOPR3**

Chapter 3

Methodology

3.1 Identifying relevant literature

Initial step was to identify a research gap in the recent studies, for that a big chunk of recent studies was analyzed. Studies recently published on the topics of disputes on construction sites and decision making led to identifying bias as one of the recent topics in construction disputes. After a few recent literatures on the topic were analyzed it led us to identifying the research gap, being very less information available on bias in the CPDR process, which lead to forming the research statement for this topic. This research aims to identify the factors affecting bias in decision making and their relevance in the CPDR process, so that remedial strategies may be put in place to reduce bias effects leading to more efficient and cost-effective dispute resolutions.

3.2 Factor Identification and literature score

In the first step, the factors related to bias were to be identified so a preliminary literature review was conducted using the keywords bias, decision making, judgment errors, judgment flaws, overconfidence, hindsight, construction disputes, arbitration, mediation and dispute resolution etc.

Most of the search for the relevant literature was carried out using google scholar, science direct and ResearchGate, and only the papers published over the last decade were selected, unless a paper seemed of more relative importance, then it was selected regardless of the publish date. The papers with at least two or more citations were selected for further review, a further review of the selected papers was carried out by studying their abstract and results after which a total of 30 relevant research papers were selected for identifying the bias factors.

Out of these research papers a total of 40 factors were identified. The factors were subjected to both quantitative and qualitative scoring based on the literature review. The quantitative score was calculated based on the number of citations of the certain factor divided by the total number of citations which in this case was 30.

$$\text{Quantitative Score} = \text{Number Of Citations}/30$$

The qualitative score was stated as High, Medium, And Low based on the importance given to the certain factor in the research article. High was given a score of 5/5, Medium a score of 3/5 and Low a score of 1/5. The average of the qualitative score of each factor was calculated to identify in which category the certain factor should be put in i-e high, medium or low.

Based on the quantitative and qualitative scores the literature score was calculated as.

Literature Score = Quantitative Score * Qualitative Score

The factors were then ranked on the basis of their literature scores as shown in the table below.

Table 3.1 Factor ranking based on literature review

Sr.	Factors Leading to Bias in Decision Making	Ranking	Sr.	Factors Leading to Bias in Decision Making	Ranking
1	Over Confidence	1	**21**	Desirability/Undesirability of an outcome	11
2	Anchoring	1	**22**	Insider Bias	11
3	Confirmation	2	**23**	Selective Perception	11
4	Hindsight	2	**24**	Conservatism	12
5	Self-Serving	3	**25**	Recollection of original information (hindsight)	12
6	Insufficient adjustment	4	**26**	Re-Constructing Information (hindsight)	12
7	Sunk Cost	5	**27**	Equalizing	13
8	Motivation	6	**28**	Splitting Bias	13
9	Group Pressure	7	**29**	Expertise	13
10	Excessive Optimism	7	**30**	Incentive	13
11	Omission of Important Variables	8	**31**	Explanation	13
12	Illusion of Control	8	**32**	Information Processing Bias	13
13	Ambiguity	9	**33**	Heuristic	13
14	Making Sense	9	**34**	Knowledge Accessibility	13
15	Ethnic Bias	9	**35**	Loss aversion	13
16	Subaddivity of probability	10	**36**	Exaggeration	13
17	Ignoring data	10	**37**	Hard-Easy	13
18	Self-Other Placement	10	**38**	Illusory Correlation	13
19	Certainty Effect	11	**39**	Mood	14
20	Proxy Weightage more than fundamental units	11	**40**	Recency	14

3.3 Preliminary Survey

Based on the identified factors a preliminary questionnaire survey had to be formed to rank the factors based on the opinions of professionals. The survey consisted of two sections. The first section of the survey consisted of questions related to personal information such as years of experience, email ID, name etc. The second section was based on the factors identified through literature score. The participants of the survey had to rank each factor's importance on a likert scale in introducing a bias effect in the decision-making process. The likert scale ranged from very low to very high. People from both inside and outside Pakistan were contacted for the

survey, a total of 150 people were contacted for the survey out of which only 40 people responded, and 30 complete responses were selected for further review comprising of 12 people from Pakistan and the rest of the 18 from different countries such as Iran, Bangladesh, Turkey, Egypt etc. After the survey was conducted the responses from the industry professionals were filtered out to collect a modal value of each individual factor, the modal value ranged from 1 to 5, in which 1 represented a very low effect and 5 as a very high effect. The normalized score of the field responses was calculated by dividing the factor score with the total combined score of all the factors.

3.4 Factor strength

Using a 70/30 ratio strength ratio 70 % weightage to the field normalized score and 30 % to the literature normalized score, a combined normalized score was calculated. The factors were ranked in the descending order of the combined normalized score, and a cumulative was calculated, thus only the factors up till 0.52 of the cumulative score were selected to be the part of the further study.

These factors are the top factors identified through both literature and field scores and are to be used in the detailed survey.

Table 3.2 Top factors based on cumulative scores

Sr.	Code	Factor	70/30	Normalized
1	7	Anchoring	0.059636562	0.059636562
2	3	Confirmation	0.054410082	0.054410082
3	17	Hindsight	0.054410082	0.054410082
4	4	Over Confidence	0.049417584	0.049417584
5	18	Self-Serving	0.044074112	0.044074112
6	1	Insufficient adjustment	0.03623439	0.03623439
7	6	Motivation	0.028277677	0.028277677
8	5	Group Pressure	0.026709733	0.026709733
9	14	Sunk Cost	0.025781429	0.025781429

10	8	Omission of Important Variables	0.025664437	0.025664437
11	2	Ambiguity	0.025141789	0.025141789
12	34	Self-Other Placement	0.023573845	0.023573845
13	10	Certainty Effect	0.023051197	0.023051197
14	27	Insider Bias	0.023051197	0.023051197
15	40	Selective Perception	0.023051197	0.023051197

3.5 Secondary Survey

Identifying the top factors was one part of the research, we identified the relevant factors that lead to bias in the decision-making process through the literature review, and to identify the effects on the CPDR process we also conducted the preliminary survey and got inputs from industry professionals. The second part of this research was to identify the remedial strategies against the identified top factors of bias, for this a secondary literature review was performed of the past research on the topics relating to each bias with key words, remedies of bias, counters to bias, mitigation strategies of bias and framework for lowering bias effects. Using this, relevant research was identified and after a detailed literature review of the newly identified research paired with the previously studied research papers, a few mitigation strategies were identified against each bias factor. All the data regarding the remedies of all the top factors was incorporated into a secondary survey. The secondary survey was divided into two parts as in the preliminary survey, the first part to collect personal data of the respondents and the second part was related to research questions. The factors were listed down in the form of 15 separate questions, for which the respondent had to select the most appropriate remedial strategy to deal with that bias, based on their professional experience. A total of 81 responses were collected, out of which all the people lying below the 3 years' experience mark were not selected for the final data analysis. The research population mainly were professionals that had foreign work experience, outside of Pakistan, and had prior experience dealing with complex construction projects, the major part of the survey was conducted via LinkedIn by individually

contacting people that fit the description of, construction managers, project management professionals, planning engineers, claims expert, commercial manager and dispute resolution experts.

After collecting the raw data, the data was compiled on an excel sheet and separated into different tables to make a combined dashboard of all the data, to make it more presentable and easier to read for the people interested in the final results.

3.5 Framework

After completion of the preliminary and secondary survey we were able to identify the top bias effects prevalent in the construction sector, and with that we were also able to identify the top remedial strategies of bias based on the results of the secondary survey. Using this data, we are able to develop a framework that better incorporates the effects of bias into the CPDR process.

Chapter 4

Results and Discussion

4.1 Demographic information of survey respondents

The survey was conducted mainly via direct email, and by individually contacting professionals using platforms such as LinkedIn, Research Gate and Academia. Over 400 people were contacted, out of which 75 people responded and filled out the questionnaire survey. The lack of respondents' vs the total contacted can be explained by the fact that most of the respondents were not actively using LinkedIn, so they never read the survey message sent to them. The survey collection started in May 2020 and was completed in the mid of July 2020. In the first section of the questionnaire survey the respondents were asked questions regarding their occupation and previous experiences. In this section the respondents were also asked about

their country of work experiences which is shown in the figures below in which they are also grouped in the form of regions.

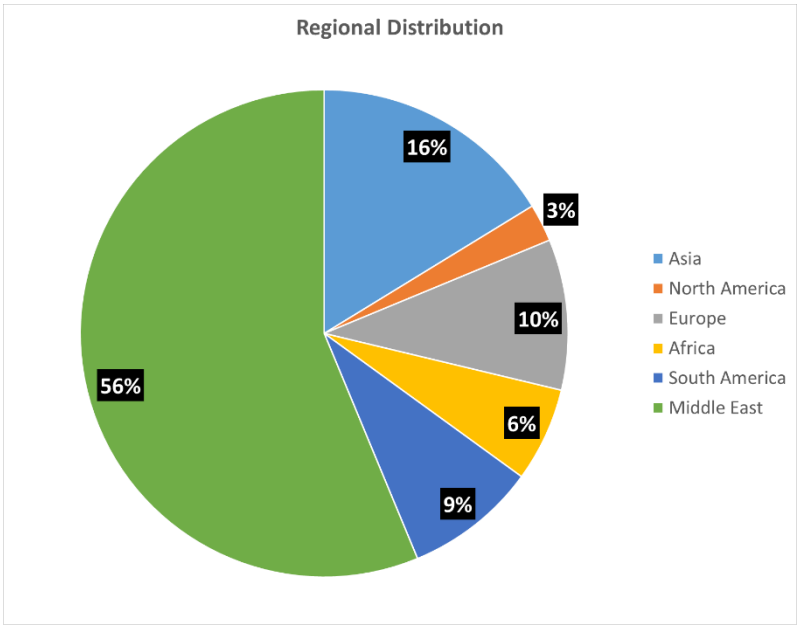

Figure 4.1 Regional Distribution

Out of the 81 responses only 75 were selected for the final data analysis as the respondents with experience lower than 3 and the respondents who had not submitted the complete response were not selected. The respondents were divided into 6 chunk s based on experience, and according to that, most of the respondents lie on the 6 to 10 years' experience range.

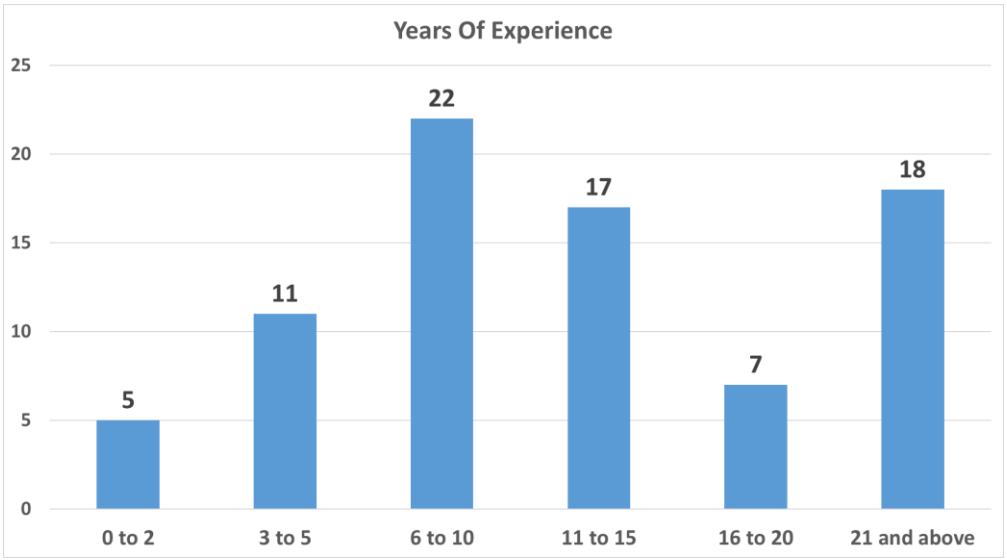

Figure 4.2 Respondent's Field Experience

It is seen that almost 80 % of the respondents have more than 6 years of experience, the reason for selection of more experienced respondents was that dispute resolution and claims in the construction sector are mostly dealt with at a higher level in the hierarchy thus only the more experienced professionals were able to answer the questions to a more accurate degree.

4.2 Top Factors and Mitigation Strategies

Two questionnaire surveys were conducted, the first survey was conducted to identify the top bias factors in CPDR, from which we were able to identify the top 15 factors that lead to bias in decision making, the factors were ranked on the basis of their normalized score calculated via the literature review and survey data.

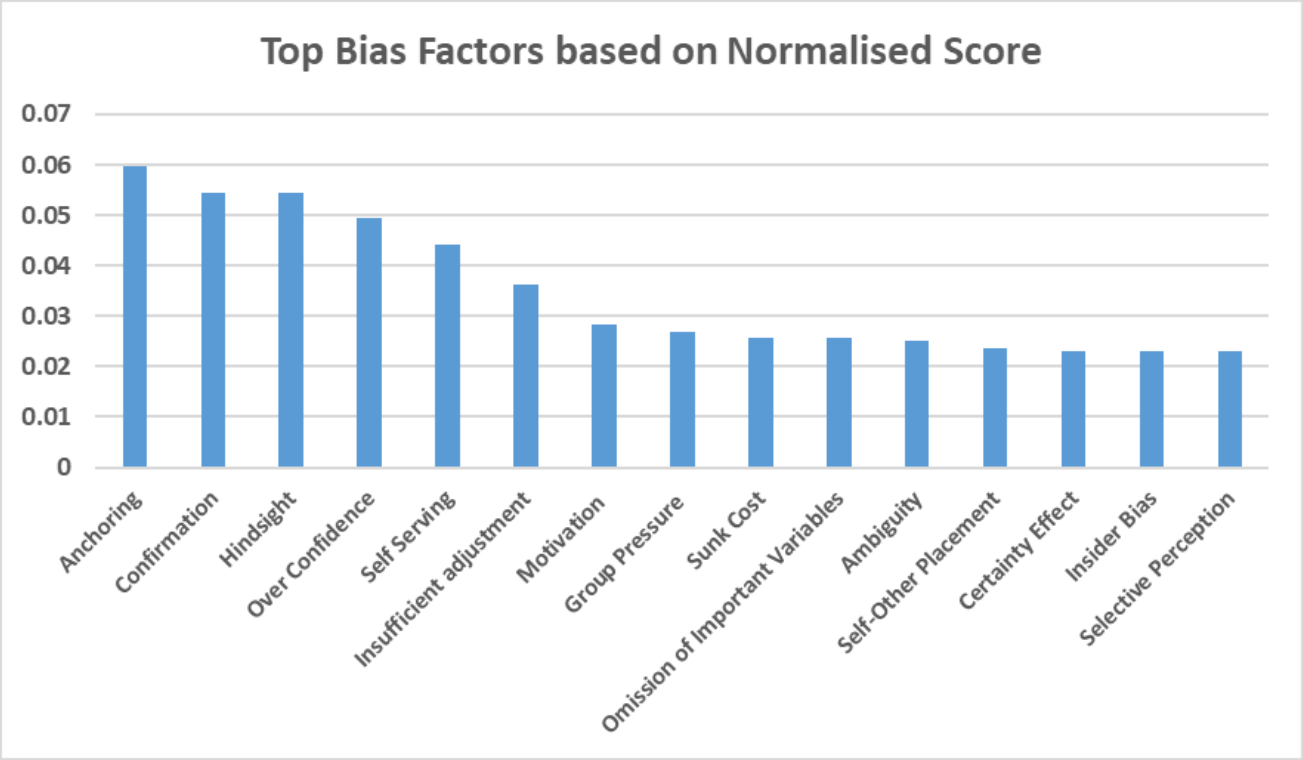

Figure 4.3 Top Bias Factors

The secondary survey was conducted after we identified the mitigation strategies through literature. The purpose of the secondary survey was to rank the mitigation strategies against each factor, based on the opinions of experienced professionals who are familiar with the

process of dispute resolution and have experience working on complex projects. The survey was completed within 2 months and was based on professionals from different regions.

Table 4.1 Mitigation Strategies Percentage Responses

Sr No	Code	Mitigation Strategy	Percentage Responses
1	AR1	Remedy1:Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decision (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	12.00%
	AR2	Remedy2:Looking at the general guidelines of the case initially before looking at numeric information (Monetary expense, losses etc) (Bennett, 2014; Montibeller & Von Winterfeldt, 2015)	41.33%
	AR3	Remedy3:Giving the decision makers incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless et al., 2013)	25.33%
	AR4	Remedy4:Employing more experienced mediators (Furnham & Boo, 2011)	16.00%
2	CR1	Remedy1: Observing the data on our own without initially being exposed to extraneous information (Kassin et al., 2013)	10.67%
	CR2	Remedy2: Working with contributing analyst's/team members to assess how evidence supports or conflicts the hypothesis (Cook & Smallman, 2008)	60.00%
	CR3	Remedy3: Adopting a linear approach of decision making process, rather than comparing data to preconceived ideas (Kassin et al., 2013)	21.33%
	CR4	Remedy4: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	5.33%
3	IAR1	Remedy1: Giving incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless et al., 2013)	17.33%
	IAR2	Remedy2: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011 (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	25.33%
	IAR3	Remedy3: Employing more experienced mediators (Furnham & Boo, 2011)	20.00%
	IAR4	Remedy4: Forewarning about anchors and insufficient adjustment so that intentional precautions are taken (Furnham & Boo, 2011)	33.33%
4	HSR1	Remedy1: Refocus the questions to ask about current state because this reduces the effort required for retrieval of previous information (MacKenzie & Podsakoff, 2012)	40.00%
	HSR2	Remedy2: Increase the respondent's motivation to expend the effort required to retrieve the information necessary to make the decision accurately (MacKenzie & Podsakoff, 2012)	36.00%
	HSR3	Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham et al., 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	9.33%
	HSR4	Remedy4: Forewarning about anchors and insufficient adjustment bias (Furnham & Boo, 2011)	12.00%
5	MR1	Remedy1: Telling the respondents the importance of the task at hand to motivate them to get to a rational and correct decision (MacKenzie & Podsakoff, 2012)	38.67%
	MR2	Remedy2: Holding the decision makers accountable and providing feedback for every decision made (Novicevic et al., 2008) (MacKenzie & Podsakoff, 2012)	40.00%
	MR3	Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	14.67%
	MR4	Remedy4: Giving incentives to make a correct decision (Adame, 2016) (Furnham & Boo, 2011) (Reckless et al., 2013) (MacKenzie & Podsakoff, 2012)	4.00%
6	AmbR1	Remedy1: Using clear and concise language; avoiding complicated syntax; defining ambiguous or unfamiliar terms; and labeling all response options rather than just the end points (MacKenzie & Podsakoff, 2012)	61.33%
	AmbR2	Remedy2: Increase the respondent's motivation to expend the effort required to retrieve the information necessary to make a decision accurately (MacKenzie & Podsakoff, 2012)	24.00%
	AmbR3	Remedy3: Employing more experienced mediators (Furnham & Boo, 2011)	12.00%
7	SSR1	Remedy1: Holding the decision makers accountable and providing feedback for every decision made (Novicevic et al., 2008) (MacKenzie & Podsakoff, 2012)	18.67%

	SSR2	Remedy2: Keep the identity of the parties hidden so as to avoid any favoritism (Kriss et al., 2011) (Deffains et al., 2016)	**17.33%**
	SSR3	Remedy3: Mediators should manifest external neutrality by eliminating conflicts of interest, and abstaining from pressing for particular outcomes (Izumi, 2010)	**14.67%**
	SSR4	Remedy4: Having multiple decision makers from each of the party (Izumi, 2010)	**14.67%**
	SSR5	Remedy5: Project Relationship management/Trust building between the stakeholders and the project management team (Meng & Boyd, 2017)	**32.00%**
8	**SCR1**	Remedy1: Cultivating awareness of the present moment. It consists of focusing on present experience and clearing one's mind of other thoughts (Hafenbrack et al., 2014)	**22.67%**
	SCR2	Remedy2: Prior warnings of sunk cost effect so as to promote more focus on the available evidence rather than on the past (Braverman & Blumenthal-Barby, 2012)	**40.00%**
	SCR3	Remedy3: Providing the parties with more options if they are able to let go of unpromising projects (Braverman & Blumenthal-Barby, 2012)	**30.67%**
	SCR4	Remedy4: Employing more experienced mediators (Furnham & Boo, 2011)	**2.67%**
9	**IBR1**	Remedy1: Keep the identity of the parties hidden so as to avoid any favoritism (Kriss et al., 2011) (Deffains et al., 2016)	**22.67%**
	IBR2	Remedy2: Having multiple decision makers rather than one (Izumi, 2010)	**26.67%**
	IBR3	Remedy3: Mediators should manifest external neutrality by eliminating conflicts of interest, and abstaining from pressing for particular outcomes (Izumi, 2010)	**49.33%**
10	**OCR1**	Remedy1: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**41.33%**
	OCR2	Remedy2: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**6.67%**
	OCR3	Remedy3: Training of the team on how to think over divergent ideas that go against the normal heuristics applied (Smith & Agate, 2004)	**21.33%**
	OCR4	Remedy4: Looking at the strong cues first rather than weaker cues so that there is less requirement to update one's decisions later on as more information is received (Tsai et al., 2008)	**9.33%**
	OCR5	Remedy5: Making other peers skill set and experience known so as each member is informed and knows about others capabilities (Moore & Healy, 2008)	**17.33%**
11	**GPR1**	Remedy1: Each member should be given a group task and sufficient time to think about it before entering the core group (Rogelberg et al., 1992)	**24.00%**
	GPR2	Remedy2: Team building training that leads to improved team performance and identifying issues such as group pressure and conformity etc (Kaba et al., 2016)	**49.33%**
	GPR3	Remedy3: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**22.67%**
12	**CER1**	Remedy1: Adding delay to certain outcomes adds a certain uncertainty to the outcome (Weber & Chapman, 2005)	**8.00%**
	CER2	Remedy2: Adding risk to immediate options, by telling the parties of the losses they'll incur due to choosing the certain outcome (Weber & Chapman, 2005)	**24.00%**
	CER3	Remedy3: Looking at the pros and cons of each item separate to its value (Montibeller & Von Winterfeldt, 2015)	**57.33%**
	CER4	Remedy4: Employing more experienced mediators (Saito, 2011) (Tormala & Petty, 2004)	**8.00%**
13	**OVR1**	Remedy1: Having multiple people in the dispute resolution process so as to capture varying aspects (Montibeller & Von Winterfeldt, 2015)	**49.33%**
	OVR2	Remedy2: Ask for unusual and extreme scenarios so as to better incorporate all the data available (Montibeller & Von Winterfeldt, 2015)	**30.67%**
	OVR3	Remedy3: Consider the opposite strategy, intentionally trying to look at opposite answers to the initial decisions one makes (Adame, 2016) (Furnham & Boo, 2011) (Montibeller & Von Winterfeldt, 2015) (Li & Cheung, 2016) (Arkes, 1991) (Croskerry & Norman, 2008)	**16.00%**
14	**SPR1**	Remedy1: Making teams comprising of individuals from varying disciplines (Shore, 2008)	**33.33%**
	SPR2	Remedy2: Creating a culture that reduces the fear of failure, so as to motivate every member of the team to pitch in their ideas (Shore, 2008)	**36.00%**
	SPR3	Remedy3: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)	**25.33%**
15	**SOPR1**	Remedy1: Avoiding thumb rules and heuristics and following a set of rules and guidelines while making the decisions (Hilbert, 2012)	**33.33%**

	SOPR2	Remedy2: Should use simple data to make decisions easier and more accurate (Hilbert, 2012)	**24.00%**
	SOPR3	Remedy3: Making other peers skill set and experience known so as each member is informed and knows about others capabilities (Pronin et al., 2002)	**40.00%**

After the completion of the survey the top mitigation strategies against each factor were identified and, thus against the top 15 factors 15 top remedies were identified.

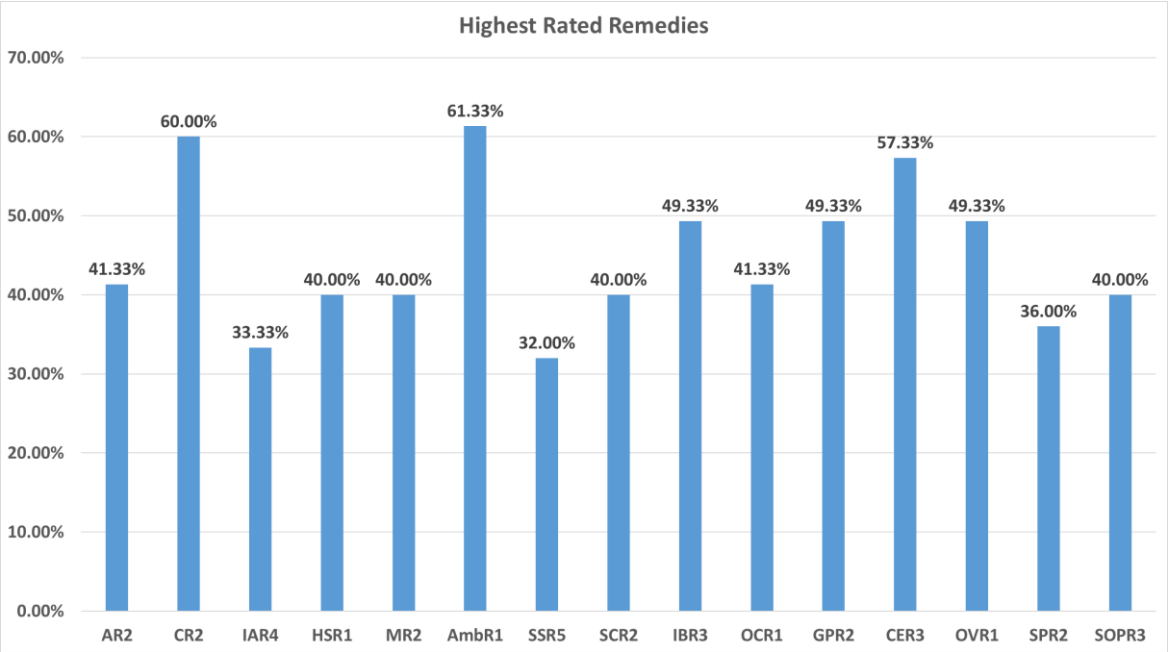

Figure 4.4 Highest Rated Remedies

Among the 15 top remedial strategies suggested by the industry professionals, a few lied in the same category, thus the categories were grouped into 6 chunks that cover each remedy, and are more easily applied through the CPDR process to lower the effects of the identified top bias factors. The major area of focus in these chunks was on team management and training as it covered 6 of the total 16 top remedies.

Table 4.2 Remedial Groups

Sr No	Remedy	Percentage response	Groups
1	AR2	42.65%	Structured data review process
2	CR2	58.82%	Team trainings and management
3	IAR4	36.76%	Forewarning about anchors
4	HSR1	39.71%	Restructuring the Questions/Data
5	MR1	38.24%	Regular Meetings to discuss results and progress
6	MR2	39.71%	Regular Meetings to discuss results and progress
7	AmbR1	61.76%	Restructuring the Questions/Data
8	SSR5	30.88%	Team trainings and management
9	SCR2	38.24%	Forewarning about anchors
10	IBR3	50.00%	Neutral mediator selection
11	OCR1	38.24%	Structured data review process
12	GPR2	47.06%	Team trainings and management
13	CER3	57.35%	Restructuring the Questions/Data
14	OVR1	50.00%	Team trainings and management
15	SPR2	35.29%	Team trainings and management
16	SOPR3	39.71%	Team trainings and management

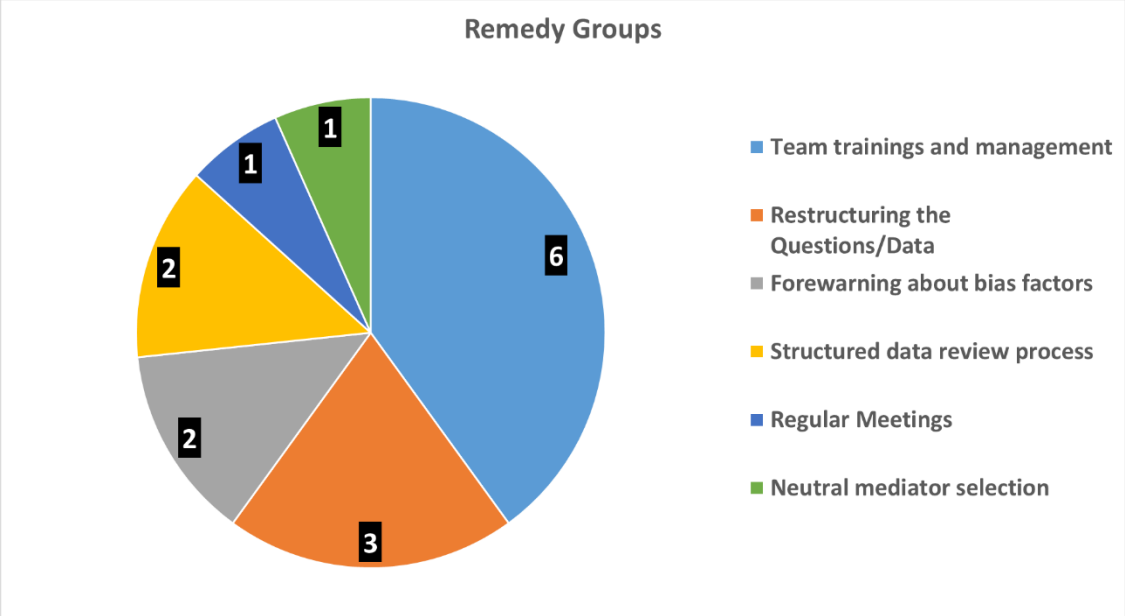

Figure 4.5 Remedial Groups

4.3 Framework

Based on the literature review and the initial survey, the top factors were identified, as indicated in Table 3.2. Anchoring, Confirmation, Hindsight, Over Confidence and Self-serving were the top five bias factors based on the combined normalized score and in accordance with (Li & Cheung, 2016) these five are the most cited factors in literature.

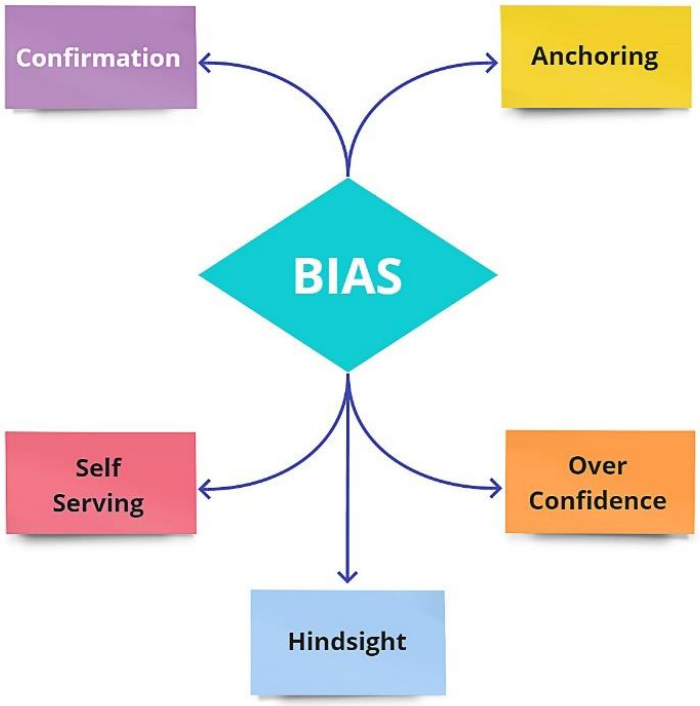

Figure 4.6 Key Bias Factors

Thus, the top five bias effects were identified and were in accordance with previous research. To develop a complete framework, we needed to incorporate the top 15 factors against their remedies into the framework. For which the dependency of the each factor was identified in the literature review, each of the top five factors is based on multiple other factors and are also in some cases adding to each other's effects as well, the dependency of each factor is listed in the Table 4.3 as under.

Table 4.3 Factor Dependency

Sr.	Dependent Factors	Independent Factors	70/30
1	**Anchoring**	Insufficient Adjustment	(A Furnham and HC Boo 2011)
		Motivation	(A Furhnam and HC BOO 2011) (Epley and Gilovich 2005)
		Selective Perception	(A Furnham and HC Boo 2011)
		Ambiguity	(Montibeller et al 2015)
2	**Confirmation**	Motivation	(Montibeller et al 2015) (Chira et al 2008)
		Ambiguity	(Montibeller et al 2015)
		Omission of Important Variables	(Montibeller et al 2015)
		Selective Perception	(Chira et al 2008)
3	**Hindsight**	Motivation	(Roese et al 2012)
		Ambiguity	(Bhattacharya et al 2018)
		Omission of Important Variables	(Musch et al 2007)
4	**Over Confidence**	Ambiguity	(Montibeller et al 2015)
		Self-Other Placement	(Chira et al 2008)
		Motivation	(Chira et al 2008) (Cooper Folta and woo 1995)
		Selective Perception	(Chira et al 2008)
5	**Self-Serving**	Insider Bias	(Izumi 2010)
		Motivation	(Izumi 2010)
		Selective Perception	(Izumi 2010)
		Group Pressure	(Izumi2010)
		Sunk Cost	(Chira et al 2008)
		Certainty Effect	(Chira et al 2008)

In Table 4.1 we listed down the data of the secondary questionnaire, in which we identified the preferred remedial strategies against the 15 factors, keeping that data in mind we come up with the combined framework for mitigation or reduction of bias effect in the CPDR process as shown in the following figures.

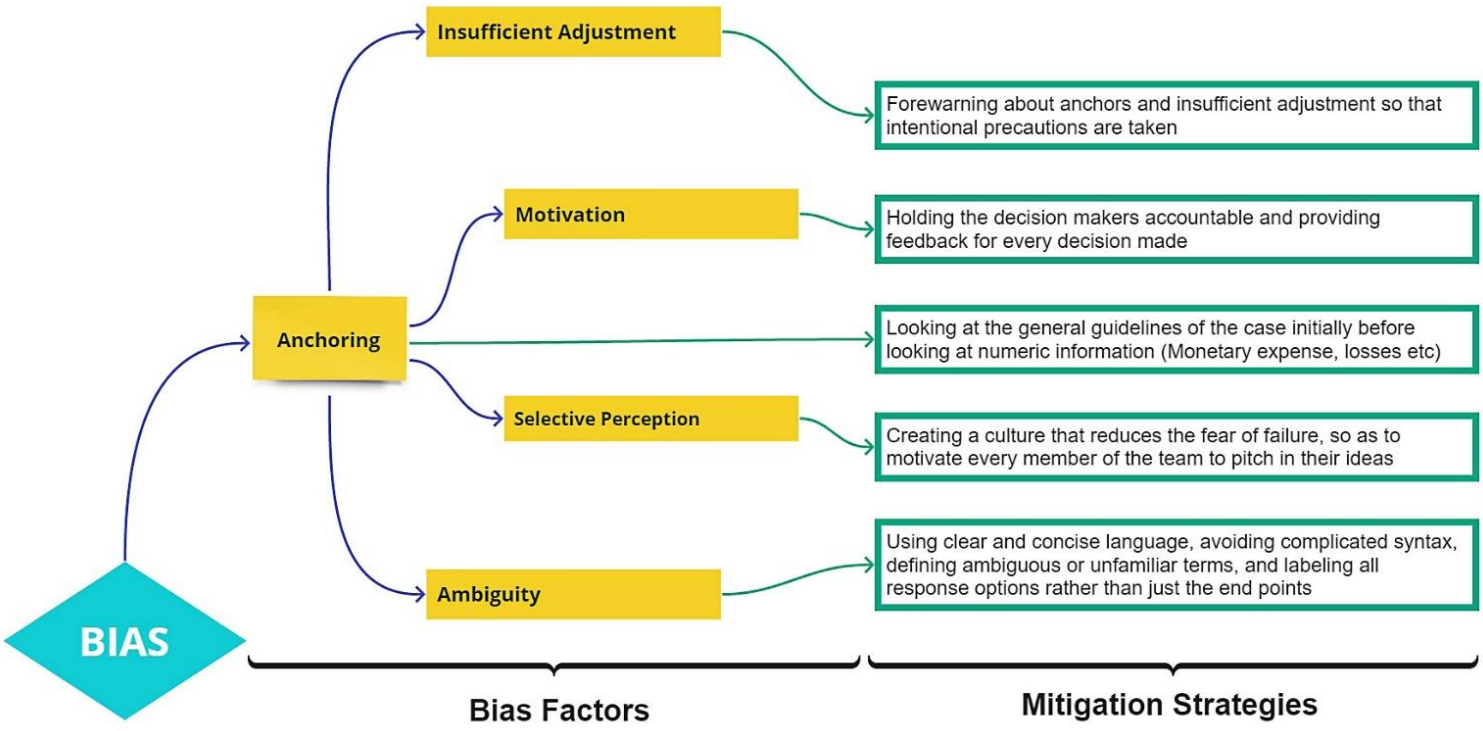

Figure 4.7 Anchoring Effect

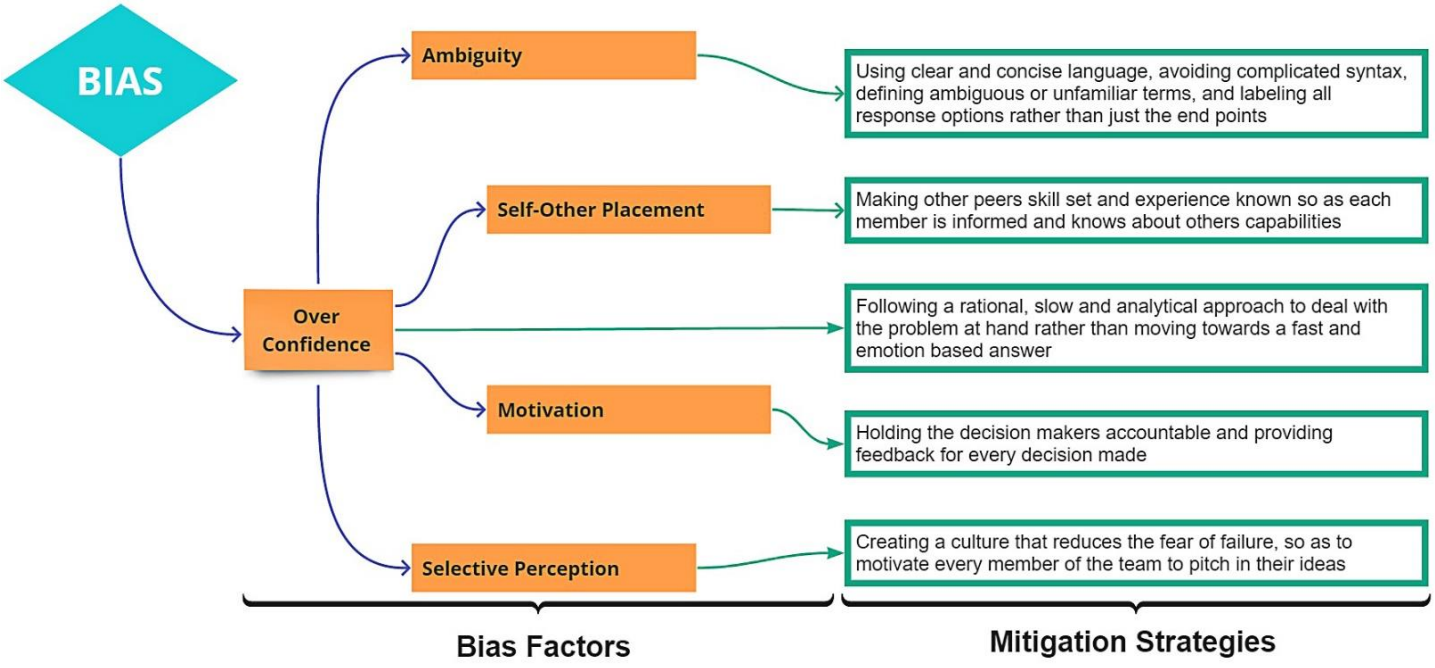

Figure 4.8 Overconfidence Effect

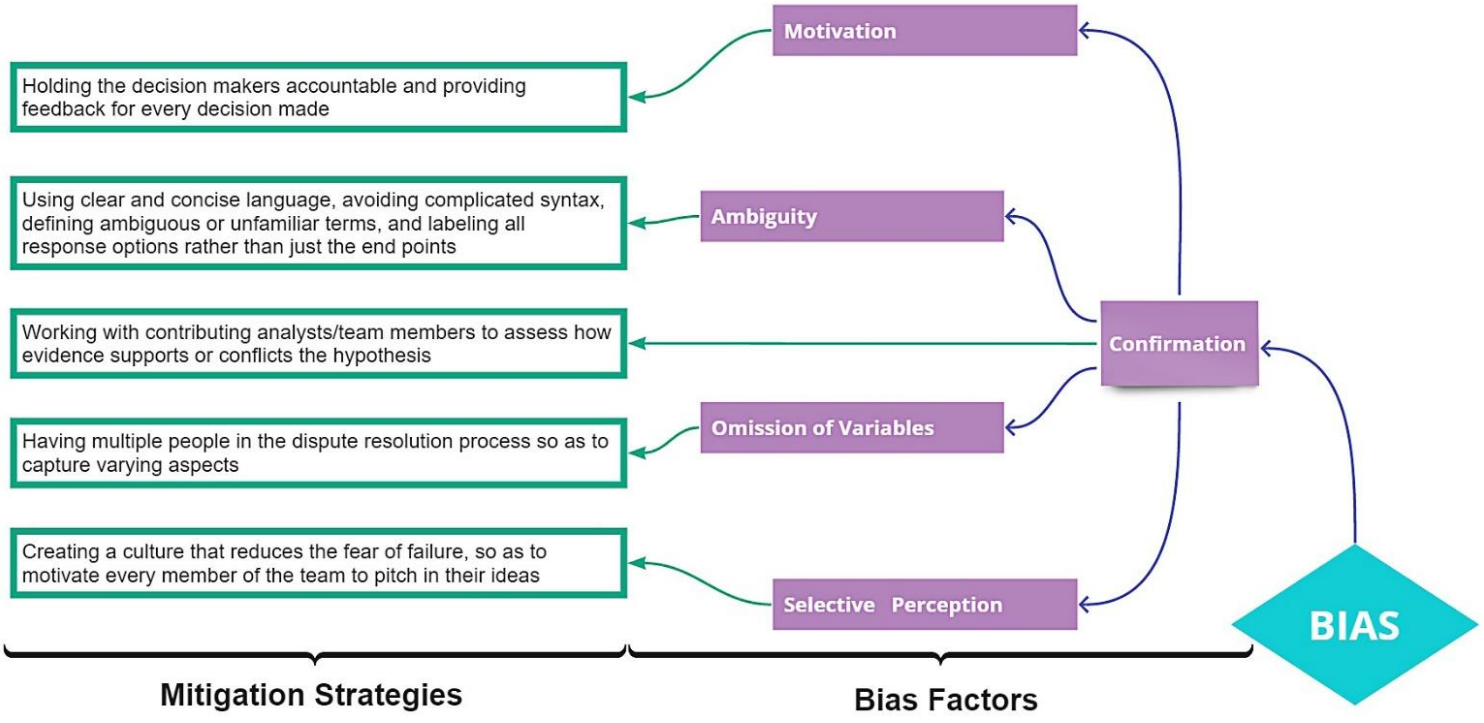

Figure 4.9 Confirmation Effect

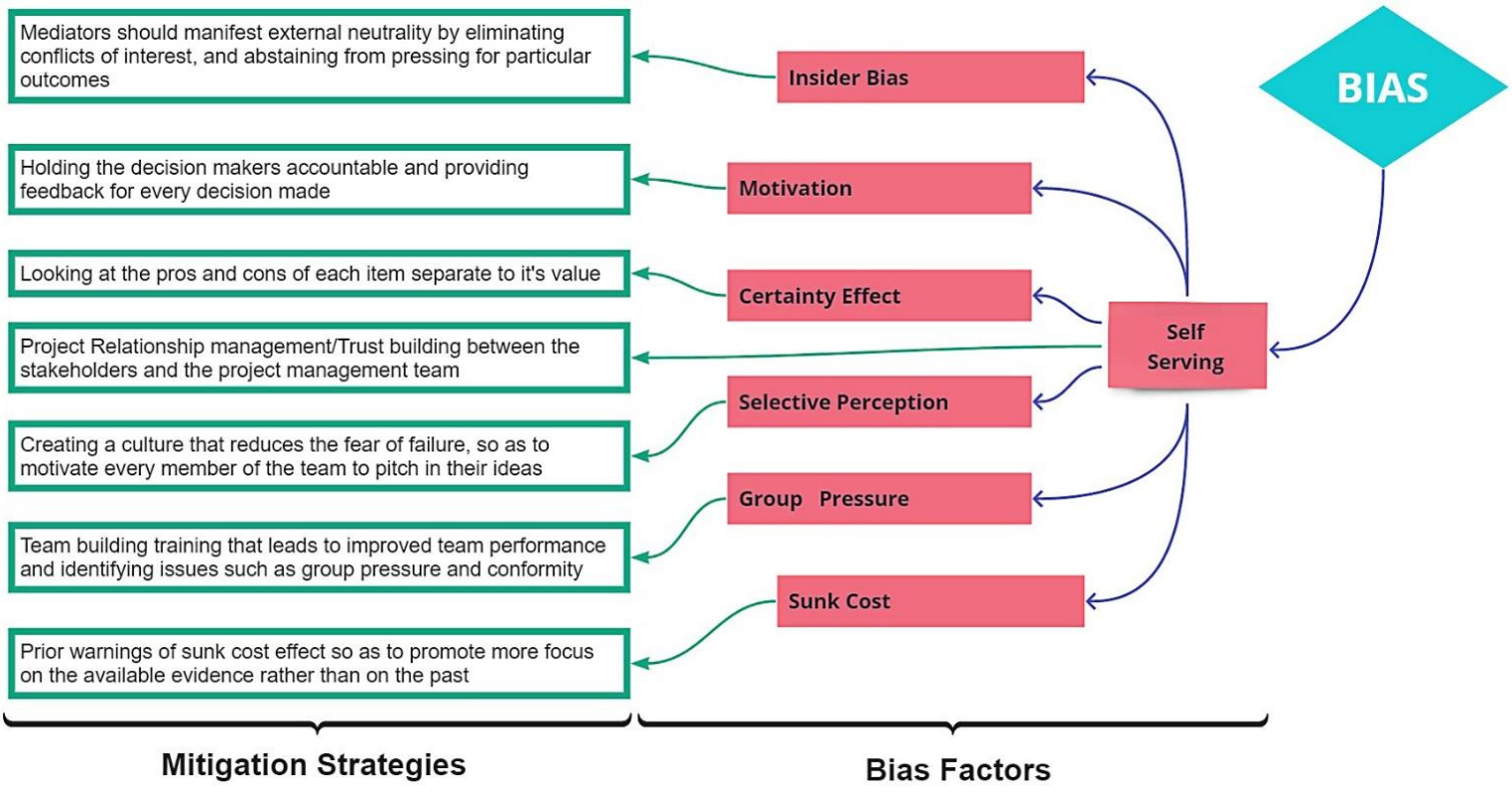

Figure 4.10 Self Serving Effect

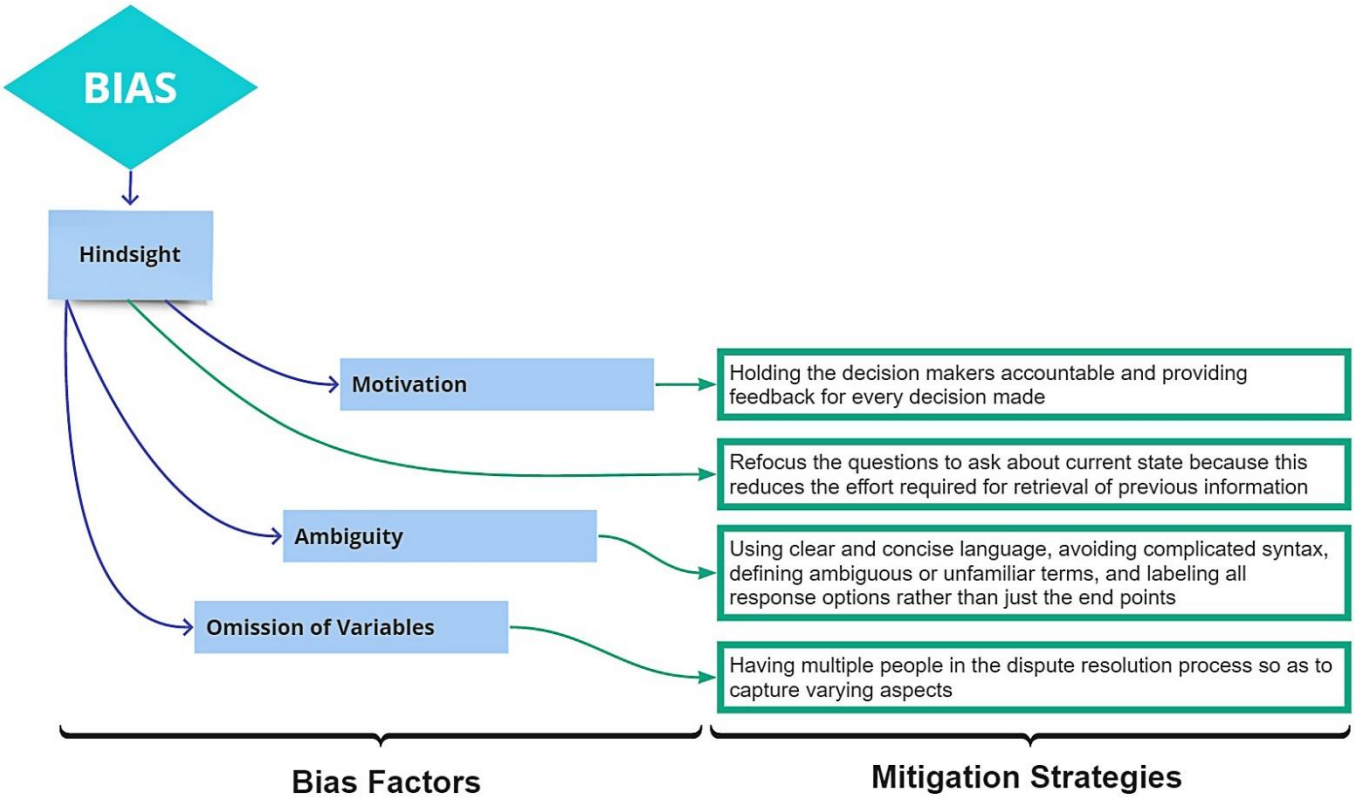

Figure 4.11 Hindsight Effect

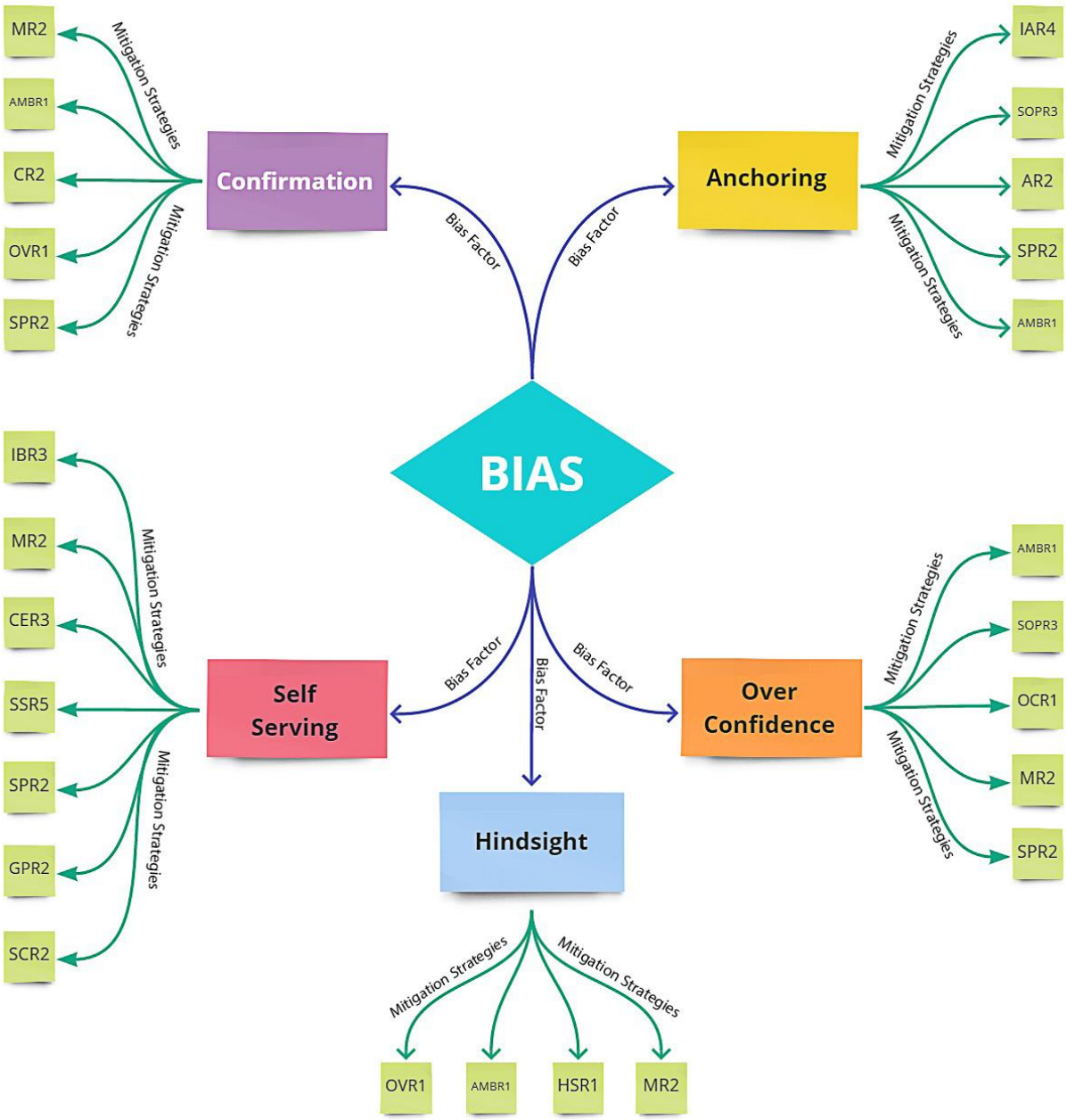

Figure 4.12 Bias Mitigation Framework

Table 4.4 To remedial strategies

Sr No	Bias Factor	Code	Code Description
1	Anchoring	AR2	Remedy2:Looking at the general guidelines of the case initially before looking at numeric information (Monetary expense, losses etc) (Bennett, 2014; Montibeller & Von Winterfeldt, 2015)
2	Confirmation	CR2	Remedy2: Working with contributing analyst's/team members to assess how evidence supports or conflicts the hypothesis (Cook & Smallman, 2008)
3	Hindsight	IAR4	Remedy4: Forewarning about anchors and insufficient adjustment so that intentional precautions are taken (Furnham & Boo, 2011)
4	Over Confidence	HSR1	Remedy1: Refocus the questions to ask about current state because this reduces the effort required for retrieval of previous information (MacKenzie & Podsakoff, 2012)
5	Self-Serving	MR2	Remedy2: Holding the decision makers accountable and providing feedback for every decision made (Novicevic et al., 2008) (MacKenzie & Podsakoff, 2012)
6	Insufficient adjustment	AmbR1	Remedy1: Using clear and concise language; avoiding complicated syntax; defining ambiguous or unfamiliar terms; and labeling all response options rather than just the end points (MacKenzie & Podsakoff, 2012)
7	Motivation	SSR5	Remedy5: Project Relationship management/Trust building between the stakeholders and the project management team (Meng & Boyd, 2017)
8	Group Pressure	SCR2	Remedy2: Prior warnings of sunk cost effect so as to promote more focus on the available evidence rather than on the past (Braverman & Blumenthal-Barby, 2012)
9	Sunk Cost	IBR3	Remedy3: Mediators should manifest external neutrality by eliminating conflicts of interest, and abstaining from pressing for particular outcomes (Izumi, 2010)
10	Omission of Important Variables	OCR1	Remedy1: Following a rational, slow and analytical approach to deal with the problem at hand rather than moving towards a fast and emotion-based answer (Croskerry & Norman, 2008) (Arkes, 1991)
11	Ambiguity	GPR2	Remedy2: Team building training that leads to improved team performance and identifying issues such as group pressure and conformity etc (Kaba et al., 2016)
12	Self-Other Placement	CER3	Remedy3: Looking at the pros and cons of each item separate to its value (Montibeller & Von Winterfeldt, 2015)
13	Certainty Effect	OVR1	Remedy1: Having multiple people in the dispute resolution process so as to capture varying aspects (Montibeller & Von Winterfeldt, 2015)
14	Insider Bias	SPR2	Remedy2: Creating a culture that reduces the fear of failure, so as to motivate every member of the team to pitch in their ideas (Shore, 2008)
15	Selective Perception	SOPR3	Remedy3: Making other peers skill set and experience known so as each member is informed and knows about others capabilities (Pronin et al., 2002)

The Bias mitigation framework in figure 4.12 is the result of this research. Using this framework, the professionals in the industry can identify the relevant mitigation strategies against the type of bias present in their CPDR process. As said previously the top 5 bias factors according to previous research are the leading cause of bias in CPDR and the other bias factors are directly or indirectly adding to these bias factors, the mitigation strategies are assigned a code in Table 3.2 and the codes are shown in the final framework for ease of use. If the person is able to identify the cause of bias when going through the top factors, then the relevant mitigation strategy can be used to lessen the effects of these bias factors.

Chapter 5

Conclusion

5.1 Conclusion

In this study we have assessed the current situation of bias in decision making in relation with the CPDR process. The major part of this research was based on data collected via online surveys. Responses were collected from different countries, initially to rank the factors identified through literature review, after which 15 factors were identified and were ranked based on a 70/30 ratio with 70% weightage for the field responses. After that a detailed literature review was conducted to identify the relevant mitigation strategies for these bias effects, a number of strategies were proposed in the literature these mitigation strategies were compiled into a secondary questionnaire survey, for which data was collected from various countries and from people having higher field experience or a direct experience in dealing with claims and disputes on construction projects. The best remedial strategies were identified for each bias factor and the data was incorporated into a bias mitigation framework.

As bias in the construction sector decision making is a relatively new topic, and not much is known about its effects in the CPDR process. Research on the topic of bias on construction projects has only recently been brought to light. Thus, this research will help bridge that gap and would add to the knowledge area of bias in the CPDR process by identifying the relevant factors that lead to bias in the decision making process and proposing mitigation strategies against each bias factor.

Using the bias mitigation framework proposed in this research, the construction teams would be better able to incorporate these mitigation strategies to reduce the effects of bias in the CPDR process.

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