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THE USE OF INTEGRATED PROJECT DELIVERY (IPD) TO REDUCE CONSTRUCTION CLAIMS IN SOUTH AFRICAN MINING CAPITAL PROJECTS

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DECLARATION

I declare that this thesis is my own unaided work. It is being submitted for the Degree of Doctor of Philosophy (PhD) in Construction Project Management to the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination to any other University.

Kuda John Shoniwa

04th day of September 2024

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ABSTRACT

The current traditional Design-Bid-Build (DBB) method on capital projects, results in adversarial relationships, insufficient collaboration, poorly defined scopes of work, inadequate designs, unsatisfactory upfront planning, and diminished integration. This often leads to various changes to planned or agreed contractor scope, schedule, cost or quality during construction resulting in numerous and expensive construction claims for additional costs and time which can be reduced by incorporating Integrated Project Delivery (IPD) benefits. In this research, reference to construction claim means a request by contractor for additional cost or extension of time during construction due to changes in planned or agreed scope, schedule, cost or quality.

This research study explores the use of IPD benefits to reduce construction claims in South African mining capital projects, contracted under the traditional DBB method. The research question for this study is therefore, “How can IPD benefits be incorporated into the traditional Design-Bid-Build method so as to reduce construction claims in South African mining capital projects?”. The researcher utilised literature review, survey and focus groups, as mixed research methods. Meta-synthesis, questionnaires and interviews were employed, as data collection techniques. Qualitative analysis incorporating descriptive and pattern coding and quantitative analysis were used for data analysis.

In answering the research question, a literature review meta-synthesis identified 28 major causes of construction claims including: changes in design and scope, unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication. Furthermore, 17 benefits of IPD essential to reducing construction claims were identified and included: early involvement of key participants, collaboration, joint decision making, and open communication.

The findings show that there is an opportunity to use aspects of IPD and infusing them into the traditional Design-Bid-Build project delivery method to reduce construction claims. IPD benefits present an opportunity to minimize changes later in the projects which in turn assists in reducing construction claims. By understanding the root causes of construction claims and reviewing the effectiveness and deficiencies of current practices used to reduce the claims, a framework that uses identified IPD benefits as remedies to causes of construction claims in capital projects can be developed.

The researcher then developed a framework incorporating IPD benefits into the traditional DBB method for South African mining capital projects, to reduce construction claims. This framework will enable project stakeholders to collaborate and integrate early to deliver quality, within budget and on-time projects so that beneficial use of the assets can commence and generate value for stakeholders. Learnings from this research will promote the required changes in behaviour and attitudes in the construction industry which can lead in the direction of full IPD implementation in the future.

Keywords: *Construction Claims, Integrated Project Delivery (IPD), Mining Capital Projects, Traditional Project Delivery, Design-Bid-Build.*

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I dedicate this thesis to the memory of my late parents, Raphael “RMJ” and Constance.

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ABBREVIATIONS

AACE	Association for the Advancement of Cost Engineering
AGC	Associated General Contractors of America
AIA	American Institute of Architects
AIACC	American Institute of Architects California Council
BIM	Building Information Modeling
CASP	Critical Appraisal Skills Program
CIDB	Construction Industry Development Board
CM@R	Construction Manager at Risk
DB	Design and Build
DBB	Design Bid Build
EPC	Engineering, Procurement and Construction
EPCm	Engineering Procurement, Construction and Management
GDP	Gross Domestic Product
IPD	Integrated Project Delivery
IPD4CRf	IPD for Claims Reduction Framework
MMoU	Multiparty Memorandum of Understanding
PMBoK	Project Management Body of Knowledge
PMI	Project Management Institute
QS	Quantity Surveyor
SPSS	Statistical Package for Social Sciences

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

The current traditional Design-Bid-Build (DBB) method on capital projects, results in adversarial relationships, insufficient collaboration, poorly defined scopes of work, inadequate designs, unsatisfactory upfront planning, and diminished integration. This often leads to various changes to planned or agreed contractor scope, schedule, cost or quality during construction resulting in numerous and expensive construction claims for additional costs and time which can be reduced by incorporating Integrated Project Delivery (IPD) benefits of early involvement, detailed design and clearly defined scope before construction, joint decision-making, open communication and collaboration. In this research, reference to construction claim means a request by contractor for additional cost or extension of time during construction due to changes in planned or agreed scope, schedule, cost or quality. Changes that occur during construction are more costly than those that happen during the design phase. This research study explores the use of IPD benefits to reduce construction claims in South African mining capital projects which are contracted under the traditional DBB method. This chapter discusses the motivation and background to the research problem, which will determine the research question and aim, and rationale of the study.

1.2 MOTIVATION

A capital project may be defined as “a large and expensive project to build or improve a capital asset” (Cambridge Dictionary, 2022). The AACE (2018:5) defines a capital project as “a project in which the cost of the end result or product is capitalized’’. Capital projects comprise “assets such as subways, pipelines, refineries, power plants, mining equipment and infrastructure, manufacturing plants, industrial or processing plants, land and buildings” (Investopedia, 2022:16). In South Africa, the National Treasury (2023:2), classifies capital projects as “very large projects (ZAR1 billion or more cost), and smaller projects (less than ZAR1 billion cost).” According to Oshungade and Kruger (2015:3), various researchers have used different terms to refer to “project delivery methods, procurement methods, project

approach and contractual arrangement on construction projects." The traditional project delivery or procurement method is "that method whereby the client goes through distinct tasks of design, bid, and build on the project" (Salla, 2020; Oladinrin *et al.,* 2013; AIA & AGC. 2011:4).

Most countries utilise the traditional DBB method for the procurement of capital projects (Hanks, 2015; Pakkala, 2002). The traditional method (DBB) is the most widely utilised worldwide (Ashcraft, 2022; Aldossari *et al.,* 2021; Salla, 2020; Harper, Molenaar & Cannon, 2016). In the 20th century, DBB emerged as the most commonly utilised project delivery method in the United States of America (AIA & AGC. 2011; Miller *et al.*, 2000). Grobler and Pretorius (2002) found that "62% of construction and civil projects in South Africa" are executed via the traditional method. The DBB method however lacks collaboration and integration (Nawi *et al.,* 2014). According to Barutha (2018), the frequently utilised project delivery methods are not conducive for large complex industrial projects because of the extreme level of ambiguities, complexities, practices, and working together needed between project stakeholders. Most capital projects are designed and constructed by a multitude of engineers, contractors and other stakeholders (Sunjka & Jacob, 2013). Burger (2008) concluded that because of the fragmentation that exists in the South African construction industry, the high degree of subcontracting and the competing goals and objectives of the stakeholders involved result in adversarial relationships which are detrimental to project success. Further research by Emuze and Smallwood (2014), also confirmed that the South African construction industry was fragmented and lacked collaboration. It is a major challenge that construction contractors are generally only brought onto the project after the design is complete on traditional DBB projects (Chang, 2017). According to Ashcraft (2014a), the use of various parties leads to disintegration of the construction industry resulting in compartmentalisation of the information essential for optimised design and construction which sequentially leads to barriers to communication and collaboration. Complicated construction projects have numerous changing components and many stakeholders (Dunn, 2019). The traditional project delivery method utilised is adversarial and makes it convenient for a claims-oriented approach to construction of the project by the stakeholders especially the contractors. The diminished collaboration and integration in the DBB method especially during the design stage

makes it vulnerable to numerous changes in scope, schedule, cost or quality later during construction resulting in contractors submitting claims for additional cost or extension of time. Research by Ernst & Young (2022) on 357 large capital projects, indicated that 64% of projects were experiencing cost overruns with 73% undergoing time or schedule delays. McKinsey & Company (2017a:10) found that “overruns and delays are common in big mining construction projects with more than four out of five mining projects coming in late and over budget, by an average of 43 percent.” The impact of cost is highest throughout the construction phase of capital projects since time is of the essence and aspects of planning or scheduling become crucial (Dobson, 2004; Watermeyer, 2002). Construction claims lead to capital projects exceeding budgeted costs and going over planned time for completion. The cost of resolving a claim could be substantially high, as it includes the amount paid out in settling plus the operational cost encountered in determining the claim (Lu *et al.,* 2015).

A partnering and collaborative “model for a new project delivery method emerged in the United States and is widely referred to as Integrated Project Delivery (IPD)” (Kent & Becerik-Gerber, 2010:815). AIA and AIACC, (2007:2) provide a definition for IPD as “a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction.”

Previous research (AIA & AIACC, 2007; Khemlani, 2009; Perlberg, 2009) indicates that IPD is practically realistic and can be applied on large and small projects for improved project results. According to Dunn (2019), IPD has potential to solve many widespread challenges in the construction sector. A study by UKOGC (2003), estimates that the construction cost will decrease by about “2 to 10% (for single projects) and up to 30% (over a programme of construction projects) through the use of IPD.” An evaluation by El Asmar *et al.* (2013) indicates that IPD obtains statistically significant improvements in the following performance areas when contrasted with traditional delivery methods: cost, quality, schedule, project changes, communication and environmental. The IPD approach presents an opportunity for

collaboration with the project team working together towards a common objective rather than seeing one another as roadblocks to advancement (Fischer *et al.*, 2017).

McKinsey & Company (2017b), states that IPD helps build long-term collaborative relationships. The open setup of the IPD approach balances the objectives of all those involved from inception of the project (Chang, 2017). Nikles (2011) highlights that IPD makes a lot of sense as it may enhance project efficiencies and therefore reduce costs. IPD leads to improved communication and reduction of delays (Ghazal & Dowlatabadi, 2018), thus minimising construction claims which cause additional costs and disputes (Darrington & Lichtig, 2010).

According to Barutha (2018:1), large industrial capital projects "built in challenging and changing environments with high levels of complexity and uncertainty" make good candidates to benefit from the IPD methodology. IPD is based on the early participation of each party's expertise and enables project stakeholders to achieve set goals whilst enhancing the worthiness which they bring to the project (Cadalyst, 2007). McKinsey & Company (2017b) however warns that "it will take time to build the level of trust needed to collaborate and transparently share data" between the parties. Previous research on utilizing collaboration, integration and partnering on construction projects in South Africa has shown potential for positive project outcomes but requiring change in culture (Watermeyer, 2012) of the project parties or participants in order to be able to implement such strategies. Case study research by Mashegoana (2023) on the mega construction of two coal fired power stations (Medupi and Kusile) in South Africa, revealed that "cultural disruptions can be found in implementing mega construction projects and ignoring and mismanaging such cultural differences could lead to massive project delays".

Ultimately, IPD aims to mitigate aspects that have traditionally impacted construction projects so as to deliver an outstanding project to the owner (Lee, 2013). McKinsey & Company (2017b) further highlights that there is an opportunity "to start incorporating some aspects of IPD into traditional models to increase" emphasis on better decision-making on projects, encouraging innovation, and reducing variability. The innovation and flexibility encouraged by the IPD approach can however lead to "scope creep" if not managed well as participants may try new things which could result in additional scope. This idea of borrowing from IPD is supported by Fischer *et*

al (2017), who further state that IPD presents a framework that can lead to the changes or shift in behaviour needed for better results on projects.

This research aims to explore the use of IPD benefits to reduce construction claims in capital projects which are contracted under the traditional DBB method. IPD is mainly based on early collaboration and integration (Ashcraft, 2022; AIA & AIACC, 2007) on projects which makes it an appropriate source of principles, enablers or benefits that can be borrowed to remedy the deficiencies of DBB in regard to its lack of collaboration and integration. Not much research has been undertaken to consider the feasibility of borrowing certain aspects of IPD for use in the commonly used traditional method to specifically reduce construction claims. The researcher then conceptualises a framework that incorporates IPD benefits into the traditional DBB method for South African mining capital projects so as to reduce construction claims.

1.3 BACKGROUND TO THE RESEARCH PROBLEM

According to research by Norton Rose Fulbright (2015), South Africa's mineral endowment incudes "precious metals, base minerals, construction materials, and natural oil and natural gas." Over 30% of the world's global mineral reserves are found in Africa (UNEP, 2024). South Africa has one of the richest economies in Africa, which is partly due to its huge mining industry. Furthermore, South Africa is in the top ten of countries with the most minerals in Africa (USGS, 2024). South Africa is the "world's largest producer of chrome, manganese, platinum, vanadium, and vermiculite, and the second-largest producer of ilmenite, palladium, rutile, and zirconium" (USGS, 2024). Research by Nedbank (2024) indicates that between the 2018 to 2023, the average annual spend for mining capital projects in South Africa was estimated at 7% (i.e. ZAR17.5billion) of total annual capital projects spend across the different industry sectors.

Not many mining companies have the design engineering capability nor the inclination to construct a mine on their own (Hickson & Owen, 2022; KPMG Global Mining Institute, 2013). Works for mining capital projects include specialist engineering designers, earthworks, civils, structural, mechanical, electrical, controls and instrumentation works. Usually EPCM (Engineering Procurement, Construction and Management) consultants are employed by the client or owner to manage the

projects and depend on contractors for the actual fabrication, construction and installation. The South African construction industry is dependent on multidisciplinary teams to deliver its projects (Kwofie, Aigbavboa & Matsane, 2017; Burger, 2008).

Ross and Hugill (2006:418) stated that as a result of the ambiguity and lack of certainty associated with construction activities, “variations and claims” are present on almost all projects. The construction sector is a sensitive, complex and uncertain industry in relation to factors such as procedures, construction methods and site conditions which often results in claims (Hayati *et al*., 2019). Awakul and Ogunlana (2002) highlighted that construction conflicts cut profits and are thus very costly and wasteful. Yiu and Cheung (2006) further indicate that construction disputes appear unavoidable as a result of the differing interests among the parties. Traditionally, contracts in the construction industry have emphasized the allocation of risk amongst parties. Some argue that this risk allocation model hinders productivity, which results in increased costs on construction projects. A study in Canada found that contract pricing shot up by up to 20% as a result of contractors marking up and pricing for risk and exclusions in contracts (Streu & Hirst, 2019).

According to Griffin (1993), the number of cases of construction claims materially amplified and grew globally since the mid-70’s. This has resulted in a litigious approach by parties in the construction process. Griffin (1993:4) further states that the majority of today’s claims are based on “schedule, delay, impact, disruption or acceleration” suppositions. According to research by Semple *et al.* (1994), most construction claims involve delays with some delays doubling the original contract duration. Since most claims are based on delays, it can be inferred that to successfully resolve claims, the assessment of planned versus actual performance will remain key. Furthermore, related to this, is the identification of causes of the delay and which party is responsible for the delay. Traditional project delivery approaches hinder the setting up of very efficient teams and hamper genuine teamwork due to the existence of silos which limit the easy transfer of expertise and information (University of Minnesota, 2016).

IPD was created to also remove these hindrances so as to enable such flows within multidisciplinary project teams. The main aim of IPD is to capitalize on alliancing and organized teamwork during the project phases (Kent & Becerik-Gerber, 2010). IPD is

a developing innovation in construction delivery and represents a fundamental difference from the traditional approach that separates; obligations, how the participants communicate, and risk and benefit. Parties to an IPD team have inducements to do what benefits the project the most, instead of own benefit (Andre, 2011).

IPD is a contracting approach that focuses on exploiting the benefits of cooperation, working together and aligning the goals of participants in complicated construction projects (Dunn, 2019). NASFA *et al.* (2010:4) describe IPD as being a philosophy as well as being a delivery method. AIA and AIACC (2007) provides a significant comparison of the traditional project delivery method and IPD as shown in Table 1.1.

Table 1.1: Comparison between Traditional Project Delivery and IPD

Traditional Project Delivery/ Design-Bid-Build (DBB)		**Integrated Project Delivery (IPD)**
"Fragmented, assembled on just-as-needed or minimum-necessary basis, strongly hierarchical, controlled"	**Teams**	"An integral team entity composed of key project stakeholders, assembled early in the process, open, collaborative"
"Linear, distinct, segregated; knowledge gathered just-as-needed; information hoarded; silos of knowledge and expertise"	**Process**	"Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect"
"Individually managed, transferred to the greatest extent possible"	**Risk**	"Collectively managed, appropriately shared"
"Individually pursued; minimum effort for maximum return; (usually) first-cost based"	**Compensation/ Reward**	"Team success tied to project success; value-based"
"Paper-based, 2 dimensional; analogue"	**Technological** **Communications**	"Digitally bases, virtual; Building Information Modeling (3, 4 and 5 dimensional)"
"Encourage unilateral effort; allocate and transfer risk; no sharing"	**Agreements**	"Encourage, foster, promote and support multi-lateral open sharing and allocation; risk sharing"

Source: (AIA & AIACC, 2007)

From the table above, if IPD is the ideal project delivery approach of the future (Dunn, 2019), this study intends to identify what can be borrowed from IPD benefits for use today in the traditional Project Delivery DBB method so as to reduce construction claims. The comparison shows IPD as a structured, collaborative and

togetherness approach focused on project success which resonates well with efforts to reduce construction claims.

According to Froise (2014), the theme of partnering has not been given enough consideration in the South African construction industry. A survey by Grobler and Pretorius (2002) indicated that the traditional DBB method was the most commonly used method in South African construction projects. Research by Mbanjwa (2003) concurred that the traditional DBB method was the most popular method in South African construction projects.

Recent research by Oshungade and Kruger (2015), also confirmed that the traditional DBB method remains the highly prevalent and most used project delivery approach in the South African construction industry. The table below summarises the results of these three researches.

Table 1.2: Usage of Project Delivery Methods in South African Construction Industry

<table>
<tr><th colspan="2">Order of Popularity in South Africa</th><th colspan="2">Project Procurement Systems</th><th>“Percentage by weight of the procurement methods used in South Africa”</th></tr>
<tr><td>Excellent Knowledge of</td><td>5</td><td>Traditional System (with or without project management)</td><td>Traditional (Design-Bid-Build)/ DBB</td><td>62%</td></tr>
<tr><td rowspan="3"></td><td>4</td><td>Construction Management</td><td>Design/Build (DB)</td><td>29%</td></tr>
<tr><td>3</td><td>Management Consulting</td><td rowspan="2">Other</td><td rowspan="2">8%</td></tr>
<tr><td>2</td><td>Design & Build (including turnkey)</td></tr>
<tr><td>Least Knowledge of</td><td>1</td><td>Design & Manage (including build, operate and transfer)</td><td>Construction Management at Risk (CM@R)</td><td>1%</td></tr>
<tr><td colspan="3">Source: Mbanjwa (2003)</td><td colspan="2">Source: Grobler & Pretorius (2002); Oshungade & Kruger (2015)</td></tr>
</table>

Research by Grobler and Pretorius (2002) found that despite the traditional DBB method being the more commonly method used in South Africa, this approach has

performed poorly, in terms of satisfying the specific project objective of fewer disputes and claims, as shown in the table below.

Table 1.3: Comparison of the Project Delivery Methods in South African Construction Industry in Terms of Fewer Disputes and Claims

	Project Delivery Method	**Average by weight of stakeholders**
Project Delivery Method which has fewer disputes and claims	DB	79.3%
	CM@Risk and Other	12.4%
	Traditional DBB	8.3%

Source: Grobler & Pretorius (2002)

From the table above, the method with the highest scoring on this project objective is DB. According to Chang (2017), IPD was developed in response to DBB challenges and is a more comprehensive version of DB. It can therefore be inferred that IPD would score higher on this objective. There has not been much research, nor usage of IPD in South Africa.

AIA and AIACC (2007) identifies the benefits of IPD for the three major stakeholders on projects i.e. owners/ clients, designers/ engineers and contractors. The owner or client gains from the timely and accessible availability of knowledge that enables the owner or client to select the best project options. The IPD method makes it conducive for the project team to grasp the owner's aims thereby allowing the team to manage costs better and focus on meeting the project's objectives. AIA (2007), further states that under IPD, designers or engineers gain from early on engagement of contractors during the design phase in terms of the knowhow that contractors bring to the table for example on budget estimates and constructability or buildability matters. On the other hand, by being part of the design phase, contractors benefit from "pre-construction planning, timely and informed understanding of the design, the ability to anticipate and resolve design related issues and visualise construction sequencing prior to the start of construction" (AIA & AIACC, 2007:3). Mossman *et al.* (2010) researched on the beneficial attributes of IPD and found that clients or owners obtained most value and experienced reduction in energy costs of use, designers or engineers experienced a reduction in time to complete designs as well

as a cut in design costs, and contractors experienced less redoing of work and more buildable facilities.

The partnering, collaboration, sharing of risk and teamwork characteristics of IPD presents an opportunity for reducing construction claims in capital projects. According to a survey on construction professionals by Kent and Becerik-Gerber (2010:824), participants suggested that “trust, respect, and good working relationships are the key to successful IPD projects.” Furthermore, most of the participants indicated a preference for IPD compared to traditional delivery methods. Little or no research has however been undertaken on specifically investigating the use of IPD benefits to reduce construction claims in mining capital projects under the traditional project delivery method. According to Sive (2009), no substantial research has been undertaken to examine the current status of embracing IPD and causes of the sluggish or slow rate of uptake of IPD within the construction industry. The construction industry is “still looking for more evidence to fully adopt IPD as a project delivery method” (Kent & Becerik-Gerber, 2010:824). According to Nikles (2011), owners are mostly content with the traditional delivery models and not yet sold on the evidence that the stated cost savings of IPD are real. De Marco and Karzouna (2018) also further highlight that IPD is battling to spread in the construction industry but its value should be unlocked.

1.4 IDENTIFICATION OF GAP AND CLARIFICATION OF RESEARCH PROBLEM

The advocates for the use of IPD in capital projects to enable collaboration and focusing on the project goals call for the complete implementation of IPD including putting in place a one multiparty contract. Such a radical move to use IPD is likely to face resistance from traditionalists in the construction industry. IPD has been successfully used in the building of health facilities in the USA and UK (Fischer *et al.,* 2017; Ashcraft, 2014b). There is no evidence that it has been broadly adopted by the construction industry in capital projects like mining or industrial processing plants. The number of projects utilising IPD are still a relatively few (Post, 2007; Sive 2009; Chang, 2017; Walker & Rowlinson, 2020). Research by Fish and Keen (2012) indicated that the three main issues of IPD which have to be addressed before the method is fully accepted by the construction industry are: the setup for facilitating IPD, which type of contracts to use and how to handle insurance on the project.

Kent and Becerik-Gerber (2010), highlighted that the underlying causes for the sluggish adoption of IPD include apprehensions on the risk of IPD and the close partnering it relies on including the necessity for new legal contracting setups to cater for new IPD approaches. According to Nikles (2011), IPD requires widespread involvement by all project members in the earlier phases of the project which results in shifting the cost curve to earlier in the project. This fact may hamper the full adoption of IPD by owners as owners generally want to delay incurring huge costs as projects may be halted, delayed or canned for various reasons, such as adverse changes in market conditions or permitting issues. The owner would not want to incur huge costs early during design for a project that may not pass a feasibility stage gate.

IPD can have its challenges since it is a relative new concept (Jayasena & Senevirathna, 2012; Walker & Rowlinson, 2020) and completely distinct when compared to the traditional contracting approach. IPD has been identified as a project delivery approach that may efficiently enable the utilisation of Building Information Modeling (BIM) on construction related projects (Kent & Becerik-Gerber, 2010). Even though IPD projects can be executed without BIM, the rewards of IPD can only be fully reaped when the two are used in sync (AIA & AIACC, 2007). Research by El Hawary and Nassar (2016) indicated that use of BIM in construction projects has a significant impact in reducing some causes of construction claims like design errors and quantities variations. The use of technologies such as BIM which IPD could rely on may however create challenges related to technology such as compatibility across project participants, security breaches and system outages which will need to be managed well.

It can be argued that IPD is an ideology, a futuristic concept which may require cultural and behavioural change (Alinezhad *et al.,* 2020; Fischer *et al.,* 2017). Research by Watermeyer (2012:1), on South African construction projects indicates that the industry requires a culture change in order to ‘’improve project outcomes’’. The AIACC (2008) warns against trying to use IPD without taking necessary steps for the required behavioural change and adopting its new benefits cautioning that such a move can lead to a poor result. There are however characteristics of IPD that the construction industry can adopt, fuse and incorporate into the traditional DBB

contracting approach. According to Franco, Cushman, and Rosenhead (2004), one of the strong points of IPD is that the project stakeholders perform together and collaborate in developing the goals and objectives of the project.

The AIACC (2008), states that the biggest challenge standing in the way of IPD for all parties is the fear of change. Parties are likely to resist radical change than incremental change. According to Chang (2017), it is feasible to leverage IPD principles to DBB projects and therefore possible to adopt IPD thinking on a project, even when a proper multiparty IPD agreement is not in place. The structural framework of IPD which “draws on each stakeholder's unique knowledge to address problems before they occur” (Fischer *et al.,* 2017), presents an opportunity to reduce construction claims. Little or no research has been carried out to examine and explore the feasibility of borrowing certain aspects of IPD for use in the traditional DBB method to reduce construction claims in mining capital projects in South Africa. The IPD benefits of early involvement, joint decision-making, open communication and collaboration have the potential to reduce construction claims.

1.5 STATEMENT OF THE RESEARCH PROBLEM

The current traditional Design-Bid-Build method on South African mining capital projects results in adversarial relationships, insufficient collaboration, poorly defined scopes of work, inadequate designs, unsatisfactory upfront planning and diminished integration which often leads to various changes to planned or agreed contractor scope, schedule, cost or quality during construction resulting in numerous and expensive construction claims for additional costs and time which can be reduced by incorporating Integrated Project Delivery (IPD) benefits of early involvement, detailed design and clearly defined scope before construction, joint decision-making, open communication and collaboration.

1.6 RESEARCH AIM

This research aims to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. This framework will enable stakeholders in

South African mining capital projects, to collaborate and integrate early to deliver projects to a high quality, on time and within budget.

1.7 RESEARCH QUESTION

How can IPD benefits be incorporated into the traditional Design-Bid-Build method so as to reduce construction claims in South African mining capital projects?

1.8 RESEARCH SUB-QUESTIONS

The research sub-questions to help out in responding to the research question are listed below.

1) “What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?”
2) “Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?”
3) “What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”
4) “How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”

1.9 RESEARCH OBJECTIVES

The research objectives listed below assisted in achieving the research aim.

1) To find out the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method.
2) To identify the benefits of Integrated Project Delivery (IPD), which are essential to reducing construction claims in capital projects.
3) To investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

4) To assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

1.10 RESEARCH METHODOLOGY OF THE STUDY

This study utilised literature review, survey and focus groups, as research methods. Qualitative meta-synthesis, questionnaires and interviews were employed as data collection techniques. Descriptive and pattern coding, quantitative and qualitative analysis were then used for data analysis.

1.11 JUSTIFICATION/ RATIONALE OF THE STUDY

The current project delivery method on capital construction projects is predominantly a traditional approach that has developed over history, including during the industrial revolution, where it was common for professional trades to specialise. This has resulted in the construction industry including professionals - for instance, architects, engineers and contractors, to adopt a segmented, rather than an integrated approach to projects (Pakkala, 2002). The current traditional DBB contracting approach on capital projects is rather adversarial, and involves allocating risk, rather than sharing risk equally. The current approach leads to each party exclusively looking after his own cause and interest, at the cost of the overall project and other parties (Cheng & Li, 2004). This fragmentation results in minimal teamwork and diminished integration between the stakeholders.

According to Chang (2017), in the traditional DBB method, due to lack of integration, the engineer or designer does not get a constructability review contribution from the contractor during the design phase. Conversely, the contractor misses out on the design background information and knowledge that the engineer or designer would have accumulated over time, during consultations with the owner. Typically, when the project moves into the construction phase, the engineer or designer's participation is reduced, which increases the risk of miscommunication or misinterpretation of the intended design, which in turn, usually results in delays and claims (Chang, 2017). Construction claims are mostly caused by changes on the

projects during construction (Tochaiwat & Chovichien, 2004). The most common cause of a claim is a design change requested by the Owner/ Client post-tender award, or during construction, which results in the overall project costs increasing (Hayati *et al.,* 2019).

Despite there being current practices used to attempt to reduce construction claims in capital projects (Hmayed & Ma, 2015; Griffin, 1993), projects still face cost overruns (Semple *et al.,* 1994) with various changes occurring during construction, resulting in claims. The current practices used to reduce claims are not systematic, but more precautionary strategies and project management practices (Mohamed, Ibrahim & Soliman, 2014), which require behavioural or cultural changes by the contacting parties. Capital projects under DBB utilize various parties through the phases of the project.

At the design stage, a designer or engineer works with the owner to design the works. Tenders are then issued for the construction works bidding. Following this, the construction contractor is contracted to execute the works, with manufacturers of equipment and material getting engaged. When the works are completed, the end users - i.e. operation and maintenance then get involved (Al Subaih, 2016). This phased approach results in breaks in continuity of regular interaction between key and important stakeholders, during the project lifecycle. Al Subaih (2016) highlights that the DBB method does not have a clear and deliberate mechanism to ensure integration and collaboration between stakeholders, throughout the project phases.

Usually the construction contractor, equipment and material suppliers and end users may still work closely together later, during the construction and commissioning phase. However, by then, it is already late as they would have missed out on the benefits of early integration during the concept, prefeasibility, and detail design phases. This integration, which only happens late and the collaboration, which occurs in bits and pieces, can lead to miscommunications and a lack of coordination, which may lead to big change orders, resulting in claims during construction (Chanmeka *et al.,* 2012).

Previous research on utilizing collaboration, integration and partnering on construction projects in South Africa has shown potential for positive project

outcomes, but requiring change in culture (Watermeyer, 2012). There has not yet been a framework developed to integrate and determine the functions and duties of the several project participants in the fight against construction claims.

Such a framework would assist in identifying at which stage each party should be engaged, so as to eliminate and prevent various changes later during construction (Long, 2014; Fayek *et al.,* 2006). One way of mitigating and reducing construction claims is to integrate the key stakeholders earlier in the project. IPD is based on philosophies and a methodology that enables prompt participation of all key parties together with the engagement of systems and procedures (Ashcraft, 2014a). IPD brings together the "owners, architect, engineers, and contractors early in the development stage to ensure that problems are caught early, and to address them in a collaborative way" (Fischer *et al.,* 2017). According to Ashcraft (2022), there has been no study, which has indicated or suggested that IPD is less effective, when compared to other approaches, meaning there is value in using IPD.

The IPD approach is fairly new to the South African mining industry. This study will add new knowledge in regard to a framework based on IPD benefits that will encourage the parties to work together, to eliminate speculative claims and ascertain the validity and quantum of genuine claims, and thereby reduce construction claims in South African mining capital projects. The study will focus on South African mining capital projects, which are typically large and mega projects of at least USD 5-million completed in remote areas under severe conditions based on a DBB traditional contracting model.

According to Kuvshinikov *et al.* (2017:1), "more than four out of five mining capital projects" are delivered "late and over budget, by an average of 43%." The high value mining capital projects typically have a design duration that "takes between 12 to 15 months, followed by bidding for supply of equipment and construction for 3 to 6 months, and then construction for 12 to 48 months" (De Villiers, 2005:32).

These capital projects follow the stage-gate process, where the project is taken through gates after each stage to check if it passes its minimum requirements. The stages it goes through are concept, pre-feasibility study, definitive feasibility study and implementation (construction). The number of stakeholders are many including

“owners, engineering design consultants, project management consultants, government and regulatory bodies, construction contractors, sub-contractors, major equipment manufacturers, minor equipment manufactures and third-party consultants” (De Villiers, 2005:146). These projects involve all disciplines of engineering works, ranging from earthworks, civils, process, mechanical, electrical, controls and instrumentation. The high value and discipline diversity of these projects makes them ideal for this research, because the bigger the project, the bigger the problems (McKinsey, 2017b).

The new knowledge, which was obtained from this research will therefore be transferrable to other construction sectors, which involve similar disciplines of engineering works, such as energy/power stations, petroleum, buildings, roads etc. This new knowledge obtained from such high-value mining capital projects, which are executed under remote and severe conditions, will also be transferrable to smaller capital projects or less complex projects executed under less severe conditions. The mining capital projects also involve engineering firms and contractors, who are from multinational companies, which brings a global perspective to this research. It is therefore envisioned that the outcomes of this research is reliable, valid and capable of being generalised for application on capital projects worldwide. It is also envisioned that the learnings from this research will promote the required changes in behaviour, attitudes, and skills, thereby resulting in the eventual acceptance and utilisation of the full IPD approach to contracting on capital projects worldwide.

1.12 THESIS OUTLINE

To achieve the research aim, Chapter 2 provides an overview of the existing literature on project delivery methods, construction claims and IPD principles. It then highlights the major causes of construction claims, current practices used to reduce construction claims and identifies IPD benefits that can remedy these causes so as to lay a foundation for tackling the aim of the study. It also investigates and makes an effort to create a new understanding of identified IPD benefits. This results in the creation of a concept framework that utilises the benefits of IPD so as to reduce construction claims in South African mining capital projects.

Chapter 3 presents the overall research methodology of the research including the research philosophy and the research approach and strategies. Furthermore, the research design is explained together with the data collection, data analysis and software utilised for analysis. It also explains the linkages between the research questions, objectives, methods, data collection techniques and the data analysis method.

Chapter 4 describes the results of the qualitative literature review done so as to answer research sub-questions 1 and 2. It also presents the results of the survey and focus groups carried out in order to answer the last two research questions. Existing literature is used to qualitatively identify the major causes of construction claims and to explore the use of IPD benefits to reduce these construction claims in capital projects. Questionnaires are then utilised to investigate the current practices used to reduce construction claims on mining capital projects and their effectiveness. The questionnaires also test the IPD knowledge of the respondents and whether they consider the IPD benefits identified in the literature review meta-synthesis to be effective in reducing construction claims in mining capital projects. This is followed up by interviews in a focus group of mining capital project management experts to review the assignment of IPD remedies to the causes of construction claims. The focus group discussion includes validating the major causes of construction claims in South African mining capital projects as identified from the literature review meta-synthesis. It also involves validating which specific IPD benefits could be remedies to these major causes of construction claims in the South African mining capital projects context. The focus group participants also review and validate a conceptual a framework that incorporates IPD benefits into the traditional Design-Bid-Build method for South African mining capital projects so as to reduce construction claims.

Chapter 5 discusses the development of a conceptual framework that incorporates IPD benefits into the traditional Design-Bid-Build method for South African mining capital projects, so as to reduce construction claims. The framework is named IPD for Claims Reduction framework (IPD4CRf).

Chapter 6 is the final chapter in this thesis. It provides a summary of the findings, discusses the conclusions of the study, lists research limitations, highlights the

research contributions to academia and industry including making recommendations for future research.

1.13 SUMMARY

In summary, it can be stated that IPD is an ideal and futuristic project delivery method. IPD remains a relatively novel method in South Africa and perhaps it will take a while for it to be fully adopted on capital projects as a cultural change may be required. There is however an opportunity to begin using some facets of IPD and infusing them into the traditional Design-Bid-Build method so as to reduce construction claims. In essence, construction claims come about as a result of changes (or perceived changes) to the contractor scope, schedule, cost or quality whether caused by a stakeholder to the project, nature or unforeseen situations. IPD benefits especially those of early involvement of stakeholders, detailed design and clearly defined scope before construction, joint decision making, open communication and collaboration present an opportunity to minimize changes later in the projects which in turn assists in reducing construction claims. IPD benefits can reduce the likelihood of construction claims by improving communication, scope certainty, collaboration, transparency and by reducing project risk though joint decision-making. By understanding and aligning the root causes of construction claims and reviewing the effectiveness and deficiencies of current practices used to reduce the claims, a framework that uses identified IPD benefits as remedies to causes of construction claims in South African mining capital projects can be developed. The following section assesses the literature related with the key conceptions in this research.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

This section reviews literature on project delivery methods, construction claims and IPD principles. It further discusses the causes of construction claims, current practices used to reduce construction claims, and identifies IPD benefits that can remedy these causes, so as to lay a foundation for tackling the aim of the study. The scope of this research is on large and mega capital construction projects in the South African mining industry. The research topics to be researched involve project delivery methods, construction claims and IPD principles.

2.2 PROJECT DELIVERY METHODS

A project delivery method is "the comprehensive process of assigning the contractual responsibilities for designing and constructing a project. A delivery method identifies the primary parties taking contractual responsibility for the performance of the work" (AIA & AGC, 2011:2). American Institute of Architects and Associated General Contractors of America (AIA & AGC, 2011) define the four primary delivery methods in Table 2.1.

Table 2.1: Types of Project Delivery Methods

Design – Bid – Build (DBB)	**Construction Management at Risk (CM@R)**	**Design – Build (DB)**	**Integrated Project Delivery (IPD)**
This method involves three stakeholders in the project delivery process—owner, designer, and construction contractor—in traditionally separate contracts. "Traditional" is commonly used to describe the Design-Bid-Build method. Under this type of contract separate contracts are signed between owner & designer and owner & construction contractor. (AIA & AGC, 2011:4).	"CM@R projects are characterized by a contract between an owner and a construction manager who is at risk for the final cost and time of construction." (TCRP, 2009:99)	"Design-build is a project delivery method in which the owner procures design and construction services in the same contract from a single legal entity referred to as the design-builder" (TCRP, 2009: 99).	The American Institute of Architects (AIA & AIACC, 2007: 2) defines Integrated project delivery (IPD) as "'...a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction."

Source: (AIA & AGC, 2011)

Figure 2.1 illustrates the differences between the traditional DBB system, the more collaborative design-build (DB) system, and the emerging IPD system (El Asmar *et. al.,* 2013:2).

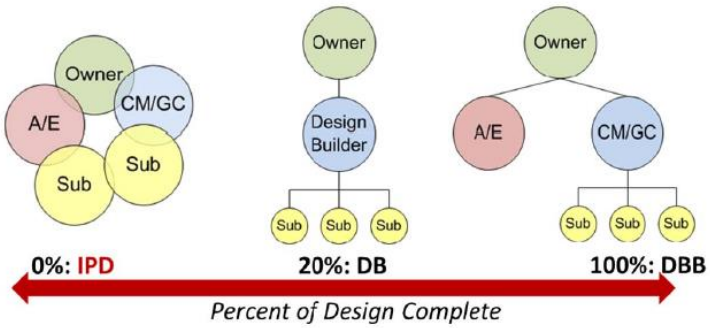

Fig. 2.1 Differences between DB, DBB, and IPD. **Source:** (El Asmar *et. al.,* 2013)

Under DBB, the owner or client contracts with the designers or engineers, and after the design is completely finalized, the owner then enters into another contract directly with a general contractor (GC) to construct the asset. In DB, the GC is engaged after the design is roughly 20% completed, and the designer and GC usually form a joint venture (JV), and the JV takes accountability for performance. On the other hand, IPD is different in that all key project stakeholders ("owner, GC, architect/ designer/ engineer, consultants, subcontractors, and suppliers") enter "into a single multiparty agreement" prior to commencing with the design (El Asmar et. al., 2013:2).

The lack of collaboration and integration during design that exists in the DBB method, where the contractor is only engaged when the design is complete, creates an opportunity for changes in contractor scope, schedule, cost and quality being required during construction, which often leads to construction claims. Ashcraft (2022) states that the DB and CM@R project delivery methods were developed as enhancements, to counter the inadequacies and weaknesses of the DBB method. These methods still lack collaboration and integration though, when compared to IPD (Nawi *et al.,* 2014; AIA & AGC, 2011). According to McKinsey & Company (2018), project delivery models can be classified as shown in Table 2.2. This classification emphasizes more on who takes overall management responsibility of the project.

Table 2.2: Types of Project Delivery Methods

Engineering, Procurement and Construction (EPC)	Engineering, Procurement, Construction and Management (EPCm)	Owner Managed	Integrated Project Delivery (IPD)
"In this method, the owner contracts only the EPC company that fully integrates engineering, procurement, construction and is responsible for all project management and integration risks. The owner has minimum control and this method potentially provides the highest cost for the owner." (McKinsey & Company, 2018)	The owner contracts both with the EPCm company and other contractors and suppliers. Various combinations within the EPCm method are possible, for example, EP+Cm, E+P+Cm and E+PCm. The EPCm company is usually accountable for the detailed design of the project. The EPCm company assists the owner to manage the other contractors and suppliers. The integration risk is spread and diluted among the EPCm company and owner. This method potentially provides more owner's control over contractors and suppliers and some cost benefits compared to the EPC method.	In this method, the owner directly contracts contractors and suppliers for the engineering, procurement and construction. The integration risk is the owner's full responsibility. This method potentially provides the lowest cost for the owner.	McKinsey & Company (2018) describes IPD "as an alternative to traditional delivery methods whereby the parties are bound by a single contract that aims to create a single project team." In IPD, a formal structure is created whereby management and joint decision-making processes are defined. The parties waive their right to claim against each other and share in pain and gain. The roles, responsibilities and risks are allocated to the party most competent of managing and executing.

Source: (McKinsey & Company, 2018)

While the classification above distinguishes based on overall management responsibility, EPC can be seen as similar to DB, while EPCM is similar to DBB in the contracting approach. According to Aldossari *et al.* (2021), usage of the different project delivery methods across the world is estimated at 60% for DBB, 25% for CM@R, 15% for DB and less than 1% for IPD.

2.3 BACKGROUND TO IPD

According to Forero et.al (2015), Construction Project Management originated as a reaction to challenges, such as a lack of throughput and minimal efficiency that the construction sector was experiencing in the past. Ideas emerged in the United States of America around the 1960s, of creating and coming up with the Construction Management model, as a remedy for the inadequacies and capability-related challenges that emanate from the traditional Design-Bid-Build model. This model then developed to a Design-Build model comprising of contracting the combined

design and construction phases with one party, which gives better control and certainty to the client, with regards to cost and time targets. Around the same time in Australia, the use of a model named Project Alliancing commenced. This model involved collaboration, teamwork and setting group goals. This approach showed promise and excellent results, leading to its adaption in the United States of America, where it was renamed Integrated Project Delivery (Sakal, 2005). In 2007, the American Institute of Architects (AIA) and American Institute of Architects California Council (AIACC) together published the following documents, which provided guidance on implementing Integrated Project Delivery (Liu, 2013).

- Integrated Project Delivery: A Working Definition (AIA, 2007) and
- Integrated Project Delivery: A Guide (AIA & AIACC, 2007).

AIA and AIACC (2007:2), provides the generally accepted and most-used definition for Integrated Project Delivery (IPD) as “a project delivery approach that integrates people, systems, business structures and practices into a process that collaboratively harnesses the talents and insights of all participants to reduce waste and optimize efficiency through all phases of design, fabrication and construction.” According to KPMG (2013), “IPD is extremely beneficial for mega projects with technical complexity and very challenging schedule targets”. Various other authors have provided definitions of IPD as shown in Table 2.3.

Table 2.3: Definitions of Integrated Project Delivery (IPD)

Reference	Definition of IPD
Ashcraft (2022)	‘’A collaborative contractual approach that alters a project’s fundamental commercial, organizational, and legal structures to minimize dysfunction and stimulate performance’’.
Othman & Youssef (2020)	“A fundamental delivery method for construction projects that intensifies the collaboration and stimulates the communication to be an effective factor”.
Viana *et al.* (2020)	“A new delivery system that fosters high efficiency by delivering accurate information and new technologies in a collaborative team environment”.
De Marco & Karzouna (2018)	“An efficient method to optimizing construction planning, reduce waste, cost, time, and risk”.
Rahim (2015)	“A method which requires early involvement of key participants in an engaging collaboratively and mutually dependent relationship throughout the entire phase of project delivery, from design to completion”
AIACC (2014)	“A collaborative project delivery approach that utilizes the talents and insights of all project participants, through all phases of design and construction”.
El Asmar *et al.* (2013)	“An emerging construction project delivery system that collaboratively involves key participants very early in the project timeline, often before the design is started”.
Matthews & Howell (2011)	“An emerging project delivery approach which aims to minimise waste in construction projects, which leads to optimal improvement in schedule, cost and quality”.
Anderson (2010)	“A business model for design, execution and delivery of buildings by collaborative, integrated and productive teams composed of key project participants, such as designer, client, contractor, manufacturer, and supplier”.
Kent & Becerik-Gerber (2010)	“A method that improves project outcomes through a collaborative approach of aligning the incentives and goals of the project team through shred risk and reward, early involvement of all parties, and a multiparty agreement ”.

The commonality of the definitions from the various authors over the years is around the collaboration and integration characteristics of IPD, towards improving project outcomes. Research by the UKOGC (2007), shows that results obtained through the use of IPD indicate considerable improvement for the construction industry, with savings of approximately 30% of construction cost through encouraging

collaboration. IPD allows the owner or client to perform a critical role in partaking and coming up with ideas and suggestions, on saving cost and time in the execution stages. Contractors benefit from having an integrated process, which enables them to understand from the beginning each stakeholder expectation. For designers or engineers, IPD results in a decrease of needless work, and the readily availability of information that is complete (Forero *et al.,* 2015).

2.4 IPD PRINCIPLES

The AIA and AIACC (2007), guide stipulates the standards below for IPD implementation to be a success. These can be divided or classified into contractual and behavioural principles or benefits.

2.4.1 Contractual IPD Principles

2.4.1.1 Mutual Benefit and Reward

Compensation under IPD takes into account early involvement and rewards value addition, constructive conduct and puts into place inducements, associated with overall project success. All participants of the project benefit from IPD, which utilizes inventive business models to foster collaboration and efficiency.

2.4.1.2 Early Involvement of Key Participants

Main participants are engaged in the earlier phases of the project, where their expertise and prudent decisions provide the utmost impact. The early involvement of key participants results in team integration (El Asmar *et al.,* 2013; Nawi *et al.,* 2014) through their expert contribution to the detailed design and adequate planning, which contributes to overall project success (Fish, 2011; AIACC, 2007). Research by Laryea and Watermeyer (2016:15) found that “early contractor involvement is mutually beneficial for the parties’’.

2.4.1.3 Early Goal Definition

During the earlier project phases, through the participation of all participants, the project aims are crafted and defined of which, the participants get to endorse and own the project goals throughout the project. Key participants are required to work as a team in achieving communal objectives of the project (Nawi *et al*., 2014).

2.4.1.4 Collaborative Innovation and Decision-Making Innovation

IPD encourages a free flow of ideas, which are appraised on merit and not on hierarchy. Furthermore, the big impact pronouncements are judged by the whole team.

2.4.1.5 Intensified Planning

IPD is based on front end loading of design efforts, so as to rationalize and abridge the time spent in the more cost-intensive construction phase. IPD aims to improve design results upfront with an intention to streamline and shorten the construction phase.

2.4.1.6 Appropriate Technology

IPD depends on advanced technologies that enable open data exchanges among project team members. Technologies are selected and specified as the project commences, so as to exploit on generalized operability across the project participants.

2.4.2 Behavioural IPD Principles

2.4.2.1 Mutual Respect and Trust

The project participants need to acknowledge the importance of alliancing and pledge to teamwork for the overall project good. According to Walker and Rowlinson (2020), IPD is structured on “trust-based collaboration”. Mutual respect and trust is crucial for maintaining a good working relationship between project participants (El-adaway, 2010).

2.4.2.2 Open Communication

It is crucial for straightforward and authentic communication between team members on IPD projects. Problems and disputes are acknowledged and resolved, as they occur with a no-blame culture in existence.

2.4.2.3 Organization and Leadership

Under IPD, everyone working on the project should be dedicated to the project objectives and ideals. Depending on the circumstances, the capability of each team member is considered, when selecting who takes the lead on specific situations.

2.4.3 Characteristics of IPD Essential for Reducing Construction Claims

Ashcraft (2014b:119), identifies five major characteristics of IPD from the characteristics stated by AIA and AIACC (2007) as being key elements of a full IPD contract. Those elements are:

1) “Mutual respect and trust,
2) Mutual benefit and reward,
3) Collaborative innovation and decision-making,
4) Early involvement of key participants; and
5) Early goal definition”

Ashcraft (2014b:125) chooses to describe the decision-making element as being more of a ‘’joint project control’’ element. Cohen (2010:5) also identified the following similar characteristics as key for IPD projects: Early Involvement of Key Participants, Shared Risk and Reward, Multi-Party contract, Collaborative Decision-Making and Control, Liability Waivers Among Key Participants, and Jointly Developed and Validated Project Goals.

Other authors like Hanks (2015:37), rated the characteristic of “early and clear goal definition’’ as very important, while Fischer *et al.* (2017) considered trust as the most crucial IPD characteristic.

KPMG (2013:6) recommends the following benefits of IPD for effective project execution: “Target Cost Pricing which is jointly developed, Team Co-location, Building Information Modeling (BIM), Lean training and principles, use of cross functional groups and core groups, tracking accountability, implementation of lessons learned from past projects, decision documentation, value stream mapping and incentives liked to behaviour and measurable outcome.”

According to Chang (2017), it is feasible to leverage such IPD principles to DBB projects so as to reap the IPD rewards. Chang (2017) further highlights that the IPD approach can be used successfully across different types of projects. Even in the absence of a formal multiparty IPD contract, it is feasible to utilize IPD principles on any project. When the IPD philosophy is used without a formal multiparty contract, such an approach can be described “as IPD lite, IPD-ish, hybrid IPD, or technology-enhanced collaboration” (Chang, 2017:3).

While the previous authors mentioned in this section, referred to characteristics of IPD essential for reducing construction claims in the context of projects in the developed world (mainly USA), where IPD has been utilised, similar studies in developing countries indicate similar findings. A study by Ling *et al.* (2020) on IPD in Singapore, recommended the adoption of IPD principles into the traditional project delivery approach for improved project performance. Research by Khanna *et al.* (2021) on IPD in developing countries (using India as a case study) concluded that implementing IPD has the potential to enhance project delivery and reduce construction claims especially due to the "coordination and transparency" characteristics of IPD. The next section will consider the types of construction claims as a build-up on how IPD benefits can be utilised to reduce the claims.

2.5 CONSTRUCTION CLAIMS

Various authors have provided definitions of construction claims, as listed in Table 2.4.

Table 2.4: Definitions of Construction Claim

Reference	**Definition of Construction Claim**
Rai *et al*. (2021)	"An aggrieved party's response to seek relief for a deviation from agreed contractual obligations".
Hayati *et al.* (2019)	"An administrative tool to correct failures that occur in the construction process".
McManus & Blank (2016)	"An application for a time extension or additional payment, due to a certain change or event that has impacted the timing, or content of the work, and caused extra costs for which restitution is sought".
Shar *et al.* (2014)	"A request by either party to the contract, usually the contractor, for compensation for damages caused by failure of the other party, to fulfil his part of obligations, as specified in the contract"
Hewitt (2011)	"The affirmation of a party's rights under contractual terms, which, in the construction industry, is the right to either additional time, or payment to complete the works".
PMI (2013)	"A request, demand, or assertion of rights by a seller against a buyer, or vice versa, for consideration, compensation, or payment under the terms of legally binding contract, such as for a disputed change".

Reference	Definition of Construction Claim
Mirza (2005)	“A demand for something due or believed to be due”. In construction that “something” is usually “additional compensation for work claimed to be extra to the contract or an extension of time for completion or both”.
Yates & Hardcastel (2003)	“An assertion of a right to money, property, or a remedy, and can be made under the contract itself; for breach of the contract, for breach of duty in common law, or on quasi – contractual basis”.
Levin (1998)	“A demand or assertion by one of the parties seeking, as a matter of right, adjustment or interpretation of contract terms, payment of money, extension of time or other relief with respect to the terms of the contract”.
Seeley (1993)	‘’The contractor's request to compensate for losses or avoid liquidated damages”

While the various authors provide different definitions of a construction claim, the commonality from these definitions is that additional cost or extension of time is what is requested by the party submitting the claim usually a contractor. In this research, reference to construction claim means a request by contractor for additional cost or extension of time during construction, due to changes in planned or agreed scope, schedule, cost or quality. According to Hughes and Barber (1993) by ascertaining their appropriate legal basis, construction claims may be classified as follows:

2.5.1 Contractual Claim

This type of claim is derived from clauses existing in the contract. In some popular standard contracts, there are clauses which stipulate when the contractors and the employers or owners have an entitlement to claim for relevant costs such as change in conditions of the ground, valuations or progress measurements, scope variations, lateness of information, and delay in inspections (Tochaiwat & Chovichien, 2004).

2.5.2 Extra-Contractual Claim

These claims do not have precise basis in the contract but come about due to breaching the contract either directly or indirectly. An example of this claim is when faulty material free issued by the owner results in a contractor having to perform additional work.

2.5.3 Ex-Gratia Claim

Such claims do not have a basis at law nor in terms of the contract but arise when the contractor is of the opinion that he can claim rights based on morality, for example extra costs suffered, due to unexpected high inflation or escalation of prices (Hughes & Barber, 1993). Such claims are also commonly known as sympathy claims.

Griffin (1998) classifies construction claims as follows:

2.5.4 Delay Claims

These are the mostly frequent claims submitted to owners for additional costs arising from delays. Such claims are typically based on lateness of approvals, deliveries and access, bad weather, interference, disruption, discrepancies in plans and specifications etc.

2.5.5 Acceleration Claims

This claim theory is based on situations like overtime, extra shift, early completion, excusable delay, denial of time extension, work efficiency, slow down, speed up etc.

2.5.6 Constructive Acceleration Claims

This is a claim where a contractor contends that he was due an extension of time, which was not approved, and as a result, the contractor was compelled to accelerate his progress, so as to meet the client's end date. Such claims are typically based on overtime, inefficiency of operations, cost of expedited vendor delivery, additional supervision and overheads, wage escalation etc.

2.5.7 Constructive Changes

In this instance, the contractor alleges that changes have come into being due to some commission or omission on the part of the owner, but the changes have not been readily acknowledged by the owner to be contract changes. Such claims are typically based on unwritten requests, additional work, substandard plans and

specifications, obstructions, changes in methodology or sequencing, excessively rigid inspections, inaccurate interpretation of plans and specifications etc.

In a similar approach, Shar *et al.* (2014:2) are more granular in classification and differentiate construction claims as “payment-related claims, change claims, delay claims, extra work claims, contractual claims, difference in pricing and measuring claims, different site condition claims, acceleration claims, damage claims and contract termination claims’’. Despite the differences in classification between the authors, the common aspect is that construction claims are associated with changes in scope, schedule, cost or quality.

2.6 CAUSES OF CONSTRUCTION CLAIMS & CURRENT PRACTICES USED TO REDUCE CONSTRUCTION CLAIMS

Construction claims are mainly as a result of changes, which in turn, cause numerous variations, delays and disruptions on the projects (Al-Qershi & Kishore, 2017; Chanmeka *et al.*, 2012; Zaneldin, 2006; Tochaiwat & Chovichien, 2004). According to Kumaraswamy (1998), recognising and noting the general causes and effects of construction conflicts and claims that are not resolved, could result in practical dispute avoidance, including being able to solve ‘unavoided and unavoidable disputes’ more efficiently. Despite there being current practices used to attempt to reduce construction claims in capital projects (Hmayed & Ma, 2015; Griffin, 1993), projects still face cost overruns (Semple *et al.*, 1994), with various changes occurring during construction resulting in claims. Various researchers have identified causes of construction claims from different countries across the world and Table 2.5 lists some of the findings.

Table 2.5: Causes of Construction Claims in Various Countries

Reference	Causes of Construction Claims	Country
Al-Qershi & Kishore (2017)	"Delay in handing over site, variation between actual and original quantities, excessive change orders by owner, delay of shop drawings, approval by owner's representative, and scope change of the project."	India
Baloyi & Agumba (2014)	"Poor communication, poor contract documentation, suspension of work, failure to understand and correctly bid or price the work, bad weather, non-circulation of information, incomplete tracing mechanism for request of information and delay in extension of time."	South Africa
Zaneldin (2006)	"Change or variation orders, delay caused by owner, oral change orders by owner, delay in payments by owner, low price of contract due to high competition, changes in material and labour costs, owner personality, variations in quantities, subcontracting problems, delay caused by contractor, contractor is not well-organized, contractor financial problems, bad quality of contractor's work, government regulations, estimating errors, scheduling errors, design errors or omissions, execution errors, bad communication between parties, subsurface problems, specifications and drawings inconsistencies, termination of work, poorly written contracts, suspension of work, accidents, and planning errors."	United Arab Emirates (UAE)
Bakhary, Adnan & Ibrahim (2013)	"Design changes being introduced at the post-tender award stage, project being implemented in short time period with inadequate site investigation, design works, tender and contract documents, inadequate definition and/or specification of the precise scope of contract works, incomplete and/or uncoordinated design, changes in employer's/user's requirements arising during the post-tender award stage, lack of clarity in the employer's requirements and/or inadequacy of the design brief, acceptance of unclear/imprecise tender offers without proper clarifications, negotiations, recording of changes, contracting environment relatively more competitive with a larger number of players and narrow profit margins, parties generally more aware of their rights and relatively more litigious/claim conscious, changes arising out of statutory, local authority sources, employer's/contract administrator's failure and/or neglect to meet the relevant contract obligations, deterioration in the general standard of professionalism of designers, contract administrators and contractors, more use of claims' consultants, sudden swings in economic and market conditions, a shift in the philosophy of project implementation towards an adversarial/confrontational direction, and negative effects of political factors."	Malaysia

Reference	Causes of Construction Claims	Country
Shen *et al.* (2017)	"External risk (sociopolitical risks, economic risks, and natural hazards), late payment, change orders, processing that is not efficient, ambiguous scope of works, and vague technical specification''	China
Alghamdi (2022)	"Delayed payments, lack of qualified and experienced personnel, low bids, delayed drawing issuance, labour shortages and insufficient skills, ineffective contractor planning and scheduling, changes in material type and specifications during construction, delays in material delivery, lack of contractor capability, and challenges in obtaining work permits."	Kingdom of Saudi Arabia
Assah-Kissiedu, Fugar and Badu (2010)	"Poor financial arrangements by clients leading to late payments; failure of the client to honour payments as and when due; unclear and incomplete description of items in the bills of quantities; ineffective communication between the parties on the project; contractor's failure to read the contract documents; design and specification oversights; award of contractors to incapable contractors; contractors' failure to price properly for the works; disruptions and delays by the contractor that create deviation from initial programme of works; and Government policy, which encourages low evaluated tenders followed by claims."	Ghana
Nazzini & Kalisz (2022)	"Unfair risk allocation, unclear risk allocation, unrealistic time/cost/quality targets (by clients), uncontrollable external events, adversarial (industry) culture, unrealistic tender pricing Inappropriate contract type, lack of competence of project participants, lack of professionalism of project participants, client's lack of information or decisiveness, unrealistic information expectations (contractor's), inadequate brief, poor communications, personality clashes, vested interests, changes by client, slow client response, exaggerated claims, estimating errors, other (e.g. work) errors, internal disputes (e.g. in JVs), inadequate contract documentation, inadequate contract administration, inaccurate design information, incomplete tender information, inadequate design documentation, inappropriate contractor selection, inappropriate payment modalities, and inappropriate contract forms."	United Kingdom
Ramy *et al.* (2022)	"Ineffective communication, delayed decisions, mistrust, incomplete or insufficient specifications, incomplete bid information, scope modifications, changes in plans and specifications during construction, mistakes in project documentation, unclear contract language, poorly drafted contracts, unclear scope of work, low contract price as a result of fierce competition, contractor unorganized, work suspension, work termination, inconsistent specifications and drawings, material changes or out-of-specification, design changes,	Egypt

	acceleration claims, insufficient risk identification and allocation, owner-furnished material, economic inflation, delayed access to the project, delayed material supply, low or absent quality control and assurance, quantity variations, variation orders, inexperienced supervision team, insufficient site investigation, contractor's financial failure, worker strikes, accidents, rising material costs, unfavourable weather, force majeure events like earthquakes and floods, unforeseen site conditions, subcontractors' difficulties (lack of capability), changes in government regulations, erroneous execution, extra work, a lack of resources, disruption, and inadequate management and administration of the construction site."	
Reference	**Causes of Construction Claims**	**Country**
Bhangwar *et al.* (2022)	"Change or variation orders, delay caused by owner, payment related issues, low price of contract due to high competition, variations in quantities, quality of work, estimating errors, scheduling errors, design errors or omissions, execution errors, unforeseen site conditions, specifications and drawings inconsistencies, final cost, inflation, lack of coordination among parties, slow client response (decisions), inadequate documentation, inadequate site investigation before bidding, delays of shop drawings approval by owner's representative, discrepancies between contract documents, complex execution of the project, awarding bid to the lowest bidder, changes in government regulations and laws, project government extrinsic factors, and evaluation of the quality and quantity of completed works."	Pakistan

The commonality between the identified causes of construction claims from these various authors and researchers across different countries, is that these causes are all associated or result in changes to planned or agreed scope, schedule, cost or quality during construction, which could lead to requests by contractors for additional costs or extension of time. Any of the causes of construction claims identified can be classified or assigned to a change in contractor scope, schedule, cost or quality.

Such changes include those that can be controlled and others beyond the parties' control like changes from government or regulatory authorities, inclement weather, labour strikes, riots or changes in economic conditions. Changes in contractor scope, schedule, cost or quality refer to:

2.6.1 Changes in Scope

These increase or reduce the original scope quantities or adding new scope all together. Such changes could also impact the contractor's preliminary and general (P&Gs) costs originally allowed for.

2.6.2 Changes in Schedule

This impacts on the contractor's original plan or schedule which the contract price is based on. This could be through delaying the contractor from accessing the works leading to standing time, disrupting the contractor's progress, late delivery of materials, late issue of drawings and instructions, or adding more scope which results in the contractor requesting for extension of time.

2.6.3 Changes in Cost

This occurs where the contractor's costs originally allowed for are impacted by situations like late payment from the client, changes in economic conditions - high inflation and recessionary situations or shortage of labour resulting in higher labour costs.

2.6.4 Changes in Quality

This occurs when the contractor is requested to complete the works at a different specification that what was originally planned and priced for. This may also include changes leading to claims due to poor quality of designs and documentation, design errors, poor workmanship by other contractors, poor document control and poor project management.

Mohamed, Ibrahim and Soliman (2014:186) investigated the factors that cause disputable construction claims, which they identified as follows:

1) "Late progress payments from client,
2) Project teamwork dynamics,
3) Extension of time,
4) Inadequate drawings and specification,

5) Poorly drafted clauses in contracts,
6) Change variations,
7) Poor communication issues among stakeholders, and
8) Late delivery of equipment and materials."

Thomas and Wright (2005) asserted that construction claims are mainly due to inaccurate information on site specifications and conditions, lack of access on site and changes or variations. Khalifa and Mahamid (2019:495) listed the following as major causes of construction claims: "owner's additional works, errors, and omissions in design, lack of coordination between construction parties, defective workmanship, and owner financial difficulties." Yasin (2004) identified the main causes of construction claims as including poor designs, inadequate tenders, late responses from client, poor communication, unrealistic schedules, allocation of risk issues and late payments. Ren *et al.* (2001:187), on the other hand, lists the following events as causes of construction claims: "additional work not specified in the contract documents; work different from that specified; work in a particular manner different from that originally anticipated; work resulting from changed, amended or clarified contract drawings or specification; suspension; strikes; force of nature"'. The commonality between the identified causes of construction claims from these various authors and researchers across different countries is that these causes are all associated or result in changes to planned or agreed scope, schedule, cost or quality during construction. Any of the causes of construction claims identified can be classified under a change to planned or agreed contractor scope, schedule, cost or quality.

Mohamed, Ibrahim and Soliman (2014) recommended various mechanism to prevent construction claims. According to Griffin (1993), the majority of claims submitted to owners are delay claims. Delays could be from late issue of drawings, in site handover, in material supply, in payments, in commencing with the works or in completing the works. In particular, Shah *et al.* (2014) noted delays in payment as a critical cause of construction claims, because it could result in financial problems, and lead to disputes between contractor and owner/ client. According to Matseke and Khatleli (2021:1), the prevalent causes of claims in mega construction projects in South Africa are due to "project delays, cost overruns, poor site management and poor project management". Further causes of construction claims are detailed in the

table below. From analysing the causes of construction claims and current practices used to reduce claims, the following benefits of IPD can be identified as potential remedies to these causes.

Table 2.6: IPD Benefits as Potential Remedies to Causes of Construction Claims

Causes of Construction Claims	**Current Practices Used to Reduce Construction Claims**	**Potential Remedies from IPD Benefits**
Errors, omissions and ambiguities on drawings and specifications (Kululanga *et al.*, 2001; Levy, 1994); Mohamed, Ibrahim & Soliman, 2014).	"Design consultants should provide quality designs that have been thoroughly reviewed. The owner has to clearly state needs and requirements before designs are produced" (Mohamed, Ibrahim & Soliman, 2014).	"Early involvement of key participants. Liability Waivers Among Key Participants" (AIA & AIACC, 2007; Ashcraft, 2014b)
"Incomplete or inaccurate responses or non-responses to questions" (Baloyi & Agumba, 2014; Levy, 1994; Rhys Jones, 1994)	"Clear definition of roles and responsibilities. Early warning signs. The owner should establish procedures for control of requests for information from contractors" (Hmayed & Ma, 2015; Griffin 1993)	"Mutual respect and trust. Open communication. Co-location" (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013).
"Inadequate administration of responsibilities by the owner, engineer, contractor, subcontractors, or vendors" (Levy, 1994; Mohamed, Ibrahim & Soliman, 2014; Molenaar *et al.*,2000)	"Design consultants need to ensure review and approval of drawings. The record keeping system should be periodically evaluated to ensure proper contract administration." (Mohamed, Ibrahim & Soliman, 2014; Griffin, 1993).	Mutual benefit and reward. "Multiparty contract. Tracking accountability" (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013)
"Unwillingness or inability to comply with the intent of the contract or to adhere to industry standards in the performance of work" (Heath *et al.*, 1994; Levy, 1994)	"All parties need to recognize that a risk-sharing philosophy will probably produce the lowest overall project cost for the owner and maximum profit to the contractor" (Mohamed, Ibrahim & Soliman, 2014)	"Collaborative Innovation and Decision-Making Innovation. Organization and Leadership. Multiparty contract. Tracking accountability" (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013).
"Site conditions which differ materially from those described in the contract documents" (Thomas & Wright, 2005; Al Momami, 2000; Levy, 1994)	Clear definition of project scope. Early warning signs (Hmayed & Ma, 2015)	"Early Involvement of Key Participants" (AIA & AIACC, 2007; Ashcraft, 2014b)

Causes of Construction Claims	Current Practices Used to Reduce Construction Claims	Potential Remedies from IPD Benefits
Unforeseen subsurface conditions (Levy, 1994; Sykes, 1996)	Change order management (Hmayed & Ma, 2015)	"Early Involvement of Key Participants. Appropriate Technology" (AIA & AIACC, 2007; Ashcraft, 2014b)
"Uncovering of existing construction conditions which differ materially from those indicated in the contract drawings" (Kululanga *et al.*, 2001; Levy, 1994)	Change order management (Hmayed & Ma, 2015)	"Early Involvement of Key Participants. Open Communication. Building Information Modeling (BIM)" (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013)
"Extra work or change-order work" (Mohamed, Ibrahim & Soliman, 2014; Thomas & Wright, 2005; Al Momami, 2000; Levy, 1994; Hewitt, 1991)	"Design consultants need to ensure the review and approval of drawings. The owner should insist that contractors provide a reasonable breakdown of their bids to determine what is included and what is excluded. A log of all change orders from initiation to final settlement should be kept" (Mohamed, Ibrahim & Soliman, 2014; Griffin, 1993)	Intensified Planning (AIA & AIACC, 2007)
"Breaches of contract by either party in the contract" (Heath *et al.*, 1994; Levy, 1994; Madden, 2005; Mohamed, Ibrahim & Soliman, 2014)	"It is important that all parties understand the" contractual notice provisions in the contracts (Mohamed, Ibrahim & Soliman, 2014)	"Early Goal Definition. Open Communication. Organization and Leadership. Liability Waivers Among Key Participants" (AIA & AIACC, 2007; Ashcraft, 2014b)
"Disruptions, bad weather, delays, or acceleration to the work that creates and deviates from the initial baseline schedule" (Baloyi & Agumba, 2014; Levy, 1994; Mohamed, Ibrahim & Soliman, 2014; Semple *et al.* 1994)	Thorough planning of the project. Change order management. "Field staff should record at least one or two weather observations each day" (Hmayed & Ma, 2015; Griffin, 1993)	Intensified Planning. "Use of cross functional groups and core groups" (AIA & AIACC, 2007); KPMG, 2013)
"Inadequate financial strength on the part of the owner, contractor, or subcontractor" (Al Momami, 2000); Mohamed, Ibrahim & Soliman, 2014; Levy, 1994)	The owner should not unnecessarily delay making interim payments (Mohamed, Ibrahim & Soliman, 2014)	Organization and Leadership. Mutual Benefit and Reward. Target Cost Pricing (AIA & AIACC, 2007; KPMG, 2013)

From Table 2.6, it can be argued that the current practices used to reduce claims are not systematic, but more precautionary strategies and project management practices, which require behavioural or cultural changes by the contacting parties. It may be difficult to enforce these current practices. without relying on behavioural change by the personnel working on the project.

The principles of IPD, which result in the identified IPD benefits are philosophical and structural and present an opportunity to potentially systematically reduce construction claims in capital projects. From Table 2.5 above, the IPD benefits of early involvement, joint decision-making, and collaboration stand out as having the potential to reduce construction claims. The research question becomes, how can these IPD benefits be incorporated into the traditional Design-Bid-Build method so as to reduce construction claims in South African mining capital projects?

By aligning the causes of contraction claims and current practices used to reduce the claims, a framework that uses identified IPD benefits as remedies to causes of construction claims in capital projects can be conceptualized.

2.7 PREVIOUS RESEARCH ON INTEGRATED AND COLLABORATIVE APPROACHES IN SOUTH AFRICAN PROJECTS

There has been previous research on utilizing collaboration, integration and partnering on construction projects in South Africa. Research by Watermeyer (2012) on construction procurement in South Africa, highlighted the importance of a culture change being required to be able to implement innovative and collaborative procurement strategies that could improve project outcomes. Watermeyer (2012:12), further recommended that clients/ owners should drive a number of cultural changes which included amongst others a move towards an “integrated project team approach, long term relationships, integrated design and construction, active risk management and mitigation’’. Similarly, in another study, Emuze and Smallwood (2014), concluded that contractors in South Africa should accept and adopt collaboration in procurement to boost project successes and recommended that project participants should work on improving relationships and building trust.

Froise (2014) researched on the use of BIM in constructing buildings as a catalyst for an integrated construction project delivery culture in South Africa. The findings of this research revealed that there is little collaboration in the South African construction industry. Froise (2014:2) recommended the use of BIM as “a central source of information that can improve communications between CPOs (construction project organisations) and foster a collaborative culture”.

A study by Laryea and Watermeyer (2016:1) on early contractor involvement in framework contracts on building construction projects at the University of Witwatersrand, South Africa, found that utilizing early contractor involvement “produced 12% cost savings in one project and 32% in another’’. Furthermore, the study highlighted that the engagement of the contractor early by the owner/ employer on the project resulted in the contractor being able to contribute to value engineering of the design and drawings.

A study by Kwofie, Aigbavboa and Matsane (2017:48) on collaborative practices in the South African construction industry suggested that the industry should pursue practices such as ‘’trust, mutual dependency, freedom of expression, established relationships and free access to participants” so as to integrate and collaborate effectively. A case study by Laryea (2019) on the procurement strategy utilized on a universities construction project in South Africa found that a collaborative procurement strategy coupled with an integrated project team contributed to the successful completion of the project leading to achieving the required outcomes.

While the above-mentioned studies indicate evidence of the use of integration, early contractor involvement and collaboration on some South African building projects, little or no research has however been undertaken on specifically investigating how incorporating IPD benefits into the traditional Design-Bid-Build method can reduce construction claims in South African mining capital projects.

2.7.1 Construction Claims Management Process

According to Matseke and Khatleli (2019:73), construction claims management involves a ‘’formal procedure used to review disputes between two or more parties which have a contractual relationship”. Keane (1994:21) defines the construction claims management as “the process of employing and co-ordinating resources to

progress a claim from identification and analysis through preparation, and presentation, to negotiation and settlement".

A number of standard contract documentation types such as FIDIC (International Federation of Consulting Engineers), NEC (New Engineering Contract) and JBCC (Joint Building Contracts Committee) are used in the construction industry for the DBB method. While such standard contracts have provisions that attempt to resolve disputes, they have an inadequacy in effective management of construction claims (Matseke & Khatleli, 2019).

According to Levin (1998), so as to effectively manage construction claims, a decent and effective construction claims management process is required. The construction claim management process is made up of six steps as shown in the table below.

Table 2.7: Construction Claim Management Process

1) "Recognition and identification of the change"
"Construction change recognition and identification involves timely and accurate detection of a change. It is the first and critically important ingredient of the claim process" (Kululanga *et al.,* 2001).
2) "Notification of the change"
"This sub-process involves alerting the other party of a potential problem in a manner that is non-adversarial. Time limit requirements are very crucial and critical Normally, the contract specifies such duties to both parties" (Kululanga *et al.*, 2001).
3) "Systematic and accurate documentation of the change"
"Records and documentation play a very important role in the settlement of contract claims. However, the importance of record management is not realized as much as it should be" (Pogorilich, 1992).
4) "Analysis of time and cost impacts of the change"
"The objective of this sub-process is to determine the impact of the change occurred. The analyser shall perform schedule analysis to calculate the time impact while break down the cost into various cost components to calculate the cost impact" (Levin, 1998).
5) "Pricing of the change"
"The purpose of this sub-process is to give the other party in the contract a substantive description and detail of the extra costs incurred or to be incurred due to a contract change. This detailed cost description is necessary for understanding, negotiating, and justifying extra contract costs. There are two types of claim pricing: forward pricing and post pricing" (Levin, 1998).
6) "Negotiation of the claim"
"This sub-process concerns the process of presenting the claim to the employer, and mutual finding the solution of such claim. If an agreement cannot be reached and any party believed his position is correct, he should propose an alternative dispute resolution method. If this fails, the choice remaining is to implement the contractor's disputes mechanism or take the matter to court" (Levin, 1998).

Table 2.7 shows that the construction claims management process involves mainly identifying the change causing the claim, substantiating the change through documentation, quantifying the impact on time and cost and then negotiating the claim. Various researchers have criticised and highlighted the deficiencies of such a claims management process.

Ren *et al.* (2001) highlighted the existence of deficiencies in current construction claims management processes and provisions such as cognizance and understanding of contract terms, insufficient information and documentation, absence of effective claims management tools and ineffective claims negotiation. According to Hayati *et al.* (2019), for the claims management process to be effective and efficient:

- Project participants have to be knowledgeable in handling claims,
- Good communication should exist between project participants, and
- Most importantly, record-keeping, and documentation should be complete when submitting the claim.

Similarly, Griffin (1993) states that effective claims management requires proper planning, strong management, mutual trust and cooperation. Claims management requires being proactive, and can be viewed as similar or as a subset of risk management (Bakhary *et al.,* 2013; PMI, 2013). The risk-sharing nature of IPD and its other collaboration and integration benefits presents an opportunity to improve the claims management process.

2.7.2 IPD and Claims Management

According to AIA and AIACC (2007:12), in comparison to traditional delivery methods where “adversarial relationships” exist, IPD consists of alliancing and teamwork stability. Due to the teamwork and joint decision-making that exists under IPD, the majority of inter team disputes can be prevented. However, there is still a chance that disputes will still occur within the project team, even within highly collaborative and well-intentioned teams. McKinsey & Company (2018) asserts that IPD creates a paradigm shift in how owners and their contractors, work together and share business risk, which significantly reduces claims management costs.

When disputes come about during progression of a traditional project, the parties' remedy is to claim against each other, which in turn results in adversarial relationships compelling each party to protect their interests. In comparison, IPD attempts to keep the project itself and team intact by solving disputes within the team with no need for submitting claims nor adversarial relationships.

Disputes that occur within the team are determined or solved by the "project's decision-making body", which decides on unanimous basis for the project's good. Utilising the project's decision-making body to decide on disputes gives the parties a feeling of owning what has been decided on. Agreements under IPD are based on resolving disputes internally and make provisions for resolution procedures. In some instances, the parties agree to waiving their rights to litigate or arbitrate (AIA & AIACC, 2007:12).

AIA and AIACC (2007) asserts that what is more important in solving internal disputes is not necessarily the procedure used but the adoption of IPD teamwork principles by the parties. The project suffers when a team member sticks to operating in a silo. Teams that work together as envisaged by the IPD approach tend to deal with internal disputes better. Under IPD, when internal dispute resolution is unsuccessful, the parties can rely on the methods stipulated in the multiparty contract for external "dispute resolution such as mediation, arbitration or litigation" (AIA & AIACC, 2007:38).

The internal dispute resolution process distinguishes IPD from traditional project delivery methods and highlights the requirement for a culture shift between the parties when implementing IPD. In comparison, contracting under the traditional project delivery methods is more about every party being allocated separate rights and obligations which creates boundaries between parties. A traditional construction contract is centred on defining the obligations of each party and setting out the consequences of failure. In such contracts, so as to avoid doubt, the responsibilities are written, such that they hardly ever overlap with emphasis on the activities that must be completed. In comparison, IPD type of contracts, concentrate on building team relationships needed for accomplishing the project goals. Such a kind of IPD relational contracts are not readily utilised in the design and construction industrial sector. Due to that such relational type of contracts are not currently often used in

the construction sector, there is scarcity of legal precedence and if disputes come about, it could be challenging to identify a party's rights and obligations or to forecast probable outcomes (AIA & AIACC, 2007).

In IPD projects, because the parties reach agreement to have no claims against each other excluding for intentional default, there may be no need for a dispute resolution process. Typically, the dispute resolution mechanism will consist of sequencing as necessary from negotiation, mediation, arbitration and then to litigation - if required. No matter which resolution procedure is selected, the focus has to be on coming with an internal dispute resolution system that allows the integrated and collaborative approach to continue. This is because when the parties are pushed to using an external dispute resolution mechanism, in essence, they are moving back to the traditional approach, which shuns integration and results in adversarial relationships. IPD requires objective continuity, and when the parties have to use an external dispute resolution mechanism that continuity is halted (AIA & AIACC, 2007). Even when an IPD multi-party agreement is used, there are some peripheral stakeholders for instance, "sub-contractors, consultants and suppliers" that will not be a part of the agreement (AIA & AIACC, 2007:38). These subcontracts should have dispute resolution mechanisms. The multi-party agreement should stipulate whether claims from sub-contractors are for the multi-party agreement's account, or for the separate party that has the subcontract. To cover for third-party risk, such as structural failures, operational malfunctions, own injuries, and monetary losses relevant insurance should be in place (AIA & AIACC, 2007).

2.8 CONCEPTUAL FRAMEWORK

The AIACC (2008), states that the biggest challenge standing in the way of IPD for all parties is the fear of change. Parties are likely to resist radical change than incremental change. There has been not much research carried out on the feasibility of borrowing certain aspects of IPD for use in traditional Design-Bid-Build contracting methods. Such gradual increments or transformational small steps towards IPD may be what the construction industry requires.

The reviewed literature indicates that the current traditional Design-Bid-Build method which is mainly used on South African mining capital projects results in

confrontational relationships and limited integration. This results in various changes during construction which in turn causes too many expensive construction claims. The shared and collective decision-making approach of IPD which entails all the main parties taking responsibility for project decisions, and moving away from the blame game, and focusing on project goals, rather than individualistic goals, creates an opportunity for reducing claims in capital projects. Incorporating IPD benefits of early involvement, joint decision-making and collaboration can reduce construction claims. This research therefore, aims to explore the use of IPD to reduce construction claims in capital projects, which are contracted under the traditional methods. It intends to provide answers on how IPD benefits can be incorporated into the traditional Design-Bid-Build method, so as to reduce construction claims in South African mining capital projects.

From the literature review, it was found that construction claims under the DBB method mainly result from changes that occur later during the construction phase. If changes are minimised, then construction claims can be reduced or eliminated. If the IPD benefits of early involvement, joint decision-making, open communication and collaboration are incorporated into the DBB method, then changes can be addressed during the design phase, and not occur during the construction phase where they cause expensive construction claims. If construction claims are reduced, then capital projects can be completed within budget and on time.

Based on the above findings obtained from the literature review, a proposed conceptual framework is shown in Fig 2.2 below. A framework is defined as “a set of notions, techniques and tools in a planned outline to complete a product, process and design” (Othman, 2011:344). The conceptual framework was developed by linking the elements required to reduce construction claims through identifying the following: the main cause of construction claims which is identified as changes from the literature review and the key participants to projects and how they can minimise changes hence reduce construction claims. These elements were then infused with the identified IPD benefits from the literature review which have potential to reduce construction claims into a conceptual framework. The conceptual framework was reviewed and evaluated during the research focus group discussion.

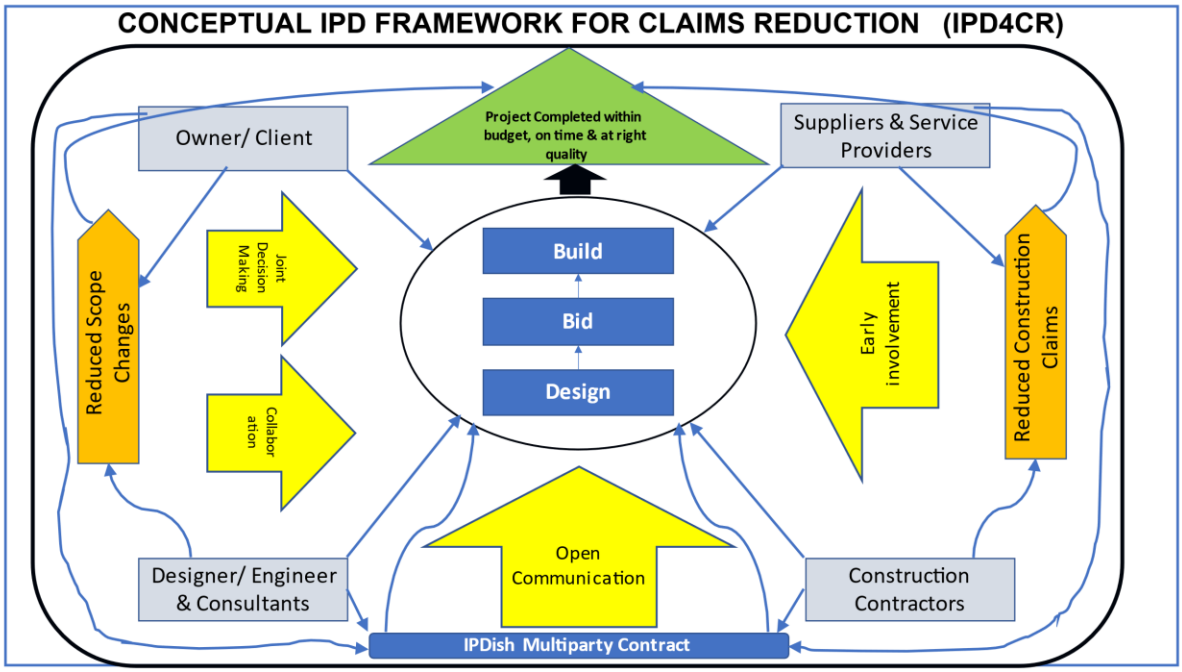

Fig. 2.2 Conceptual Framework for Claims Reduction

2.9 SUMMARY OF THE LITERATURE REVIEW

In summary, the literature review found out that construction claims are mainly caused by changes in planned or agreed scope (whether caused by a stakeholder to the project, nature or unforeseen situations/ conditions or circumstances) experienced during the construction phase of the project. Current practices used to reduce claims are not systematic, but more precautionary strategies and project management practices. IPD prevents the causes of claims, whilst current practices are an attempt to cure the causes. The partnering, collaboration, sharing of risk and teamwork characteristics of IPD presents an opportunity for minimizing changes during construction, and thereby reducing construction claims in capital projects. The literature review shows that by identifying the main causes of construction claims and aligning them with IPD benefits which could reduce those claims, a framework for better project outcomes can be developed. The themes emerging from the literature review are around identifying IPD benefits which can remedy causes of construction claims and how those can be infused into the DBB approach. The following section indicates the research methodology to be applied in this study.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter will look at the research methods, data collection techniques and data analysis that was used in answering the research sub-questions. In particular, this chapter will discuss literature review, survey and focus groups as research methods. Meta-synthesis, questionnaires and interviews were explored as data collection techniques. Descriptive and pattern coding, quantitative and qualitative analysis were then reviewed as data analysis practises.

3.2 RESEARCH PHILOSOPHY

Before conducting a research, it is crucial to be cognizant of the various philosophical frameworks that may have an impact on how the research will evolve. According to Saunders et al (2000), “research philosophy can be defined as the development of research assumption, its knowledge, and nature”. Research philosophy is associated “with a system of beliefs and assumptions,” related to knowledge development (Saunders, 2009). Sarantakos (1998), describes a philosophical framework as the leading force guiding the aim of a study. During research, there are several kinds of assumptions that the researcher makes. Such assumptions can be classified (Saunders, 2009) as follows:

- **“Epistemological** – This has assumptions about human knowledge” (Burrell & Morgan, 1979).
- **“Ontological** – This has assumptions about realities encountered during the research” (Thomas & Hardy, 2011).
- **“Axiological** – This has assumptions about the extent and ways the researcher’s own values influence the research process” (Heron, 1996).

Crotty (1998) states that such assumptions influence how the researcher gets to understand the research questions, methodology used and how to interpret the findings. A well-crafted set of assumptions will result in a reasonable research philosophy.

According to Žukauskas et al (2018), there are four main types of research philosophy that are recognized and considered by numerous authors:

1. **Positivist research philosophy** – This gives a perspective of a natural scientist or objective analyst relying on accurate knowledge. (Crotty, 1998).
2. **Interpretivist research philosophy** – The emphasis is on that human beings create meanings and the "researcher performs a specific role in observing the social world" (Žukauskas et al, 2018; Saunders, 2009)
3. **Pragmatist research philosophy** – This is based on "that concepts are only relevant when they result in action" (Keleman & Rumens, 2008). In such a philosophy, the practicality of results is regarded as crucial (Lancaster, 2005).
4. **Realistic research philosophy** – This "focuses on explaining what we see and experience" with reality being the most important consideration (Saunders, 2009).

This present research aims to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional DBB method. This framework will enable stakeholders in South African mining capital projects to collaborate and integrate early to deliver projects to a high quality, on time and within budget.

To design such a framework, it is crucial to evaluate in what way project personnel have encountered the applicable events (in this case claims) over the lifecycle of capital projects. It is vital to comprehend the perceptions of project personnel into their challenges, tasks and their thought process, when dealing with the construction claims problems. This study therefore aims to appreciate "how the research participants make sense of their own reality" (Žukauskas et al, 2018). An interpretivist research philosophy depends on such an approach; therefore, this research can be deemed as being based on an interpretivist research philosophy approach. Furthermore, in the process of gathering evidence as much as possible about reality (Denzin & Lincoln, 2000) and to obtain a deeper viewpoint of realistic world occurrences, this research uses documents (literature), questionnaires and interviews as sources of evidence.

3.3 RESEARCH METHODS

Research methods are apparatuses used to carry out research and can be “qualitative or quantitative or mixed”. Quantitative methods investigate “numerical data and use statistical tools” to analyse the gathered data which involves “the measurement of variables and relationships between them” (University of Pretoria, 2018). Quantitative data is usually shown on graphs and tables. Qualitative data, in contrast, is non-numerical and concentrates on determining patterns. Mixed methods consist of both qualitative and quantitative research, and enable the clarification of unpredicted results (University of Pretoria, 2018).

Crotty (1998), defines research methods as “the techniques or procedures used to collect and analyse the data with the purpose of answering the research questions or hypothesis”. Denzin and Lincoln (2000) state that the research method links the “researcher to methods of data collection and analysis.” The research method as an approach maintains the patterns of analysis in motion (Too, 2009).

In this research, the following research methods were employed in a sequential manner with one method and its findings feeding and influencing the next method’s data collection:

- Literature review
- Survey
- Focus Groups

3.3.1 Literature Review

Existing literature was utilized to answer the first and second sub-questions.

- “What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?”
- “Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in mining capital projects?”

A literature review pinpoints and analyses accessible appropriate research to a specific research question (Kitchenham, 2004). Literature review may also be

referred to as document analysis (Noblit & Hare, 1988), when used to gather research data. According to Yin (2009), literature review poses proof to support the data from other sources. Bowen (2009) highlights that prior studies are a source of data, entailing the researcher to make use of the “description and interpretation” of data, instead of using raw data as a source for analysis.

Merriam (1988) asserts that documentation of different kinds can assist the researcher to reveal sense, improve awareness, and realise perceptions pertinent to the research problem. According to Bowen (2009), literature provides backdrop and perspective, further questions to be queried, accompanying data, a way of tracing change and progress, and authentication of outcomes from other sources.

Other recent researchers like Alinezhad et al (2020), and Kahvandi et al (2020) investigating IPD benefits have also used literature review as a research method, due to the available written documents on IPD. The above reasons make literature review the ideal research method for the first and second sub-questions, since IPD is a relatively new concept with less case studies, but with various articles written about it which are available.

3.3.2 Survey

According to Remenyi et al (2002:290), a survey is “the collection of a large quantity of evidence usually numeric, or evidence that was converted to numbers, normally by means of a questionnaire”. A survey was used to answer the third sub-question:

- “What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”

A survey enables the researcher to “elicit reliable responses from a chosen sample” (Remenyi *et al.*, 2002). This makes it ideal for the third sub-question as specialists and personnel knowledgeable in construction claims on capital projects was surveyed. According to Leedy and Ormond (2001), a survey makes it possible to “collect a large quantity of evidence (through questionnaires)” that was converted to numbers or percentages for analysis. The evidence to be collected on current practices used to reduce construction claims was analysed to determine trends. A

survey also assists the researcher “to establish what a selected group of participants think” (Watkins, 2010). This is ideal for the third sub-question, as the researcher wants to establish what stakeholders on capital projects deem as the current practices used to reduce construction claims.

3.3.3 Focus Groups

Cooper and Schindler (2006:212), define a focus group as “a panel of people, typically made up of six to ten participants, led by a trained facilitator, who meet for ninety minutes to two hours”. This methodology is used for gathering information on a subject matter from a group of very specialised experts who will engage in discussions with the researcher. Watkins (2010), asserts that focus groups are commonly utilised as one of various different evidence collection methods within a single study for business and management research.

IPD is a relatively new concept with a few experts who are knowledgeable on the subject, which makes the use of focus groups the ideal method to answer the fourth sub-question:

- “How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”

Cooper and Schindler (2006:213) point out that “in traditional focus groups, participants meet face-to-face”, nevertheless, there may be a need to connect with people that face-to-face groups cannot bring together.

In such circumstances, the following focus groups can be effective: “Telephone focus groups, online focus groups, and video conferencing focus groups” (Watkins, 2010:57). The video conferencing focus group was used to provide answers to the fourth sub-question, since the IPD and project management experts are located in different locations.

Focus groups are useful in the following circumstances:

- Getting broad backdrop information about a subject matter.

- Creating research questions to be studied through the quantitative research method.
- Clarifying earlier acquired quantitative results.
- Modelling new concepts for products and projects.
- Emphasizing opportunities for managers to chase.
- Detecting problems that managers need to attend to.
- Creating thoughts and insights for new products.
- Producing a degree of comprehension on “influences in the participant’s” operating space (Watkins, 2010).

The above reasons make focus groups the ideal method to tackle sub-questions on using IPD to reduce construction claims. Focus group research entails prearranged dialogue with a carefully chosen grouping of knowledgeable participants to gather evidence, in terms of their opinions and involvements on a subject matter (Gibbs, 1997).

IPD is a relatively new concept with not many subject matter experts. Focus groups can assist to discover or create suppositions (Powell & Single, 1996). Focus group research will therefore allow the researcher to interact with such subject matter experts, and test the hypotheses of reducing construction claims using IPD benefits on mining capital projects under the traditional Design-Bid-Build delivery method.

According to Race *et al.* (1994), focus group research can be utilised to assess or create a specific programme of activities. Focus group research is commonly utilised as a qualitative method to obtain a deep appreciation of a subject matter, as well as to acquire data from an intentionally chosen group of experts (Bloor *et al.*, 2001). Due to the adversarial relationships created by the traditional project delivery method utilised in capital projects, which leads to construction claims resulting in cost and schedule overruns, this research is aimed at developing a framework that uses IPD benefits to reduce construction claims.

The interaction experienced in focus groups allows participants to ask each other questions, including being able to re-assess and re-evaluate own conceptions of understandings on a subject matter (Kitzinger, 1994, 1995). Due to the above

reasons, the focus group study method was deemed as appropriate for the development of a framework for the use of IPD to reduce construction claims in capital projects.

According to Breen (2006), focus group research provides a greater comprehension of a trend or concept and provides new insights. The main question of this research is to explore if the use of IPD benefits can reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. This requires a deep understanding of IPD and provides an additional reason for using focus group research for this thesis.

The fourth sub-question of this research also involves the development of a framework for the use of IPD benefits to reduce construction claims in mining capital projects. The main differentiator “between one-to-one interviews and focus-group discussions” is that focus groups are more suited and geared for the production of new ideas (Breen, 2006). In developing the framework, the researcher had to come up with new ideas, which can be derived from focus groups. Such reasoning makes focus group research suitable for this thesis, which involved developing a new framework. The following section indicates the data collection methods to be used in this study.

3.4 DATA COLLECTION TECHNIQUES

Data can be collected from primary and secondary sources. According to Saunders *et al.* (2000), primary sources “are those that are directly collected at field source while secondary sources are those whereby data is collected from literature, audio or video documents such as textbooks, journals, archives, reports, publications and films”. The popular techniques used to gather any of qualitative or quantitative data include “observation, interviews, questions, focus groups, protocol analysis, diary methods, and content analysis of documents” (Collis & Hussey, 2009).

In this research, the following data collection techniques were used:

- Meta-synthesis
- Questionnaire

- Interview

3.4.1 Qualitative Meta-Synthesis

Qualitative meta-synthesis is a deliberate and comprehensible technique to examining data qualitatively. It empowers researchers to pinpoint a particular research question and then “search for, select, appraise, summarize, and combine qualitative evidence to address the research question” (Erwin, Brotherson & Summers, 2011). Campbell *et al.* (2003), define qualitative meta-synthesis as “the bringing together of findings on a chosen theme, the results of which should in conceptual terms, be greater than the sum of the parts”. According to Jensen and Allen (1996), qualitative meta-synthesis emphasises on interpretation of conclusions or findings from a carefully chosen assortment of research studies in a selected subject matter.

Qualitative meta-synthesis is “an interpretation of qualitative findings that are themselves interpretive syntheses of data, including phenomenologies, ethnographies, grounded theories, and other integrated and coherent descriptions or explanations of phenomena, events, or cases that are the hallmarks of qualitative research” (Sandelowski & Barroso, 2007). Qualitative meta-synthesis enables a means of viewing both a particular research within a discipline, as well as amalgamating the findings into a structure that can be easily accessed and understood (Chenail *et al.,* 2018). The meta-synthesis technique is used for integrating studies in a special field (Noblit & Hare, 1988). This study pertains to construction claims and IPD, which can be viewed as specialised fields with subject matter experts. Meta-synthesis technique aims to create certainty in outputs (Kahvandi, *et al.,* 2019), which is crucial in researching on causes of construction claims and IPD benefits.

Since the following first and second sub-questions were researched using the literature review method, qualitative meta-synthesis was thus the ideal data collection technique to come up with answers to these sub-questions on causes of construction claims and IPD benefits.

- “What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?”

- “Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?”

Use of qualitative meta-synthesis as a data collection technique on research involving IPD benefits, has also been found to be appropriate by other researchers, like Kahvandi *et al.* (2019). The seven steps of conducting a qualitative meta-synthesis are as shown in Table 3.1.

Table 3.1. Seven Steps of Conducting a Qualitative Meta-Synthesis

Step 1: Formulating the review question	The review question should seek to bring together published knowledge, in order to come up with inferences and conclusions. According to Petticrew and Roberts (2006), the review question may seek “to address apparent discrepant findings by providing a new interpretation”.
⇩	
Step 2: Performing a systematic literature search	This involves the reviewer choosing vital wording to lead the literature pursuit. “The parameters of who, what, and time establish the inclusion and exclusion criteria. Throughout the search the reviewer continually re-evaluates the definitions of the search terms or the time frame” (Sandelowski & Barroso, 2007).
⇩	
Step 3: Vetting and choosing suitable research articles	This step includes identifying available studies and reviewing them to evaluate, if they satisfy the inclusion basis put in place, before commencing with the search.
⇩	
Step 4: Extracting the required data from texts	This step involves extracting and presenting formal data. Collected data is coded based on their nature, and then classified.
⇩	
Step 5: Analysing and synthesizing qualitative findings	This step involves looking for topics that appear throughout the studies contained in the meta-synthesis. It includes creating a category and placing associated matters in a category that explains the phenomenon in the best way.

	
Step 6: Maintaining quality control	This step encompasses providing clear narratives and justifications for the options selected. It involves using proven methodologies to the synthesis of primary qualitative research studies. The quality of the primary qualitative research studies has to be appraised using recognized programs. Electronic and manual search techniques can be utilised to pinpoint all pertinent articles.
	
Step 7: Presenting findings	The final step comprises depicting the steps made in the creation of the synthesis. Visual presentations including charts, tables, and figures can be used to present the findings. This step comprises presenting depictions of the data, quotations, and the creation of "the conceptual model or working hypotheses derived from the integration".

Source: (Sandelowski & Barroso, 2007).

Step 1 of the meta-synthesis technique involves articulating the research questions. The researcher has to provide answers to four simple questions – "What, Who, When, and How?" The first question is 'What" and refers to what is being researched. The second question is "Who?" which refers to the research sample. The third question is "When?" which determines time period of the research. Lastly, the final question is "How?" which indicates a method that was utilised to gather research data.

In Step 2, the researcher has to search texts presented in recognised and reliable scientific and engineering databases through selecting a keyword connected to the research question. Step 3, in particular is crucial, as it includes identifying available studies and reviewing them, to evaluate if they satisfy the inclusion basis put in place. A criterion (usually a publication period and reliability of the texts) has to be defined and set with some of the texts being eliminated. From the collected articles, the Critical Appraisal Skills Program (CASP) technique is used to investigate the quality of the remaining articles. The CASP technique comprises of 10 indices for qualitative evaluation of accuracy and reliability of each article (Arbabi *et al.,* 2017). The indices consist of:

1. Research objectives,
2. The logic of the method,
3. Research plan,

4. Sampling,
5. Data collection,
6. Reflectivity,
7. Ethical considerations,
8. Data accuracy and analysis,
9. Clear expression of findings, and
10. Research value (Campbell *et al.*, 2003).

In the CASP technique scoring, a score of 30 or less on an article is considered not good enough, and such articles have to be removed (Jensen & Allen, 1996). In Step 4, the remaining resources from the CASP technique results are examined further. Collected data in this step has to coded and classified.

In Step 5, a code is assigned to each data (descriptive analysis) and similar codes are identified and fall in a subgroup (pattern coding) (Arbabi *et al.*, 2017). This step facilitates the transformation of unstructured data into ideas and is the linkage back and forth between the gathered information and ideas (Richards & Morse, 2007).

Step 6 involves quality control of the results, which is part of the meta-synthesis method. The CASP technique described and utilised in Step 3, ensures the quality of articles is examined through the scoring of indices. Furthermore, the coding and classification of data used in Step Five is another check on the quality of identified data. In the final Step 7, the research question stated in Step One has to be answered and presented.

3.4.2 Questionnaires

According to Watkins (2010:67), a questionnaire “is a list of carefully structured questions, chosen after considerable resting with a view to elicit reliable responses from a chosen sample”. Questionnaires are used to research what a chosen group of those who participate “do, think or feel”. Questionnaires are classified in the broader description of “survey or descriptive research”. There are two methods in creating questions that is, “positivistic (structured ‘closed’ questions) and phenomenological (unstructured ‘open-ended’ questions)” (Watkins, 2010:67). Since questionnaires are the ideal method to carry out a survey (Remenyi et al, 2002), the data collection method used for the third sub-question was a questionnaire.

The third sub-question involves investigating the current practices used to reduce construction claims, which requires reliable responses from a chosen sample (Remenyi *et al.,* 2002) as envisaged in the use of questionnaires. According to Watkins (2010), questionnaires should be used to establish what a selected group of participants think, which is consistent with what Sub-Question Three requires in terms of identifying the current practices used to reduce construction claims.

Sub-Question Three reads as follows – "What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?" Questionnaires also enable the collection of a large quantity of evidence that was converted to numbers/ percentages for analysis (Leedy & Ormond, 2001), which is what was required for Sub-Question Three. The questions in the questionnaire were based on the findings of the literature review.

3.4.3 Interviews

Interviews are used as a data collection methodology for qualitative research methods. According to Cooper and Schindler (2006:204), interviews can be classified as follows:

- **Unstructured interview:** No specific questions or order of topics to be addressed, with each interview customized to each participant.
- **Semi-structured interview:** Generally, starts with a few specific questions and then follows the individual's tangents of thought with interviewer probes.
- **Structured interview:** Similar to a questionnaire to guide the question order and the specific way the questions are asked, but the questions generally remain open-ended".

Since the fourth sub-question was researched using focus groups, which involves interviewing subject matter experts on IPD and project management, interviews were used as the data collection method. An interview protocol with a list of themes and key questions was prepared and used by the researcher as a guide (Opoku, Ahmed & Akotia, 2016). The interviews in the focus groups involved conversations between the researcher and the participants, in order to collect reliable data, based on the

research questions (Saunders *et al.*, 2019). The use of interviews is considered as an efficient method of data collection in qualitative research (Bryman & Bell, 2007).

IPD is a relatively new concept with a few experts who are knowledgeable on the subject, which makes the use of focus groups the ideal method to answer the fourth sub-question:

- "How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?"

The fourth sub-question involves asking experts on how causes of construction claims can be remedied by identified IPD benefits, which requires an organised discussion with subject matter experts to gain information on a topic (Gibbs, 1997) making the interview process appropriate.

The fourth sub-question requires gaining an in-depth understanding of a subject matter (Bloor *et al.,* 2001; Race *et al.,* 1994) through interviewing experts. Tahe interview process in focus groups also gives a deeper understanding of a phenomenon or concept like IPD, and provides new insights and the generation of new ideas (Breen, 2006), which is what is required for the fourth sub-question. The interview questions for the focus group were based on the findings of the literature review and questionnaire. The following section describes the sampling techniques used in this study.

3.4 SAMPLING

Saunders *et al.* (2019) describes a sampling frame as the full list of elements "in the target population" from which a sample will be taken. The sampling frame for this research is made up of construction professionals, working on mining capital projects in South Africa, which include clients/ owners, engineers, contractors, quantity surveyors, claims consultants, project managers and executive managers.

According to Saunders *et al.* (2019), the size of the sample effectively depends on the research questions and objectives. O'Reilly and Parker (2013), further indicate that the sufficiency of sample size is determined by depth of data, and not frequencies, meaning that samples have to be made up of participants who are

better placed to respond to the research questions. The above was taken into account when determining the sample sizes for both the quantitative and qualitative data collection for this study.

3.4.1 Purposive Sampling

The sampling of participants for the survey was purposive. Johnson, Beuhring, Cassell and Symon (2007:25), stated that “purposive sampling is used where the aim is not to establish a representative sample, but rather to identify key informants whose knowledge and expertise, regarding the issues relevant to the research are significant and rich in information”. According to Saunders *et al.* (2000:230), purposive sampling enables the researcher to use his judgement to select cases that will enable the researcher to answer the research question.

The sample frame identified for this study’s questionnaire for Research Sub-Question 3, consisted of 100 project management experts, who all were involved in managing the activities of mining capital projects and construction claims. The personnel were selected by the researcher, based on their qualifications and experience in managing mining capital projects and construction claims, and were mainly identified on the LinkedIn networking platform, and from engineering, quantity surveying and construction professional associations. In determining the sample frame of 100 for the questionnaire, the researcher took into account time and cost resource constraints as envisaged by authors like Lakens (2022) and Lenth (2001). The researcher had to find the balance in completing the research on time and within a reasonable cost and the worthwhileness of the data collected. The researcher also considered that the number of project management experts with mining capital projects and construction claims experience are limited in arriving at the sample frame of 100.

In a research on BIM and IPD in South Africa, which targeted construction industry participants, Froise (2014) obtained response rates of 16% and 24% on two sets of questionnaires. In a similar research on IPD, Agbaxode (2022), achieved a 54% response rate on a questionnaire. A total of 42 responses were received on the questionnaire of this study, which represents a response rate of 42%. This response

rate is consistent and better than the 31.3% average, which was obtained in the above mentioned previous and similar studies.

For the sample size of the qualitative data, collection done through a focus group for Research Sub-Question 4, a panel of 15 experts in IPD and project management were interviewed. The sample size is adequate and surpasses the requirements of Cooper and Schindler (2006:212), who indicate that a focus group is typically “made up of six to ten participants”. Due to the sequential nature of the approach in data collection employed, having 15 experts participate in the focus group was also an attempt to complement and compensate for the 42% responses achieved in the questionnaires. The outcome of the questionnaire responses had an influence on having more experts participate in the focus group. The following section indicates the data analysis techniques and software that were used in this study.

3.5 DATA ANALYSIS TECHNIQUES & SOFTWARE USED

According to Yin (2009), *“*data analysis is the process of examining, grouping, testing or recombining different quantitative or qualitative information to address the main research questions”. In this research, the following data analysis methods was used:

- Qualitative Analysis incorporating Descriptive and Pattern Coding
- Quantitative analysis

3.5.1 Qualitative Analysis Incorporating Descriptive and Pattern Coding

For the data collected from the literature review through the qualitative meta-synthesis technique, descriptive coding and pattern coding was employed to evaluate the data. The intention of coding scripts is to explore the key concepts and evaluate what the collected data is all about. This step facilitates the transformation of unstructured data into ideas and is the linkage back and forth between the gathered information and ideas (Richards & Morse, 2007).

The data to be collected from review of the documents for sub-questions one and two, was evaluated by means of QSR NVivo software, “which is expert software for qualitative analyses”. QSR NVivo software facilitates in the presentation and

simplification of the collected data. QSR NVivo prevents data analysis delays through providing a rapid coding method of suggestions from the interview discussions and texts (Bazeley & Richards, 2000).

QSR NVivo software is ideal for the evaluation of Research Sub-Questions 1 and 2, which read as shown below, because it simplifies the complexity of synthesizing a large number of research reports, as envisaged by Scruggs and Mastropieri (2006):

- "What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?"
- "Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?"

QSR NVivo software is also capable of "coding, categorizing and organising qualitative data into general themes" (Scruggs & Mastropieri, 2006), which is what is required for Sub-Questions 1 and 2. QSR NVivo software also allowed the researcher to think through the analysis as it was happening, and to classify date and get insights into themes (LeCompte & Preissle, 1993),

3.5.1.1. Choice of Analysis Method

Methods for analysing qualitative data can be described as follows:

- **Content Analysis:** This is a descriptive approach used for exploring huge amounts of information in text format so as to ascertain "trends and patterns of words used, frequency, relationships and structures of communication" (Krippendorff, 2004). This method is the most popularly used analysis method, because it can make valid interpretations from textual data to context of use (Krippendorff, 2004).
- **Comparative Analysis:** This approach involves comparing and contrasting data from different sources of people, until no new issues come up (Mills *et al.*, 2010).
- **Discourse Analysis:** This approach analyses speech as performance in terms of how people speak, and what inspires them to speak (Dawson, 2009).

- **Grounded Theory:** This is an analytical procedure, which involves coding and categorising data so as to derive concepts from data (Saunders *et al.*, 2000).

As the researcher plans to assign remedies to the causes of construction claims from identified IPD benefits, and conceptualise a framework that uses identified IPD benefits as remedies to causes of construction claims, there is the need to obtain knowledge from the ideas, interpretations and thoughts of the focus groups candidates.

For this reason, content analysis was utilised to examine the collected qualitative data for Sub-Question 4, which reads:

- "How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?"

QSR NVivo software, which is expert software for qualitative analyses (Bazeley & Richards, 2000), was used for analysis.

3.5.2 Quantitative Analysis

Quantitative data collected from questionnaires consists of two sub-groups of data, i.e.

- Discrete data made of fixed values
- Continuous data, which represents all values within a specific interval (Watkins, 2010).

According to Dudovskiy (2018), in quantitative analysis of data, unprocessed numbers are converted into significant data via using logical and essential reasoning. Quantitative analysis of data includes the computation "of frequencies of variables and their differences". Analytical software for instance, MS Excel, MS Access and SPSS can be used to facilitate evaluation of quantitative data (Dudovskiy, 2018).

Saunders *et al.* (2000), state that "quantitative data analysis with the application of statistical software consists of the following stages:

- Preparing and checking the data for input into computer.
- Selecting the most suitable tables and diagrams to use as per the research objectives.
- Selecting the most appropriate statistics to describe the data.
- Selecting the most suitable statistics to examine trends in the data".

Because the third sub-question ("What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?") is being answered through questionnaire data collection, discrete data quantitative analysis was utilised to identify the current practices used to reduce construction claims.

3.5.2.1 SPSS

Quantitative analysis was used to find evidence to support and infer on the earlier literature review findings. SPSS is a powerful statistical analysis tool (Dudovskiy, 2018), which makes it the ideal software to use for the quantitative analysis.

A summary table of the research method, data collection method, data analysis technique and software to be used for each sub-question is shown in the table below.

Table 3.2: Research Method, Data Collection Method, Data Analysis Technique and Software To Be Used

Research Sub-Questions	Research Objectives	Research Methods	Data Collection Methods	Data Analysis Techniques	Software To Be Used
What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?	To find out the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method.	Literature Review	Qualitative Meta-synthesis	Descriptive & Pattern Coding	NVivo
Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?	To identify the benefits of Integrated Project Delivery (IPD) which are essential to reducing construction claims in capital projects.	Literature Review	Qualitative Meta-synthesis	Descriptive & Pattern Coding	NVivo
What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?	To investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.	Survey	Questionnaires	Quantitative	SPSS
How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?	To assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.	Focus Groups	Interviews	Qualitative	NVivo

3.6 DATA VALIDITY, RELIABILITY AND GENERALIZABILITY

Data validity, reliability and generalizability are crucial in guaranteeing the quality of the research results (Saunders *et al.,* 2019). This section explains how they were applied in this research.

3.6.1 Validity

Collis and Hussey (2003:186), state that "validity is concerned with the extent to which, the research findings accurately represent what is happening". Validity includes the accuracy and generalization of the results (Saunders *et al.,* 2019; Sutrisna, 2009). According to Saunders *et al.* (2019), validation deals with verifying research data and its interpretation so as to deduce its validity or credibility. In this study, two validation techniques of triangulation and participant validation were used.

3.6.1.1 Triangulation

This study used triangulation by utilising both qualitative and quantitative research methods. The first two research sub-questions used qualitative meta-synthesis on literature or documents collected and reviewed. The third research sub-question used a questionnaire as a data collection method, with data being quantitatively analysed. The mixed method approach utilised gives this research depth, perspective, and value (Denzin, 2012) resulting in better construct validity of the data including ensuring consistency and coherence between the different data sources.

3.6.1.2 Participant Validation

Participant validation was used during the focus group for the fourth research sub-question. This was done by requesting the participants to verify and comment on the accuracy of the results (Saunders *et al.,* 2019), of the document review, questionnaire results as well as validating the conceptual framework for reducing construction claims. The conceptual framework was presented to participants who were then requested to comment on the elements of the framework and its practical workability including making any further suggestions. This validation by participants assisted in developing and improving the framework presented in this research, which uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional DBB method.

3.6.2 Reliability

Reliability or trustworthiness is focused on the outcomes or conclusions of the study (Collis & Hussey, 2003). Research findings qualify as reliable if when the research is done again, identical results can be achieved (Saunders *et al.,* 2019). The research methods, data collection methods, data analysis techniques and software used were clearly presented in this study, so as to enhance the research's reliability. Multiple research methods of document review, survey and focus group were used in this study which enhanced the reliability of the research results.

3.6.2.1 Cronbach's Alpha

Cronbach's alpha measures consistency or reliability of a test or scale (Bonett & Wright, 2015). It was used in this study to determine the reliability of the questionnaire Likert scale results. The questionnaire survey was made up of questions adapted from the literature, so as to be reliable.

3.6.3 Generalizability

According to Saunders *et al.* (2019), generalizability deals with how research findings can be applicable to other circumstances or situations. The proposed framework from this research, which uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method, can be generalized as construction claims, and their causes are similar on capital projects across the world (Griffin,1993).

Relevant literature, responses to questionnaires and reviews and validation from the focus group were used to satisfy the aim of this research in developing the framework. This mixed method approach to the research assisted in the generalizability of this research's findings. The following section considers ethics matters on this study.

3.7 ETHICS

Saunders *et.al.* (2000:130), state that "ethics refers to the appropriateness of your behaviour in relation to the rights of those who become the subject of your work, or

are affected by it". Research ethical matters can be classified under one of these groupings: "protection from harm, informed consent, right to privacy, and honesty with professional colleagues" (Leedy & Ormrod, 2001:107). As per the requirements, an ethics clearance certificate (Appendix 6) was obtained before collecting data. In this research study, the ethics below were observed:

3.7.1 Informed Consent

Those who were participating in the questionnaires and focus group were communicated with, ahead of time and advised what the research is about, and afforded the choice of being involved or not. Since participation was on a voluntary basis, and the participants were permitted to withdraw from the study as they wished.

3.7.2 Privacy Right

The extent and level of participation of the candidates was held private, and confidential. The respondents to the questionnaires and participants of the focus group were not referred to by their actual names in this research write up. Furthermore, the identities of owner/ client, engineer and contractor examples given by the focus participants when expressing their experience, were also not disclosed in this research write up.

3.7.3 Truthfulness with Professional Associates

Findings from the research were stated in a comprehensive and truthful way, with no distortion of anything that occurred nor deliberately deceiving others. There was no false creation of data to aide a specific outcome or finding. The findings from the research questionnaire and focus group were stated and analysed as obtained and received.

3.7.4 Confidentiality/ Secrecy

Collis and Hussey (2003:38) state that in order to enable participants' openness and honesty, it is important to grant them "confidentiality or anonymity" in the research.

Such an approach was followed in this study in terms of the identity of the questionnaire respondents.

3.7.5 Dignity

In line with recommendations by Collis and Hussey (2003), in this research, participants were treated with dignity, and there was no attempt to humiliate or mock participants. All the focus group participants were given a chance to express themselves freely during the discussion.

3.8 SUMMARY OF THE RESEARCH METHODOLOGY

In summary, this study utilised literature review, survey and focus groups, as research methods. Qualitative meta-synthesis, questionnaires and interviews were employed as data collection techniques. Descriptive and pattern coding, quantitative and qualitative analysis were then used for data analysis. The following section considers the research findings of this study.

CHAPTER 4: RESEARCH FINDINGS

4.1 INTRODUCTION

The chapter presents the research results obtained to answer the research sub-questions. A meta-synthesis is run for Sub-Questions 1 and 2 from the data obtained from literature. Data obtained through a questionnaire for Sub-Question 3 is then analysed and presented. Finally, the findings from the focus group sessions for Sub-Question 4 are also presented in the form of a framework that uses identified IPD benefits, as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

4.2 MAJOR CAUSES OF CONSTRUCTION CLAIMS IN CAPITAL PROJECTS DELIVERED UNDER THE TRADITIONAL DESIGN-BID-BUILD METHOD

Following the meta-synthesis method described in Chapter 3, the steps were followed for Research Sub-Question 1 as follows:

4.2.1 Step 1: Expressing the Research Sub-Question 1

The researcher had to provide answers to the four simple questions as follows:

- “What?” For Research Sub-Question 1, it is evaluating causes of construction claims. This is because construction claims are a challenge to the construction industry.
- For the second question “Who?”, recognised databases, scientific and engineering journals, university dissertations, articles and books are used for that. These have been selected, because they are reliable and recognised.
- For the third question “When?”, the time period of the research is from the Second World War (1945) to 2022. This period has been selected because construction claims have been documented in academia for a long period.
- Lastly, for the final question “How?”, reference is made to previous research and published studies on construction claims management. Thus, the

Research Sub-Question 1 of this study is as follows: What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?

4.2.2 Step 2: Systematic Text Searching for Research Sub-Question 1

In Step 2, the researcher searched texts presented in recognised and reliable scientific and engineering databases through selecting a keyword connected to the research question. The related keywords to the major causes of construction claims are:

- Construction claims (with synonyms building disputes)
- Major causes of construction claims (with synonyms reasons for construction claims)
- Capital projects (with synonyms large or mega infrastructure projects)
- Traditional Design-Bid-Build method

Recognised and reliable scientific databases reviewed for Research Sub-Question 1, are listed below. These databases were selected based on a combination of where the findings of the literature review in Chapter 2 were obtained from, where previous authors on related topics published and the popularity of the databases with academics.

- ASCE
- Science Direct
- AIA
- SMPS Foundation
- Springer
- Wiley
- ProQuest
- Taylor & Francis
- Researchgate
- Academia.edu

- WitsLib Guides

4.2.3 Step 3: Reviewing and Selecting the Appropriate Texts for Research Sub-Question 1

In Step 3, the meta-synthesis of texts is executed. This step includes identifying available studies and reviewing them to evaluate if they satisfy the inclusion basis. A criterion has to be defined, and set with some of the texts being eliminated. The criterion in this study is time of publications (publication period from 1945 to 2022) and reliability of the examined texts. From the collected articles, the Critical Appraisal Skills Program (CASP) technique is used to investigate the quality of the remaining articles. The process of searching and selecting articles is shown in the Figure 4.1 below.

18040 resources	Total number of resources found in searched databases.
	⇩
8452 resources	Total resources found based on title and abstract.
	⇩
748 resources	Total resources found, due to removing those incompatible with research questions.
	⇩
253 resources	Total resources found, due to removing those with lack of quality of research finding.
	⇩
20 resources	Total resources found, based on the content of texts.
	⇩
16 resources	Total resources found, based on the CASP technique as shown in Table 4.1. The 16 resources were selected, as those which scored a total score of over 31 on the CASP scale.

Figure 4.1: Process of Searching and Selecting Articles for Research Sub-Question 1

In the process of searching and selecting reliable resources, 16 resources were selected, which include 14 articles and 2 theses as shown in Table 4.1 below.

Table 4.1: CASP Scoring for Research Sub-Question 1 Articles

			CASP Indices										
Title of Article/ Publication	**Authors**	**Year of Publication**	Research Objectives	Logic of the Method	Research Plan	Sampling	Data Collection	Reflectivity	Ethical Considerations	Data Accuracy & Analysis	Clear Expression of Findings	Research Value	**Total Score**
"Development of Framework Towards An Effective Claims Management Process In Construction Industry Using A Hybridized SWOT-AHP Model. A Case of 5 Top Leading Construction Organizations in South Africa."	Matseke, D. & Khatleli, N.	2020	5	4	5	5	4	5	4	4	5	5	41
"Construction claims, their types and causes in the private construction industry in the Kingdom of Bahrain."	Al Malki, Y. M. & Alam, M. S	2020	5	5	4	5	4	4	4	5	5	5	41
"Understanding and Preventing Construction Conflict, Claims and Disputes: A Critical In-depth Study into their Causes and Recommendations to Control in the United Arab Emirates."	Taher, N. A. B. A	2009	5	4	4	5	5	3	4	5	5	5	40
"Construction Contractor's Claims Process Framework."	Kululanga *et al.*	2001	5	4	4	4	5	5	4	4	5	5	40
"Project Management in Construction."	Levy, S. M,	1994	5	4	3	3	4	5	4	4	5	5	37
"Construction claims and disputes: causes and cost/time overruns."	Semple *et al.*	1994	5	3	3	3	4	4	4	5	5	5	36
"Causes of Constrction Claims in International Enginnering-Procurement-Construction Projects."	Shen *et al.*	2016	4	4	3	3	4	5	3	4	5	5	35
"Construction Contract Claims, Changes & Dispute Resolution."	Levin, P.	1998	5	4	4	3	3	4	3	4	4	5	34
"A Qualitative Study and Analysis of Casues and Disputes in Claims in Construction Industry."	Mukilan *et al.*	2019	4	4	3	3	3	4	3	4	4	4	32
"Nature and Causes of Construction Claims in Iraqi Turnkey Projects."	Ezraij, K. R.	2020	3	3	3	3	4	4	3	4	5	5	32
"Claims in Construction Projects: A Comprehensive Literature Review."	Shaikh *et al.*	2020	4	4	3	3	3	4	3	4	4	4	32
"Types and Causes of Construction Claims."	Shah *et al.*	2014	4	4	3	3	3	3	3	4	4	4	31
"The Effect Of Building Information Modeling (BIM) On Construction Claims."	El Hawary, A. N. & Nassar, A. H.	2016	4	3	3	3	3	3	3	4	5	4	31
"BIM-based claims management system: A centralized information repository for exension of time claims."	Ali *et al.*	2019	4	3	3	4	4	4	3	3	3	4	31
"Construction Claim Types and Causes for a Large-Scale Hydropower Project in Bhutan."	Hadikusumo, B. H. W. & Tobgay, S.	2015	4	3	3	3	3	4	3	4	4	4	31
"Causes and Problem Identification in Construction Claim Management."'	Hayati *et al.*	2019	4	3	3	3	3	5	3	3	4	4	31
"Building Information Modelling as a Catalyst for an Integrated Construction Project Delivery Culture in South Africa."	Froise, T.	2014	3	3	4	4	3	2	3	3	3	2	28
"Strategic Data for Employers' Construction Claims."	Tochaiwat, K. & Chovichien, V.	2004	3	3	3	3	4	2	3	3	3	2	27
"Claim management in EPC-Projects: A case study of claim causes and claim management during plant installation."	Soderlund, M.	2018	3	3	3	3	3	2	3	2	2	2	24
"Operational framework to settle contractual claims in construction projects."	Saad, A. S. A.	2017	3	3	3	2	3	2	3	2	2	2	23

As shown Step 2, a number of relevant databases were looked up in order to gather articles. The majority of the articles contain material on causes of construction claims. Following the first assessment, several publications that did not meet the

requirements outlined in Step 3 and had nothing to do with construction claims were eliminated (Arbabi *et al.*, 2017). All necessary data was covered by employing the CASP method and carefully and methodically choosing publications based on quality criteria (Sandelowski & Barroso, 2006). On the CASP method, the indices were scored based on a scale of 1 to 5, to indicate the relevance and strength of each article to causes of construction claims on these criteria: research objectives, logic of research method, research plan, sampling, data collection, reflectivity, ethical considerations, data accuracy and analysis, clear expression of findings, and research value.

Table 4.1 indicates the total resources found using the CASP approach. The 16 resources were selected as those which scored a total score of over 31 on the CASP scale. By evaluating each paper's accuracy and dependability to determine the 16 resources that remained, the CASP technique helped reduce the total number of publications in the meta synthesis.

4.2.4 Step 4: Retrieving the Necessary Data from Texts for Research Sub-Question 1

In Step 4, the 16 remaining resources from the CASP technique results were examined further. Various causes of construction claims mentioned by researchers in earlier studies were extracted. Collected data in this step was coded, based on whether they are time, cost, quality or scope of work-related, plus being classified according to the causer of the claim, i.e., client, engineer, contractor or general. Some of the challenges experienced during the coding is when the cause of claim could be coded against more than one of the criteria or when the causer of the claim could be more than one. In such a scenario, the criteria with a heavy weighting or more likely to be, was selected for the coding and classification.

4.2.5 Step 5: Analysing and Combining the Results for Research Sub-Question 1

As per the meta-synthesis method, in Step 5, descriptive analysis and pattern coding is applied. This pattern analysis was done using the NVivo Pro 14 software as shown in Figure 4.2.

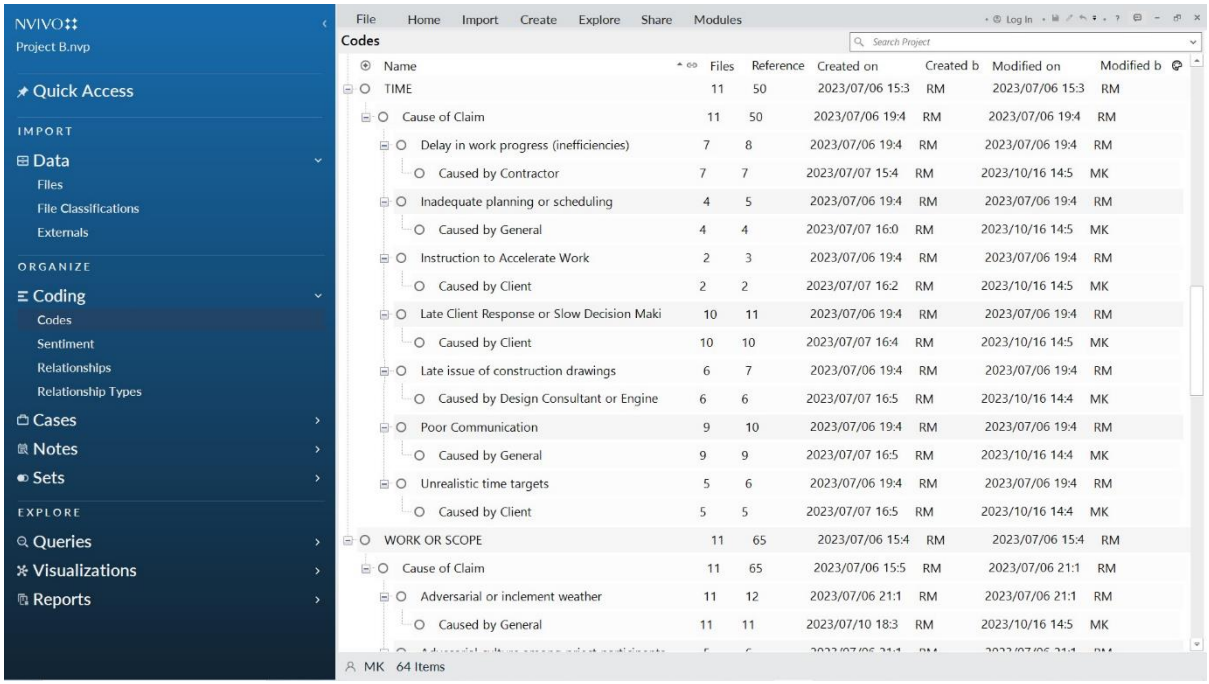

Fig. 4.2: Causes of Construction Claims Categorized in NVivo Pro 14

4.2.6 Step 6: Control of Quality of the Results for Research Sub-Question 1

The CASP technique was utilised as a quality control measure in Step 3 to select the 16 articles. In addition, the coding and classification of data used in Step 5, according to type of claim and causer of claim is an additional check on the quality of identified data.

4.2.7 Step 7: Presenting the Results for Research Sub-Question 1

In the final Step 7, the research question stated in Step 1 is answered and presented in Table 4.2. The known causes of construction claims are taken into account during this classification. Recognising and classifying the reasons for construction claims, their category and causers are important, because they are useful in identifying the benefits of IPD, which can reduce the claims.

A similar Step 1 to 7 meta-synthesis process as above was applied to Research Question 2, which reads as follows – “Which benefits of Integrated Project Delivery

(IPD) are essential to reducing construction claims in mining capital projects?" The findings of Research Question 1 are presented in the Table 4.2 below.

Table 4.2: Findings of Research Sub-Question 1

Macro Code/ Category	Micro Code/ Cause of Claim	Caused By	References
Quality	Incomplete tender information	Client	Taher (2009); Shah *et al*. (2014); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Inappropriate contractor selection	Client	Taher (2009); Shah *et al*. (2014); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Poor document control	Client	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Lack of competence of project participants	General	Taher (2009); Matseke and Khatleli (2020); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Poor workmanship and remedial work	Contractor	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Ali et al. (2019); Ali *et al.* (2019); Erzaij (2020); Levy (1994)
	Poor project management	Design Consultant/ Engineer	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Design errors and revisions	Design Consultant/ Engineer	Mukilan *et al.* (2019); Shah *et al*. (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Erzaij (2020); Hayati *et al.* (2019); Shaikh *et al.* (2020); Levy (1994)
	Improper or defective contract documents	Client	Mukilan *et al.* (2019); Shah *et al*. (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Levy (1994)
Cost	Unrealistic tender pricing	Contractor	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Erzaij (2020)
	Unclear risk allocation	General	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Erzaij (2020); Levy (1994)
	Uncontrollable external events including statutory and regulatory changes, socio-political risks and *Force Majeure*	General	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Shen *et al.* (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Hayati *et al.* (2019)

	Micro Code/ Cause of Claim	Caused By	References
	Unexpected rise in material prices and swings in economic and market conditions	General	Mukilan *et al.* (2019); Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Shen *et al.* (2016); Erzaij (2020); Hayati *et al.* (2019)
	Payment delays leading to financial issues	Client	Mukilan *et al.* (2019); Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Shen *et al.* (2016); Erzaij (2020); Shaikh *et al.* (2020); Kululanga *et al.* (2001)
Time	Unrealistic time targets	Client	Taher (2009); Mukilan *et al.* (2019); Al Malki and Alam (2020); Erzaij (2020); Hayati *et al.* (2019)
	Late client response or slow decision-making	Client	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Ali *et al.* (2019); Erzaij (2020); Hayati *et al*. (2019); Shaikh *et al.* (2020); Kululanga *et al.* (2001); Semple *et al.* (1994); Levy (1994)
	Poor communication	General	Taher (2009); Matseke and Khatleli (2020); Shah *et al.* (2014); Malki and Alam (2020); El Hawary and Nassar (2016); Shen *et al.* (2016); Erzaij (2020); Levy (1994); Baloyi & Agumba (2014)
	Late issue of construction drawings	Design Consultant/ Engineer	Mukilan *et al*. (2019); Shah *et al*. (2014); Al Malki and Alam (2020); Erzaij (2020); Shaikh *et al.* (2020); Levy (1994)
	Delay in work progress (inefficiencies)	Contractor	Mukilan *et al.* (2019); Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Levy (1994)
	Inadequate planning/ scheduling	General	Shah *et al.* (2014); Al Malki and Alam (2020); El Hawary and Nassar (2016); Erzaij (2020)
	Instruction to accelerate work	Client	El Hawary and Nassar (2016); Erzaij (2020)
Works/ Scope	inadequate or unclear design documentation and specifications	Design Consultant/ Engineer	Taher (2009); Thomas and Wright (2005); Shah *et al*. (2014); Malki and Alam (2020); Shen *et al.* (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Hayati *et al.* (2019); Shaikh *et al*. (2020); Levy (1994)
	Unclear scope of works	Design Consultant/ Engineer	Shen et al, (2016); Kululanga *et al.* (2001); Semple *et al.* (1994); Levin (1998); Levy (1994)

Micro Code/ Cause of Claim	Caused By	References
Changes by client	Client	Taher (2009); Thomas and Wright (2005); Shah *et al.* (2014); Malki and Alam (2020); El Hawary and Nassar (2016); Shen *et al.* (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Hayati *et al.* (2019); Kululanga *et al.* (2001); Levy (1994)
Variations in quantities	General	Hawary and Nassar (2016); Ali *et al.* (2019); Erzaij (2020); Shaikh *et al.* (2020); Levy (1994)
Differing or inadequate information on site conditions	Design Consultant/ Engineer	Taher (2009); Thomas and Wright (2005); Shah *et al.* (2014); Malki and Alam (2020); El Hawary and Nassar (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Shaikh *et al.* (2020); Levy (1994)
Adversarial culture among project participants	General	Taher (2009); Shah *et al.* (2014); Al Malki and Alam (2020); Erzaij (2020); Hayati *et al.* (2019)
Poor safety measures	Contractor	El Hawary & Nassar (2016)
Adversarial or inclement weather	General	Mukilan *et al.* (2019); Shah *et al.* (2014); Al Malki and Alam (2020); Malki and Alam (2020); Shen et al, (2016); Ali *et al.* (2019); Erzaij (2020); Shaikh *et al.* (2020); Semple *et al.* (1994); Levy (1994); Baloyi & Agumba (2014)

In Table 4.2, the findings of Research Sub-Question 1 are presented. The causes of construction claims identified are codified and classified, based on which project facet they belong to i.e., time, cost, quality or works. At the same time, the project participant who mainly causes each of the construction claims is identified. This means the causes of construction claims are also categorised, based on who causes the construction claim i.e. owner/ client, design consultant/ engineer, contractor of general. By classifying the causes of construction claims, according to which project facet or variable they belong to, as well as to which participant mainly causes the construction claim, it becomes possible to identify and assign IPD benefits essential to reducing the construction claims.

From the 28 identified major causes of construction claims in capital projects, which are contracted under the traditional Design-Bid-Build method, eight can be categorized under the macro code of quality, five under cost, seven under time/

schedule, and eight under scope. Only three causes from the list can be classified as being uncontrollable or beyond the control of the parties, as shown below.

1. Uncontrollable external events, including statutory and regulatory changes, socio-political risks and *force majeure*.
2. Unexpected rise in material prices, and swings in economic and market conditions.
3. Adversarial or inclement weather.

The causes of construction claims can be allocated or be associated with a change in planned or agreed contractor scope, schedule, cost or quality during construction. It is crucial to acknowledge that construction claims from contractors are for additional cost, extension of time or both.

The mind map 4.3 identifies major causes of construction claims and classifies each of them under changes to planned or agreed contractor scope, schedule, cost or quality from the findings in Table 4.2. By minimizing events and situations, which impact or lead to changes in contractor scope, schedule, cost or quality during construction, claims can therefore be reduced. Mapping these findings of the major causes of construction claims under changes to planned or agreed contractor scope, schedule, cost or quality provides insight into what elements are required for the framework required to reduce construction claims.

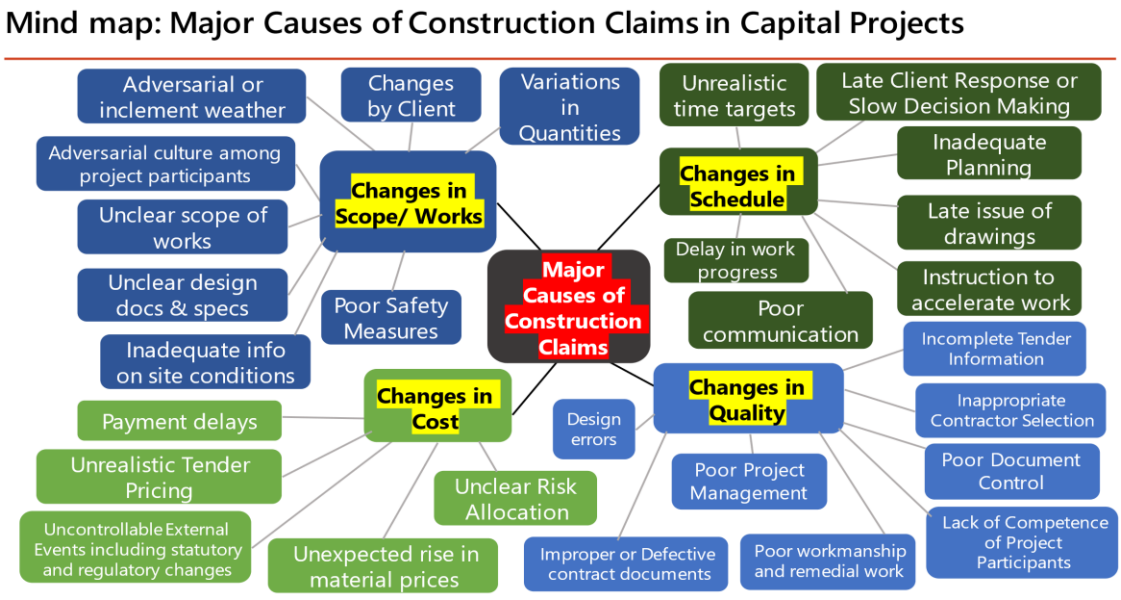

Fig. 4.3: Mind Map Showing Major Causes of Construction Claims. **(Source:** Author)

4.3 BENEFITS OF IPD ESSENTIAL TO REDUCING CONSTRUCTION CLAIMS IN CAPITAL PROJECTS

Similar to the above, from the meta-synthesis method described in Chapter 3, the steps were also followed for Research Sub-Question 2 as follows:

4.3.1 Step One: Expressing the Research Sub-Question 2

The researcher had to provide answers to the four simple questions as follows:

- “What?” For Research Sub-Question 2, it is evaluating the benefits of IPD that can reduce construction claims. This is because IPD has the potential to reduce construction claims.
- For the second question “Who?”, recognised databases, scientific and engineering journals, theses from universities, articles and book publications are also utilised. These have been selected, because they are reliable and recognised.
- For the third question “When?”, the study spans the years 2001 through 2022. This is due to the fact that the IPD approach's first definitions were originally given in 2001, and in 2007 the USA developed the approach's initial set of guidelines.Lastly, for the final question “How?”, reference is made to previous research and published studies on IPD. Thus, the Research Question 2 of this study is as follows: “Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?”

4.3.2 Step 2: Systematic Text Searching for Research Sub-Question 2

In Step 2, the researcher searched texts presented in recognised and reliable scientific and engineering databases through selecting a keyword connected to the research question. The related keywords to evaluating the benefits of IPD that can reduce construction claims are:

1) Integrated Project Delivery (IPD)
2) Benefits of Integrated Project Delivery (IPD) (with synonyms advantages of IPD)

3) Reducing construction claims (with synonyms decrease, minimize or diminish construction claims)
4) Capital projects (with synonyms large or mega infrastructure projects)

Recognised scientific databases reviewed for Research Question 2, are listed below. These databases were selected based on a combination of where the findings of the literature review in Chapter 2 were obtained from, where previous authors on related topics published and the popularity of the databases with academics.

- ASCE
- Science Direct
- AIA
- SMPS Foundation
- Springer
- Wiley
- ProQuest
- Taylor & Francis
- Researchgate
- Academia.edu
- WitsLib Guides

4.3.3 Step 3: Examining and Choosing the Relevant Texts for Research Sub-Question 2

In Step 3, the meta-synthesis of texts is executed. This step includes identifying available studies, and reviewing them to evaluate if they satisfy the inclusion basis put in place. A criterion has to be defined and set with some of the texts being eliminated. The study's criteria include the texts' dependability and publication timeline (which spans from 2001 to 2022). From the collected articles, the Critical Appraisal Skills Program (CASP) technique is used to investigate the quality of the remaining articles. The process of searching and selecting articles is shown in Figure 4.4 below.

2817 resources	Total count of resources retrieved from databases.
	
1417 resources	Total resources obtained through the abstract and title.
	
555 resources	Total resources obtained due to removing those incompatible with research questions.
	
201 resources	Total resources obtained due to removing those with lack of quality of research finding.
	
18 resources	Total resources obtained as a result of the texts content.
	
14 resources	Total resources obtained based on the CASP technique as shown in the table below. The 14 resources were selected as those which scored a total score of over 31 on the CASP scale.

Fig. 4.4: Process of Searching and Selecting Articles for Research Sub-Question 2

In the process of searching and selecting reliable resources, 14 resources were selected as shown in Table 4.3 below.

Table 4.3 CASP Scoring for Research Sub-Question 2 Articles

			CASP Indices										
Title of Article/ Publication	**Authors**	**Year of Publication**	Research Objectives	Logic of the Method	Research Plan	Sampling	Data Collection	Reflectivity	Ethical Considerations	Data Accuracy & Analysis	Clear Expression of Findings	Research Value	**Total Score**
"Integrated project delivery: a guide."	AIA	2007	5	5	5	5	4	5	5	5	5	5	44
"A review and classification of integrated project delivery implementation enablers."	Kahvandi *et al.*	2020	5	5	4	4	5	5	5	5	5	5	43
"Integrated Project Delivery Agreement - A Lawyer's Perspective."	Ashcraft, H. W	2014	5	5	4	4	5	5	4	5	5	5	42
"Analysis of the Benefits of Implementation of IPD for Construction Project Stakeholders"	Alinezhad *et al.*	2020	4	4	5	5	5	4	4	5	5	5	41
"Assessing the Benefits of the Integrated Project Delivery Method: A Survey of Expert Opinions."	De Marco, A., Karzouna, A.	2018	4	4	4	4	4	4	4	5	5	5	38
"Understanding Construction Industry Experience and Attitudes toward Integrated Project Delivery."	Kent, D. C., Becerik-Gerber, B.	2010	4	5	5	4	4	3	4	5	4	5	38
"Integrated Project Delivery (IPD): An Updated Review and Analysis Case Study."	Viana *et al.*	2020	5	4	4	4	4	4	4	4	4	5	37
"Integrated Project Delivery: Managing risk and making it work for all parties."	KPMG	2013	3	3	3	4	4	5	4	4	5	5	35
"Describing the Role of Building Information Modeling and Integrated Project Delivery in Iran Construction Projects and Their Role to Solve Conventional Problems of Construction ."	Bahmani, H.	2017	4	4	4	4	4	4	3	4	4	4	35
"Implementation of Integrated Project Delivery on Department of Navy Military Construction Projects."	Lee, C. S.	2013	4	4	3	4	4	3	4	4	5	4	35
"Adaptability of Integrated Project Delivery in a Construction Industry."	Jayasena, H. S., Senevirathna, N. S.	2012	5	5	4	3	3	3	3	4	4	5	34
"Building Information Modeling and Integrated Project Delivery in the Commercial Construction Industry: A Conceptual Study."	Ilozor, B. D., Kelly, D. J	2011	4	4	3	4	4	4	3	4	4	4	34
"Exploring performance of the integrated project delivery process on complex building projects."	Mesa *et al.*	2016	4	4	3	3	4	4	3	4	4	4	33
"Transitioning to Integrated Project Delivery: Potential Barriers and Lessons Learned."	Ghassemi, R., Becerik-Gerber, B	2011	4	4	4	4	4	4	3	3	3	4	33
"Analysis of the Barriers to the Implementation of Integrated Project Delivery (IPD): A Meta-Synthesis Approach."	Kahvandi *et al.*	2019	4	3	3	4	4	3	3	3	3	3	30
"Quantifying Performance for the Integrated Project Delivery System as Compared to Established Delivery Systems."	El Asmar *et al.*	2013	3	3	3	3	3	3	3	3	4	3	28
"The use of Integrated Project Delivery Approach to reduce stakeholder management challenges in Design-Build contracts."	Bagheri *et al.*	2019	3	3	3	3	3	3	3	3	3	3	27
"Using Integrated Project Delivery (IPD) to Resolve the Major Construction Project Delay Causes in Saudi Arabia."	Alkhalid, K. A	2011	2	3	3	3	4	2	3	3	3	2	26

As can be seen in Step 2, several scientific and engineering databases were investigated to collect articles. Most of the research articles focus on benefits of IPD. After the initial evaluation, a number of articles, which lacked the conditions mentioned in this Step 3, and were irrelevant to IPD were removed (Arbabi *et al.*,

2017). By using the CASP method and selecting articles in accordance with a quality criterion, in a systematic and precise way, all of the required data were covered (Sandelowski & Barroso, 2006). On the CASP method, the indices were scored based on a scale of 1 to 5, to indicate the relevance and strength of each article to IPD benefits which can reduce construction claims on these criteria: research objectives, logic of research method, research plan, sampling, data collection, reflectivity, ethical considerations, data accuracy and analysis, clear expression of findings, and research value.

Total resources found based on the CASP technique are shown in Table 4.3. The 14 resources were selected, as those which scored a total score of over 31 on the CASP scale. By evaluating each paper's accuracy and dependability to determine the 14 resources that remained, the CASP technique helped reduce the total number of publications in the meta synthesis.

4.3.4 Step 4: Extracting the Required Data from Texts for Research Question 2

In Step 4, the 14 remaining resources from the CASP technique results were examined further. The benefits of IPD, which are essential to reducing construction claims in capital projects as mentioned by researchers in earlier studies were extracted. Collected data in this step, was coded, based on whether the type of IPD benefit is contractual or behavioural. Some of the challenges experienced during the coding is when the IPD benefit could be coded against more than one of the criteria. In such a scenario, the criteria with a heavy weighting or more likely to be, was selected for the coding.

4.3.5 Step 5: Analysing and Combining the Results for Research Question 2

As per the meta-synthesis method, in Step 5, descriptive analysis and pattern coding is applied. This pattern analysis was done using the NVivo Pro 14 software, as shown in Figure 4.5.

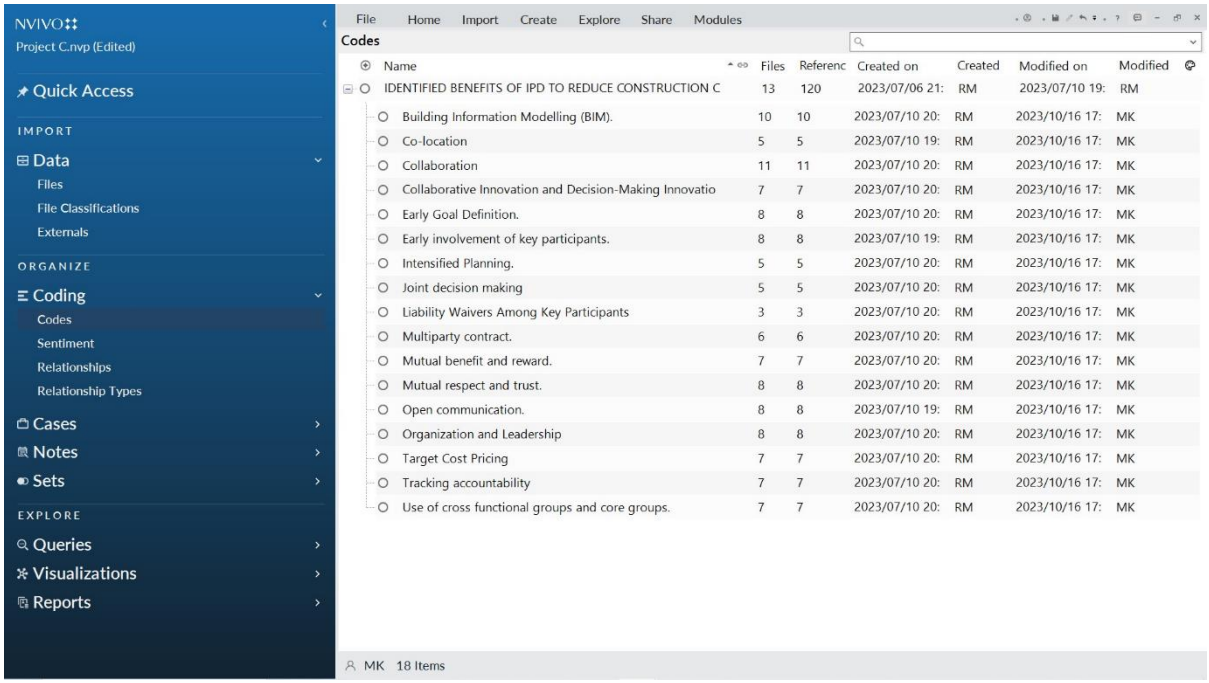

Fig. 4.5: Identified Benefits of IPD Categorized in NVivo Pro 14

4.3.6 Step 6: Quality Control of the Results for Research Sub-Question 2

The CASP technique was utilised as a quality control measure in Step 3 to select the 14 articles. In addition, the coding and classification of data used in Step 5, according to assigning the IPD benefits to the type of claim, which they can reduce, and causer of claim is an additional check on the quality of identified data.

4.3.7 Step 7: Presenting the Results for Research Sub-Question 2

In the final Step 7, the research question stated in Step 1 is answered and presented in the table below. The benefits of IPD which are essential to reducing construction claims in capital projects are considered in this classification. Identifying and classifying the benefits of IPD which can reduce the claims. Their category and link to causers of the claims are important, because they are useful in conceptualising a framework that uses identified IPD benefits as remedies, to causes of construction claims.

For Research Sub-Question 2, benefits of IPD that can reduce the claims identified in the meta-synthesis of Research Question 1 were selected. The findings of Research Sub-Question 2 are presented the Table 4.4 below.

Table 4.4: Findings of Research Sub-Question 2

Macro Code: Type of IPD Benefit	Micro Code: Identified Benefits of IPD to reduce Construction Claims	References
Contractual	Early involvement of key participants.	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Alinezhad et al (2020); Kahvandi *et al.* (2020); Viana *et al.* (2020); Jayasena & Senevirathna (2012); Mesa *et al.* (2016)
	Co-location	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Alinezhad et al (2020); Kahvandi *et al*. (2020); Viana *et al.* (2020); Jayasena & Senevirathna (2012); Mesa *et al.* (2016)
	Intensified Planning.	AIA & AIACC (2007). Ashcraft (2014b); Alinezhad *et al.* (2020); Viana *et al.* (2020); Kent and Becerik-Gerber (2010)
	Tracking accountability	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Kahvandi et al (2020) ; Viana *et al*. (2020); Jayasena & Senevirathna (2012); Mesa *et al.* (2016)
	Liability Waivers Among Key Participants	AIA & AIACC (2007); Ashcraft (2014b); Viana *et al.* (2020)
	Joint decision making	AIA & AIACC (2007); Ashcraft (2014b); Kahvandi *et al.* (2020); Viana *et al.* (2020); Jayasena & Senevirathna (2012)
	Multiparty contract.	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Viana *et al.* (2020); Kent and Becerik-Gerber (2010); Jayasena & Senevirathna (2012)
	Mutual benefit and reward.	AIA & AIACC, (2007); Ashcraft (2014b); Kahvandi *et al.* (2020); Viana *et al.* (2020); De Marco and Karzouna (2018); Jayasena & Senevirathna (2012); Mesa *et al.* (2016)
	Target Cost Pricing	AIA & AIACC, (2007); Ashcraft (2014b); Kahvandi *et al.* (2020); Viana et al (2020); De Marco and Karzouna (2018); Jayasena & Senevirathna (2012); Mesa *et al.* (2016)
	Early Goal Definition.	AIA & AIACC (2007); Ashcraft, (2014b) Kahvandi *et al.* (2019); Kahvandi *et al.* (2020); Viana *et al.* (2020); Kent and Becerik-Gerber (2010); Jayasena & Senevirathna (2012); Mesa *et al*. (2016); Ghassemi and Becerik-Gerber (2011)

	Micro Code: Identified Benefits of IPD to reduce Construction Claims	References
	Collaborative Innovation and Decision-Making Innovation.	(AIA & AIACC, 2007; Ashcraft (2014b); KPMG (2013) Kahvandi *et al.* (2019); Alinezhad *et al*. (2020); Kahvandi *et al.* (2020); Viana *et al.* (2020)
	Building Information Modelling (BIM).	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Alinezhad *et al.* (2020); Kahvandi *et al.* (2020); Viana et al (2020); Jayasena & Senevirathna (2012); Ilozor and Kelly (2011); Bahmani (2017); Mesa *et al.* (2016)
Behavioural	Open communication.	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Alinezhad *et al*. (2020); Kahvandi *et al.* (2020); Viana *et al.* (2020); Jayasena & Senevirathna (2012); Mesa *et al*. (2016)
	Organization and Leadership.	AIA & AIACC (2007); Ashcraft (2014b); Alinezhad *et al.* (2020); KPMG, 2013); Viana *et al.* (2020); Kent and Becerik-Gerber (2010); Jayasena & Senevirathna (2012)
	Use of cross functional groups and core groups.	AIA & AIACC, (2007); KPMG (2013); Alinezhad *et al.* (2020); Viana *et al.* (2020); De Marco and Karzouna (2018); Kent and Becerik-Gerber (2010); Jayasena & Senevirathna (2012)
	Mutual respect and trust.	AIA & AIACC (2007); Ashcraft (2014b); KPMG (2013); Kahvandi *et al.* (2020); Viana *et al.* (2020); Kent and Becerik-Gerber (2010); Jayasena & Senevirathna (2012); Mesa *et al.* (2016); Ghassemi and Becerik-Gerber (2011)
	Collaboration (willingness)	(AIA & AIACC, 2007; Ashcraft (2014b); KPMG (2013); Alinezhad et al (2020); Kahvandi *et al.* (2020); Viana *et al.* (2020); De Marco and Karzouna (2018); Jayasena & Senevirathn (2012); Ilozor and Kelly (2011); Mesa *et al.* (2016); Lee (2013)

Table 4.4 shows 17 identified benefits of IPD, which could reduce construction claims. From this list, 12 can be categorized under the macro code of contractual,

and 5 under behavioural. Identifying the benefits of IPD provides insight into what elements are required for the framework required to reduce construction claims.

The findings of Research Question 1 are presented against the findings of Research Question 2 in Table 4.5 below by assigning identified IPD benefits as remedies, to each of the causes of construction claims. Table 4.5 shows the interrelationships between the causes of construction claims and what IPD can provide to reduce these claims. By assigning appropriate IPD benefits to each cause of construction claims, some identified benefits begin to emerge, as the main remedies by being applicable on various causes of construction claims.

Table 4.5 Findings of Research Sub-Questions 1 and 2

Code/ Category	Cause of Claim	Caused By	Benefits of IPD to reduce the Claim
Quality	Incomplete Tender Information	Client	Early involvement of key participants. Open communication. Co-location
Quality	Inappropriate Contractor Selection	Client	Intensified Planning. Organization and Leadership
Quality	Poor Document Control	Client	Open communication. Co-location. Tracking accountability
Quality	Lack of Competence of Project Participants	General	Intensified Planning. Organization and Leadership
Quality	Poor workmanship and remedial work	Contractor	Tracking accountability. Liability Waivers Among Key Participants
Quality	Poor Project Management	Design Consultant	Tracking accountability. Liability Waivers Among Key Participants. Joint decision making
Quality	Design Errors and Revisions	Design Consultant	Early involvement of key participants. Liability Waivers Among Key Participants.
Quality	Improper or Defective contract documents	Client	Organization and Leadership. Multiparty contract.
Cost	Unrealistic Tender Pricing	Contractor	Open communication. Mutual benefit and reward. Target Cost Pricing

Code/ Category	Cause of Claim	Caused By	Benefits of IPD to reduce the Claim
Cost	Unclear Risk Allocation	General	Open communication. Mutual benefit and reward. Tracking accountability. Joint decision making
Cost	Uncontrollable External Events including statutory and regulatory changes, sociopolitical risks and Force Majeure	General	Organization and Leadership. Intensified Planning. “Use of cross functional groups and core groups.”
Cost	Unexpected Rise in material prices and swings in economic and market conditions	General	Open communication. Mutual benefit and reward. Target Cost Pricing
Cost	Payment delays leading to financial issues	Client	Open communication. Mutual benefit and reward. Target Cost Pricing
Time	Unrealistic time targets	Client	Organization and Leadership. Intensified Planning. Use of cross functional groups and core groups. Joint decision making.
Time	Late Client Response or Slow Decision Making	Client	Mutual respect and trust. Open communication. Co-location
Time	Poor Communication	General	Mutual respect and trust. Early Goal Definition. Open Communication. Organization and Leadership.
Time	Late issue of construction drawings	Design Consultant	Early Involvement of Key Participants. Open Communication. Building Information Modelling (BIM). Intensified Planning
Time	Delay in work progress (inefficiencies)	Contractor	Organization and Leadership. Intensified Planning. *“Use of cross functional groups and core groups”.*
Time	Inadequate planning/ scheduling	General	Early Involvement of Key Participants. Open Communication. Building Information Modelling (BIM). Intensified Planning. Collaboration
Time	Instruction to Accelerate Work	Client	Organization and Leadership. Intensified Planning. “Use of cross functional groups and core groups”

Code/ Category	Cause of Claim	Caused By	Benefits of IPD to reduce the Claim
Works	Inadequate or Unclear Design Documentation and Specifications	Design Consultant	Early Involvement of Key Participants. Open Communication. Building Information Modelling (BIM). Intensified Planning. Collaboration
Works	Unclear Scope of Works	Design Consultant	Collaborative Innovation and Decision-Making Innovation.
Works	Changes by Client	Client	Early Involvement of Key Participants. Open Communication. Building Information Modelling (BIM). Intensified Planning. Collaboration. Use of cross functional groups and core groups.
Works	Variations in Quantities	General	Early Involvement of Key Participants. Building Information Modelling (BIM). Intensified Planning. Use of cross functional groups and core groups.
Works	Differing or Inadequate Information on Site Conditions	Design Consultant	"Early Involvement of Key Participants"
Works	Adversarial culture among project participants	General	Organization and Leadership. Intensified Planning. "Use of cross functional groups and core groups"
Works	Poor Safety Measures	Contractor	Organization and Leadership. Intensified Planning. "Use of cross functional groups and core groups"
Works	Adversarial or inclement weather	General	Intensified Planning. "*Use of cross functional groups and core groups"*

In Table 4.5, identified IPD benefits are assigned as remedies to each of the causes of construction claims based on the findings of the literature review and meta-synthesis. The key findings of Research Sub-Questions 1 and 2 can be summarised by the mind map shown below in Fig. 4.6. Some of the main benefits of IPD, which can reduce construction claims were identified as early involvement, collaboration, joint decision-making and open communication.

The mind map also shows some of the major causes of construction claims causes of construction claims which can possibly be reduced by four of the IPD benefits being: changes by client, unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication.

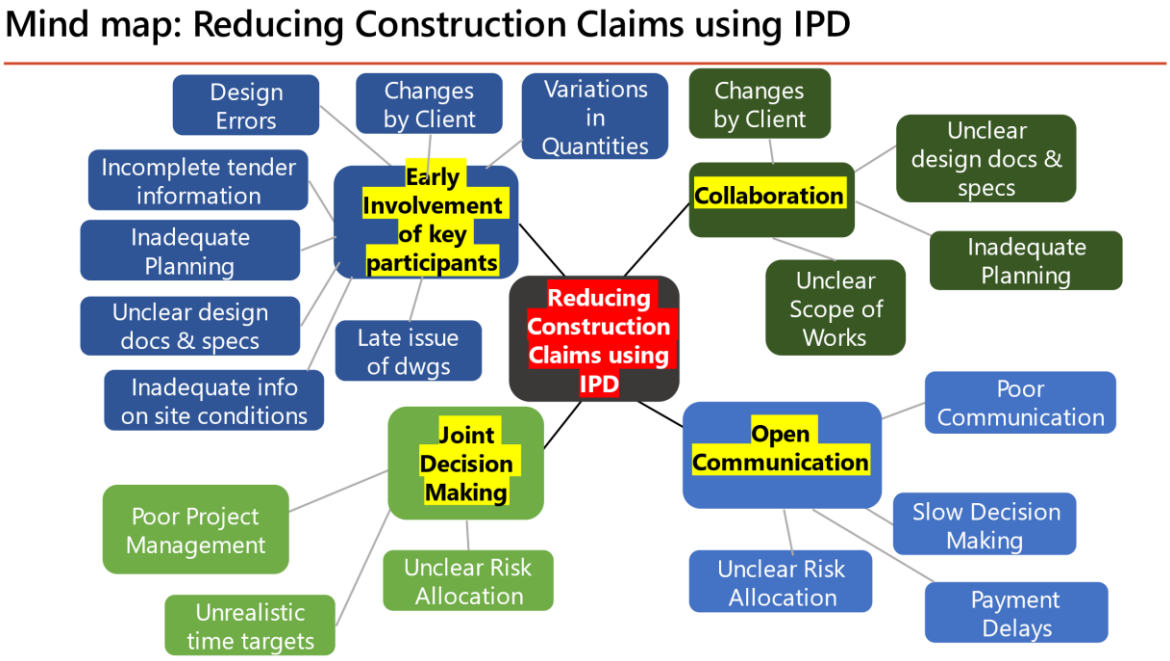

Fig. 4.6: Mind Map of Main Findings of Research Question 1 and 2 (Source: Author)

4.4 CURRENT PRACTICES USED TO REDUCE CONSTRUCTION CLAIMS IN SOUTH AFRICAN MINING CAPITAL PROJECTS

Descriptive analysis using IBM SPSS was used to analyse the results of the questionnaire. This section provides details on how the data was captured, described, analysed, and interpreted in a systematic manner. This includes the demographics results of the respondents and other descriptive statistics.

4.4.1 Statement 1 - Role of Respondent in Mining Capital Projects

The results in Table 4.6 illustrate that most respondents (42.9%) occupy the role of project designer/ consultant/ engineer in the mining capital projects, followed by 33.3% of respondents that occupy the role of client/ owner's team member.

Table 4.6: Role of Respondent in Mining Capital Projects

Statement	Frequency	Percentage
Client/ Owner's Team Member	14	33.3%
Project Designer/ Consultant/ Engineer	18	42.9%
Contractor	10	23.8%
Total	**42**	**100%**

This demographic result shown above sets the stage of the analysis, in terms of the roles played by the participants in mining capital projects. There is a fair representation of the participants across the main stakeholders (client/ owner, designer/ engineer and contractor) on projects, in regard to managing construction claims. This gives balanced responses, from different points of view to the questionnaire.

4.4.2 Statement 2 - How Respondent's Organization Selects Contractors for Capital Projects

The results below (see Table 4.7) show that the majority of respondents (69%) report that their organisation mainly selects contractors using the DBB method. This is consistent with previous research that found that the traditional DBB method was the most commonly used method in South African construction projects (Oshungade & Kruger, 2015; Mbanjwa, 2003; Grobler & Pretorius, 2002). The 19% reporting using IPD may just be the use of some IPD principles on their capital projects, but not full IPD implementation with a multiparty contract, as there is no known real IPD projects implemented in South Africa.

Table 4.7: How Respondent's Organization Selects Contractors for Capital Projects

Statement	Frequency	Percentage
Design-Bid-Build (DBB)	29	69%
Design & Build (DB)	5	11.9%
Integrated Project Delivery (IPD)	8	19%
Total	**42**	**100%**

It is clear from the results above that the majority utilise the DBB method. This makes the responses of the participants to the questionnaire appropriate, since this research aims to reduce construction claims on capital projects, which are contracted under the traditional DBB method.

4.4.3 Statement 3 – Respondent's Experience with Construction Claims On Capital Projects

According to the results below, 40.5% of respondents reported that construction claims cause additional costs on capital projects. This result is as envisaged by other researchers (Lu *et al.*, 2015; Darrington & Lichtig, 2010; Griffin, 1998), who also state that construction claims cause additional costs. 33.3% of the respondents indicated that construction claims can be reduced.

Table 4.8: Respondent's Experience With Construction Claims On Capital Projects

Statement	**Frequency**	**Percentage**
Construction claims are ever present on capital projects	11	26.2%
Construction claims cause additional costs on capital projects	17	40.5%
Construction claims can be reduced	14	33.3%
Total	**42**	**100%**

The results in Table 4.8 are fairly distributed and indicate that construction claims are usually present, cause additional costs but can be reduced. These results are relevant to this research as it aims to reduce construction claims.

4.4.4 Statement 4 – Respondent's experience with the concept of Integrated Project Delivery (IPD)

As indicated in Table 4.9 below, most of the respondents (61%) report that they have only read about IPD. This confirms that IPD is a fairly new concept, which has not yet been fully adopted in South Africa. Previous research by Froise (2014), found similar results that the theme of partnering has not been given enough consideration in the South African construction industry. Only 29.3% of the respondents had experience of working on a project, where IPD was used.

As there is no known full implementation of an IPD project in South Africa, the 29.3%, who reported IPD experience may have been referring to working on projects, were some of the IPD principles - like ‘collaboration’ were used.

Table 4.9: Respondent’s Experience with Concept of Integrated Project Delivery (IPD)

Statement	**Frequency**	**Percentage**
I have experience of working on a project where IPD was used	12	29.3%
I have only read about IPD	25	61%
I have never heard of IPD	4	9.8%
Total	**41**	**100%**
Missing	1	
Total	42	

The results above indicate the newness of the concept of IPD to South African capital projects. These results are appropriate to this research and indicate the opportunity that a newish concept like IPD could bring to the construction industry in South Africa in terms of reducing construction claims.

4.4.5 Statement 5 – Respondent’s Experience with Concept of Building Information Modeling (BIM)

According to the results below (See Table 4.10), majority of the respondents (66.7%) indicate that they have only read about BIM. This indicates that BIM is not being used often on mining capital projects in South Africa. Only 23.8% of the respondents had experience of working on a project where BIM was used.

Table 4.10: Respondent's Experience with Concept Of Building Information Modeling (BIM)

Statement	Frequency	Percentage
I have experience of working on a project where BIM was used	10	23.8%
I have only read about BIM	28	66.7%
I have never heard of BIM	4	9.5%
Total	**42**	**100%**

The results above show that while BIM is known in the capital projects industry, it has not been widely used. These results are relevant to this research, as the use of BIM and IPD in sync has its benefits, which can reduce construction claims.

4.4.6 Statement 6 – Respondent's Years of Experience Working on Mining Capital Projects

The mean score results as shown in Table 4.11 below indicate that on average most respondents have about 14 years of experience working on mining capital projects (Mean= 14,40). This shows that the respondents were experienced professionals in the construction industry. The combined number of years of experience from the respondents, amounted to 605 years, with the most experienced respondent having 43 years' experience, and the least experienced with 2 years' experience, as shown in Table 4.12 below.

Table 4.11: Statistics of Respondent's Years of Experience Working on Mining Capital Projects

N	**42**
Mean	14,40
Std. Deviation	7,221

Table 4.12: Respondent's Years of Experience Working on Mining Capital Projects

Number of Years of Experience	Number of Individuals
0 to 4 Years	1
5 to 9 Years	6
10 to 14 Years	18
15 to 19 Years	8
20 to 30 Years	8
More than 30 Years	1

4.5 ANALYSIS OF QUESTIONNAIRE

The survey questionnaire in Appendix 1, was a purposive and confidential survey within a population of project professionals to investigate the current practices, used to reduce construction claims in South African mining capital projects, delivered under the traditional Design-Bid-Build method. The questionnaire consisted of 20 statements stating various current practices used to reduce construction claims on capital projects.

The participants were asked to rate each statement by placing a cross in only one box most representative of their opinion based on their own experience on using these practices and their effectiveness. A five-point Likert scale where the value 1 corresponds to "Very ineffective" and the value 5 corresponds to "Very effective" was used to measure the following concept: Effectiveness of Current Practices Used to Reduce Construction Claims.

The following scale was used to determine to what degree the participants agreed or disagreed with the statements:

1 = VERY INEFFECTIVE, 2 = INEFFECTIVE, 3 = UNDECIDED,

4 = EFFECTIVE, 5 = VERY EFFECTIVE.

The results of the pre-populated Likert-type scale questionnaires were validated and compared with the theory of the literature study. Central tendency measures were conducted, to assess how centred is the distribution of the constructs involved in the study.

The mean point of a five-point Likert scale is 2.5 (5/2), any mean scores below 2.5 indicate that most respondents tend to either indicate that the practices are very ineffective or ineffective. While mean scores between 2,5 and 3.4 suggest that most respondents tend to be undecided. All the mean scores equal to or above 3.5, suggest that the majority of respondents tend to either report that the practices are effective, or very effective with the statements measuring the constructs, respectively.

As presented in Table 4.13, the overall results indicate that most (n=37; 88.1%) respondents consider a clear definition of project scope to be very effective, while 81% (n=34) of the respondents regard open communication between owner/ client, engineer/ designer, and contractors to be very effective as well. 78.6% (n=33) of the respondents answered, “Very Effective” for the statements “Collaboration between owner/ client, engineer/ designer and contractors” and “Mutual trust between owner/ client, engineer/ designer and contractors”, respectively. Lastly, the results show that 73.8% (n=31) of the respondents believe that ensuring Design Consultants provide quality designs that have been thoroughly reviewed, is very effective.

Table 4.13: Effectiveness of Current Practices Used to Reduce Construction Claims

1. Ensuring Design consultants provide quality designs that have been thoroughly reviewed				
	Frequency	Percentage	Mean	Std. Deviation
Undecided	1	2.4%	4.71	0.508
Effective	10	23.8%		
Very Effective	31	73.8%		
Total	42	100%		
2. Owner or Client has to clearly state needs and requirements before designs are produced				
Effective	15	35.7%	4.64	0.485
Very Effective	27	64.3%		
Total	42	100%		
3. Clear definition of roles and responsibilities on the project				
Undecided	2	4.8%	4.50	0.595
Effective	17	40.5%		
Very Effective	23	54.8%		
Total	42	100%		
4. Early warning process in contracts				
Undecided	5	11.9%	4.21	0.645
Effective	23	54.8%		
Very Effective	14	33.3%		
Total	42	100%		
5. Having procedures in place for control of requests for information from contractors				
Undecided	6	14.3%	4.29	0.708
Effective	18	42.9%		
Very Effective	18	42.9%		
Total	42	100%		
6. Having a risk-sharing philosophy on the project				
Ineffective	2	4.8%	3.98	0.841
Undecided	9	21.4%		
Effective	19	45.2%		

Very Effective	12	28.6%		
Total	42	100%		
7. Clear definition of project scope				
Undecided	1	2.4%	4.86	0.417
Effective	4	9.5%		
Very Effective	37	88.1%		
Total	42	100%		
8. **Change order management on the project**				
Ineffective	1	2.4%	4.17	0.696
Undecided	4	9.5%		
Effective	24	57.1%		
Very Effective	13	31%		
Total	42	100%		
9. A log of all change orders from initiation to final settlement should be kept				
Undecided	5	12.2%	4.29	0,680
Effective	19	46.3%		
Very Effective	17	41.5%		
Total	41	100%		
Missing	1			
Total	42			
10. The owner should insist that contractors provide a reasonable breakdown of their bids to determine what is included and what is excluded				
Undecided	4	9.5%	4.45	0.670
Effective	15	35.7%		
Very Effective	23	54.8%		
Total	42	100%		
11. It is important that all parties understand the contractual notice provisions in the contracts				
Undecided	4	9.5%	4.29	0.636
Effective	22	52.4%		
Very Effective	16	38.1%		
Total	42	100%		

12. Field staff should record at least one or two weather observations each day				
Very Ineffective	1	2.4%	3.74	0.828
Ineffective	1	2.4%		
Undecided	12	28.6%		
Effective	22	52.4%		
Very Effective	6	14.3%		
Total	42	100%		
13. The owner should not unnecessarily delay making interim payments				
Undecided	4	9.5%	4.43	0.668
Effective	16	38.1%		
Very Effective	22	52.4%		
Total	42	100%		
14. Early involvement of key participants i.e. contractors & suppliers being part of the design phase				
Undecided	4	9.5%	4.62	0.661
Effective	8	19%		
Very Effective	30	71.4%		
Total	42	100%		
15. Open communication between owner/ client, engineer/ designer and contractors				
Ineffective	1	2.4%	4.76	0.576
Effective	7	16.7%		
Very Effective	34	81%		
Total	42	100%		
16. Collaboration between owner/ client, engineer/ designer and contractors				
Undecided	2	4.8%	4.74	0.544
Effective	7	16.7%		
Very Effective	33	78.6%		
Total	42	100%		
17. Mutual trust between owner/ client, engineer/ designer and contractors				
Undecided	4	9.5%	4.69	0.643
Effective	5	11.9%		

Very Effective	33	78.6%		
Total	42	100%		
18. Joint decision-making between owner/ client, engineer/ designer and contractors				
Ineffective	1	2.4%	4.50	0.804
Undecided	5	11.9%		
Effective	8	19%		
Very Effective	28	66.7%		
Total	42	100%		
19. Use of Building Information Modeling (BIM) for the design				
Ineffective	1	2.4%	4.24	0.878
Undecided	9	21.4%		
Effective	11	26.2%		
Very Effective	21	50%		
Total	42	100%		
20. Shared risk and reward between owner/ client, engineer/ designer, and contractor				
Undecided	8	19%	4.38	0.795
Effective	10	23.8%		
Very Effective	24	57.1%		
Total	42	100%		
21. Use of a multi-party agreement signed by all major stakeholders - owner/ client, engineer/ designer and contractors				
Very Ineffective	1	2.4%	4.33	1.004
Undecided	10	23.8%		
Effective	4	9.5%		
Very Effective	27	64.3%		
Total	42	100%		
Mean = 4,41 Std. Deviation = 0,337				

The results also show (See Table 4.13 and Fig. 4.7) that most (n=27; 64.3%) respondents think that the use of a multi-party agreement signed by all major stakeholders - owner/ client, engineer/ designer and contractors is very effective,

however, the mean (M=4.33) indicates that it is effective. The mean (M=4.38) of the statement “Shared risk and reward between owner/ client, engineer/ designer, and contractor” also indicates that the respondents believe it to be effective, while the results show that most (n=24; 57.1%) respondents chose “Very Effective” as their response. The results also reveal that even though, most (n=23; 54.8%) respondents believe that the owner should insist that contractors provide a reasonable breakdown of their bids to determine what is included and what is excluded, to be very effective, the overall mean (M=4.45) shows that the respondents consider it as simply effective.

Additionally, the overall mean (M=4.43) shows that the respondents believe that the owner should not unnecessarily delay making interim payments to be simply effective even though most (n=22; 52.4%) respondents believe this to be very effective. Lastly, most (n=22; 50%) respondents chose “Very Effective” for the following statement “Use of Building Information Modeling (BIM) for the design,” whilst the mean shows that the respondents consider the statement to be effective.

In conclusion, the overall results (M=4.41) shows that the respondents consider the statements regarding the effectiveness of current practices used to reduce Construction claims to be effective. The respondents considered the following to be the top five most effective based on the mean scores:

- Clear definition of project scope.
- Open communication between owner/ client, engineer/ designer and contractors.
- Collaboration between owner/ client, engineer/ designer and contractors.
- Ensuring design consultants provide quality designs that have been thoroughly reviewed.
- Mutual trust between owner/ client, engineer/ designer and contractors.

Fig. 4.7: Mean Scores to Responses to The Questionnaire

4.5.1 Responses to Open Question on the Best Practice of Reducing Construction Claims on Capital Projects

Based on the results in Table 4.14, when asked an open question in the questionnaire on what is the best practice of reducing construction claims on capital projects, most of the respondents (43.3%) expressed that there is a need to define the scope of work clearly, and have quality or properly developed designs. This observation is supported by the notable emphasis placed on the highlighted variables, marked in yellow. While some respondents provide further elaboration on the necessity of clearly defining the scope of work, others simply acknowledge its importance.

The majority of respondents who gave this response perform the role of Project Designer/ Consultant/ Engineer on mining capital projects. Similarly, the outcomes highlighted in green, indicate that there is a tendency by some of the respondents (16.8%) alluding to collaborative work, albeit with potential variations in focus.

Another emerging theme from the results in grey (7.2%) is the need for early involvement of contractors, so that they contribute to having a detailed design of the project, as well as giving input into constructability.

Table 4.14: Responses to Open Question on the Best Practice of Reducing Construction Claims on Capital Projects

In your opinion, what is the best practice of reducing construction claims on capital projects?	**Role on mining capital projects**	**Total Percentage**
"A clear scope with a good contracting strategy with effective day to day contract management. Early involvement of constructors in designs to ensure constructability and potential design methodologies to support modular erecting strategies. this is a potential hybrid to IPD. No matter what strategy is used, risk remains with the Owner. There is a misconception that risk can be contracted away. Production losses will never be agreed to in any IPD in my view."	Client/ Owner's Team Member	43.3%
"A clearly defined project scope with solid design, robust early project risk detection system, coupled by the use of modelling technologies and good project governance."	Project Designer/ Consultant/ Engineer	
"Clear scope of work."	Contractor	
"Clearly defined design, scope, and contractual agreements."	Client/ Owner's Team Member	
"Clearly defined scope of work. Early involvement of key stakeholders. Open communication. Collaboration and joint decision-making."	Project Designer/ Consultant/ Engineer	
"Detailed scope."	Project Designer/ Consultant/ Engineer	
"Good maturity of designs."	Client/ Owner's Team Member	
"In my experience, a proper design before construction commences can make the world of difference in terms of Contractor claims. This will limit SI's, rework, awaiting technical query responses and EOT's, due to outstanding or incorrect drawings."	Project Designer/ Consultant/ Engineer	
"Managing Client scope creep. Early engagement. Very clear scope definition."	Project Designer/ Consultant/ Engineer	
"Properly defined scope of work."	Contractor	

In your opinion, what is the best practice of reducing construction claims on capital projects?	Role on mining capital projects	
“Quality designs and good communication.””	Project Designer/ Consultant/ Engineer	
“The client should clearly define his requirements, so that the scope of work is also clearly designed in full.”	Project Designer/ Consultant/ Engineer	
“The client should ensure the scope of work is clearly defined and designed fully to specifications.”	Contractor	
“The owner/ client should ensure the designs prepared by the engineer are clear and accurate to the client’s needs.”	Contractor	
“The scope of work should be clearly defined.”	Project Designer/ Consultant/ Engineer	
“Well defined and detailed scope which is constructable.”	Contractor	
“Well defined project scope of work.”	Client/ Owner’s Team Member	
“Client requirements all stakeholders, request tender to design, sign off, Design, RFQ, review, bid allocation, manufacture, build, regular client meetings, limit design changes, this impacts time cost quality.”	Project Designer/ Consultant/ Engineer	16.8%
“Collaborate and risk/ reward sharing.”	Client/ Owner’s Team Member	
“Collaboration.”	Project Designer/ Consultant/ Engineer	
“Collaboration and trust.”	Contractor	
“All parties working together and trusting each other.”	Contractor	
“Collaboration, open communication, joint decision-making and early involvement of key participants.”	Client/ Owner’s Team Member	
“Teamwork, collaboration, mutual trust and communication amongst all the parties.”	Project Designer/ Consultant/ Engineer	
“Early involvement of contractors in the design stage, so that constructability aspects can be considered.”	Contractor	7.2%
“Early involvement of contractors to ensure design is adequate.”	Client/ Owner’s Team Member	
“Early involvement of the contractors to contribute in the detailed design.”	Contractor	

In your opinion, what is the best practice of reducing construction claims on capital projects?	Role on mining capital projects	Total Percentage
"BIM"	Client/ Owner's Team Member	2.4%
"Adherence to contractual Early Warning process, where all role players issue Early Warning timeously, and this is followed by a risk reduction meeting with relevant stakeholders and a clear action plan. Any changes on the project should be approved by the owner, to avoid scope creep."	Project Designer/ Consultant/ Engineer	2.4%
"The best practice for reducing construction claims on capital projects involves a combination of proactive measures, effective communication, and strong contract management. Here are some key strategies to achieve this goal: Thorough planning and risk assessment: Before starting the project, conduct comprehensive planning and identify potential risks. Assess the project's scope, schedule, budget, and resources to develop a clear understanding of the project's requirements. This helps in reducing the likelihood of disputes arising from misunderstandings, or unrealistic expectations. Clear and detailed contracts: Develop well-defined and comprehensive contracts that outline the responsibilities and obligations of all parties involved. Ensure that the contract includes detailed specifications, project scope, payment terms, and dispute resolution mechanisms. A clear and detailed contract can significantly reduce the chances of misunderstandings or disagreements during the project. Effective communication: Establish open and transparent communication channels between all stakeholders, including the project owner, contractor, subcontractors, and suppliers. Regularly update all parties on project progress, changes, and potential issues. Effective communication helps to identify and resolve potential disputes before they escalate into construction claims. Regular progress monitoring and documentation: Monitor project progress closely and document all aspects of the project, including work completed, change orders, delays, and additional costs. Maintain a comprehensive record of project documentation, including correspondence, meeting minutes, and photographs. This information can be crucial in resolving disputes or defending against construction claims. Change order management: Establish a well-defined process for managing change orders, including a clear procedure for reviewing, approving, and documenting changes. Ensure that all parties understand the process and adhere to it. Properly managing change orders can help prevent disputes related to scope changes, cost overruns, and delays. Proactive issue resolution: Identify potential	Client/ Owner's Team Member	2.4%

issues early and address them proactively. Engage in open dialogue with all stakeholders to resolve problems before they escalate into disputes or claims. Encourage collaboration and foster a problem-solving mindset among all parties involved in the project. Expertise and training: Employ experienced professionals and ensure they receive proper training in contract management, communication, and dispute resolution. This helps create a knowledgeable and competent team that can effectively manage and mitigate construction claims. Dispute resolution mechanisms: Include clear and efficient dispute resolution mechanisms in the contract, such as mediation, arbitration, or adjudication. This can help resolve disputes quickly and cost-effectively, reducing the likelihood of construction claims. By employing these best practices, construction claims on capital projects can be significantly reduced, ensuring smoother project execution, cost control, and improved stakeholder relationships."		
"IPD Methodology."	Client/ Owner's Team Member	2.4%
"It's important to adhere to the project milestone."	Client/ Owner's Team Member	2.4%
"Open communication, early warning, collaborative problem-solving, and fair and equitable claim determination."	Project Designer/ Consultant/ Engineer	2.4%
"Openness, transparency, preparedness of the Engineering design team with respect, completeness of construction designs. A good understanding of client end-user requirements, and an incentivised performance system anchored on informed comprehensive construction schedule."	Project Designer/ Consultant/ Engineer	2.4%
"Proper change management processes."	Project Designer/ Consultant/ Engineer	2.4%
"Proper planning, and construction management processes, including the early selection of competent designers and construction firms."	Client/ Owner's Team Member	2.4%
"Sound Contract and Construction Management from all project entities (Owner, Design Consultant and Construction) by having the right personnel for critical project personnel."	Project Designer/ Consultant/ Engineer	2.4%
"The whole planning process for the project from design, procurement, construction and commissioning should be subjected to reviews by all stakeholders. All stakeholders should be aligned, as far as the project scope and deliverables are concerned."	Client/ Owner's Team Member	2.4%

In your opinion, what is the best practice of reducing construction claims on capital projects?	Role on mining capital projects	Total Percentage
"Turnkey Projects to minimise cost and schedule risk for client/owner."	Client/ Owner's Team Member	2.4%
Total		**100%**

4.6 RELIABILITY OF CONSTRUCTS

Reliability is associated with the degree to which measuring a phenomenon yields reliable, consistent and steady data (Taherdoost, 2016). The reliability analysis was carried out on "Effectiveness of Current Practices Used to Reduce Construction Claims" in order to measure consistency.

The threshold value of the Cronbach's alpha is 0.7, (Hair *et al.*, 2014) with 0.6 being acceptable in some instances (Malhotra, *et al.*, 2017). The results in Table 4.15 below demonstrate that the construct is intrinsically compatible and consistent in the way it measures since the Cronbach's Alpha value of 0.836 is above the required threshold (0.7) and meaning the test was 83.6% reliable.

Table 4.15: Reliability of Constructs

Constructs	Items	Corrected item-total correlation	Cronbach's alpha	Number of items
Effectiveness of Current Practices Used to Reduce Construction Claims	Ensuring Design Consultants provide quality designs that have been thoroughly reviewed	,530	0.836	21
	Owner or Client has to clearly state needs and requirements, before designs are produced	,242		
	Clear definition of roles and responsibilities on the project	,312		
	Early warning process in contracts	,308		
	Having procedures in place for control of requests for information from contractors	,334		
	Having a risk-sharing philosophy on the project	,558		
	Clear definition of project scope	,609		

	Change order management on the project	,061		
	A register of change orders from commencement to close out should be kept	,215		
	The owner should insist that contractors provide a reasonable breakdown of their bids to determine what is included, and what is excluded	,274		
	It is important that all parties understand the contractual notice provisions in the contracts	,338		
	Field staff should record at least one or two weather observations each day	,460		
	The owner should not unnecessarily delay making interim payments	,274		
	Early involvement of key participants i.e., contractors & suppliers being part of the design phase	,446		
	Open communication between owner/ client, engineer/ designer, and contractors	,281		
	Collaboration between owner/ client, engineer/ designer, and contractors	,566		
	Mutual trust between owner/ client, engineer/ designer, and contractors	,650		
	Joint decision-making between owner/ client, engineer/ designer and contractors	,488		
	Use of Building Information Modeling (BIM) for the design	,390		
	Shared risk and reward between owner/ client, engineer/ designer, and contractor	,574		
	Use of a multi-party agreement signed by all major stakeholders - owner/ client, engineer/ designer, and contractors	,672		

4.7 USE OF IDENTIFIED IPD BENEFITS AS REMEDIES TO CAUSES OF CONSTRUCTION CLAIMS

This section presents the qualitative data that was collected using a focus group and the analysis. A focus group interview session (as per the protocol in Appendix 3) running for 90 minutes was conducted with 15 experts in the area of project management and IPD to answer the 4th Research Sub-Question – "How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?"

The researcher was the moderator of the session, which was held and recorded online via MS Teams with the 15 experts. The recorded discussion was converted and transcribed. The transcribed data was then uploaded into NVivo Pro 14. Typographical errors and missing words were discarded, and meaningful codes were developed to support and ease the analysis process. The focus group participants are identified with pseudonyms as speakers, to avoid the use of their names.

The pseudonyms to identify each speaker are Speaker 1, Speaker 2, Speaker 3, Speaker 4, Speaker 5, Speaker 6, Speaker 7, Speaker 8, Speaker 9, Speaker 10, Speaker 11, Speaker 12, Speaker 13, Speaker 14 and Speaker 15, as shown in Table 4.16.

Table 4.16: Focus Group Participants' Background Information

Pseudonym	Role	Industry	Qualification	Years of Experience
Speaker 1	Project Director	Client/ Owner	Master's Degree	25
Speaker 2	Commercial Director	Engineering Consultant	Master's Degree	16
Speaker 3	Director, Quantity Surveying	Quantity Surveying Consultant	BSc Honours Degree	36
Speaker 4	Principal Project Manager	Client/ Owner	Master's Degree	32
Speaker 5	Expert Partner	Project Management Consultant	Master's Degree	22
Speaker 6	Project Director	Contractor	Master's Degree	27

Pseudonym	Role	Industry	Qualification	Years of Experience
Speaker 7	Construction Project Manager	Engineering Consultant	BSc Honours Degree	19
Speaker 8	Project Director	Client/ Owner	BSc Honours Degree	34
Speaker 9	Expert Partner	Project Management Consultant	Master's Degree	18
Speaker 10	Manager, Quantity Surveying	Quantity Surveying Consultant	BSc Honours Degree	22
Speaker 11	Project Director	Client/ Owner	BSc Honours Degree	29
Speaker 12	Construction Project Manager	Contractor	BSc Honours Degree	32
Speaker 13	Project Director	Contractor	Master's Degree	26
Speaker 14	Construction Project Manager	Engineering Consultant	BSc Honours Degree	23
Speaker 15	Project Director	Client/ Owner	Master's Degree	27

The background information on the focus group participants gives an overview of their roles, qualifications and experience in the capital projects construction sector. The participants' qualifications and experience are in construction project management, engineering, quantity surveying, contracting, equipment supply and project management consultancy.

The diversity of where the participants work as in Client/ Owner, Engineer/ Consultant or Contractor side, gave balance and fairness to the data collected. The participants are experienced construction industry experts in project management with an understanding of IPD, who provided data that was relevant and reliable.

The responses from the experts were merged with findings from the literature review, and questionnaires performed for the other research questions, together with industry best practices, reports and standards to conceptualise a framework that uses identified IPD benefits. as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

4.7.1 Analysis of Focus Group Interviews

The data from the focus groups interviews was organised and classified through linking it to the following themes that were identified during the organising and perusal phases.

1) Theme 1 - Main causes of construction claims in capital projects.
2) Theme 2 - Benefits of IPD most effective to be used as remedies to construction claims.
3) Theme 3 - How IPD benefits can be borrowed and infused into the management of mining capital projects delivered under the traditional DBB method so as to reduce construction claims.
4) Theme 4 - Reviewing and validating a framework that uses identified IPD benefits as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

The results of the focus group interviews will now be discussed.

4.7.2 Theme 1 – Main Causes of Construction Claims

To kick-start the focus group discussion, the moderator outlined findings from literature, in terms of changes being the main causes of construction claims on DBB projects, together with the other identified main causes, being unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication.

In a mission to unpack the different experiences speakers faced with regards to the rise of construction claims, participants were asked to comment on these findings, and what seemed to be their understanding of the causes of construction claims in mining capital projects. The discussion for Theme 1 on the main causes of construction claims was categorized in NVivo Pro 14 as shown in Figure 4.8 below.

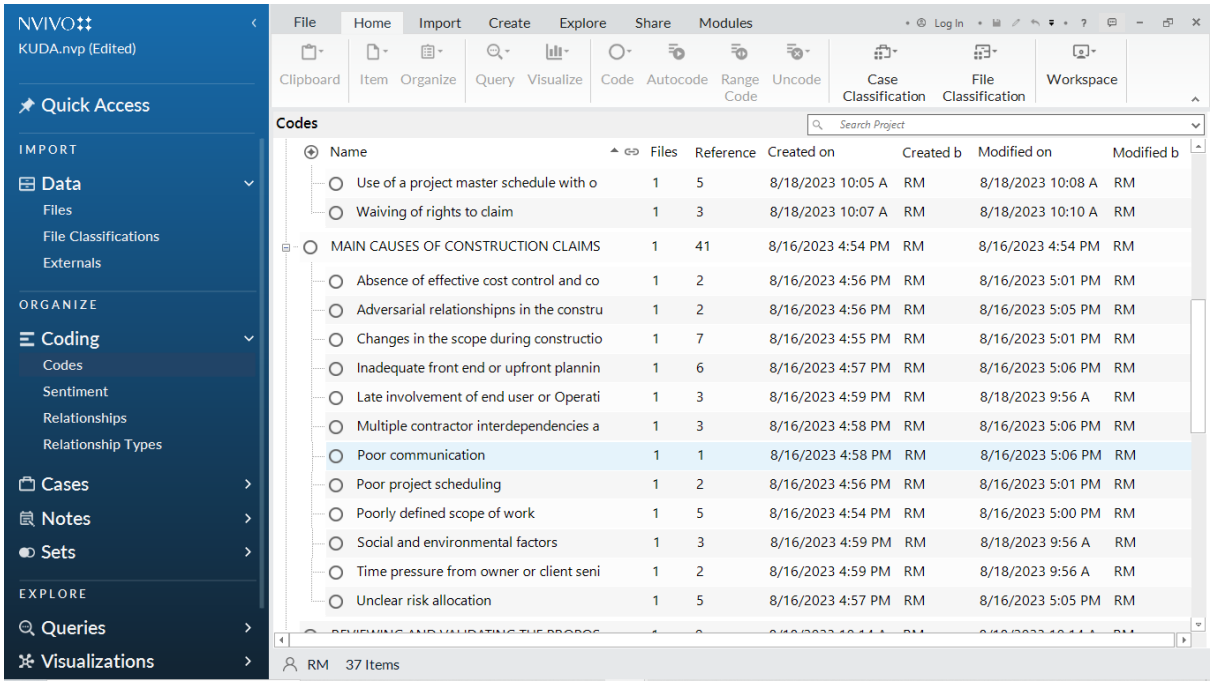

Fig. 4.8: Main Causes of Construction Claims in Mining Capital Projects Categorized in NVivo Pro 14

4.7.2.1 Poorly Defined Scope of Work

Speaker 1 argued that besides changes, claims are mainly caused by poorly defined scopes of work and had this to say.

> "I think the one that we see fairly regularly, you just touched on it, apart from change, it is scope definition not properly done. And I include in that, scope definition, also your construction drawings are not 100% there or unclear. That caused us quite a bit of issues."

Speaker 2 echoed sentiments shared by Speaker 1 and further alluded that it is not the only issue.

> "I would definitely agree with that. I would say, aside from unclear scope definition at the time of construction, integration and coordination probably marks one of the greatest sources of risk when it comes to construction claims."

Speaker 10 added on, emphasising the importance of mature detailed designs at tender stage, so that there are no variations later which cause construction claims.

"On that project for Client X, there were so many variations on specifically the structural steel contracts. You have to really look at the maturity of your design and ensure, even at feasibility phase that your maturity is at the level it should be, and that is one of the problems we have; that we don't have maturity of designs when we go to tender on the documentation that you issue to the contractor. I think you have covered it under design documents, specifications, drawings, and I think that's the biggest problem in the industry - is chasing end dates, without having proper designs."

4.7.2.2 Poor Project Scheduling

Other participants outlined that poor project scheduling, often results in some contractors being requested to establish on site too early, before access to the works can be handed over to them, leading to delay and standing time claims.

Speaker 3, expounded further:

"I think one of the other things I don't see here, which we have also experienced in some of the projects on claims, is the too early establishment of the follow-on contractors. We've had a couple of projects with civils, which were awarded, and then the following on contract, gets awarded too early and they established on site too early. So, it's poor scheduling from the client and then when it gets to sites, he's got no access, resulting in standing time claims and stuff like that."

Additionally, Speaker 4 stated that she concurs with the argument made by the speakers in the extract below that inadequate scheduling is one of the factors leading to construction claims.

"I want to support what the other speakers have said. Your scope and your schedule, probably 80% of all claims can be in some sort of fashion, connected to those two buckets. And then of course, the risk allocation or contingency, whether that's financial or scheduler related or whatever related. But in my mind, those three big headings (scope, schedule and risk allocation) probably really cover 90% of all claims or even more."

4.7.2.3 Absence of Effective Cost Control and Contract Management

Speaker 3 indicated that sometimes owners or clients fail to put in place effective cost control and contract management on capital projects, leading to contractors taking advantage and submitting various construction claims.

> "I mean, Power Station 1 and Power Station 2, I was initially involved in assisting the client in trying to set up proper cost management on the project, but the recommendations we made, they never followed. But I think that the biggest problem for me, on Power Station 1 and Power Station 2, was that proper cost management wasn't applied from day one. Hence all your construction claims coming forward."

Speaker 3 further highlighted that:

> "The project was not executed with one QS on the project. In the old days, the Electricity Company always appointed quantity surveyors separately to manage the cost of your big, measured packages. And we had various discussions and recommendations we have written to the management contractor, both from Power Station 1 and Power Station 2. Engineering Consultant Y, on Power Station 1, I wrote a big report, and we had lots of meetings in Electricity Company's head office with Engineering Consultant Y and eight Quantity Surveying practices that could provide proper cost management and contract management. The client never accepted that. So, I think that's one of the issues is, if you don't have proper cost management from Day 1 on the project and contract management, you will sit with claims."

4.7.2.4 Adversarial Relationships in the Construction Industry

Speaker 1 highlighted the mistrust and adversarial relationships that exist in the South African construction industry, which hinder collaboration and lead to some contractors undercutting their pricing, when bidding to get the contracts, but then try to recover costs through inflated construction claims:

> "It comes back to the adversarial relationship between the client and the contractor. I have also been on projects, where I got the feeling that the contractor submitted a tender at a very low price, so as to get the job, and he

does everything in his power to recover through claims. Claims, whether those are valid or not, he inflates those out so much so that I think with the hope of putting a 200% claim in there, with the hope of getting 120%. This is 20% more than what he should have got in the first place" (Speaker 1).

Speaker 8 agreed with Speaker 1, saying:

> "I totally agree with Speaker 1. There is so much mistrust in our construction industry. Some contractors are known for being more claims-orientated than others, they are always looking for loopholes to submit claims. Collaboration and teamwork is just absent on these DBB projects. The industry is antagonistic in general."

4.7.2.5 Inadequate Front End or Upfront Planning

Owners typically have an understanding of the capital project, but do not have capacity, nor capability to properly execute the project. The speakers mentioned that it was important for the project team executing the project to adequately plan upfront on execution during the feasibility studies, and spend time understanding the scope and its specifications.

Speaker 5 explains further:

> "I think there's a bit of nuance as well that we always pick up. So even if either scope was well-defined or specification, you will also sometimes see that the interpretation of a requirements is not clear, and we are not investing enough time upfront to make sure everybody understands these specifications and the requirements."

Speaker 5 insinuated that there is a thorough need to map out a project thoroughly without skipping other phases involved in planning.

> "When we talk about scoping, the direct scope often is probably the best to find, the indirect scope and the project execution plan and the testing of that we often find, that's actually the biggest issue during construction. We know what we want to build, but not how we want to build it. And I think just on the execution model, we talk about poor project management, but also if the

processes are streamlined in dealing with variations and change orders, that in itself creates claims as well, because work gets done, or people are standing, or work has to be reworked, or because it's taking so long to get a decision. It's got a massive cash flow impact on the contractors, and then the contractors also then start to do concurrent claims and stuff to try and get some cash."

Speaker 3 echoed similar sentiments, arguing that there is pressure from the Owner/ Client to implement the project, without thoroughly going through all the feasibility studies, and planning stage gates. This often leads to many changes during construction, as design deficiencies are rectified, resulting in construction claims.

Speaker 3 elaborated as follows:

> "Absolutely correct, we sometimes push through the project stage gates of concept, pre-feasibility (PFS) and definitive feasibility studies (DFS), without having due diligence done properly. Some clients get to DFS on something that they haven't really selected as the right option."

4.7.2.6 Multiple Contractor Interdependencies and Lack of Access

Participants in the focus group mentioned that when contracts are interdependent, or when one contract's performance depends on another, complexity increases, and lack of access to the works when required, often arises. For instance, delays or changes to one contract may have an impact on the others, disrupting the schedule, and leading to construction claims.

Participants illuminated:

> "And then obviously the link between the different multiple constructing companies, if you have more than more than one, if you don't have a principal contract, as EPCM management also leads to quite a bit of issues and claims, lots of claims as well" (Speaker 1).

Speaker 2 went on to explain the negative effects of the contracts' interdependence on the project, stating that:

> “The complexities can make it difficult to maintain consistent quality standards across multiple contracts.”

Speaker 15 agreed and added:

> "Interfacing and integration with multiple contractors, particularly, where you don't have a principle or main contractor, often results in lack of access to the works, when required by the contractor as per schedule, which often results in claims for standing time and delays.”

4.7.2.7 Time Pressure from Owner/ Client Senior Leaders or Board

The speakers were asked what could be the reason why project designs and documentation are not mature enough, when bidding or requests for tender are launched. It was mentioned that it is typical in the construction sector to chase project end dates, without having proper designs. This being due to time pressure from Owner/ Client senior leaders or board, requiring capital projects to be completed early, so production can commence for profit, as promised to shareholders. Such chasing of early project completion dates could have the opposite effect, and leads to overall project lateness, which results in delay construction claims.

Speaker 3 gave an example as follows:

> “Yeah, we have got a typical example. We are doing a gold plant in the Z Province, where the decision was taken by the client to get gold to the market at a certain set date. The feasibility wasn't done properly, in our view, the design work was far behind, ordering of material also behind, because the design work was late. So ordering of material, specifically piping, because everything was pre-issued, I mean, the project is nearly six to eight months late. So sometimes it's not good to say, I need to hit the market with my product on this date, but I'm not near ready to get my contractors on site from a design point of view. And then the Owner/ Client blames the engineering and design consultants. But he's not giving them adequate time to set the project up, and do design properly.’’

4.7.2.8 Social and Environmental Factors

The focus group discussion progressed to the social and environmental factors that could delay and impact capital projects in the South African context. The speakers emphasized the lack of attention, given to the social and community unrests, specifically labour issues, and the presence of community forums (who disrupt sites demanding business opportunities) within the construction industry in South Africa. The impact of lobbying and demonstrations by environmental activists against some mining capital projects was also mentioned. They highlighted that these factors contribute to disruptions and delays, which cause construction claims.

Speaker 2 had this to say:

> “Not a lot of focus is given, particularly in our contracting environment in this country, specifically to the social environment with regards to labour issues and things like the so-called ‘construction mafia’ and how that creates disruption, and delay on projects and results in claims.”

Speaker 11 concurred and added:

> "We have done projects in this country that are on the scale of giga, the likes of Power Station A and Power Station B, of which the greatest source of construction claims was undoubtedly due to labour unrest in South Africa, as well as integration and coordination amongst contractors (main contractors/ principal contractors)."

Speaker 10 made a comment on the delay impact that could be caused by environmental activists:

> “On one of the capital projects I worked on in KZN, which was delayed for many months, due to environmental objections and appeals. If the host communities and the environmental activists were engaged earlier, we would have avoided the delays, which caused us construction claims. I think this early involvement of key participants called for by IPD, in the South African context, should involve other stakeholders, like the host communities and environmental activists, and that type.”

4.7.2.9 Late Involvement of End User/ Operational Team

The focus group discussion moved to discussing the role of the end user or operations team in the design and their involvement on the project, and its impact on construction claims. The importance of involving the operational team early in a project to avoid numerous changes, (which cause construction claims) later on was highlighted.

Speaker 6 gave an example and had this to say:

> “So the initial design was done by Project Team. Then on execution you bring on, (1), a different execution team, (2), you then bring on the end client in terms of the operators, who had a totally different idea at the point of execution with an ordinate amount of power. Which then results in a lot changes. So while sometimes the project may have matured to where it needs to be, but not all stakeholders have been included or rather powerful stakeholders that stay on the side line, either deliberately or through a lack of time, then get involved much later in the project, and they create quite a lot of design chaos. In my experience, the day that you get the final owner on your project, is the day your nightmares start. Because that's when all the changes come that you had not anticipated. Do the changes mean that what you've done was wrong? Probably not. A lot of it is probably opinion engineering. And a lot of it may be preferences, due to personal experience and so on. So it's the stakeholders, and who the stakeholders are. Sometimes you underestimate the power of the final user of the plant, who are normally too busy in other areas of the business to participate in the early stages of development.”

Speaker 13 concurred with Speaker 6 and mentioned the importance of involving the operational readiness team early:

> “Exactly. But you see, the operational team needs to be part of the design team, because by the time they get involved, they will come and say No, but this is what you’ve designed. No, we don't want this. And you've done 90% of the work, and they are quite adamant. So it becomes very difficult.”

Speaker 3 further mentioned the importance of avoiding design changes, (which cause construction claims) that come later on the project from the operational team.

> “One of the lessons learned is clearly that the operational team came on board on that project very late, resulting in lots of changes. I think I've done a couple of projects in my life where it worked well, but the operational team was involved during the feasibility phase of the project. So it was clear that the problem is when your operational team gets on board later on, which is the reason for lots of changes, and you need to mitigate that during your feasibility phase.”

4.7.2.10 Key Findings from Theme 1

The speakers in general agreed that changes in design and scope during construction are the main causes of construction claims in mining capital projects.

From the discussions, inadequately defined scope of work also emerged as a main cause of construction claims in capital projects. This is line with literature review, which identified unclear design documents and specifications as another main cause. Inadequately defined scope of work results in changes in scope during the construction phase.

In essence, what the participants said confirms the literature review finding that changes are the main causes of construction claims in capital projects. Other causes identified from literature which the focus group speakers also agreed with, were unclear risk allocation, inadequate planning and poor communication to complete the top five ranked causes, as per the focus group discussion.

Additional causes, which the focus group highlighted as other causes of construction claims on mining DBB projects are listed and ranked in Table 4.17 with the frequency of responses and comments from the speakers.

Table 4.17: Main Causes of Construction Claims in Mining Capital Projects in South Africa Identified by Focus Group Speakers

Main Causes of Construction Claims in Mining Capital Projects in South Africa identified by Focus Group Speakers	**Frequency**	**Rank**
Changes in scope during construction	7	1
Inadequate front end or upfront planning	6	2
Poorly defined scope of work	5	3
Unclear risk allocation	5	3
Poor communication	5	3
Multiple contractor interdependencies and lack of access	3	6
Social and environmental factors	3	6
Late Involvement of End User/ Operational Team	3	6
Poor project scheduling	2	9
Absence of effective cost control and contract management	2	9
Adversarial relationships in the construction industry	2	9
Time pressure from Owner/ Client senior leaders or board	2	9

4.7.3 Theme 2 – Benefits of IPD Most Effective to Be Used as Remedies For Construction Claims

This section examines the benefits of IPD most effective to be used as remedies to construction claims on DBB capital projects. During the focus group, the moderator indicated that literature review research had identified the following benefits of IPD as those most effective to be used as remedies to construction claims: early involvement, collaboration, joint decision-making and open communication. The speakers were then asked whether they agreed with this, and what their comments and insights were on the matter.

The discussion for Theme 2 on the benefits of IPD most effective to be used as remedies for construction claims was categorized in NVivo Pro 14, in Figure 4.9.

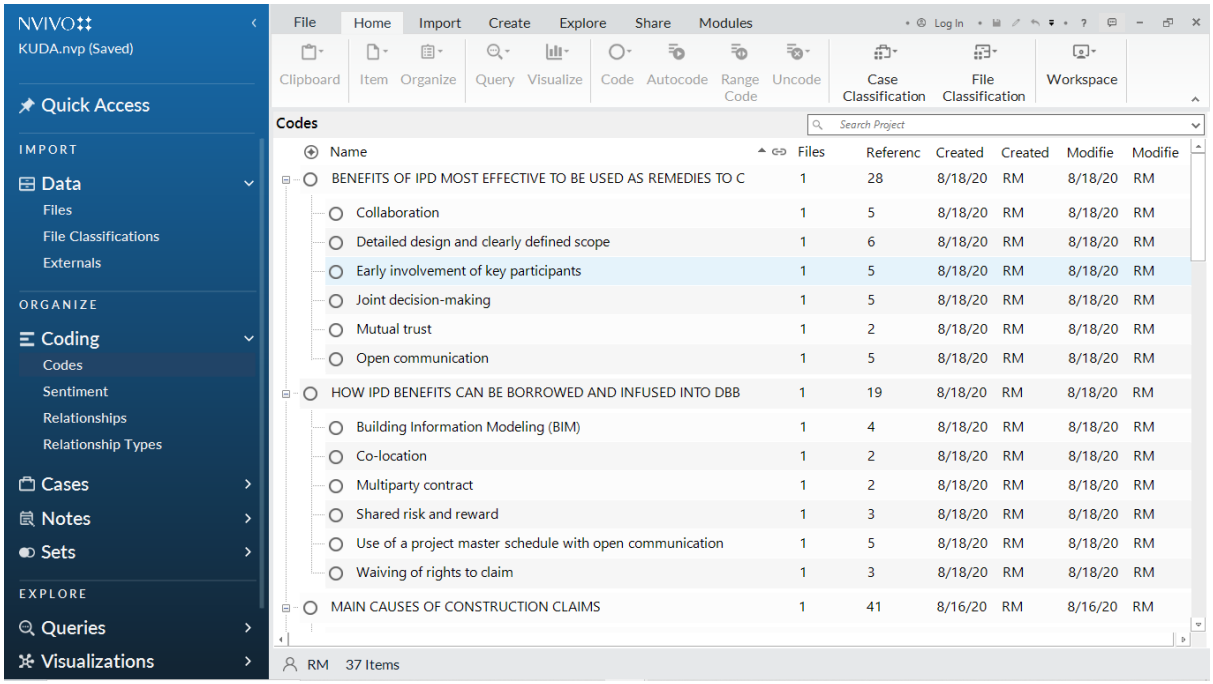

Fig. 4.9: Benefits of IPD Most Effective to be Used as Remedies for Construction Claims Categorized in NVivo Pro 14

Below is what the speakers mentioned and discussed.

Table 4.18: Speakers' Responses to IPD Benefits that Can Be Used to Reduce Construction Claims

Pseudonym	Discussion Responses
Speaker 1	"I don't find any issue with using these IPD benefits to reduce construction claims. The only thing that I question a little bit is on, and maybe there's ways of dealing with it, it's on the commercial side of it. If you are creating an expectation with the contractor by involving them early on the design, that if you haven't contracted with him yet, how do you deal with the commercial side of it and make sure that you still get a competitive price at the end?"
Speaker 2	"A couple of years ago, Mining Co1 embarked on building lots of platinum concentrated plants. Obviously, they had a very strong project department, but what we did is exactly what is being suggested, is we did the collaboration agreements. We went to tender on a typical bill of quantities for a concentrator because the platinum concentrators, in essence are very similar. We then signed collaboration agreements with two or three, three or four contractors. Say for instance, on the civil side and the same with the SMPP, but that you can only do if you have got a pipeline of projects coming. So you can do that collaboration, if you have a project pipeline."

Pseudonym	Discussion Responses
Speaker 3	“I agree with you, early involvement and even the second item collaboration, we tend not to involve some of our construction contractors. During our feasibility phase, and some of the clients that I've worked with in the past, especially on the larger projects, is to try and get some of the contractors involved to look at constructability during feasibility phase to ensure that you have that early involvement, and early advice that what you're trying to build from a constructability point of view will work, during even preparing your feasibility. Now a lot of the clients don't do that. And then when we go out in the market (on tender), the contractors come back questioning constructability of the project.“
Speaker 6	“I understand the motivation of wanting to go into collaboration, I also have some experience of working with a particular client in a collaborative sense, going through construction. The first couple were okay, until the view was that we are running out of work, and contractors then started kind of changing goalposts, slowing things down and trying to milk as much as possible. And the model collapsed. So it's difficult to create the level of honesty that is required to get the collaboration, because sometimes the contractors themselves feel that the collaboration is always in favour of the owner. And the owner has very little trust in many ways, with even the collaborating partners, because of the inherent mistrust that sometimes exists between contractors and their clients.”
Speaker 12	“On early involvement of key participants, what we have seen is that most of the times in these mining companies, the Owner’s team has an instruction from their finance departments to push out spending capital, as far as they can. In other words, they would be reluctant to spend more upfront by engaging contractors in the feasibility and design stages to get that detailed design and constructability we spoke about. This is because sometimes projects get canned or stopped in earlier stage gates, and don’t get to construction. Nonetheless, if the project gets approved for construction and you have not done your detailed design fully, it creates time pressure to commence with construction, because the same Owner’s team does not change the required overall project completion date. We experience many design changes, lack of access for contractors and delays, with such an approach, which leads to construction claims. This just emphasizes the importance of early involvement of key contractors in reducing construction claims.”
Speaker 15	“There is so much benefit to a capital project, if proper planning, upfront design engineering and more time and effort spent, before construction commences, in terms of reducing changes later, which causes claims. I have seen the benefits of this on two mining capital projects in iron and platinum sectors. Early design and early design development will save you time and cost during your construction phase. You get to only get contractors on site, when all the designs and construction drawings are complete, which leads to the avoidance of standing time and lack of access claims. From my experience, to achieve this, it is important for the client to freeze the P&IDs (which drive the design), design developed fully, or almost and equipment suppliers data obtained for inclusion in the design before commencing with construction.”

In a follow-on discussion on the advantages of the Owner/ Client collaborating with contractors that have proven experience on similar projects, Speaker 13 had this to say.

> "In many projects that I've worked, the client normally works with their usual and trusted contractors, even when they go out to tender. Obviously, there's a bias towards those that they have worked with because, one, it is a lot easier and they normally even ask for specific individuals within the teams for obvious reasons because they know how they work and so on. So in many ways, trying to get to some level of collaboration. The challenge is the full collaboration, where the contractor is fully aware and knows that they are the only game in town. That's where people always find the discomfort. So you know that you are tendering, I mean, even in my current situation, there are a lot of customers that I know this is my customer. It's my job for me to lose. But I know that I'm not there without competition. So it kind of keeps me in check."

The discussion evolved to the use of joint decision-making in DBB projects, so as to reduce construction claims. The speakers were requested to comment on the use of a project decision-making committee that has representatives from all the key participants, as envisaged by the IPD philosophy. Such a joint committee will have the authority to decide on the validity of any claims from a contractor, and approve the cost quantum of the claim.

Speaker 10 had this to say:

> "We have a client that started that. With what he calls a 'construction claims work group'. Which then entitles the team and the contractor to attend a sort of committee meeting to jointly sort out issues regarding the claim and the changes, inspections and stuff like that, so I think it's an attempt by the client to try and do this joint decision-making. The problem is that, the reason I think they have set it up, is they do all their contracts on New Engineering Contract (NEC), and NEC is supposed to be more lenient. But, in real life, it doesn't work like that, especially if the client on the Z clauses adds 28 (many) Z clauses to the conditions to protect themselves from previous bad experiences. Such a contract then, becomes a one-sided contract. So I think definitely on the joint decision-making, there is some room to look at that.

Specifically, when you start sizing, for instance, cables and big materials of construction and stuff like that, I think there is definitely room for that."

Speaker 5 made further comments on the matter as follows:

''It's like a forced marriage currently what a lot of companies are trying, and not investing enough up front in actually developing that partnership. It's a partnership to make collaborative contracting work, so it's not an IPD for specific terms, but it's how do you actually design a project together? How do you set up a partnership? Who gets included in IPD? Because also if you look at the successful IPDs, not all contractors but the primary contractors are part of IPDs. The whole operating model around the IPD, you guys touched on a lot of the points, like how you make decisions. For example, in the US with the IPDs, each one has an equal seat in the decision-making process, so you have a technical committee where, a contractor has the same say as a client and then the whole terms and conditions definitions, because as a group, they can reassign scope if one of the contractors is not performing, they even make decisions around how to share risk, in a pain and gain share pool. So I think there is a lot of good principles in collaboration, and I think we have a lot that we can leverage from IPD. It doesn't have to necessarily be an IPD multi-party contract."

In response, Speaker 1 was of the view that the South African construction industry lacked trust and was not yet mature and ready for full IPD implementation, but could borrow some aspects for use today.

"It comes back to the maturity of the industry, as well. And we probably not 100% there yet, because there's a lot of trust that you need to put in there, and at the moment, I think my views about EPCM design engineers, they not there really to help you. They are there to sell hours and they'll do everything to sell those hours. It's that type of comment that still sits there, that feeling that sits, and you'll have to get past that and trust that the guy is there to assist you in doing what you trying to do on your project. I don't think it's there at the moment. I think that adversarial relationship is much stronger now than ever. And we'll have to break that down to get to a collaborative type. It really goes back to trust, and that trust is not there yet." (Speaker 1)

Picking up on the lack of trust in the South African construction industry, the discussion moved to the IPD benefit of open communication, and how it can reduce construction claims. Speaker 12 had this to say:

> "That lack of trust is closely related to the absence of open communication. If you think of it, if you have open communication, then you can build trust over time. Open communication enables alignment on project goals so that they can, for example, be early warnings between Owner and contractors, so that delays and changes can be minimised. Such open communication assists in reducing construction claims, such as standing time and lack of access to the works."

Speaker 13 agreed to this stating that:

> "The blame game is prevalent in the South African construction industry. I once worked on a project as a contractor where the Owners Team was untouchable, unreachable, you could only talk to them through the Engineer, and did not listen to any suggestions that could improve the project delivery. It was frustrating for us as experienced contractors, who could see that the project was doomed, in terms of time deadlines and constructability. Needless to say, that project ended up being eight months late, and of course we submitted our delay construction claims due to that."

4.7.3.1 Key Findings from Theme 2

In general, the speakers agreed that the identified IPD benefits of early involvement, collaboration, joint decision-making, and open communication were effective in reducing construction claims.

The key findings from this theme are as follows:

- There is lack of trust in the South African construction industry.
- Lack of trust is closely related to the absence of open communication in the South African construction industry.
- The South African construction industry culture and blame game may not be ready for the full implementation of IPD, but can borrow some aspects of it for infusion into the DBB approach.

- In practice, early involvement and collaboration on capital projects using DBB has to be done in such a way as to keep the contractor honest, in check and avoid them from over pricing their works during bidding thinking they are already in bed with the Owner/ Client on the project. If the Owner/ Client wants to get design input from the contractors on constructability and value engineering during the design phase, then the Owner/ Client would just pay for those services, without committing to use the same contractors during construction.
- Open communication assists in reducing construction claims, such as standing time and lack of access to the works.
- Traditional DBB contracts tend to reward individual party performance rather than the team of parties on the project.
- The project design and scope must be well defined and developed before construction commences.
- Changes that happen during construction are more expensive and cause time delays more than changes, which are done during the design phase.
- Knowledge from contractors and end user/ operations team can inform and shape the project design, if they are engaged earlier.

4.7.4 Theme 3 – How IPD Benefits Can Be Borrowed and Infused Into DBB Projects

This section examines how IPD benefits can be borrowed and infused into the management of mining capital projects delivered under the traditional DBB method, so as to reduce construction claims. During the focus group, the moderator requested the speakers to comment on what can be put in place now (today) to enhance DBB projects, as borrowed from IPD.

The discussion for Theme 3 on how IPD benefits can be borrowed and infused into DBB projects so as to reduce construction claims was categorized in NVivo Pro 14 as shown in Figure 4.10.

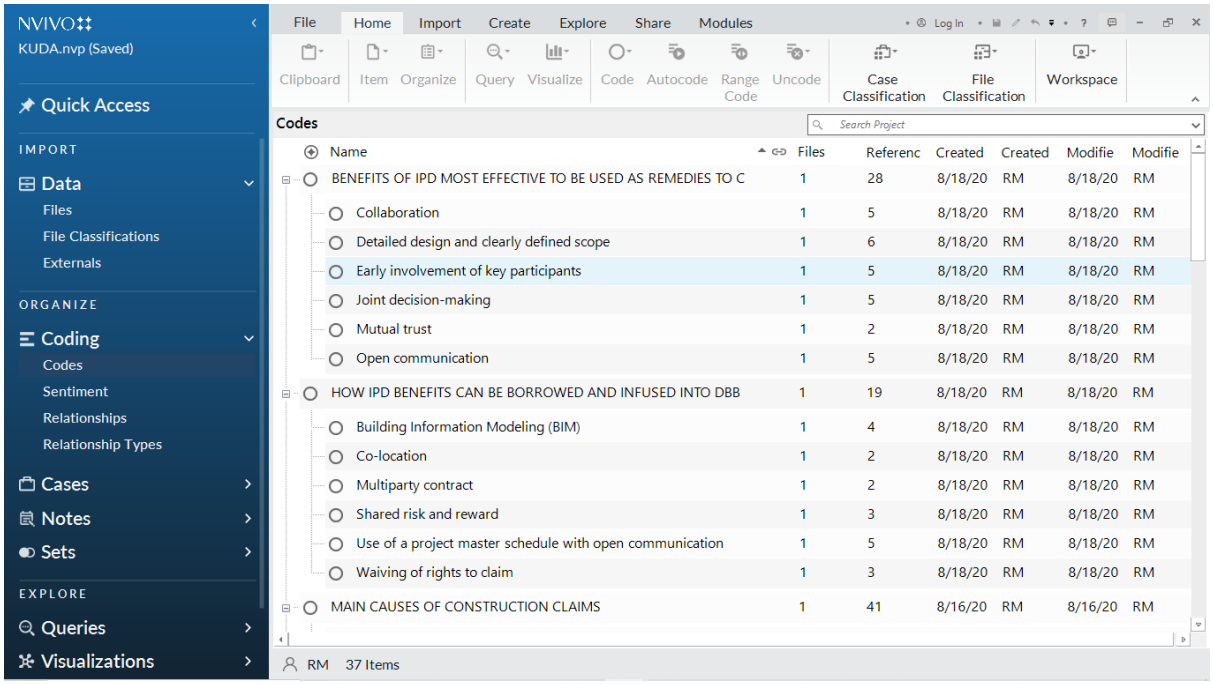

Fig. 4.10: How IPD Benefits can be Borrowed and Infused into DBB Projects Categorized in NVivo Pro 14

The discussion on this theme commenced with looking at open communication around project scheduling, since most construction claims are time delay claims. The moderator asked the speakers, whether it was possible for a DBB project to only have one master schedule that every contractor can updates, and is communicated openly to all. This would be in contrast to the current DBB approach, where every contractor is contractually required to regularly submit their separate progress schedule to a project master scheduler. Table 4.19 details what the speakers mentioned and discussed.

Table 4.19: Speakers' Responses on the Importance Of Project Master Scheduling and Open Communication

Pseudonym	Discussion Responses
Speaker 5	"It really starts with a single source of truth with the schedule, like what the actual progress is on site, and how do you get that source of truth? And everybody has the same source of truth? It's a big enabler for exactly that'.'
Speaker 8	"Well, you can't implement the project with multiple schedules, there's only one master schedule. The problem though, is if you take it back to IPD, it goes back to trust as well. It means some of the guys using the schedule as their way of claiming, and they are using the source of truth now, as their source of claims, and then everything falls back again because now you taking it away from them. You don't want to let them see It, because they are just going to use it against you. It all comes back to that maturity that we have, and trust that we have, but having a single source of truth is not negotiable. There should be one master schedule on the project and that is it; everything included there including your production readiness.
Speaker 10	"And scenario planning. What's going to happen if this happens? What's going to happen? There should be more on that, than further reporting what has already happened."
Speaker 13	"As Speaker 8 said, also the project master scheduling needs to be efficient. I think the amount of resources and efforts spent in collecting data and processing data and explaining why things are going wrong on the project, we spend 60-70% of our resources on reporting, and not on constructing."
Speaker 14	''The contractor's planner doing the work needs be part of that scheduling plan. Like we often see this disconnect, where somebody or senior planner (on Client or Engineer's side) plans the work, but it's almost impossible for them to know each step and sequence properly. There needs to be a lot more collaboration with contractors on developing the scheduling plans."

The discussion progressed to commenting on the benefits of co-location between Owner, Engineer and Contractors, in terms of enhancing collaboration and open communication on the current DBB projects.

Speaker 1 commented as follows:

‘’There are some aspects we can implement to enhance our current practices on DBB projects, and how we do things. So, this co-location between the client, engineer and contractors – look, from my own experience, I have seen it happen, and it adds value in terms of integration, teamwork and better communication. You know, it might be that the client goes and sits with the design team for better and quick collaboration and decision-making during the design phase. It should be possible to also include the key contractors for them to contribute to the design on constructability, for example. I would expect the client to take care of the costs for such a co-location.”

The moderator then moved on to request the focus group speakers to comment on the practicality of implementing BIM on DBB projects, so as to minimise changes later and improve coordination and avoid construction clashes which all can lead to construction claims.

Speaker 9 had this to say:

“Yes, I think the design engineer can utilise BIM for the design and get input and share design information with client and contractors, but from my own experience, it is not being fully utilized in mining capital projects. I know the industry uses the lesser advanced 3D modelling in some instances, but I've always been disappointed with what you get at the end of the day. The selling point would be that if you use 3D modeling during design, you will be able to create a bill of quantities from there, and be able to generate construction drawings, and take care of coordinating any design clashes. Many times, I have gone to sites and still seen, for example, big pipes going straight into a beam, resulting in the need for site instructions to change pipe routes, resulting in additional cost construction claims.”

Additional comments from the other speakers are as shown in Table 4.20.

Table 4.20: Speakers' Comments on Implementing BIM on DBB Projects

Pseudonym	Discussion Responses
Speaker 5	"Research done at our management consulting firm on 50 BIM projects has shown that the true benefits and cost savings of using BIM only starts happening by your third project. And there is a big upfront investment to set up for BIM and create the database. So if the contractor, EPCM or owner doesn't have a pipeline of projects, it is difficult to justify using BIM, just for one project. It really starts with a single source of truth with the schedule, like what the actual progress is on site, and how do you get that source of truth? And everybody has the same source of truth? It's a big enabler for exactly that'.'
Speaker 9	"From my own experience, if you are building similar type of things like a building or hospitals, for example, and that they all look exactly the same, then you will have a BIM model that looks similar from one project to the other, then that you will get the advantages and benefits of BIM. To be honest, considering the amount of time and investment required upfront for the BIM model, I can't see the advantage if its only for a single project, without a pipeline of similar projects."
Speaker 12	"I have also been disappointed with 3D modeling on mining capital projects. For example, I have seen the design engineers say, we have a 3D model of the structural steel structure on the project, then I ask, did you model all the components like rods, purlins and purlins, and then they say, no, we only modelled the main members. You know, we haven't, we haven't seen a 3D model giving us a full bill of quantities to 90% accuracy. I haven't seen that yet."

The focus group discussion moved to the use of a multi-party contract between client, design engineer and contractor and how that could be infused into a DBB project. Speaker 3 had this to say.

> "From my experience, I haven't seen a multi-party contract between three parties or more on a capital project. Yes, I have seen joint ventures, design and build and lump sum contracts but those are mainly two-party contracts. So, I am not sure how a multi-party contract with three parties would work under DBB conditions. Perhaps, a memorandum of understanding (MOU) between the key participants on a project to say, let's agree to work together, collaborate, communicate openly, that kind of thing could work in reducing construction claims. Such an MOU would be over and above the bilateral

contracts, which the owner/ client would have with the engineer and contractors.”

Speaker 7, further commented as follows:

> ‘’I like the idea of an MOU and agreeing to work as a team, because usually when projects commence such statements about collaboration and open communication, are mentioned verbally between the parties. It could therefore be in the right direction to document such intentions, at least in an MOU. I would want to think senior leaders from the parties would try to abide by the MOU and build trust, even when the other bilateral contracts exist. This could be the first step in moving towards an IPD multiparty contract for the construction industry in South Africa.”

Speaker 1, added on saying:

> ‘’I also think the commercial aspects of a multiparty contract under DBB will be challenging. Lawyers and insurers will have questions, and issues with such a contract around obligations, liabilities and waiving of rights. The industry may not be ready for that, as we speak.”

The discussion progressed to whether the Owner/ Client, Engineer and Contractor could waive their rights to claim against each other as envisaged by the IPD philosophy and agree to share the risk and the reward on the project. Speaker 10 had this to say.

> “I think you can do that. We are busy negotiating a contract for a project up in Province Z, where you know they will be a sharing of risk and sharing of savings on the project. But you have to set it up properly, because you don't want to share cost savings on the capital value of the project, but rather on the direct field cost, because that's where the real savings must be made.”

The other speakers further commented as shown in Table 4.21.

Table 4.21: Speakers' Comments on Waiving of Rights to Claim Between Parties

Pseudonym	Discussion Responses
Speaker 14	"I have seen contracts that have something like this, waiving of rights to claim or some variation to that, even under the current DBB projects. For example, parties can agree to focus on reducing project costs, so that they come within a target budget, and then share the savings based on some formula. So this waiving of right to claims is something that could be adopted on DBB projects, so as to reduce construction claims.''
Speaker 3	"I know the NEC (New Engineering Contract) has clauses on risk and benefit sharing, which can be applied on DBB projects. The problem is that typically, clients like to exclude those clauses from contractor contracts. Further, even when such clauses are included, for NEC to work effectively, your whole project team on site and your engineering team who make big decisions need to understand how NEC works on instructions, early warnings, compensation events, compensation events meetings etc. You need to have proper training on both sides, the contractor, the client team, the project manager - you know everybody on the project needs to understand how it works, as NEC can become a contract administration nightmare. I know, some of our big clients in oil and power industries changed back from NEC to FIDIC on their capital projects, because of this."

4.7.4.1 Key Findings from Theme 3

This specific focus group theme discussion examined how IPD benefits can be borrowed and infused into the management of mining capital projects delivered under the traditional DBB method, so as to reduce construction claims. The key findings from this theme are as follows:

- It is possible for a DBB project to only have one master schedule that every contractor updates in, and is communicated openly to all.
- Co-location between the client, engineer and contractors can add value in terms of integration, teamwork, collaboration and better communication.
- BIM is not currently being fully utilized in mining capital projects in South Africa. In some instances, 3D modelling is being used, but with limited results. BIM features that enable information exchange and collaboration between the design team and contractors are not being fully used.

- Research has shown that the true benefits and cost savings of using BIM only start happening by your third project, and that is if you have a pipeline of similar projects.
- There are reservations on how a multi-party contract with three parties or more would work under DBB conditions.
- Waiving of rights to claim by parties under a DBB project is possible.

4.7.5 Theme 4 – Reviewing and Validating the Proposed Conceptual IPD for Claims Reduction (IPD4CR) Framework

This section provides an analysis of the review and validation of the conceptual framework (as shown in Appendix 3) pertaining to the reduction of construction claims. The speakers were shown the conceptual framework and requested to review and comment on its validity.

The discussion for Theme 4 on reviewing and validating the proposed conceptual IPD for Claims Reduction (IPD4CR) framework was categorized in NVivo Pro 14 as shown in Figure 4.11.

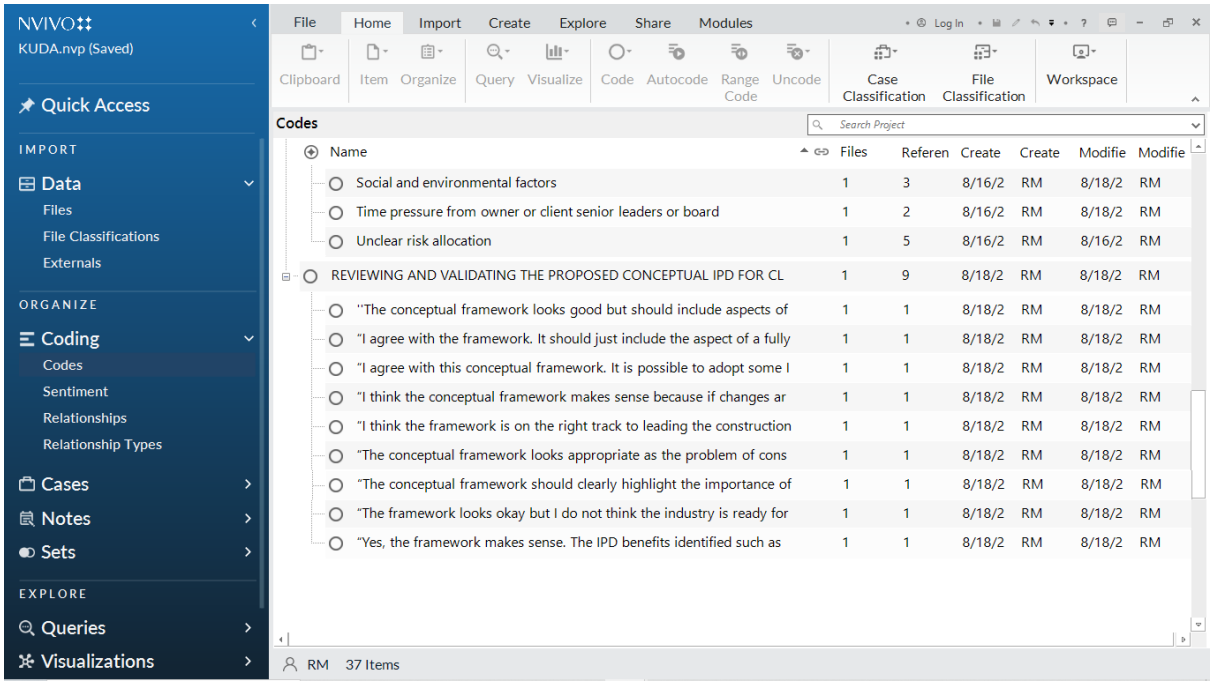

Fig. 4.11: Reviewing and Validating the Proposed Conceptual IPD for Claims Reduction (IPD4CR) Framework Categorized in NVivo Pro 14

Speaker 7 agreed with the conceptual framework, but suggested incorporating aspects of open communication between participants to promote collaboration. This indicates the importance of effective communication in achieving successful project outcomes.

> “The conceptual framework looks good, but should include aspects of open communication between the participants to foster collaboration” (Speaker 7).

Speaker 9 supported the conceptual framework, reasoning that minimizing changes during the construction phase can help reduce claims. He recognized the connection between addressing one of the underlying causes of claims, that is, changes and claim mitigation.

> “I think the conceptual framework makes sense, because if changes are minimized during construction phase, then claims are also reduced” (Speaker 9).

Speaker 11 viewed the conceptual framework as appropriate, recognizing the prevalence of construction claims in the industry. He expressed support for implementing the framework, suggesting that it can address the issues related to claims.

> “The conceptual framework looks appropriate, as the problem of construction claims is prevalent in the industry. I would support the implementation of this framework in industry” (Speaker 11).

Another speaker, Speaker 15 agreed with the conceptual framework and supported infusing some IPD principles into the DBB approach to reduce construction claims.

> “I agree with this conceptual framework. It is possible to adopt some IPD principles, and infuse them into DBB, so as to reduce construction claims” (Speaker 15).

In addition to that, Speaker 12 agreed with the framework, emphasizing the importance of the identified benefits of IPD. She acknowledged that these aspects are crucial for reducing construction claims.

> “The framework makes sense. The IPD benefits identified, such as early involvement, collaboration, open communication and joint decision-making, are crucial to reducing construction claims” (Speaker 12).

Speaker 13 agreed with the framework, but suggested clearly including and indicating a fully detailed design, as an important aspect of the framework.

> “I agree with the framework. It should just include the aspect of a fully detailed design” (Speaker 13).

Speaker 10 further emphasized the importance of clearly defining the project scope of work and having a detailed design, before commencing construction. This aligns with the idea of having a clear project scope with minimum changes, so as to minimize claims.

> “The conceptual framework should clearly highlight the importance of having a clear project scope of work and detailed design, before construction commences” (Speaker 10).

Speaker 14 opined that the framework is heading in the right direction to eventually leading the construction industry to adopt the full IPD methodology. This indicated support for the framework's potential to bring about positive change in the construction industry.

> “I think the framework is on the right track to leading the construction industry to eventually adopt the full IPD methodology” (Speaker 14).

Speaker 8 expressed reservations about the industry's readiness for an IPD multi-party contract. Instead, he suggested considering a multi-party Memorandum of Understanding (MoU) to establish commitment among key participants to work together, beyond their individual contracts with the Owner/Client. The speaker highlighted the need for a collaborative approach while acknowledging the current limitations of the industry.

> “The framework looks okay, but I do not think the industry is ready for an IPD multi-party contract. Perhaps you should look at a multi-party Memorandum of Understanding for the key participants to commit to work together, beyond the

conventional individual contracts they may have directly with the Owner/ Client" (Speaker 8).

4.7.5.1 Key Findings from Theme 4

In general, the speakers concurred with the proposed conceptual framework, placing particular emphasis on the imperative of fostering transparent and open communication, enabling collaboration, ensuring early involvement of key participants, joint decision-making, multiparty consensus and developing a detailed design, before construction commences. There are proponents who advocate for the incorporation of IPD principles into the conventional DBB approach. It is widely agreed upon that the framework possesses the capacity to engender favourable transformations within the construction industry.

4.8 CHAPTER SUMMARY

The summary of this chapter which represents the research findings of the literature reviews, questionnaire and focus group is detailed below.

The key findings from the literature review meta synthesis in answering Research Sub-Question 1, identified 28 causes of construction claims which include: changes in design and scope, unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication. Furthermore, in answering Research Sub-Question 2, 17 benefits of IPD which can address and remedy the main causes of construction claims on DBB projects were identified including: early involvement of key participants, collaboration, joint decision-making and open communication.

The results of the responses to the questionnaire in answering Research Sub-Question 3 indicate that the top five most effective practices to reduce construction claims on mining capital projects are clear definition of project scope, having quality and detailed designs, open communication, collaboration and mutual trust.

In answering Research Sub-Question 4, the results of the focus group session were codified into four themes. The first theme being main causes of construction claims in mining capital projects. A second theme emerged on discussing benefits of IPD,

which are most effective to be used as remedies to construction claims in mining capital projects.

The third theme focussed on how the identified IPD benefits could be borrowed and infused into DBB projects, so as to reduce construction claims. The final theme was on reviewing and validating the proposed conceptual IPD for Claims Reduction framework (IPD4CRf).

The focus group speakers, in general, agreed with and validated the conceptual framework with key elements being multiparty consensus, early involvement of key participants, clearly defined project scope of work and detailed designs, open communication, collaboration and joint decision-making. The next chapter discusses the research findings, as well as the development of the proposed framework.

CHAPTER 5: DISCUSSION OF FINDINGS AND FRAMEWORK DEVELOPMENT

5.1 INTRODUCTION

The research question of this research reads as: “How can IPD benefits be incorporated into the traditional Design-Bid-Build method so as to reduce construction claims in South African mining capital projects?’’. In answering this research question, this research aimed to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

This chapter discusses the research findings leading to the development of that framework. The framework is named Integrated Project Delivery for Claims Reduction framework (IPD4CRf). This framework will enable stakeholders in South African mining capital projects to collaborate and integrate early, to deliver projects to a high quality, on time and within budget.

5.2 DISCUSSION OF FINDINGS

The outcomes of the research sub-questions are presented and discussed below. The development of the framework was based on the results of the initial literature review plus the outcomes from the research methods used namely, literature review, survey and focus groups.

The initial literature review showed that construction claims are mainly caused by changes in scope (whether caused by a stakeholder to the project, nature or unforeseen situations/ conditions or circumstances) experienced during the construction phase of the project. Current practices used to reduce claims are not systematic, but more precautionary strategies and project management practices. IPD prevents the causes of claims, whilst current practices are an attempt to cure the causes. The partnering, collaboration, sharing of risk and teamwork characteristics of IPD presents an opportunity for minimizing changes during construction, and thereby reducing construction claims in capital projects.

5.2.1 Research Sub-Question 1

- "What are the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method?"

This sub-question sought to find out the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method. In answering the first research sub-question, existing literature identified 28 causes of construction claims as follows:

- Incomplete tender information
- Inappropriate contractor selection
- Poor document control
- Lack of competence of project participants
- Poor workmanship and remedial work
- Poor project management
- Design errors and revisions
- Improper or defective contract documents
- Unrealistic tender pricing
- Unclear risk allocation
- Uncontrollable external events, including statutory and regulatory changes, socio-political risks and *force majeure*
- Unexpected rise in material prices, and swings in economic and market conditions
- Payment delays, leading to financial issues
- Unrealistic time targets
- Late client response, or slow decision-making
- Poor communication
- Late issue of construction drawings
- Delay in work progress (inefficiencies)
- Inadequate planning/ scheduling
- Instruction to accelerate work
- Inadequate or unclear design documentation and specifications
- Unclear scope of works

- Changes by client
- Variations in quantities
- Differing or inadequate information on site conditions
- Adversarial culture among project participants
- Poor safety measures
- Adversarial or inclement weather

5.2.2 Discussion of Findings on the Major Causes of Construction Claims

The findings on the major causes of construction claims under this sub-question were for capital projects in general. This was done to initially get an overall understanding of the causes of construction claims.

The commonality between the identified causes of construction claims from the findings, is that these causes are all associated with changes in planned or agreed scope, schedule, cost or quality, during construction. In the focus group discussion, the participants further reviewed the list of identified causes, and considered the following to be the major causes of construction claims: changes in design and scope, unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication.

In comparing previous research by various authors (Taher, 2009; Thomas and Wright, 2005; Shah *et al.,* 2016; Malki & Alam, 2020; El Hawary and Nassar, 2016); Erzaij, 2020; Hadikusumo and Tobgay, 2015; Hayati *et al.,* 2019; Kululanga *et al.,* 2001; Levy, 1994), changes in design and scope by ultimately the Owner/ Client during construction emerged, as one of the prominent major causes of construction claims. The same cause of construction claim was also identified in the overall research literature review in Chapter 2, where it was highlighted that construction claims are mainly as a result of changes on the projects (Chanmeka *et al.,* 2012; Tochaiwat & Chovichien, 2004). This finding is also consistent with the focus group discussion, which identified changes in scope during construction, as the top ranked cause of construction claims in South African mining capital projects.

Unclear risk allocation came out as one of the major causes of construction claims from the research. A number of authors, (Taher, 2009; Shah *et al.,* 2014; Al Malki & Alam, 2020; Erzaij, 2020; Levy, 1994) identified unclear risk allocation as a challenge

in DBB projects, which results in construction claims. This unclear risk allocation also leads to contractors pricing for risk and marking up and inflating pricing, beyond the norm at tender stage, as well as on claims (Streu & Hirst, 2019).

The focus group discussion findings also show unclear risk allocation, as a major cause of construction claims on mining capital projects. It can be argued that risk is best managed by allocating it to the party that is best placed to manage the risk. In DBB projects, the Owner/ Client tends to allocate the risk to contractors, usually through unfair, unclear and unbalanced contracts. Mosly (2016) highlighted that in the traditional DBB approach, the allocation of risk is unclear, uneven and unfair to some contractors.

When the risk allocation is unclear and hidden in the contract, contractors tend to take advantage of this, and submit claims when the risk materialises during construction. This shows that in essence, the risk remains with the Owner/ Client, even if contracted out, because any costs associated with the risk, will still have to be paid for by the Owner/ Client, either as priced for in the contract, or through claims. It highlights the importance of properly planning for the risk, and allocating it appropriately upfront.

From the literature review meta synthesis findings, unclear design documents and specifications, also came out as one of the major causes of construction claims. Review of documents from previous research showed that various authors, including Taher (2009); Thomas and Wright (2005); Shah *et al.* (2014); Malki and Alam (2020); Shen et al, (2016); Erzaij (2020); Hadikusumo and Tobgay (2015); Hayati *et al.* (2019); Shaikh *et al.* (2020); and Levy (1994), all noted unclear design documents and specifications, as a major cause of construction claims.

The inadequacy of design documentation including drawings and specifications creates ambiguities and opportunities for contractors to submit construction claims where they could allege not having allowed for certain items in their pricing. This is consistent with the Chapter 2 literature review where Kululanga *et al.* (2001) and Mohamed, Ibrahim & Soliman (2014), asserted that ambiguities on drawings and specifications were a source of construction claims.

In the focus group discussion, the same was noted and described similarly as ''poorly defined scope of work,'' and ranked highly as a major cause of construction

claims on mining capital projects in South Africa. It is important to note that unclear design documentation and specifications is closely related to changes in design and scope, as a cause. This is because if the design and scope is unclear, it leads to changes being required to make it more specific during construction, which in turn results in construction claims.

A number of authors from the literature review meta synthesis (Shah *et al.,* 2014; Al Malki and Alam, 2020; El Hawary & Nassar, 2016; Erzaij, 2020) identified inadequate planning, as another major cause of construction claims. Planning, especially upfront, is very important on executing a capital project for it to be completed within time, within budget, and at the right quality. The majority of construction claims are delay claims (Griffin, 1993). Without proper adequate planning, projects are likely to experience schedule delays, lack of access to the works by contractors, standing time issues, lack of coordination and sequencing, which all lead to contractors submitting construction claims. The focus group discussion also ranked "inadequate front end or upfront planning," highly within the top five as a major cause of construction claims in South African mining capital projects.

The other major cause of construction claims identified from the literature review meta synthesis was poor communication among the project participants (Taher, 2009; Matseke & Khatleli, 2020; Shah *et al.*, 2014; Malki & Alam, 2020; El Hawary & Nassar, 2016; Shen *et al.*, 2016; Erzaij, 2020; Levy, 1994). Poor communication on a construction project results in misunderstandings between parties, ambiguities, cost overruns, inefficiencies, lack of coordination and delays, which all lead to construction claims. The literature review in Chapter 2 similarly identified poor communication issues among stakeholders (Mohamed, Ibrahim & Soliman, 2014), as a cause of construction claims. This is consistent with the research findings of Baloyi and Agumba (2014), who also identified poor communication, as one of the main causes of claims on construction projects in South Africa. The focus group discussion also ranked ‘’poor communication’’ highly in the top five as a major cause of construction claims in South African mining capital projects.

5.2.3 Research Sub-Question 2

- "Which benefits of Integrated Project Delivery (IPD) are essential to reducing construction claims in capital projects?"

The second research sub-question looked at identifying the benefits of IPD, which are essential to reducing construction claims in capital projects. In answering the second research question, existing literature review meta-synthesis identified 17 benefits of IPD essential to reducing construction claims in capital projects as follows:

- Early involvement of key participants
- Co-location
- Intensified planning
- Tracking accountability
- Liability waivers among key participants
- Joint decision-making
- Multiparty contract.
- Mutual benefit and reward
- Target cost pricing
- Early goal definition
- Building Information Modelling (BIM)
- Open communication.
- Organization and leadership
- Use of cross functional groups and core groups.
- Mutual respect and trust
- Collaboration
- Collaborative innovation and decision-making innovation.

From the identified IPD benefits, in the focus group discussion, the participants reviewed the list, and regarded the following to be the main benefits which could address and remedy the main causes of construction claims on DBB projects: early involvement of key participants (including having detailed design and clearly defined scope before construction), collaboration, joint decision-making and open communication.

5.2.4 Discussion of Findings on which Benefits of IPD Are Essential to Reducing Construction Claims

Early involvement of key participants emerged, as one of the main benefits of IPD, which are essential to reducing construction claims from reviewing research, by various authors (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013; Alinezhad *et al.,* 2020; Kahvandi *et al.,* 2020; Viana *et al.,* 2020; Jayasena & Senevirathna, 2012; Mesa *et al.,* 2016). The early involvement of the main contractors enables them to give design input and participate in value engineering of the project (Laryea & Watermeyer, 2016), including constructability considerations.

Such early involvement results in experienced contractors giving practical input into the design, so as to minimise changes during construction, which are a main cause of expensive construction claims. This was also confirmed in the questionnaire responses, where 71.4% of the respondents considered early involvement of key participants in the design phase as very effective in reducing construction claims. Changes and looking at scenarios is less expensive, when done during the feasibility studies and design stages compared to the construction stage (Dunn, 2019).

The early participation of key project participants also enables coordination and upfront project planning to be completed before construction commences. In addition, early involvement of key participants positively, contributes to building a team and developing trust early in the project. Early involvement of key participants has the capability to also remedy other identified causes of construction claims on DBB projects, such as design errors, unclear design documentation and specifications, variations in quantities, inadequate planning, late issue of drawings, inadequate tender information, and inadequate information on site conditions. In essence, by involving key participants early, the project is designed and planned, together with those who will construct it, resulting in less ambiguities and changes during construction, thereby minimising construction claims.

In the focus group discussion, the interviewees agreed that early involvement of key participants was essential to reducing construction claims, but warned that in practice, on capital projects using DBB, it has to be done in such a way as to keep the contractor honest, in check and avoid them from over pricing their works. The focus group discussion also highlighted that knowledge from contractors and end

user/ operations team can inform and shape the project design, if they are engaged earlier.

From the literature review meta-synthesis, collaboration was identified as one of the main IPD benefits, essential to the reduction of construction claims. Various authors (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013; Alinezhad *et al.,* 2020; Kahvandi *et al.,* 2020; Viana *et al.,* 2020; De Marco & Karzouna, 2018; Jayasena & Senevirathn, 2012; Ilozor & Kelly, 2011; Mesa *et al.,* 2016; Lee, 2013) highlighted collaboration, as being key to successful project outcomes, including containing and reducing construction claims.

Collaboration enables project team integration and allows for issues to be identified and addressed in real-time. Such an approach makes it possible to communicate effectively, thereby reducing uncertainties and ambiguities, which can be sources of construction claims. Through collaboration, coordination matters between contractors and suppliers can be resolved in real-time, leading to the reduction of incidences of lack of access to works, and standing time issues.

The findings of the literature review meta-synthesis were consistent with the findings of the questionnaire, where 78.6% of the respondents affirmed that collaboration between owner/ client, engineer/ designer and contractors was very effective in reducing construction claims. Previous research in the South African construction industry also confirms that the industry should embrace collaboration, since it results in positive project outcomes (Laryea, 2019; Kwofie, Aigbavboa & Matsane, 2017; Laryea & Watermeyer, 2016; Emuze & Smallwood, 2014). However, Watermeyer (2012) warns that the South Africa construction industry requires a culture change, to be able to implement innovative and collaborative procurement strategies that could improve project outcomes.

The use of cutting-edge technology to communicate and work together also enhances collaboration on projects. Froise (2014) recommended the use of BIM on South African construction projects, so as to improve communication between project participants and enhance collaboration. The literature review meta-synthesis findings also indicate that collaboration has potential to remedy identified causes of construction claims, such as changes by client, unclear design documentation and specifications, inadequate planning and unclear scope of works.

In an open question in the questionnaire on the best practice of reducing construction claims on capital projects, 16.8% of the respondents mentioned collaboration. In the focus group discussion, while there was a general agreement that collaboration was crucial, the interviewees cautioned that owners/ clients should ensure the contractors they select for collaboration, have proven experience on similar projects.

Another main IPD benefit, which can reduce construction claims identified from the literature review meta-synthesis was joint decision-making on the key aspects of the capital project (AIA & AIACC, 2007; Ashcraft, 2014b; Kahvandi *et al.,* 2020; Viana *et al.,* 2020; Jayasena & Senevirathna, 2012). Joint decision-making (between the Owner/ Client, Designer/ Engineer and Contractors) for final decisions or approvals on matters concerning scope of work, quality, specifications, cost and time, goes a long way in reducing construction claims, though quick and efficient decision-making, which assists in eliminating uncertainties and ambiguities. Having such an arrangement leads to a shared interest in project success, and can be aligned to shared risk and reward. By the contractors having a voice on decision-making could result in mutual trust being created between the key participants of the project.

The perceived fairness that comes with joint decision-making may also lead to mutual trust and respect. In the questionnaire responses, 66.7% of the respondents indicated that joint decision-making between owner/ client, engineer/ designer and contractors was very effective in reducing construction claims. In the focus group discussion, the interviewees agreed that a project decision-making committee that has representatives from all the key participants, would be useful in reducing construction claims on a capital project. One speaker in the focus group, however cautioned that for joint decision-making to work effectively, it was important to invest in building collaborative partnerships upfront between the parties, which could take time to achieve.

This is consistent with the findings of Watermeyer (2012), who recommended a cultural change towards building integrated and collaborative long-term relationships in the South African construction industry. The literature review meta-synthesis identified that joint decision-making could remedy causes of construction claims, such as unclear risk allocation poor project management and unrealistic time targets.

Open communication also emerged from the literature review meta-synthesis, as one of the main IPD benefit that was essential to reducing construction claims (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013; Alinezhad *et al.,* 2020; Kahvandi *et al.,* 2020; Viana *et al.,* 2020; Jayasena & Senevirathna, 2012; Mesa *et al.,* 2016). Open communication between the project key participants reduces ambiguities and misunderstandings. It also enables transparency and builds mutual respect and trust between the participants. Open communication results in problems and challenges being acknowledged and resolved, as they occur, which assists in reducing construction claims. A culture of open communication on a project can be enhanced through co-location of the participants, and using a big room approach. Such attributes of open communication are essential to reducing construction claims.

Open communication is linked, inter-related and enhances other IPD benefits, such as collaboration, co-location, mutual respect and trust, which all support the reduction of construction claims. From the questionnaire responses, 81% of the respondents considered open communication between owner/ client, engineer/ designer and contractors to be very effective, in reducing construction claims on mining capital projects in South Africa.

In the focus group discussion, the interviewees commented and agreed that open communication assists in reducing construction claims, such as those which arise from standing time and lack of access to the works. The literature review meta-synthesis identified that open communication could remedy causes of construction claims, such as poor communication, slow decision-making, unclear risk allocation and payment delays.

5.2.5 Research Sub-Question 3

- “What are the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”

The third research sub-question sought to investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

The results of the questionnaire used to answer the third research sub-question in investigating the current practices and their effectiveness indicates that respondents consider the following to be the most effective:

- Clear definition of project scope,
- Open communication,
- Collaboration,
- Ensuring design consultants provide quality designs; and
- Mutual trust between participants.

The results of the questionnaire also indicate that most of the respondents expressed that the best practice for reducing construction claims on capital projects, is to define the scope of work clearly, and have quality or properly developed designs, before construction commences. Other emerging themes from the questionnaire results on the best practice for reducing construction claims on capital projects, were collaboration between project participants, and the early involvement of contractors, so that they contribute to having a detailed design of the project. These findings are consistent with the Chapter 2 literature review, in regard to similar IPD benefits, which can reduce construction claims.

5.2.6 Discussion of Findings on the Current Practices Used to Reduce Construction Claims

In the questionnaire, the identified current practices used to reduce construction claims from the Chapter 2 literature review, were presented to the respondents to measure the effectiveness of the practices. In addition, IPD benefits that had been identified as essential to reducing construction claims were also included in the questionnaire. The respondents were given the opportunity, through an open question, to give their opinions on what the best practice of reducing construction claims on capital projects is.

The results of the questionnaire show that the traditional current practices, which are more precautionary strategies and project management practices, were considered to be relatively effective. However, the mean scores indicate that the IPD benefits, which are more philosophical and structural, were considered to be more or very effective in comparison.

The results of the questionnaire identified clear definition of project scope, open communication, collaboration, ensuring design consultants provide quality designs and mutual trust between participants, as the top five most effective at reducing construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. In comparison, the Chapter 2 literature review shows early involvement, joint decision-making, and collaboration (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013, standing out as having the potential to reduce construction claims effectively.

The effectiveness of collaboration was ranked highly both from the literature review and questionnaire results. The practice of ensuring design consultants provides quality designs, which was identified as most effective from the questionnaire is closely linked to the early involvement of participants noted in the literature review. The early involvement of contractors to contribute to the design and value engineering results in quality and adequate designs of the works.

It is interesting and important to note that the practices identified as being very effective in reducing construction claims by the questionnaire respondents are consistent and similar to the benefits of IPD, which are essential to reducing construction claims in capital projects, as identified in the literature review meta-synthesis for Research Sub-Question 2. The question then becomes - How can these benefits be adopted and infused into the DBB method, so as to reduce construction claims which is addressed in the findings of Research Sub-Question 4?

5.2.7 Research Sub-Question 4

- “How can identified IPD benefits be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method?”

The fourth research sub-question sought to assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The outcomes of the focus group discussion confirmed that the identified IPD benefits could be infused and adopted through a framework that uses IPD benefits to reduce

construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

5.2.8 Discussion of Findings on How IPD Benefits Can Be Used as Remedies for Causes Of Construction Claims

The focus group speakers, in general, agreed with and validated the conceptual framework with key elements being multiparty consensus, early involvement of key participants, clearly defined project scope of work and detailed designs, open communication, collaboration and joint decision-making. The focus group speakers supported the incorporation of IPD principles into the conventional DBB approach, so as to reduce construction claims.

This is consistent with research by McKinsey & Company (2017b), which highlighted that there is an opportunity to start including some IPD aspects into the traditional procurement approach for better project outcomes. This idea of borrowing from IPD is also supported by Fischer *et al.* (2017), who further state that IPD presents a framework that can lead to the "behavioural change required to achieve high-performance projects". Furthermore, a study by Ling *et al.* (2020) on IPD, recommended the adoption of IPD principles into the traditional project delivery approach for improved project performance.

In particular, previous research in the South African construction industry also confirms that the industry should embrace collaboration since it results in positive project outcomes (Laryea, 2019; Kwofie, Aigbavboa & Matsane, 2017; Laryea & Watermeyer, 2016; Emuze & Smallwood, 2014). The focus group speakers agreed that the conceptual framework possesses the capacity to engender favourable transformations within the construction industry, and recommended finalising it for use in the industry. The focus group also deliberated on other enablers of IPD, and how they could fit in the framework.

One of the findings as discussed in the focus group was that it is possible for a DBB project to only have one master schedule that every contractor updates in, and is communicated openly to all. Having such a master schedule, which is the one source of the truth on the project, and is openly communicated allows the engineer and contractors to collaborate and be proactive, when indications of delays arise.

Such collaboration and proactiveness can lead to minimising lack of access issues and standing time claims.

The focus group discussion also highlighted that co-location between the client, engineer and contractors, can add value in terms of integration, teamwork, collaboration and better communication. This is consistent with findings from the literature review meta-synthesis, where various authors identified the importance of co-location in improving project outcomes (AIA & AIACC, 2007; Ashcraft, 2014b; KPMG, 2013; Alinezhad *et al.,* 2020; Kahvandi *et al.,* 2020; Viana *et al.,* 2020; Jayasena & Senevirathna, 2012; Mesa *et al.,* 2016).

The focus group discussion indicated that BIM is not currently being fully utilized in mining capital projects in South Africa. In some instances, 3D modelling is being used but with limited results. BIM features that enable information exchange and collaboration between the design team and contractors are not being fully used. By not fully utilising the capabilities of BIM, construction projects are losing out on the design collaboration, coordination, clash detection and open communication benefits that can be derived from BIM, in terms of saving time and effort, and thereby reducing claims later during construction.

The AIA and AIACC (2007) cautioned that the rewards of IPD can only be fully reaped, when it is used in sync with BIM. Froise (2014) recommended the use of BIM in South African projects as “a central source of information that can improve communications between CPOs (construction project organisations) and foster a collaborative culture”. In the focus group discussion, it was however mentioned that the true benefits and cost savings of using BIM only start happening by the third project, and that if there is a pipeline of similar projects.

The focus group discussion had reservations on how a multi-party contract with three parties or more would work under DBB conditions, highlighting that the South Africa construction industry culture was not ready for such. Notwithstanding this, other authors like Chang (2017) and Ling *et al.* (2020), assert that it is possible to adopt IPD thinking on a project, even when a proper multiparty IPD agreement is not in place. The focus group discussion rather recommended the use of a multi-party Memorandum of Understanding (MoU) to establish commitment among key participants to work together, beyond their individual contracts with the Owner/Client.

A multi-party contract has legal implications around liabilities, indemnities and insurance (Fish & Keen, 2012), in terms of "'parties' roles, rights, responsibilities, remedies and risks" (Reed, 2017), which is what the South African construction industry may not yet be geared for.

5.3 SUMMARY OF RESEARCH FINDINGS

5.3.1 IPD for Claims Reduction Framework (IPD4CRf)

5.3.1.1 Framework Development

The aim of this research was to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The development of such a framework was carried out based on the research findings. To achieve the research aim and develop the framework, the following steps were followed:

1) Establish literature on the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method.
2) Establish literature on the benefits of Integrated Project Delivery (IPD), which are essential to reducing construction claims in capital projects.
3) Develop first draft conceptual framework
4) Review and perform meta-synthesis on the literature gathered.
5) Conduct a survey (through questionnaire) to investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.
6) Conduct interviews (through focus group) to assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.
7) Review and validate the conceptual framework during focus group of project management experts.
8) Finalise proposed IPD for Claims Reduction Framework (IPD4CRf).

Existing literature was used to qualitatively identify the major causes of construction claims, and to explore the use of IPD benefits to reduce these construction claims in capital projects. Questionnaires with responses received from 42 respondents were then used to investigate the current practices used to reduce construction claims on mining capital projects, and their effectiveness.

The questionnaires also tested the IPD knowledge of the respondents, and whether they considered the IPD benefits identified in the literature review meta-synthesis to be effective in reducing construction claims in mining capital projects. This was followed-up by interviews in a focus group of 15 mining capital project management experts, to review the assignment of IPD remedies to the causes of construction claims.

The focus group discussion included validating the major causes of construction claims in South African mining capital projects, as identified from the literature review meta-synthesis. It also involved validating, which specific IPD benefits could be remedies to these major causes of construction claims in the South African mining capital projects context.

The focus group participants were also requested to review and validate a conceptual a framework that incorporates IPD benefits into the traditional Design-Bid-Build method for South African mining capital projects, so as to reduce construction claims. The results of the research towards developing the framework are summarised in the table below.

Table 5.1: Research Findings as Elements Towards Development of the Framework

Traditional Procurement Method	Key Participants	IPD Benefits adopted for use with DBB	Main Causes of Construction Claims that can be reduced by IPD Benefits	Impact on Construction Claims	Impact on Project
Design-Bid-Build (DBB)	Owner/ Client, Designer/ Engineer, Contractors and Suppliers	Multiparty consensus through a Memorandum of Understanding	Changes by Owner/ Client, unclear risk allocation, unclear design documents and specifications inadequate planning and poor communication	Reduced changes in planned or agreed contractor scope, schedule, cost or quality leading to less variations, less delays and less disruptions resulting in reduced construction claims	Project completed within budget, on time and at right quality
		Early Involvement of key participants			
		Clearly defined project scope of work and detailed designs			
		Open communication between participants			
		Collaboration between participants			
		Joint decision-making between key participants			

5.3.2 Incorporating IPD Benefits into the framework

From the focus group review and validation of the conceptual framework, the aspects of the identified IPD benefits, and how they will operate in the framework were articulated to arrive at the proposed approach. In general, the focus group speakers concurred with the proposed conceptual framework, placing particular emphasis on the imperative of fostering transparent and open communication, enabling collaboration, ensuring early involvement of key participants, joint decision-

making, multiparty consensus, and developing a detailed design before construction commences.

The summary of the review and validation comments of the conceptual framework from the focus group, which were used to develop and finalise the framework are as follows:

- The framework should emphasize open communication between the participants to promote collaboration.
- The industry may not yet be prepared and willing to use a IPD multi-party contract. A multi-party Memorandum of Understanding for the key participants, to commit to work together, may instead be the appropriate starting point.
- The framework is appropriate, since construction claims can get decreased, if changes are kept to a minimum throughout the construction phase.
- The significance of having a precise project scope of work, and thorough and detailed design, prior to the start of construction should be amply demonstrated in the framework.
- The framework is suitable, and should be implemented, given the industry's pervasiveness of the construction claims issue.
- The framework is logical, since IPD benefits, such as early involvement, collaboration, open communication and joint decision-making are vital to reducing construction claims.
- The framework should include the aspect of a fully detailed design.
- The framework is headed in the correct direction to encourage the construction industry to ultimately implement the full IPD approach.
- The framework makes sense, because it is possible to reduce construction claims by incorporating some IPD benefits into the DBB method.

The approach on how the IPD benefits will be incorporated in the framework follows.

5.3.2.1 Open Communication

- Open communication should be encouraged between the parties participating in the detailed design of the project.

- Weekly progress meeting to be held between Owner/ Client, Designer/ Engineer and main Contractors and key Suppliers. Such meetings should allow open discussions, and updates on project time, cost and quality elements.
- Informal daily meetings between the project key participants should also be organised, to discuss progress and anticipate any challenges or conflicts.
- Open communication on a daily basis through phone conversations and messaging (for example, a project WhatsApp group) should be encouraged and permitted between the Owner/ Client, Designer/ Engineer and main Contractors and key Suppliers. This can assist in faster notification, problem-solving, drawings review and approval and processing of documents, which may have been sent formally on emails.
- Problems and disputes should be acknowledged and resolved, as they occur with a no-blame culture in existence.
- Efficient and electronic exchange of information should be fostered and encouraged, through the use of cutting-edge technology.
- Co-location of key participants and big room approach should be enabled.
- Key contractors should openly share information, and provide visibility of cost drivers and sub-contractor costs.

In summary, open communication, will reduces ambiguities and misunderstandings, enable transparency, build respect and trust including enhancing co-location and big room approach, all which enables remedying the causes of construction claims and hence reduces the claims.

5.3.2.2 Collaboration

- During the detailed design phase of the project all the key participants from Owner/ Client, Designer/ Engineer and seconded members from contractors and suppliers are to co-locate at same offices, at the cost of the Owner/ Client. This will ensure easy collaboration between the parties. Virtual meetings can also be utilised, when participants cannot be physically all in one place.

- Free flow of ideas between the participants should be encouraged. Big impact decisions should be judged by the Project Decision-making Committee (PDMCom)
- Cutting edge technology should be utilised to collaborate and communicate between project participants. Where it makes economic sense and there is pipeline of similar projects for the Owner/ Client, BIM should be used and implemented.
- Intensified project planning should involve key project participants and done upfront collaboratively.
- The overall project scope and schedule should be co-created by all the key participants. Through collaboration, the project schedule can be enhanced and made efficient.
- Owner/ Client should encourage and make it possible for the key contractors and equipment suppliers to collaborate aspects, such as modularization and prefabrication, where possible, so as to gain time on the project.

In summary, collaboration will enable project team integration, allow for issues to be identified and addressed in real-time including getting coordination matters resolved promptly. These aspects of collaboration provide a remedy to the causes of construction claims which will result in the reduction of claims.

5.3.2.3 Early Involvement of Key Participants

- Owner/ Client goes out on tender, and contracts designer/ engineer for the feasibility study and design.
- Before detailed design stage, the Owner/ Client goes out on tender for the key contractors and suppliers, utilising high level scopes of work from the feasibility study.
- Key contractors are selected from the tender, based on an adjudication matrix criterion consisting of unit pricing, previous experience, track record, safety and compliance, financial strength, and willingness to collaborate.
- Key contractors and suppliers are contracted by the Owner/ Supplier, based on high level of scopes of work and bill of quantities, indicating units of measure as appropriate.

- Key contractors and suppliers second team members to participate in the detailed design of the project and contribute to value engineering. Owner/ Client pays for the cost of the seconded team members.
- Owner/ Client also involves the operations team (who the complete project will be eventually handed over to) to review and participate in the detailed design, to ensure their requirements are catered for, within the agreed project budget. This is meant to minimise changes later during construction that could arise, if operations team requirements are not addressed during detailed design stage.
- The project benefits from the constructability, design clashes rectification, long-lead procurement support, locking project scope, and value engineering input from key contractors and suppliers, through their early involvement in the project.

In summary, early involvement of key participants, will enable design input by contractors, facilitate early value engineering, ensure constructability is considered early, enable upfront project planning including providing an opportunity for end users/ operations to give input into the design. Having this in place will assist in minimising changes later during construction which in turn results in reduced construction claims.

5.3.2.4 Define the Scope of Work Clearly and Have Quality Or Properly Developed Designs

- The Owner/ Client should ensure that the project scope of work is defined clearly, and that the designer/ engineer develops designs fully (Class 1: 70 to 100% definition), before construction commences.
- Upfront planning for the project should be encouraged, and implemented by the Owner/ Client, so that enough time is allocated to complete the detailed design, before construction commences.
- The key contractors should review the detailed design for constructability, contribute to value engineering, give insights on appropriate site selection, participate in finalising, and locking the project scope, and provide long-lead procurement support.

- The key suppliers should provide detailed equipment footprint and measurements early, so that such information is included, and taken into account during the detailed design.
- The key contractors identified and contracted for the project should price for the works, using fully detailed designs, as per agreed unit rates, where applicable.
- The Owner/ Client should have strict project rules that construction for any work package should only commence, when detailed design drawings are issued.

In summary, defining the scope of work clearly and having properly developed designs leads to minimizing changes during construction, improves contractor tender pricing accuracy and enables clear risk allocation. Such attributes will in turn result in the reduction of construction claims.

5.3.2.5 Joint Decision-Making

- Owner/ Client should create a Project Decision-making Committee (PDMCom) comprising of representatives from:
  - Owner/ Client
  - Designer/ Engineer
  - Quantity Surveyor
  - Key contractor representatives (e.g. representatives from the following contractors: Civils, Structural Mechanical Platework & Piping [SMPP] and Electrical, Controls & Instrumentation)
- Each party has equal voting power on project decisions, with the Owner/ Client having a second vote, in the case of a stalemate.
- The role of the PDMCom is to make final decisions or approvals on matters concerning any changes to the project baselines, on scope of work, quality, specifications, cost and time, which are kept on a decision register.
- PDMCom should govern how contractors and suppliers will be compensated for reasonable costs, if conditions outside the party's direct control impact project schedule and cost.

- Joint decision-making strengthens the Owner/ Client leadership team through having other key project participants, availing their knowledge and capability in the decision-making.
- Joint decision-making sets aside boundaries between the key participants leading to shared goals and trust building.
- Joint decision-making leads to better innovative decisions, greater transparency, and increased acceptance of decisions. It also promotes teamwork, open communication and builds trust.

In summary, joint decision-making will strengthen Owner/ Client leadership team, enable quick and efficient decision making, enhance shared interest in project success and facilitate alignment on shared risk and reward between the project participants. These aspects have the ability to remedy the causes of construction claims which results in reduction of such claims.

5.3.2.6 Multiparty Memorandum of Understanding (MMoU) between Key Participants

- While the Owner/ Client may have direct single contracts with the other participants on the project, the key participants (Owner/ Client; Designer/ Engineer and key contractors and suppliers) should sign a Multiparty Memorandum of Understanding (MMoU). In the MMoU, the key participants should commit and agree to approach the project using IPD as a philosophy, and apply the above mentioned integrated practices, to the traditional delivery approach of Design-Bid-Build.
- The MMoU should indicate and describe how risk and reward will be shared on the project.
- The MMoU should indicate and describe how construction claims will be evaluated managed and adjudicated, on the project linked to the PDMCom.
- The MMoU should clearly state the potential overall project incentives (win-win) and key performance indicators for collaborative practices and behaviours.
- The MMoU should define the overall project vision for success, including target cost and schedule.

- The MMoU should define processes on how innovation and value will be recorded, quantified, captured and rewarded for on the project, in terms of improving time, cost and quality elements.

In summary, the MMoU will document the rules of engagement and expected norms and culture on the project which enhances collaboration and integration leading to minimised changes during construction resulting in reduced claims.

5.3.3 Final Framework as Reviewed and Validated

The Integrated Project Delivery for Claims Reduction framework (IPD4CRf) is a proposed framework developed by this research, which incorporates IPD benefits into the traditional Design-Bid-Build method for South African mining capital projects, so as to reduce construction claims. The IPD4CRf is an innovative project management improvement tool that uses IPD benefits to enable the reduction of construction claims in South African mining capital projects, delivered under the traditional Design-Bid-Build method.

This IPD4CRf will enable stakeholders in South African mining capital projects to collaborate and integrate early, to deliver projects to a high quality, on time and within budget. The IPD4CRf can be viewed as bringing the ‘future’ IPD into DBB and taking the current DBB to reach out to IPD. In comparison, it is something in between DBB and IPD, as shown by the comparison of its attributes to the other approaches in Table 5.2.

Table 5.2: Comparison of IPD4CRf Attributes with DBB and IPD

Traditional Project Delivery/ Design-Bid-Build (DBB)		**Proposed IPD4CRf (DBB with IPD Benefits for Claims Reduction)**	**Integrated Project Delivery (IPD)**
Fragmented, assembled on just-as-needed or minimum-necessary basis, strongly hierarchical, controlled	**Teams**	Owner managed team with designer/ engineer working within that team. Key contractors and suppliers contracted and involved early in the detailed design	An integral team entity composed of key project stakeholders, assembled early in the process, open, collaborative
Linear, distinct, segregated; knowledge gathered just-as-needed; information hoarded; silos of knowledge and expertise	**Process**	Focus on having a detailed scope of work fully designed and detailed upfront before construction commences. Open communication between Owner, engineer, contractors and suppliers.	Concurrent and multi-level; early contributions of knowledge and expertise; information openly shared; stakeholder trust and respect
Individually managed, transferred to the greatest extent possible	**Risk**	Appropriately allocated to the party (who prices for it) best placed to manage the risk	Collectively managed, appropriately shared
Individually pursued; minimum effort for maximum return; (usually) first-cost based	**Compensation/ Reward**	Shared risk and reward between Owner and the various contracts with engineer, contractors and suppliers.	Team success tied to project success; value-based
Paper-based, two dimensional; analogue	**Technological Communications**	Digitally based and virtual	Digitally based, virtual; Building Information Modeling (3, 4 and 5 dimensional)
Encourage unilateral effort; allocate and transfer risk; no sharing	**Agreements**	Direct individual contracts between Owner and engineer, contractors and suppliers but with a multiparty Memorandum of Understanding between the parties agreeing to collaborate and work together.	Encourage, foster, promote and support multi-lateral open sharing and allocation; risk sharing
Source: AIA & AIACC (2007)		Source: Author	Source: AIA & AIACC (2007)

The IPD4CRf is required, so as to provide project teams with a structured way of reducing construction claims on South African mining capital projects that are contracted under the traditional Design-Bid-Build method. The current traditional

Design-Bid-Build method on South African mining capital projects results in adversarial relationships and diminished integration, which leads to various changes during construction, and in turn causes too many expensive construction claims. These can be reduced by incorporating IPD benefits of early involvement, joint-decision-making, open communication and collaboration.

If construction claims are reduced, it is envisaged that capital projects will be completed within budget, at the right quality and on time, so that beneficial use can commence to generate value for stakeholders. The IPD4CRf shown in Figure 5.1 and Table 5.3 will enable stakeholders in South African mining capital projects to collaborate and integrate early to deliver projects to a high quality, on time and within budget. Learnings from this research will promote changes in behaviour and attitudes in the construction industry, which can lead to future full IPD implementation.

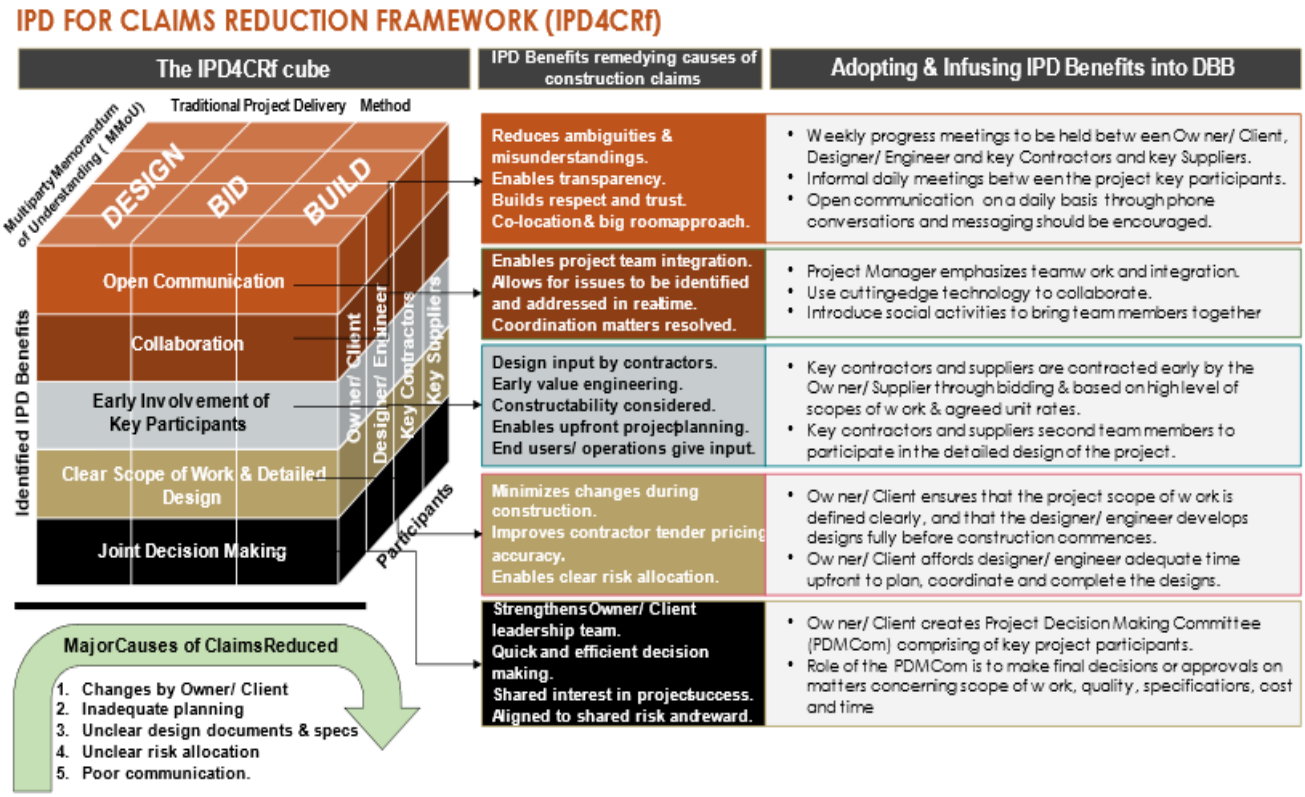

Fig. 5.1: Final Proposed IPD for Claims Reduction Framework (IPD4CRf)

The selected format for the framework of a Rubik's Cube is symbolic in showing the integration and collaboration required to reduce claims, in that, as in such a cube,

shuffling or moving one aspect, affects the other. The project delivery method, participants and IPD benefits and all connected and interlinked, and when they are at the right configuration, construction claims can be reduced. Potential challenges to implementing the proposed framework may include resistance from project participants who are used to the traditional delivery method, legal or regulatory constraints including insurance requirements, as well as resource limitations that may be experienced. The right organizational culture, leadership support, and stakeholder alignment is required to successful implement such a framework.

5.4 CHAPTER SUMMARY

This chapter discussed the findings of this research. This was done based on the aim of the research, which is to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

The discussions included data on the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method; benefits of IPD essential to reducing construction claims in capital projects; the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method, and how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects, delivered under the traditional Design-Bid-Build method. These findings and discussions resulted in the development of the framework to reduce construction claims.

The research aim was achieved in this chapter, including the processes involved in the development of the framework. The framework development was based on a mixed research approach, consisting of both qualitative and quantitative research. The conceptual framework was reviewed and validated by construction industry experts in project management during the focus group, to ensure that the framework has capability to reduce construction claims in South African mining capital projects. Comments from the review and validation were considered resulting in the final Integrated Project Delivery for Claims Reduction framework (IPD4CRf) presented in this chapter.

This research therefore contributed to reducing construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. If construction claims are reduced, it is envisaged that capital projects will be completed within budget, at the right quality and on time so that beneficial use can commence to generate value for stakeholders. It is envisaged that the implementation of the IPD4CRf framework will enable stakeholders in South African mining capital projects to collaborate and integrate early. Learnings from this research will promote the required changes in behaviour and attitudes in the construction industry, which can lead in the direction of full IPD implementation in the future. The next chapter concludes this research, indicates limitations and contributions, as well as proposing recommendations.

CHAPTER 6: CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The research achieved its aim of developing a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. This framework will enable stakeholders in South African mining capital projects to collaborate and integrate early, to deliver projects to a high quality, on time and within budget.

Existing literature was used to qualitatively identify the major causes of construction claims, and to explore the use of IPD benefits to reduce these construction claims in capital projects. Questionnaires with responses received from 42 respondents were then used to investigate the current practices used to reduce construction claims on mining capital projects and their effectiveness. The questionnaires also tested the IPD knowledge of the respondents, and whether they considered the IPD benefits identified in the literature review meta-synthesis to be effective in reducing construction claims in mining capital projects.

This was followed up by interviews in a focus group of 15 mining capital project management experts to review the assignment of IPD remedies to the causes of construction claims. The focus group discussion included validating the major causes of construction claims in South African mining capital projects as identified from the literature review meta-synthesis.

It also involved validating. which specific IPD benefits could be remedies to these major causes of construction claims in the South African mining capital projects context. The focus group participants were also requested to review and validate a conceptual a framework that incorporates IPD benefits into the traditional Design-Bid-Build method for South African mining capital projects, so as to reduce construction claims.

This chapter presents the conclusion to the research; a summary of research findings; research limitations; research contributions and recommendations for future research.

6.2 CONCLUSION

In commencing with this research, it was established from the literature that the most used method of DBB in capital projects lacks collaboration and integration, which results in inadequate upfront planning and incomplete designs, and poor scopes of work used for pricing and construction. This, in turn, leads to various changes to planned or agreed contractor scope, schedule, cost or quality during construction, resulting in numerous and expensive construction claims for additional costs and time.

Previous research has shown that collaboration and integration in construction projects can result in improved project outcomes. Projects still experience cost overruns, even with current practices designed to try and minimize construction claims in capital projects. Current practices of reducing construction claims in DBB projects are contract administration practices, focused on the notifying procedures and keeping records for use in defending and rejecting claims when they occur.

Such practices are not effective and do not address the underlying causes of construction claims. Research to reduce construction claims in mining capital projects under the DBB approach by using IPD benefits is little or non-existent. This research therefore developed a framework that uses IPD benefits to reduce construction claims in South African mining capital projects, delivered under the traditional DBB method.

The research identified IPD benefits which could remedy the major causes of construction claims in DBB projects and adopted and infused them in a framework for reducing construction claims. The research outcome showed that the traditional DBB method lacks collaboration and integration which results in many changes to contractor scope, schedule, cost or quality during construction resulting in contractors submitting numerous construction claims for additional costs or extension of time. Any effort in minimising changes during construction will therefore result in reducing construction claims. The objectives of this research which assisted in achieving the research aim are:

1) To find out the major causes of construction claims in capital projects delivered under the traditional Design-Bid-Build method.
2) To identify the benefits of Integrated Project Delivery (IPD) which are essential to reducing construction claims in capital projects.
3) To investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.
4) To assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

The findings of this research on the first objective indicate 28 major causes of construction claims in capital projects which include: changes in scope during construction, inadequate front end or upfront planning, poorly defined scope of work, unclear risk allocation and poor communication.

The second research objective findings identified 17 IPD benefits essential for reducing construction claims. The findings show that IPD benefits especially those of early involvement of stakeholders, detailed design and clearly defined scope before construction, joint decision-making, open communication, and collaboration present an opportunity to minimize changes later in the projects which in turn assists in reducing construction claims. These IPD benefits reduce the likelihood of construction claims by improving communication, scope certainty, collaboration, transparency and by reducing project risk though joint decision-making.

The third objective sought to investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The findings of the research indicates that respondents consider the following to be the most effective practices at reducing claims: clear definition of project scope, open communication, collaboration, ensuring design consultants provide quality designs and mutual trust between participants.

The fourth research objective was to assess how the identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The findings of the

research confirmed that the identified IPD benefits could be infused and adopted through a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The conceptual framework was validated with key elements being multiparty consensus, early involvement of key participants, clearly defined project scope of work and detailed designs, open communication, collaboration and joint decision making. These IPD benefits reduce the likelihood of construction claims by improving communication, scope certainty, collaboration, transparency and by reducing project risk though joint decision-making.

These findings provided sufficient data in achieving the aim of this research which was to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

6.3 SUMMARY OF FINDINGS

The diminished collaboration and integration in the DBB method, especially during the design stage makes it vulnerable to numerous changes in scope, schedule, cost or quality later during construction, resulting in contractors submitting claims for additional cost or extension of time. In summary, it can be stated that IPD is an ideal and futuristic project delivery method. IPD remains a relatively novel method in South Africa, and perhaps it will take a while for it to be fully adopted on capital projects, as a cultural change may be required.

There is, however, an opportunity to begin borrowing some facets of IPD and infusing them into the traditional Design-Bid-Build method, so as to reduce construction claims. In essence, construction claims come about as a result of changes to planned or agreed the contractor scope, schedule, cost or quality during construction. IPD benefits, especially those of early involvement of stakeholders, joint decision-making, open communication and collaboration present an opportunity to minimize changes later in the projects, which in turn, assists in reducing construction claims.

By understanding the root causes of construction claims and reviewing the effectiveness and deficiencies of current practices used to reduce the claims, a framework that uses identified IPD benefits as remedies to causes of construction claims in South African mining capital projects, was developed. The framework was reviewed and validated by focus group participants who included those with experience and working on the Owner/ Client, Designer/ Engineer and Contractor sectors. The framework is named Integrated Project Delivery for Claims Reduction framework (IPD4CRf) and will enable stakeholders in South African mining capital projects to collaborate and integrate early to deliver projects to a high quality, on time and within budget.

6.4 RESEARCH LIMITATIONS

This research has certain limitations, even though it has made major contributions. One limitation is that only 42 respondents completed the questionnaire, due to constraint in time, or some industry professionals surveyed being busy with job requirements. A bigger number of respondents should be sought in future studies.

The quantitative research on current practices used to reduce construction claims was limited to South African mining capital projects, which are typically large and mega projects, in which most of the claims are submitted by contractors during the construction of the project. This may have limited the completeness of the collected data.

The focus group discussion with project management experts was not held physically, due to the various geographical locations of the participants. This was mitigated by conducting the discussion online, via MS Teams video and recording. Another limitation was that the researcher was the only person collecting and analysing the data. This may bring some bias into the data.

6.5 RESEARCH CONTRIBUTIONS

This research aimed to develop a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. Most of the previous research on construction claims identified the causes and impact associated with construction claims. This research on the other hand, identified IPD benefits that can be adopted and infused into the DBB method and developed a framework (IPD4CRf) that reduces construction claims. This is a significant contribution to the body of knowledge by this research especially in the construction industry. As a result, this study contributes to the academic field and industry.

6.5.1 Contributions to Academic Field

This research offers significant contributions to the academic field in the construction projects sector, which include:

1) The data and analysis from this research on the causes of construction claims, inadequacies of the traditional DBB method integration and collaboration, weaknesses of the current practices used to reduce construction claims, IPD benefits essential for reducing construction claims and the developed IPD4CRf framework, gives pertinent information for further academic research on construction claims.
2) It provides a theoretical perspective of the prevalence of construction claims in the construction industry, especially under the traditional DBB method.
3) It highlights the inadequacies of the traditional DBB method in containing and reducing construction claims, due to the method's lack of integration and collaboration.
4) It identifies the attributes needed for the traditional DBB method to lessen the effects of its flaws, which include; adequate upfront planning, complete designs, and having properly defined scopes of work used for pricing and construction.

5) It bridges the gap in the literature between the current practices used to reduce construction claims and borrowing IPD benefits, and infusing them in the DBB method so as to reduce claims.
6) It offers practical data on how IPD benefits can be adopted and infused into the DBB model, so as to reduce construction claims on capital projects.

6.5.2 Contributions to Industry

The following are some notable practical contributions made by the research's findings to the construction industry:

1) The data and analysis from this research and the developed framework will assist owners or clients to contain, avoid and reduce additional costs on projects through reducing expensive construction claims from contractors.
2) Project designers/ engineers and other professionals in the construction industry will benefit from the research, by learning the importance of IPD benefits, such as early involvement, joint decision-making, clearly defined scope of work and detailed designs, open communication, and collaboration in reducing changes during construction on capital projects.
3) The developed IPD4CRf framework from this research will promote the required changes in behaviour and attitudes in the construction industry, which can lead in the direction of full IPD implementation in the future.
4) The developed IPD4CRf framework provides guidelines on adopting and infusing IPD benefits into the traditional DBB method, which will enable key participants in the construction industry, to collaborate and integrate early and improve project outcomes.
5) The overall research findings present insights into the implementation of IPD which could enable the construction industry to have projects being completed within budget, at the right quality and on time.

6.6 RECOMMENDATIONS

This research developed a framework that uses IPD benefits to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. Nonetheless, the findings of this research lead to some recommendations for further research.

6.6.1 Research How to Fully Implement IPD

Future research could include research on how to fully implement IPD in South African capital projects, including the legal, contractual, financial and insurance implications. This should include further research on the enablers required to transition from DBB to IPD in South African capital projects. Such future research should include case studies, field experiments, or surveys.

6.6.2 Develop a Contractual Mechanism for the IPD4CRf framework

Possible additional research could focus on developing a contractual mechanism for the developed IPD4CRf framework. Such future research should include field experiments and case studies.

6.6.3 Importance of Owner/ Client Leadership

Further research should focus on the importance of owner/ client leadership capability and knowledge on instilling and implementing integration and collaboration aspects on capital projects, for improved project outcomes.

6.6.4 Use of Artificial Intelligence

Research could be conducted to consider the use of Artificial Intelligence (AI) in predicting and pre-empting construction claims, before they occur. Such future research should include field experiments and case studies.

6.6.5 Impact of Early Involvement

Finally, future research could examine the social and economic impact of early involvement of other stakeholders like host communities, business forums and environmental activists on capital projects.

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APPENDIX 1 - QUESTIONNAIRE

Research Sub-Question 3 – Questionnaire

Objective of the Questionnaire:

The objective is to carry out a purposive and confidential survey within a population of project professionals and investigate the current practices used to reduce construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method. The results were tabulated, interpreted and the findings will form part of a PhD Construction Project Management thesis titled: **The Use of Integrated Project Delivery (IPD) To Reduce Construction Claims in South African Mining Capital Projects**. There are no right or wrong answers in this questionnaire. It is your opinion on each of the statements that matters. This survey should only take about 15 minutes of your time.

Questionnaire Questions

1. Which of the following best describes your role in mining capital projects?

a) Client/ Owner's Team Member

b) Project Designer/ Consultant/ Engineer

c) Contractor

2. Please enter the number of years of experience you have working on mining capital projects below.

I have ____ years' experience working on mining capital projects.

3. Which of the following is true of how your organization mainly selects contractors for capital projects?

a) Design-Bid-Build (DBB)

b) Design & Build (DB)

c) Integrated Project Delivery (IPD)

4. Which of the following best describes your experience with construction claims on capital projects?

a) Construction claims are ever present on capital projects

b) Construction claims cause additional costs on capital projects

c) Construction claims can be reduced

5. Which of the following best describes your experience with the concept of Integrated Project Delivery (IPD)?

a) I have experience of working on a project where IPD was used.

b) I have only read about IPD

c) I have never heard of IPD

6. Which of the following best describes your experience with the concept of Building Information Modeling (BIM)?

a) I have experience of working on a project where BIM was used.

b) I have only read about BIM

c) I have never heard of BIM

7. There are various current practices used to reduce construction claims on capital projects. Below are related statements for which you are requested to rate from Very Effective to Very Ineffective based on your own experience on using these practices and their effectiveness.

Please answer each question by placing an "X" in the box which is most representative of your opinion relating to the effectiveness of each practice in terms of reducing construction claims. Please use the following scale:
Scoring:
1 = VERY INEFFECTIVE., 2 = INEFFECTIVE., 3 = UNDECIDED., 4 =EFFECTIVE., 5 = VERY EFFECTIVE.

	Effectiveness of Current Practices Used to Reduce Construction Claims	**1**	**2**	**3**	**4**	**5**
7.1	Ensuring Design consultants provide quality designs that have been thoroughly reviewed					
7.2	Owner or Client has to clearly state needs and requirements before designs are produced					

	Effectiveness of Current Practices Used to Reduce Construction Claims	1	2	3	4	5
7.3	Clear definition of roles and responsibilities on the project					
7.4	Early warning process in contracts					
7.5	Having procedures in place for control of requests for information from contractors					
7.6	Having a risk-sharing philosophy on the project					
7.7	Clear definition of project scope.					
7.8	Change order management on the project					
7.9	A register of change orders from commencement to close out should be kept					
7.10	The owner should insist that contractors provide a reasonable breakdown of their bids to determine what is included and what is excluded					
7.11	It is important that all parties understand the contractual notice provisions in the contracts					
7.12	Field staff should record at least one or two weather observations each day					
7.13	The owner should not unnecessarily delay making interim payments					
7.14	Early involvement of key participants i.e. contractors & suppliers being part of the design phase					
7.15	Open communication between owner/ client, engineer/ designer and contractors					

	Effectiveness of Current Practices Used to Reduce Construction Claims	1	2	3	4	5
7.16	Collaboration between owner/ client, engineer/ designer and contractors					
7.17	Mutual trust between owner/ client, engineer/ designer and contractors					
7.18	Joint decision-making between owner/ client, engineer/ designer and contractors					
7.19	Use of Building Information Modeling (BIM) for the design					
7.20	Use of a multi-party agreement signed by all major stakeholders - owner/ client, engineer/ designer and contractors					

8. In your opinion what is the best practice of reducing construction claims on capital projects?

_____
_
_____
_
_____
_

End of Questionnaire

APPENDIX 2 – PARTICIPANT INFORMATION SHEET FOR QUESTIONNAIRE

“Dear Sir / Madam

My name is Kuda John Shoniwa, I am a PhD candidate in Construction Project Management at the University of the Witwatersrand, Johannesburg. My supervisor is Assoc. Prof. Ehsan Saghatforoush. I am conducting a research study about Integrated Project Delivery (IPD). The study title is - **The Use of Integrated Project Delivery (IPD) to Reduce Construction Claims in South African Mining Capital Projects.**

I am inviting you to take part in answering a questionnaire. If you decide to take part, your participation in this research study will last about 15 minutes. The research activity will take place online.

The collected data from the questionnaire will be stored electronically on researcher’s laptop (with password protection). Only the researcher will have access to the data.

The participation in the questionnaire will be confidential and anonymous. When I share the results of the research study, I will not include your name or anything else that could identify you.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits or rights you would normally have if you decide not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study. Completing and submitting the online questionnaire is taken to mean consent to participate.

The risks for this research study are no more than what happens in everyday life.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Kuda John Shoniwa

Researcher:
Kuda John Shoniwa, 326839@students.wits.ac.za

Supervisor:
Assoc. Prof Ehsan Saghatforoush
Ehsan.Saghatforoush@wits.ac.za

Co-Supervisor
Prof Samuel Laryea
Samuel.Laryea@wits.ac.za”

APPENDIX 3 – FOCUS GROUPS INTERVIEW PROTOCOL

Research Sub-Question 4 – Focus Groups Interview Protocol

Welcome

Good day and welcome to our session. Thanks for taking the time to join me to talk about Integrated Project Delivery (IPD). My name is Kuda Shoniwa and I am a PhD Candidate in Construction Project Management from the University of Witwatersrand. My thesis is titled: **The Use of Integrated Project Delivery (IPD) To Reduce Construction Claims in South African Mining Capital Projects.**

Purpose of the Focus Group

The purpose of this group discussion is to get insight and thoughts from you the IPD experts on how identified IPD benefits can be used as remedies to causes of construction claims in South African mining capital projects delivered under the traditional Design-Bid-Build method.

Ground Rules

1. I would appreciate if you to do most of the talking. I expect you all to participate.
2. There could be differing opinions but not necessarily right or wrong answers. The opinions and experiences of every individual matter. Feel free to speak regardless of whether in agreement or not.
3. What we discuss during this session will not be shared elsewhere except for the research. Feel free to state your views.
4. I am recording this MS Teams sessions so that I capture all of your remarks and contributions. We were on a first name basis today and you may be assured of complete confidentiality. I will solely utilize the data I collect today to support my research thesis. In my thesis, I will not include any names. You won't be identified by name.
5. I have previously emailed you consent forms and if you have not already sent them back to me, please remember to do so.
6. This session will take approximately one and half hours.

Well, let's begin. We all see the names of the participants on the MS Teams screen. Let's find out some more about each other by going around. Tell us your name and briefly what you do.

Background to the Research

The reviewed literature indicates that the current traditional Design-Bid-Build method which is mainly used on South African mining capital projects results in confrontational relationships and limited integration. This results in various changes during construction which in turn causes too many expensive construction claims. The shared and collective decision-making approach of IPD which entails all the main parties taking responsibility for project decisions and moving away from the blame game and focusing on project goals rather than individualistic goals creates an opportunity for reducing claims in capital projects. Incorporating IPD benefits such as early involvement, joint decision-making, open communication and collaboration can reduce construction claims. This research therefore aims to explore the use of IPD to reduce construction claims in capital projects which are contracted under the traditional methods and provide answers on how IPD benefits can be incorporated into the traditional Design-Bid-Build method so as to reduce construction claims in South African mining capital projects.

Interview Question 1

My previous literature review research has indicated that changes are the main causes of construction claims in capital projects. These changes can be any type of change - changes in scope, schedule, cost or quality, change in site conditions, change in economic environment, change in weather, change in laws and regulations etc. Other identified main causes of construction claims are unclear risk allocation, unclear design documents and specifications, inadequate planning and poor communication. What would be your comments to this? Do you agree? What is your own experience with causes of construction claims?

Interview Question 2

In addition, my literature review research and questionnaire results has identified the following benefits of IPD as those most effective to be used as remedies to construction claims:

- **early involvement,**
- **collaboration,**
- **joint decision-making and**
- **open communication.**

Would you agree with this? Can IPD benefits reduce construction claims in mining capital projects? What are your comments? Can I have your insights on this?

Interview Question 3

If the above mentioned IPD benefits can be remedies to construction claims, how can they be borrowed and infused into the management of mining capital projects delivered under the traditional Design-Bid-Build (DBB) method so as to reduce construction claims?

- Can the main contractor be selected earlier and made part of the design team under DBB? How will the client deal with the additional costs of engaging the contractor earlier?
- Will the client, design engineer, contractor and suppliers be able to collaborate without animosity under DBB?
- Under DBB, how can joint decision-making be implemented? The Client has so much power and authority under DBB, how will that be managed when joint decision-making is put in place?
- How can open communication between client, design engineer, contractor and suppliers be realised under DBB? There is usually an adversarial relationship between client and contractor under DBB, can that be overcome by open communication? Practically, how would it work when the contractor is usually required to formally communicate with the client and engineer through written notices, early warnings and claims?

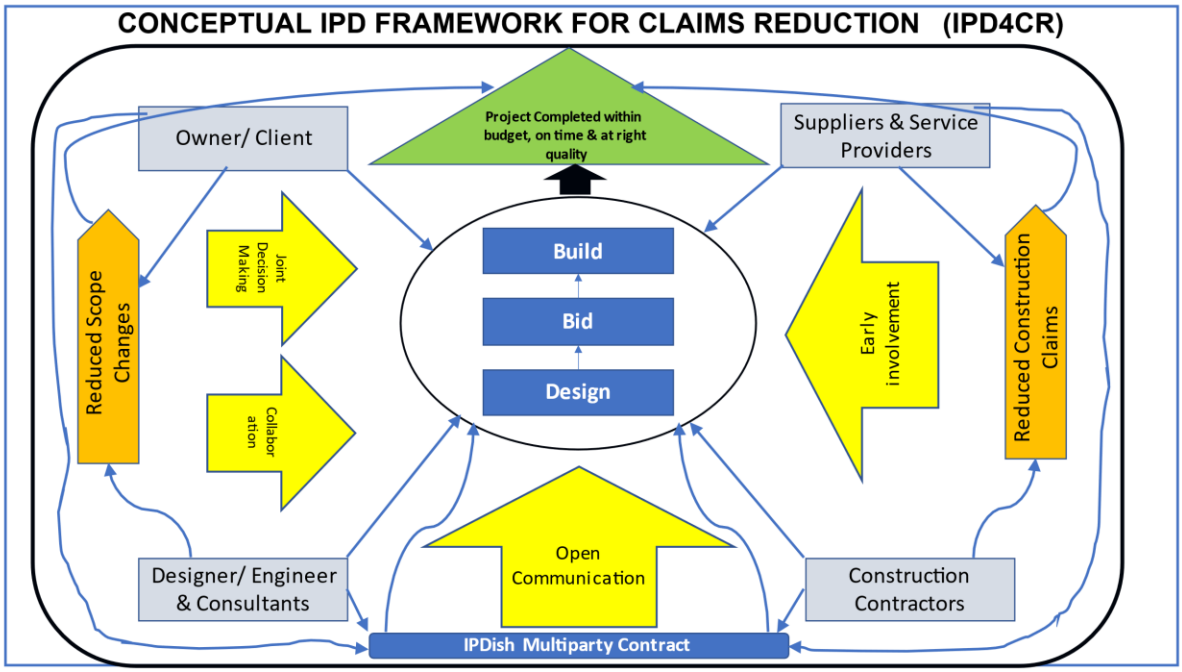
Interview Question 4

What is your view on putting in place the following today to enhance DBB projects as borrowed from IPD:?

- Co-location of the client, engineer and contractor in one place for the duration of the project so as to enhance open communication. Surely that can easily be implemented? Client will have to pay for the costs to have this in place which can be regarded as additional?
- Is it practical to implement BIM on DBB projects so as to minimise changes later and improve coordination and avoid construction clashes? The design engineer can utilise BIM for the design and get input from contractors?
- How about having a multi-party contract between client, design engineer and contractor under DBB? Will it be feasible?
- Can the client, engineer and contractor waive the right to claim against each other under DBB? What was the implications?
- Having one integrated master project schedule which is run by the client and all parties getting to participate in a regular update schedule meeting? We then get rid of the contractual requirement for each discipline contractor to submit separate and disengaged (from other contractors' activities) update schedules to the client?

Interview Question 5

If the IPD benefits of early involvement, collaboration, joint decision-making and open communication are incorporated into the DBB method then changes can be addressed during the design phase and not occur during the construction phase where they cause expensive construction claims. If construction claims are reduced, then capital projects can be completed within budget and on time. Based on these findings what is your view on this proposed conceptual framework IPD4CR which is shown below? Does it make sense?



End of Interview

APPENDIX 4 – CONSENT FORM TO PARTICIPATE IN FOCUS GROUP

"Title of project
THE USE OF INTEGRATED PROJECT DELIVERY (IPD) TO REDUCE CONSTRUCTION CLAIMS IN SOUTH AFRICAN MINING CAPITAL PROJECTS

Name of Researcher: KUDA J. SHONIWA

I, …….., agree to participate in this research project.

I agree to the following:

(Please circle the relevant options below)

The research study was explained to me. I understand what this study is about.	YES	NO
I understand that I can volunteer to take part in the study	YES	NO
I agree that direct quotations from my responses in the focus group may be used by the researcher in their research report/ manuscript/book chapter	YES	NO
I agree that my participation will not be anonymous, but my name will not be used by the researcher in their research report/manuscript/book chapter.	YES	NO
I agree to audio recording of my participation in this research project.	YES	NO
I agree to video recording of my participation in this research project.	YES	NO
I agree that other researchers may use the information I provide in my responses in the focus group (depending on their own ethics clearance being obtained) but my name and any personal information will not be used or passed on.	YES	NO

…… (signature)
…… (name of participant)
…… (date)

…… (signature)
…… (name of researcher/person seeking consent)
…… (date)"

APPENDIX 5 – PARTICIPANT INFORMATION SHEET (PIS) FOR FOCUS GROUP

"Dear Sir / Madam

My name is Kuda John Shoniwa, I am a PhD candidate in Construction Project Management at the University of the Witwatersrand, Johannesburg. My supervisor is Prof. Ehsan Saghatforoush. I am conducting a research study about Integrated Project Delivery (IPD). The study title is - **The Use of Integrated Project Delivery (IPD) to Reduce Construction Claims in South African Mining Capital Projects.**

I am inviting you to take part in a focus group. If you decide to take part, your participation in this research study will last about 90 minutes. The research activity will take place online via MS Teams as per meeting invite to be emailed.

With your permission, I would like to audio/video record the focus group MS Teams session. The collected data from the focus group will be stored electronically on researcher's laptop (with password protection). Only the researcher will have access to the data.

As you may be aware, the participation in the focus group will not be confidential nor anonymous. However, when I share the results of the research study, I will not include your name or anything else that could identify you.

If you decide to take part in the research study, it should be because you want to volunteer. You do not have to take part. You can stop being in the study at any time. You do not have to answer any questions if you do not want to. You will not get any direct benefits if you choose to join the research study. You will not lose any services, benefits or rights you would normally have if you decide not to join. Taking part in the research study will not cost you anything. You will not be paid for being in this research study.

The risks for this research study are no more than what happens in everyday life.

This research study will be written up as a research report. The report will be available on the university library website. If you would like to receive a summary of this report, I will be happy to send it to you.

If you have any questions during or afterwards about this research study, feel free to contact me or my supervisor on the details listed below. If you have any concerns or complaints about the ethical procedures of this research study, you are welcome to contact the University Human Research Ethics Committee (Non-Medical), telephone +27(0) 11 717 1408, email hrecnon-medical@wits.ac.za.

Yours sincerely,

Kuda John Shoniwa

Researcher:
Kuda John Shoniwa, 326839@students.wits.ac.za

Supervisor:
Assoc. Prof Ehsan Saghatforoush
Ehsan.Saghatforoush@wits.ac.za

Co-Supervisor
Prof Samuel Laryea
Samuel.Laryea@wits.ac.za"

APPENDIX 6 – ETHICS CLEARANCE CERTIFICATE

UNIVERSITY OF THE WITWATERSRAND JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Shoniwa

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H22/11/80**
PROJECT TITLE	The use of integrated project delivery (IPD) to reduce construction claims in South African mining capital projects
INVESTIGATOR(S)	Mr K Shoniwa
SCHOOL/DEPARTMENT	School on Construction Economics and Management /
DATE CONSIDERED	25 November 2022
DECISION OF THE COMMITTEE	Approved Risk level: Minimal
EXPIRY DATE	09 February 2026

DATE 10 February 2023 **CHAIRPERSON** _____
(Professor J Watermeyer)

cc: Supervisor : Prof E Saghatforoush

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **A SIGNED COPY** returned to the Secretary electronically. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure be contemplated from the research procedure as approved I/we undertake to submit an amendment of the protocol to the Committee. **I/we agree to completion of a regular progress report. For Minimal and Low Risk studies, this is due annually on 31 December. For Medium and High Risk studies, this is due twice annually on 30 June and 31 December.**

_____ 13 / 02 / 2023
Signature **Date**

PLEASE QUOTE THE PROTOCOL NUMBER ON ALL ENQUIRIES

APPENDIX 7 – TURNITIN REPORT

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