FACILITATING CLAIM ESTABLISHMENT AT THE DEFECT LIABILITY PERIOD OF MEP PROJECTS: A GUIDELINE FOR RECORD-KEEPING

Kattandige Vajira Prageeth Kumara

179168 G

Degree of Master of Science

Department of Building Economics

University of Moratuwa

Sri Lanka

December 2020

FACILITATING CLAIM ESTABLISHMENT AT THE DEFECT LIABILITY PERIOD OF MEP PROJECTS: A GUIDELINE FOR RECORD-KEEPING

Kattandige Vajira Prageeth Kumara

179168 G

Thesis/Dissertation submitted in partial fulfillment of the requirements for the degree Master of Science in Construction Law and Dispute Resolution

Department of Building Economics

University of Moratuwa

Sri Lanka

December 2020

DECLARATION

I hereby declare that this submission is my own work and this dissertation does not incorporate without acknowledgement any materials previously submitted for a Degree or Diploma in any other University or institution of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

Also, I hereby grant to University of Moratuwa the non-exclusive right to reproduce and distribute my dissertation, in whole or in part in print, electronic or other medium. I retain the right to use this content in whole or part in future works (such as articles or books)

---------- ----------

K.V.P. Kumara Date

Department of Building Economics

University of Moratuwa,

Statement of the Supervisor

The above candidate has carried out research for the Master's Dissertation under my supervision,

Name of the supervisor: Dr. Chandanie Hadiwattege

---------- ----------

Signature of the Supervisor Date

DEDICATION

To my beloved Wife and Daughter--------

ACKNOWLEDGMENTS

Many people contributed several ways to achieve the success of this research study. I would like to express my deepest gratitude to every person for encouraging me by providing valuable ideas, assistance, and in particular for their commitment to make this research a success.

First and foremost, I pay my deepest gratitude to Dr. (Mrs.) Chandanie Hadiwattege, my dissertation supervisor, for her valuable guidance, advice, and encouragement to make this research a successful one.

I must express my appreciation to the Department of Building Economics, University of Moratuwa, and all the academic as well as the non-academic staff of the Department for the tremendous service rendered. I extend my gratitude to Prof. (Mrs.) Yasangika Sandanayake, Head of the Department of Building Economics and Coordinator of the Master of Science in Construction Law and Dispute Resolution degree programme for her valuable guidance and encouragement in making this dissertation a real success.

Further, I would like to acknowledge the support received from all the respondents to conduct a successful survey with their busy schedules.

Finally, I express my sincere thanks to my wife and daughter for giving me an excellent corporation to make this dissertation possible.

ABSTRACT

If any party raised a claim, the main objective is to achieve success. Researchers have found that Contractors' claims mostly fail due to the inadequate proof documents to substantiate the claims.

This study investigates the record-keeping related to claim management, with the aim of developing a guideline for record-keeping for successful claims in the MEP trade. Existing record-keeping practices were identified through a literature survey. Said existing record types were tested with industry trade experts via a questionnaire survey for the importance and applicability related to claims establishing in MEP projects during the defect liability period.

Partly organised interviews and online question feedback assessments were selected as appropriate research methodologies as suitable methods are required to collect a high degree of information from the construction professionals. A total of 36 satisfactory responses were received in the questionnaire survey, representing seven (07) from employers, eleven (11) from consultants, 18 from contractors, and one (01) representing other parties. Two (02) experts from the contractor's side and one (01) expert consultant and one (01) expert representing Engineer's side, participated in semi-structured interviews.

The questionnaire survey outcome for the ranking for applicability of the records types for managing MEP claims at the defect liability period was used as the key in developing the guideline. The expert ratings on record types were treated as a high priority and incorporated to the top of the applicability ratings. The outcome was further developed by cross-checking the similar record types verified by literature review findings and confirmed by industry experts during the interview. Additional record types that were identified by the industry experts through interviews and open-ended questionnaire survey responses were compiled to the similarities and added further to the guideline covering the total record-keeping requirement for the claim success. As per the views of interview responders, the common record types of original contract document and progress photograph records on milestone completion (indicating milestone name, date, and time of completion), were rated as high priority requirement for establishing MEP related claims in DLP. The O&M manuals record was ranked third priority type. However, the record types; testing and commissioning reports, proper completion records, proper handing over records, material approvals, maintain a log for attendance for maintenance, and complaint register were newly identified as high priorities.

As the scarcity of the studies available to MEP trade produced guidelines from the present study would enhance the contracted parties to schedule their record-keeping mechanism from the pretender stage for achieving the claim success.

Keywords: Records, Recordkeeping, MEP Claims, Defect Liability Period,

TABLE OF CONTENTS

Page

LIST OF FIGURES

Page

LIST OF TABLES

Page

LIST OF ABBREVIATIONS

AIQSSL	-	Associate Member of the Institute of Quantity Surveyors Sri Lanka
APAWE	-	Advanced Professional Award in Expert Witness Evidence
BMS	-	Building Management System
BOI	-	Board of Investment
BSc	-	Bachelor of Science
CCTV	-	Closed-circuit television
CIDA	-	Construction Industry Development Authority
CL&DR	-	Construction Law and Dispute Resolution
CPM	-	Construction Project Management
CUSDEC	-	Customs Declaration
D&B	-	Design & Build
D.L.P	-	Defect Liability Period
EPC	-	Engineering, Procurement, and Construction
FIDIC	-	Federation of Consulting Engineers
FIR	-	First Inspection Request
HVAC	-	Heating, ventilation, and air conditioning
ICIOB	-	Incorporated Member of the Chartered Institute of Building
ICTAD	-	Institute for Construction Training and Development
IFC	-	Issued for Construction

IIESL	-	The Institution of Incorporated Engineers, Sri Lanka
IR	-	Inspection Request
LC	-	Letter of Credit
M&E	-	Mechanical and Electrical
MAIQS	-	Member of the Australian Institute of Quantity Surveyors
MAS	-	Material Approval Sheet
MECF	-	Metropolitan Engineering, Consulting & Forensics
MEP	-	Mechanical Electrical Plumbing
MICCP	-	Member of the Institute of Construction Claims Practitioners
MRICS	-	Member of the Royal Institute of Chartered Surveyors
MSc	-	Master of Science
O&M	-	Operation and Maintenance
OM	-	Operation and Maintenance
PMP	-	Project Management Professional
RFI	-	Request For Information
SBD	-	Standard Bidding Document.
TKMEC	-	Thangal Kunju Musallar College of Engineering

LIST OF APPENDICES

Page

CHAPTER ONE

1.1 Background

The Mechanical Electrical Plumbing (MEP) systems could distinguish from other elements of building as they consume resources such as water, gas, and electricity and incurs initial installation and running costs to operate and maintain (Cunningham, 2017). Further Adewunmi, Odesola, and Ugochukwu (2019) identify that the choice of an inefficient procurement system causes delays, cost overruns, and claims in MEP service installations as well as in maintenance stages. Specifically, in MEP projects, the required quality of a building electro-mechanical system should not limit to its construction period, it should also properly function throughout the whole life cycle (Wenfang, 2013). Cunningham (2017) identified that the selection and approval of the MEP system depend on the value for money concept and consultant engineers may select a high capital system with lesser running costs considering the benefits in long-run operation.

As per Wenfang (2013), most claims in civil engineering projects were raised by the contractor to the owner. Author further states that, in the context of a building electro-mechanical system, the owner's claims are more evident as the owners should be compensated in the event of the failure of the function of an electro-mechanical system. Chester and Hendrickson (2005) state that owners can save cost with the choice of a less experienced designer in the MEP system however reworks and delays due to poor design causes project cost overrun to a large extent.

According to Bakri (2014), building defects contain faulty lighting/electrical wiring, defective or inadequate plumbing/ drainage systems, defective ventilation, cooling or heating systems, insufficient soundproofing, and insufficient fire protection suppression systems. As per the view of industry experts, the Contractor will not maintain the MEP systems during the Defects Liability Period (DLP), yet the Contractor has to remedy any malfunction or fault which is not related to wear and tear (Pillai, 2017).

Vidogah and Ndekugri (1998) identified the most important cause for rejecting the contractor's claim is not suitability according to the contract principles. Subsequent rejection factors are inadequate details, wrong calculation of entitlement, absence of claim analysis from the cause, not following the contractual practices, insufficient mitigation measures, the correctness of the engineer's/architect's orders and any relent causes (Vidogah & Ndekugri, 1998). Above rejection factors are required to be verified properly as in DLP, even though the contractor must rectify any defects, he should get paid for the works which he is not responsible (Corbett & Co, 2016).

Jayasena and Alwis (2011) surveyed the disruption claims in Sri Lanka and identified that in a majority of claims, the person, who handles the claim fails to understand the term 'disruption claim' and identifies the heads of the disruption claim at once. As per the authors, most of the claimants fail to identify the base of the disruption, and the resource loading and leveling aspects were not considered in the construction program, which uses as a key to justifying a claim. Moreover, Ramachandra, Rotimi, and Gunaratne, (2014) indicated that contractors claims in the Sri Lankan context fail due to common reasons such as the use of unsuitable delay study techniques, unsuccessful in building a connection with claim cause and effect, contractors lag in claim information submission and failure in proving the claim due to insufficient information. Further to the findings by Ramachandra et al. (2014), contractors should submit genuine documental records and the consultants shall reasonably determine the same. Finding by Kumaraswamy and Yogeswaran (2003) proves that quick claim determination can be achieved by retaining joint tracking information for all events with parties' consent. In terms of the claims under DLP, the party's liability plays a vital role which is required to be validated from the genuine documental records.

Cambridge Online Dictionary (2011, para, 2) defines recordkeeping as depositing and manage any form of information, archives, bills, and the like, which links to the actions of any institute or company. As expressed by Scott (1990), all companies should keep records to satisfy vital functions such as settling expenses for creditors, completing auditors' requirements, search for debtors, and also to retain information about significant purposes Further to the author, the records are justified that the

correct materials usage and its correct placing had done as per the scope directed. Scott (1990) further elaborates that the records may be originated from the Contractor, or evaluated by the Engineer, which serves as the valid source of information required for preparing time and money claims. The types of progress records can be elaborated as, photographic evidence, on-site reports representing weekly progress, transcripts of progress evaluation discussions, details of actives carried out by daywork basis sign by the parties in the approved format, and site manager's journals (Scott. 1990, p.243). The author further expressed that, the key functions of the records are; confirm the works including variations that have been executed, document the resource usage which may ensure the correct payment process, monitor the work progress with the project programme, enabling the parties to take pre-action to ensure the on-time project completion, and act as the key source of data for backup the additional costs and/or time claims for the contractor and helps the engineer to assess the claims correctly.

Importantly, research by Kuruduwage (2016) shows that the industry is reluctant to sustain a record-keeping system while executing the project. Complementarily, preparation of claims on an extension of time can be affected due to the requirement of additional details like delayed records, disagreement between the parties, presentation problems with inaccurate facts, time limits on program activates, critical path deviations, and contract information disagreements (Maduranga, Palamakumbura, & Dissanayake, 2016). Hence, the development of document practice will enable determining the contractual liability of delay more accurately about construction contracts in Sri Lanka (Baduge & Jayasena, 2012).

As per Cushman, Carter, Gorman, and Coppi (2001), the damages by disruptions can be justified by the contractors' cost records on separate job cost accounts opened for impacted activities. The authors further highlight that the accuracy of the cost records should be verified by considering whether; labour categories consists of the affected activity, material charges represent the true excess cost, or do they include the original scope of works, costs incurred in the appropriate period, and whether the cost is reasonable. Work execution records such as manpower, equipment utilisation work sequence, can be recorded as time-lapse images with the aid of digital video cameras,

and the same would treat as strong evidence in arbitral or court proceedings (Cushman et al., 2001). Moreover, the prompt settlement of claims in a fair manner depends on weak demonstration, lack of scientific and legitimate substantiation, and retaining inefficient track records (Sibanyama, Muya, & Kaliba, 2012).

O'Connor (2003) indicates the impact of effective record keeping to establish the entitlement and causation leads to successful claims. As per the author, the contractor's delay claims fail as there are no sufficient documents to prove the same, delays in claim detail submissions, and inability to convey on time notices by securing parties entitlement for charging cost/time implications as stipulated under the contract agreement. Failing to justify the entitlement by establishing the link leads to claim failure and poor presentation of the claim without proper breakdowns, damages do not calculate under the contract enhance the failure (O'Connor, 2003). Kululanga, Kuotcha, and McCaffer (2001), therefore stated that to produce a successful claim, contractors must comply with the procedures set out in the contract conditions and submit a detailed breakdown of additional costs and times with adequate documental backups.

As suggested by Yates and Epstein (2006), accurate administration of delay claims can be achieved by referring to a large amount of properly ordered credentials. Consequently, it is a contractor's liability to record details promptly to justify any claim incident (FIDIC Conditions of Contract, 1999).

Teacher, Law. (November 2013) indicates the importance of keeping accurate contemporary records for labour, equipment, and materials. Further to the author, successful claim administration can be achieved by maintaining the on-sited records such as, schedules of material certification from consultants, record on work executed, complete contract document and tender details, daily usage monitoring records of staff labour and equipment, received vouchers for goods and its site issue records, list of drawings, records on ordering goods with price statements, schedules of additional information requested, information recorded about quality, risk as well as cost, records on shareholders communications, schedule of engineers instructions, meeting transcripts and communication record between parties, site journals maintained by

workplace managers, change order register, schedule of extra/additional works , details on baseline programs and updated programs as per the contract, program representing constructed status, audio-visual and snaps records, measurements of closed or buried works agreed by both contractor and consultants as well as records on claim and delay notices.

Gilliss, Berkley, Loewke and McLaughin, (2016) state that the MEP contractors should be suspicious about their obligations as the consultants are trying to interpret the prescriptive specifications as performance specifications by inserting wordings like "a complete and working system" into the contract conditions.

In the above backdrop, the requirement of record-keeping to establish MEP related claims during the DLP can be identified as an important aspect that needs to be studied in the Sri Lankan context as limited studies prevailing related to the said subject. Therefore, this research intends to study the importance and usage of record-keeping in the Sri Lankan construction industry during DLP related to claims in MEP contracts.

1.2 Problem statement

As per the findings by Ramachandra et al. (2014), contractor's applications on additional time /cost entitlements are mainly failed due to insufficient substantiation documents. Thus, most of the time contractors' claims are concluded at a lesser value than the contractor's actual rights (Ramachandra et al., 2014). This proves that there is a requirement of establishing best practices for a proper record-keeping process to achieve success in claims.

The finding of Wenfang (2013) confirms that studies are limited related to the claims of MEP projects. The author further states that people apply the theory and experience in civil engineering projects for the MEP project claim events also. The author further postulates that, even though such applications solve some problems related to MEP contracts, there is a big restriction as MEP projects are very different from civil engineering projects.

Further to the findings by Cunningham (2017) and Pillai (2017), maintenance plays a vital role under the MEP scope. The maintenance mostly effects during the DLP. As per the present industry practice, the DLP can be considered as a problematic area for all the parties to the contracts. The behaviour of claims during DLP may be an even more complex issue. Under the MEP available information's there are limited studies available about the MEP claim events at the DLP, as such it is important to study the behaviour of the claims during the defect liability periods.

In the light of existing theory, it is worth studying the client/contractor claims management relation to record-keeping in MEP projects to establish best practices for proper record-keeping in establishing client/contractor claims during the DLP of MEP projects in the Sri Lankan construction industry.

1.3 Aim

This study aims to investigate essential record-keeping practices for establishing MEP claims in the DLP addressing the current knowledge gaps.

1.4 Objectives

Following research objectives were decided to achieve the above aim,

- Critically review the importance of proper record keeping for claims management in MEP projects
- Appraise the MEP related claims at the DLP
- Explain the process of claims management in MEP related projects with special reference to claims establishment in the DLP
- Develop a guideline for record-keeping in assisting MEP related claims at the DLP

1.5 Research method in outline

The mixed approach was used to investigate the claim types in MEP projects and essential record-keeping practices for establishing claims in the MEP projects. In this research project, due to the higher degree of information requirement, the most appropriate research methods were selected as parallel execution of a questionnaire

survey and expert interviews conducted as semi-structured interviews with domain experts based on observed data from literature findings.

1.5.1 Literature survey

The investigation on existing varieties of record-keeping methods was conducted by using sources like academic journals, newsletters, and books.

1.5.2 Questionnaire survey

The questionnaire survey was designed to get the MEP professionals' views on best record-keeping practices for the success of MEP claim establishment at DLP. As the MEP experienced persons are limited, the respondents were collected from professional association's networks available in Dubai, Oman, and Qatar. Further contacts were collected from professional profiles websites like LinkedIn which can be treated as a reliable source.

1.5.3 Expert interviews

Experts were selected by Judgement sampling; Senior professionals specialised in MEP trade in the Sri Lankan context were interviewed. A guideline was prepared for conducting semi-structured interviews to abstract the data from experienced experts.

1.6 Scope and limitations

Further to the literature findings, there are very limited studies available about MEP claim events. As the research scope narrows further to study MEP claims at the DLP make harder events due to lack of literature. Further MEP experienced persons also can be treated as scarce resources to found as such the outcome of the research was conducted with limited resources for collecting the information. Professional profiles websites like LinkedIn were used to identify the professionals as the details are credible as the credentials were given in a detailed manner with evidence. In overcoming the impact of such, the research has taken methodological measures such as using a mixed approach that allowed to bring additional insights via expert interviews towards handling lack of specific literature and also using a survey was useful in obtaining generalisable findings amid lack of experts in the field.

CHAPTER TWO-LITERATURE REVIEW

2.1 Introduction

A literature review can be considered as an important segment of any research as it investigates the theoretical background and existing knowledge of the research problem. Literature review becomes the basis for the selection of the research approach, and it helps to discover the gaps in the current knowledge.

Naoum (2007) elaborates the literature review as an effort, to combine what others have spoken and cited, establish links among selected subject matters, recognise key problems in the selected industrial study as well a detailed analysis of past academic researches. Analysts can compose/plan their examination successfully by observing past structures and polls (Naoum, 2007).

Accordingly, this chapter explores and reviews the existing knowledge and theoretical background of the record-keeping procedures and claims management systems. The review is presented in sections and sub-sections as necessary for the clarity and brevity of the presentation.

2.2 Record-keeping in the construction industry

This section considers the existing knowledge and theoretical background of the record-keeping procedures in essential sub-sections as presented below.

2.2.1 Record-keeping: Definition and requirement in the context of construction claims management

As per the Cambridge business English online dictionary (2011), record keeping is a process of arranging and storing all the communications, papers, bills, and all information linking to the functions of any institute or business.

The records are maintained to monitor and control the construction process as well as to resolving construction conflicts and disputes (Zubair et al., 2006). The information about the provisions and practices from successful projects can be used to avoid and resolve disputes during construction (Zaneldin, 2006).

Further, as highlighted by Watt (2011), the burden of proof lies with the claimant to justify his/her entitlement. The author further states that the claimant must prove what occurred in the record promptly following the contract provisions. This task is only possible with the aids of project records and the justification of the claim is difficult if such records are not available with the claimant (Watt, 2011).

Ramachandra et al. (2014) found out that insufficient documentation to justify the entitlement is the highest-ranked cause to fail the contractors' delay claim. The authors further state that ineffective claims can be resulted due to the failure to keep sufficient records on project activities and costs. Yates and Epstein (2006) suggest that delay claims can be effectively managed with the necessity of a wide range of documental records. In some contract conditions, maintenance of contemporaneous details was established as a contractor's liability which is necessary to establish the claim entitlement (FIDIC, 1999).

Therefore, the document keeping to be kept as separate independent records to substantiate the claim effectively (Carmichael & Murray, 2006). Carmichael and Murray (2006) further state that reimbursement for any interruptions or delays and evaluation of time extension entitlements should follow the proper method as directed by the protocol of the Society of Construction Law (SCL). Figure 2.1 depicted the main theory of the procedure set out in SCL.

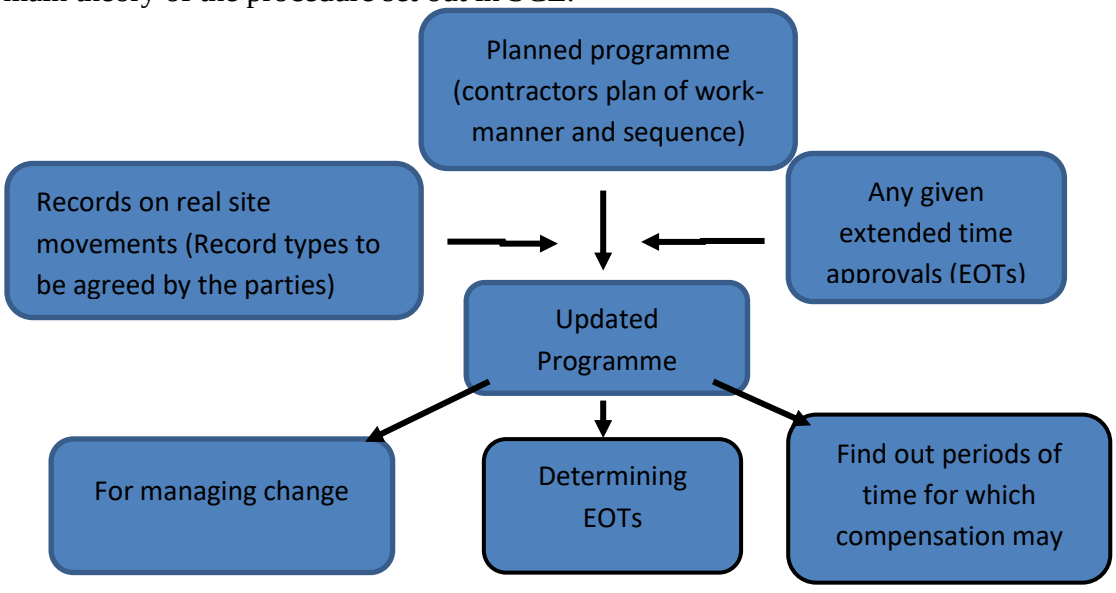

Figure 2.1: Key principles of SCL protocol for claim management

Further, Shadid (2015) observes that every construction project requires capturing the record types promptly as said records can be used to initiate a claim even years later after completion. Further to the author, keeping of some records becomes compulsory requirements in the events of, 1) tracking and observing the current status of the projects with the preparation of reports on progress review, 2) it is required to preserve the contractor's entitlements and also to get compensation for the work done, 3) to present the advancement of work done amount against at any given time, 4) as specified according to contract conditions like FIDIC forms with signed agreements between client consultants and contractors as directed, 5) become a statutory requirement of countries.

Therefore, Carmichael and Murray (2006), recommended the procedures set out in the SCL protocol to establish an appropriate procedure for documenting and substantiating any delay and disruption incidents.

2.2.2 Significant records to be maintained for Claims management

As stated by Carmichael and Murray (2006), there are various types of records to be documented depending upon the liability of the project completions and the success of the project management services. Further to the authors, progress reports, period reports, job meeting minutes, programme updates and revision are important records that enable all the parties to become aware of delay and disruption occurred and also support to assess the impact of said institution associated delay. If a dispute occurs, a properly updated project program can be used as contemporaneous proof (SCL protocol, 2002).

To reduce or prevent claims in construction projects Zeneldin (2006) recommends promptly maintenance of following onsite activity records such as records for tracking the development of the construction, engineers instructions, climatic records with details of impact, timesheets, labour records, daily monitoring sheets, statements with important information's, snapshots of work activities. Transcribed engineers' instructions, price breakups, take-off records on measurements, specifications, and shop/as-built drawings play a vital role as the documents required to settle the claims (Bakharya, Adnanb, & Ibrahim, 2015). As per Zubair, Zaimi, Majid, and Mushairry,

(2006), site records are required to cover a-range of aspects namely finance, quality, and progress. The authors further suggest that progress records should capture, what claim incident happens, when and should include resources used for any delay/disruption. Further, China and Hamida (2015) state that many people understand the importance of the progress reports, and the same was recorded unwittingly and incorporated into a database for future reference. The authors further state that people were aware of the labour allocation records to be kept while doing the work. The research indicates that the people are aware of record-keeping concerning compensation or delay-related events and works also to be recorded by task on schedule for both labour and plant and equipment (China & Hamida, 2015).

The site records are required for the reasons - protections against disputes, for employer's information, recalling memories about the site actives with the aids of site diaries, and to get a clear understanding of what occurred at sites. Accordingly, in "project diaries - construct administration manual" (2011), records maintained play a vital role, and the record is the document that proves the construction event executed at site. Said manual further elaborates that records shall serve as proofs for the additional works carried out at the site. The records shall also help to defend any liquidated damages claims, forged claims, and violations from authorities or employers ("project diaries", 2011).

Therefore, the records demonstrate what has happened and the Engineer or consultant's approval is recommended on what type of records to be kept for future claims management purposes (Castell, 2007). Moreover, Castell (2007) elaborates that parties should keep electronic copies of records, where cross-examine and analysis can easily be done using computer software. The author further states that the records should not be discarded without proper investigation at the project completion and proper review of records should be made after finalisation of final accounts.

Castell (2007) identifies the best practices of a list of records to be produced in a construction project, which are used to claim preparation and defense of claims as evidence. Further Wideman (2001) also identified a record list, which could suit construction projects. The author further states that the records types determine based

on the requirement by law and jurisdictions, requirements under the contract agreement to protect the parties' rights according to contract conditions and technical specifications, and requirements to monitor and control ongoing works. The case study done by Sulbaran (2011) identified the record types which are required in the event of litigation successes. As per the author said record types represent the most important record types used in existing in construction companies to preserve their rights. The contract administration construction manual (2013) also indicates a model list of site records that are to be kept at the site. The Newsletter - Proving up claims (2013 August), also identified the record types which need to maintain at sites proactively, which helps to establish or disapprove parties' claims. Each set of records presented by the above authors were compiled and summarised according to similarities and presented as the record types used in the current construction industry under Table 2.1 with the references.

Table 2.1: Existing record types in the construction industry

Reference	**Record type**
Contract administration construction manual (2013)	Contract status
Sulbaran (2011), Wideman (2001), Contract administration construction manual (2013)	The original contract document- original contract
Sulbaran (2011), Wideman (2001)	Issued For Construction (IFC) drawings which represent the agreed scope as confirmed by employer and Engineer
Sulbaran (2011), Castell (2007), Contract administration construction manual (2013), Wideman (2001)	Filing record of all the record with tracking index of the documents (all filed by topic) (written communications between the parties including memos and faxes)
Wideman (2001), Sulbaran (2011)	Progress, milestone photographs with each milestone name, date, and time of completion
Wideman (2001)	Any reports from special consultants
Sulbaran (2011)	Progress reports presenting the site progress according to the milestone or project completion

Reference	Record type
Wideman (2001)	Reports on projected completions including details of any omissions, prepared on a monthly or weekly basis as required
Sulbaran (2011), Wideman (2001)	Notes of telephone conversations between contractors or the owner which linked to changes
Wideman (2001), Contract administration construction manual (2013)	Anticipated variation instructions from clients indicating additional or extra works, estimates on variations, work direction from the engineer to contractors
Sulbaran (2011), Wideman (2001)	Contractors claim notifications related to any additional time or cost implications
Sulbaran (2011)	Special instructions to contractors like plants available at the sites to be protected by the contractor and the like statements
Sulbaran (2011), Wideman (2001)	Quotations related to suppliers, sub-contractors, or any other service provider with purchase orders, contract agreements, or any other communication backups
Sulbaran (2011), Wideman (2001)	All shop drawings including revisions done by Contractors, Sub-contractors, producers, and suppliers. Said submissions to be recorded with submittal log indicating the dates submitted
Sulbaran (2011), Newsletter - Proving up claims (2013 August), Wideman (2001)	Requests for information for the contractor or subcontractor of the project
Contract administration construction manual (2013), Newsletter - Proving up claims (2013 August)	Work inspection reports from Engineer/ consultant/ government authorities
Sulbaran (2011), Castell (2007), Wideman (2001), Contract administration construction manual (2013)	A daily diary or journal entries recorded what has done at the site in writing
Sulbaran (2011), Castell (2007), Wideman (2001)	Records related to daily resource usage at site. Daily production also recorded against the resources used
Sulbaran (2011), Castell (2007), Wideman (2001), Contract administration construction manual (2013)	Cost records for daily resource usage / budgeted and actual costs and man-hours
Newsletter - Proving up claims (2013 August)	Work records demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time

Reference	Record type
Newsletter - Proving up claims (2013 August)	Incoming wires, Incoming conduits, subdivide conduits, and details on terminations
Newsletter - Proving up claims (2013 August)	Work records- details on project type like renovation of the existing building, new building, or carry out the modifications whilst engagement of people
Wideman (2001), Sulbaran (2011) Contract administration construction manual (2013)	Incoming material records with reconciliation on usage, bookkeeping information's on dues, owing's, payrolls, and other accounts
Contract administration construction manual (2013), Newsletter - Proving up claims (2013 August)	Requests for material tests & testing reports
Contract administration construction manual (2013)	Report of rejected materials
Sulbaran (2011), Wideman (2001) Contract administration construction manual (2013)	Interim payment applications and certifications which indicates the monthly completed works according to the condition of the contract including supporting documents
Sulbaran (2011), Wideman (2001)	Baseline construction programme with milestone completion dates
Sulbaran (2011), Wideman (2001)	Programme task records which include a detailed narrative with resources planned and actual usage, required clothing and equipment, durations, environmental conditions
Sulbaran (2011), Wideman (2001)	Analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints
Wideman (2001)	Details on actually spent expenditure, budget management of the construction
Wideman (2001), Sulbaran (2011), Contract administration construction manual (2013)	Meeting minutes especially related to contractual issues and site coordination issues. Transcription of site organising meetings
Castell (2007)	Records of design or post-contract variations with supporting drawings, instructions with a detailed narrative of the incident
Contract administration construction manual (2013)	Pile driving records
Contract administration construction manual (2013)	Special orders/directives to contractors

Reference	Record type
Contract administration construction manual (2013)	Noncompliance and compliance notices
Contract administration construction manual (2013)	Certified payrolls and labour wage checks
Contract administration construction manual (2013)	Environmental forms and reports
Newsletter - Proving up claims (2013 August)	Record contractor's home office general, and administrative costs
Newsletter - Proving up claims (2013 August)	Equipment rental invoices
Newsletter - Proving up claims (2013 August)	Any out of schedule works that impact productivity
Newsletter - Proving up claims (2013 August)	Weather records including rainfall, temperature, and humidity, affect the progress
Newsletter - Proving up claims (2013 August)	Restrictions for site access, onsite actives, stacking materials, vertical movements of material and equipment by using cranes and elevators, special material handling needs which hindrance the efficiency
Newsletter - Proving up claims (2013 August)	Records on security, safety, work hours restrictions, and site clearing

2.3 Claim management in the construction industry

2.3.1 Claim process

The Cambridge online dictionary (2011) defines the claim as a request for something worth, as you presume that it is vested by you and you have an entitlement to make such a request. Wood (2006) stated that the "Claim" word was initiated by the word "claime" from France. As stated by Shadid (2015), the definition of "Claim" can be elaborated as one's ownership demand for something, expecting that it as belonging to him or a request for entitlement to a commodity title. The claim was further defined by the Canadian Law Dictionary, as the recovery against any party's incompetent in fulfilling their contractual duties (Shadid, 2015).

In the context of the construction industry, Chappell, Smith, Powell, and Sims (2005) define the "Claim" as contractor declaration for demanding the entitlement to

compensation for any cost and time implications resulted due to the applicable conditions of the contract or any implied terms.

Claims in construction projects were identified by the FIDIC as an appeal made by the suffered party for suitable reimbursements to cover the losses due to a breach of the contract by the other party or any entitlement according to the contract conditions or contract law (Abdulnabi & Agrawal, 2016).

During the “Claim in perspective” seminar held in 1992, Barber and Hughes elaborated the term claim as an appeal, request, or submission for compensation of assumed right to the contractor thinks that he is eligible to compensate however the amount yet to be determined and agreed (Shadid, 2015).

Ekhator (2016) describes “Claim is another source of dispute in the construction industry”. The creator further expresses that "During the execution of an undertaking, a few issues emerge that can't be settled among venture members". Ekhator (2016) brought up that "such issues commonly include temporary worker mentioning for either time expansion or repayment of an extra expense, or in some cases both". Said requests from the contractor are also considered as ‘claims’ (Ekhator, 2016).

The meaning of the word claim can be different in numerous references, however, the most suitable technical interpretation for “Construction claim” is defined as a demand to perceived entitlement by an applicant (generally a party related to construction sites), requesting relief for any time/cost implications according to the condition of the contract or outside the contract (Chappell, 2011).

Carmichael (2009) saw that contractual workers kept case rates low when customers carried on correspondingly.

Claims can be utilised by the contractor as an effective tool to mitigate the risks associated with project execution and said risks are elaborated as, risks arising from contract, any unforeseeable financial threats, risks due to natural phenomena and any risk occurred in the construction of the project (Lihong, 2011).

Further to Kululanga et al. (2001), claims are identified as a liability under the industry and can be found in all construction projects in increasing nature. There is no precise meaning for claim however claim can be a statement of appeal submitted by a party to reimburse any loss with the aids of supporting facts and documents to secure the entitlement (Kululanga et al., 2001). Ho and Liu (2004) identified that claims in construction projects are treated as unfriendly and troublesome incidents by many development project members.

Contractual demands may begin against one gathering yet wind up influencing numerous contractual workers even at various periods of the undertaking, particularly in instances of consecutive contracting (Chester & Hendrickson, 2005).

Stamatiou et al. (2018) suggest the claim to be used as a final option since the arguments during claim settlement may destroy the good relationship between parties to the contract, hence claims to be raised only if it is required. Further to the authors, the claim is highly impacted by goodwill and the necessity of the claimant who interprets the condition of the contract thinking that he has suffered from known risk. Further in-depth investigations by Zhou and Hong (2012) founds that effectiveness in project administration can be achieved as a benefit from claim application. Time is considered a vital factor in construction projects. If the project is unable to finish on time due to contractors' default, the owner would incur losses in profit that employer intended to earn from functioning the project (Salwa, Fawzy, & Islam, 2012).

A declaration of rights by a party in a project is defined as a claim (Badenfelt, 2011). The contracts normally consist of one client and one contractor. However, said parties would sublet the works to domestic subcontracts trade-wise by producing in-house administration culture (Badenfelt, 2011).

Claims are normally raised by the affected party of a contract, as a remedy to recover losses from the party who caused the damage (Kululanga et al., 2001).

2.3.2 Common Causes of Claims

Alloh (2014), Samantha (2002), Ekhator (2016), and Mohsin (2012) identified the contract documents related factors as a common cause of claims. The authors also

identified the owner requested changes as another common cause of claims. Claims due to differing site conditions, termination of contracts, insufficient plans, and specifications; were other common causes, which were identified by the same authors.

Alternatively, Semple, Hartman, and Jergeas, (1994) indicate that delays can be mitigated by rescheduling the programme by using additional labour forces or working additional hours with overtime payments however if the contractors are not liable for the delays then the client has to pay for the additional resources and associated cost which is termed as acceleration claim.

Yang and Xu (2011) pointed out that contractors tend to quote low prices assuming that they could recover the profits by raising claims in the post-contractual stage.

According to Yang and Xu (2011), claims should comprise supportive documental proofs, a general narrative about the claim, contract provisions for the entitlement, and detailed calculation for monitory demands. Further to Abdul-Malak., El-Saadi, and Abou-Zeid, (2002), the impact assessment of a claim can be done by calculating the effect represented in the event impacted program and cost allocations after finishing the claim incident.

If the claims have a continuing effect, impact evaluation cannot be succeeded at the time of notice received from the contractor, as parties can't predict the impact and hence difficult to calculate the magnitude of the claim (Abdul-Malak et al., 2002).

There are possibilities to occur disputes and fairness of the claim determination can be questioned if different control measures are adopted in various stages under the claim management (Aibinu, 2006).

According to Revay (1993), high magnitude compound claims can be evident in larger complex construction projects. The author further observes that claims are unavoidable.

In the case of supply chains, it is practically not possible to give complete details covering the contingencies related to duties and responsibilities of the parties to the contract (Coltman, Bru, Perm-Ajchariyawong, Devinney, & Benito, 2009).

As a preliminary precaution, clients tend to transfer all the likely risks to different entertainers although it does not imply that the impact of the risk is fully disposed of (Revay, 1993).

As per the view of Singh and Tiong (2005), normally contractors may suffer from loss due to insufficient designs and specifications caused by the negligence of the consultants. The author further expresses that the client could hold responsible for the design liability as there is no contractual link between the consultant and contractor. However, the owner could recover the losses by raising a claim against the consultant for the breach of consultant agreement and negligence (Singh & Tiong, 2005).

2.3.3 Claims management

The removal of disagreement and clash situations can be resolved under the claim management.

Providing quick and appropriate solutions to claim situations, can be treated as the prime objective of the claim administration method (Bakharya et al., 2015).

Scott (1990) highlights that claims schemes that incorporate invoicing, payment facilities and policy management enables service providers to cover the obligation on crosscheck and delivery of payment. Further to the author, arranging the claim administration process as a combined system enables the development of the organization and high functional productivity.

As explained by Data (2012), the duties of the contract administrator are not only limiting to improve the continuously changing claim management system but also to correctly attend to consumer requirements. Further to the author, determination functions of contract administrator can be enhanced by establishing modern trade rules and recharging trade shapes with the aids of proper developing claim administration structure.

Further to Data (2012), the claims management systems are consistently being updated to have a successful system by minimising errors and by identifying scams as well. As per the author, such improvements to claim management systems would replace the traditional trends.

According to Banwo, Parker, and Sagoo, (2015), the causes of claims could be classified into three (03) major categories namely (i) excusable event, (ii) non-excusable event, and (iii) external events.

Levin (1998) standardises the management process as given in Figure 2.2:

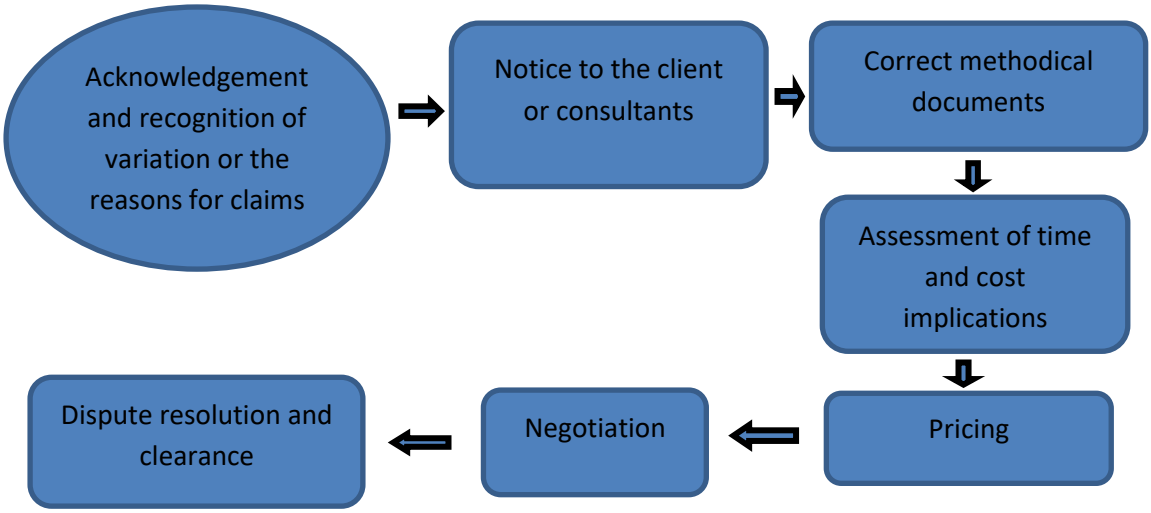

Figure 2.2: Claim management process flow chart

As per Figure 2.2, the contractor must identify the claim incident as soon as practicable. Further compliance with the notice procedure is required to convey the contractor's intention to claim relief to the owners. Some forms of contracts require formal notices to be served in compliance with the time bar provisions. Failing to notify may sometimes lose the contractor's rights to claim entitlements. If the claim is equipped with proper documental backups, then the claimant could secure his entitlement leading towards a favourable solution. Under the analysis, the impact of time could be achieved with the critical path method analysis tools. It uses a cause and effect relationship of the impact events. Pricing of claim is required to give an idea to the owner about the claimed impact in monitory terms. The pricing could include direct costs, impact, or delayed performance costs and mark-ups. The amount could agree before the work is done or after executing the works. Under the negotiation, parties try to reach a reasonable settlement for the incurred due to the claim situation. If the negotiation failed and ended with a dispute, parties could select a convenient resolution method. The litigation could be considered as the final solution however depending on the viability of the dispute, parties could use

alternative dispute resolutions like mediation, conciliation, adjudication, or arbitration.

As highlighted by Enshassi, Choudhry, and El-Ghandour, (2009), every party, mainly the Contractor must properly understand the function of the claim administration process.

The key elements of a claim management process consist of the following; A) Prevention B) Foresee and minimize, c) Resolve, D) If un-resolved, reference for dispute resolution procedure, E) Conclude (Liyanage, 2018). Also, Zaneldine (2006) identifies that claim management consists of recognition of the claim, notice of claim, analysis of the claim, arranging claim credentials, demonstration of the claim, and finally claim determination. Bakharya et al. (2015) recommended that settlement of problems professionally and successfully are the driving factors in claim management.

As explained by Enshassi et al. (2009), both claim to assess expertise and claim preparation knowledge are expected from the persons who look after the claim administration process.

In the claimant's viewpoint, determination plays a vital role as If the claim submission is not equipped with correct supportive documents, the claim assessor could easily negate the claim with the aid of well reasoning determination (Enshassi et al., 2009).

2.3.4 Factors for successful claims

Hewitt (2011) states that in a claim submission or a determination, the following requirements are essential to ensure the claim success,

- Cause- The incident that gives the birth of the claim
- Effect - the fact that links cause & effect and this is the key factor that needs to prove.
- Entitlement -the demonstration of the time and/or cost implication
- Substantiation- the proving of submitted fact/calculations is correct in an acceptable way.

Stojadinovic (2018) also commented about 3 elements for claim success.

- Identify the risk event and justify the other parties liable for the damages by showing the legal basis for compensations of costs.
- Accurate cause and effect analysis to be carried out to prove the risk event had incurred cost and delay.
- Cost and time implications to be recorded for the proper determination of damages.

As per the finding of the authors, documentation should comply with the contractual procedures and time frames set out in the relevant forms of contract especially the notice procedures and the like.

Tochaiwat and Chovichien (2004) state that accurate and efficient documental records play a vital role in justifying claims. As per the author, contractors should always keep records, and techniques like cameras and recording devices could be very useful for record management processes.

2.3.5 Claim assessment and resolving methods

Zaneldin (2006) commented that there are four (04) basic settlement methods used to resolve claims in the United Arab Emirates: i) negotiation; ii) mediation; iii) arbitration, and iv) litigation.

However, the litigation process is a high cost and time-consuming process. The prevention of litigation would incur an opportunity cost-saving and Ho and Liu (2004) expressed that the facts like; impact on the image, labour hour losses due to non-availability of works, client contractor connection, and the disruption to the works should consider by the contractor as an incidental cost which may incur due to following litigation process.

As explained by Aibinu et al. (2011), failure or success may heavily depend on the negotiation of the claim, as such negotiation can be treated as a vital factor. Factors like parties' views on their connections may impact critically the negotiation process (Aibinu et al., 2011).

As identified by Vidogah and Ndekugri (1998), there are eight reasons for total or partial rejection of the claims from the contractor, specifically (in sliding significance), non-privileged on a fundamental level, deficient data, measurement of

guarantee, absence of breakdown of a case by causes, resistance with authoritative methods, lacking exertion at relief, the legitimacy of designer/ architect's guidelines, and different grounds.

2.3.6 Claim documentation

As expressed by Nobari and Dehkordi (2015), documentation is a key consideration under claim management, which also controls the reduction and preventions of claims. The authors indicate that the clarification of uncertainties in the project documents shall be the start of the documentation process under claim management.

As per the findings of Nobari and Dehkordi (2015), the steps of the claim documentation were described further as follows.

- The documentation shall then elaborate on the prompt and correct discovery of the claim occurrence under the steps of identification /recognition/ tracking. Under this section the plus and minus points of the claim to be identified first
- Then a series of lawsuit arguments to be made to secure the positive chances and also to eliminate the impact of negative chances.
- As the next step, the above arguments were converted in to delay time impacts or monitory terms of the losses with associated costs.

As identified by Sibanyamaa et al. (2012), the agreement of claims fails to maintain at a satisfactory level due to delayed notifications, inadequate record-keeping backups, insufficient legal and actual backups to validate the claim including poor presentation.

Maintaining good site records is very important especially for delayed events (Scott, 1990). As stated by Kumaraswamy and Yogeswaran (2001), the contractor’s intention to claim to be conveyed to the authorised persons under the contract as a valid notice. Maintenance of detailed particulars shall then follow as an effort of formalising the claim event. Inefficient clashes can be escaped by adopting proper document management systems among groups. (Enshassi et al., 2009). As per the findings of Enshassi et al. (2009), lack of recorded information and lack of sufficient documents

are considered as general difficulties in the claim management process. As observed by Hassanein and Elnemr (2007), researchers identified that the amount of consideration given to the administration of document by the site team, restrict the claim management process. Keeping records of written communication could be treated as important under the claim administration method and backup records to be properly stored. However, such importance is still not understood by the parties to the contract in practice. (Bakharya et al., 2015)

Bakharya et al. (2015) identify that specifications, drawings, engineers' orders, take-off records, and pricing details can be considered as some sample documents requires for the claim success.

Administration of claims can be heavily impacted due to a lack of relevant recorded documents. As per Newsletter – "Proving up claims" (2013 August), the claimed costs could comprehensively recover by maintaining proper contemporaneous documents related to, effects on programs, details on problems, price details, and efficiency of the executed works. Said newsletter further states that the purpose of record-keeping is to assists one or more out of three needs for claim entitlement namely- responsibility for the damages, reasonably forecasted losses, and establishment of the connection between responsibility and effects on resulted damage.

Further to Sadid (2015), five (05) major features can be mention under the claim administration process, which can be treated as appropriate claim justification backups.

1. Gathering detailed supporting documents which support in subsequent assessment
2. Reports on the progression of the site indicating,
    - The tracking of executed works with dates
    - Details elaborating events occurred in sites such as climatic conditions
    - Clients were indolent for transfer delays and stoppages.
    - RFI requested with the Engineers responses
    - Explanations or special notes on completes works

3. Records on oral instructions, electronic mails, telephonic discussion, and transcripts from the Engineer or any approved agent
4. Transcripts of technical/progress meetings which represent the unattended problems as such action on disputed matters would pass the onus to the contractor
5. Snapshots indicating the relevant time and dates as the photographic evidence plays a vital role in the justification of the works at different project phases

2.4 Importance of continuous record-keeping for MEP related claim management in DLP

This section initially elaborates the claim causes and claim management system related to MEP trade and further explains the behaviour of MEP related claims in DLP. The latter part of the section addressed the importance of contemporary record-keeping for MEP Claim establishment.

2.4.1 MEP as a major sub-section in contemporary building construction projects

Siddiqi, Khalid, and Hunt, (2015) identified that Mechanical and Electrical Services (M&E) requires better purchasing and cost administration methods as said subsections play a vital role under the construction business. The authors further elaborate that the expense of such M&E service maybe amounting to 10% to &70% of the overall project cost in well-developed territories, however as per the observations on the Malaysian construction industry, 40 % of the building cost required for the M&E services.

2.4.2 MEP related claims in DLP

As defined by FIDIC 4th Edition published in 1987, the Defect Liability Period is the period that the Contractor is notified of defects. The same meaning is referred to as the "Defects Notification Period" under the new FIDIC 1999. This period is normally considered as 365 days and may be extended by the employer (Tweeddale, 2016).

As stated by Gulfnews (2018), both contractors and employers get the advantages by introducing a defect liability period to the contract conditions. The employer could

ask the contractor to come to the site and rectify any defects. Further to the article, it would be beneficial for the employer to ask the contractor to rectify the defect as it prevents the additional losses incurred for arranging a new party. This would be beneficial to the contractors also as the employer tends to deduct the associated cost related to rectification from the contractor's retention money in the event, if contractors are liable for the defects, as the costs are higher if the work carried out by a third party (Gulfnews, 2018). The authors further elaborate that the above procedure would prevent the costs for legal actions or arbitral proceedings.

Further to Tweeddale (2016), contractors should not be blamed for defects that resulted due to the Engineer's design.

Keegan (2014) identified that the MEP claims can arise as construction defect claims due to the damages from poor quality of workmanship which results in plumbing leaks and electrical, mechanical problems. Author further states that defects could occur in HVAC systems when an owner is not operating the HVAC system as it is designed in the operation and maintenance stage. As such a defect claim may raise against the MEP contractor for the defects in the HVAC system.

Defective HVAC systems and electrical-mechanical systems, electrical accidents, unacceptable supervision, design defects, and fire losses can be considered as claim events related to MEP trades (Kent/McBride, 2019).

Metropolitan Engineering, Consulting & Forensics (MECF, 2014) and klwtlaw.com (2019) identify the defects which cause the claim event in the MEP trade projects during the DLP. The parties who are liable for the fault have to remedy the other party for any loss incurred. If the contractor has the fault liability then Employer's claims can occur mainly for defective or poor quality workmanship.

Bray (2019) identifies causes that occur due to clients' faults and neutral events where either party does not have any responsibility. The Contractor could raise claims where clients are liable for the defects.

Table 2.2 summarised the MEP Claim causes and fault liabilities. As per the table majority of the fault, liabilities causes due to contractors' fault as such the employer's claims are mostly visible in the MEP trade under the DLP.

Table 2.2: MEP Claim causes and fault liabilities

System	Causes of Claims	Liability of the fault	Reference
Plumbing	Inadequate water pressure	Contractor	klwtlaw.com (2019)
	Improperly installed water heaters and water heater vents	Contractor	klwtlaw.com (2019)
	Improperly installed air unit vents and condensation drains	Contractor	klwtlaw.com (2019)
	Improper installation of hangers and supports to prevent water hammering	Contractor	klwtlaw.com (2019)
	Improperly installed backwater valves	Contractor	klwtlaw.com (2019)
	Corrosion and leaks in copper water piping	Contractor	klwtlaw.com (2019)
	Non-functioning water shutoff valves	Contractor	klwtlaw.com (2019)
	Waste pipe clean-outs buried inside walls	Contractor	klwtlaw.com (2019)
	Excessive sound transfer	Contractor	klwtlaw.com (2019)
Electrical	Improper selection and installation of outlets	Contractor	klwtlaw.com (2019)
	Improper weather protection of exterior fixtures	Contractor	klwtlaw.com (2019)
	Improper grounding of electrical fixtures	Contractor	klwtlaw.com (2019)
	Improper installation of aluminum wiring	Contractor	klwtlaw.com (2019)
	Improper labeling of panel directories	Contractor	klwtlaw.com (2019)
	A power failure occurred due to the transformer not working or fire occurred due to electrical shock	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
	Raise in power or electricity inconsistency affected the electrical scheme, causing damages for electrically operated plants and other equipment, ultimately leading fire induction or power interruption	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
	Electricity failure occurred due to breakdown of a turbine generator	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).

System	Causes of Claims	Liability of the fault	Reference
Mechanical	Fault in production apparatus or a machine which stop the manufacturing of a product or destroys valuable assets	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
	Faults in the HVAC or cooling scheme causes decay in commodities due to heat variances or non-availability of fresh air and causes dismissal of farm animals	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
	Faults in hydraulic scheme induced by a malfunction of a pump or compressor which causes liquid ejection in high pressure	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
	Terrible effects caused by a fault of a boiler resulting blast and subsequent harms from fire	Contractor	Metropolitan Engineering, Consulting & Forensics (MECF).
All	Failure to provide proper maintenance, owners abuse, misuse, and negligence	Client	Bray (2019)
	Wear and tear of materials impacts due to weather conditions, natural disasters	Neutral	Bray (2019)
	Damage from rioters, vandals, animals, or "acts of god"	Neutral	Bray (2019)
	Damage caused by hired personals by the owner	Client	Bray (2019)

In line with MEP works, Gulfnews (2018) states that appropriate observation and maintenance are required by the specialist plants as some maintenance contractors may not familiar with the process and may not have the required expertise. As per the author, the manufacturer and installation contractor must arrange proper training for the operation team so that the operating teams become familiar with the operations units and the systems. HVAC systems, district cooling systems, heat exchangers, CCTV, BMS, steam, and sauna systems can be taken as examples for said operation units and systems (Gulfnews, 2018).

In DLP, the contractor hands over the equipment, and the liability of maintenance transfers to the employer. The employer must take necessary actions to provide preventive maintenance. The manufactures have specified the required maintenance procedures in maintenance manuals and may also provide the training facilities to employer's persons depending on the nature of the contract. In general situations, the manufacturer provides the repair works during the warranty period however the

contractors must facilitate the necessary arrangements as there is a liability to the contractor to take care of the defective works.

In the event of the failure of the equipment, the cause to be investigated and the correct cause to be identified to avoid disputes.

In the event of disputes arises, the parties may decide whether to go ahead with the disputes and claim for losses suffers, depending on the cost-effectiveness of the claim situations, if the claim preparation process is costlier and the likely recovery of the damages is less then bearing the loss will be more beneficial other than incurring the cost for claim production.

At the occurrence of any disagreement, groups should select the best option available as per the time constraints. If the project is ongoing, then the progress cannot be held due to the matter of disputes. However, the resolution of the dispute is also an important factor in preventing any losses.

As such, the preventive measure of disputes must be taken to ensure a win-win situation for both the contractor as well as the employer. When considering the MEP contracts, most disputes during the defect liability period occurs due to poor maintenance or manufacturing defects. It is very difficult to prove the liability of each party for the disputes. As such the requirement of a checklist of a guideline is required to ensure that the correct maintenance procedure is followed by the employer and monitor the contractor liability for manufacturing defects.

Further to the literature review, there are limited studies available for the MEP claims. As the research focused on the MEP claims in the defect liability period, the availability of literature is very limited. As such, the industry best practices to be investigated as per the professional's experience related to the MEP subsection with the aids of questionnaire surveys and interviews.

2.4.3 Establishing MEP related Claims.

As identified by Siddiqi et al. (2015) under the construction defect, the HVAC Systems had the second-highest impact on the recurring maintenance costs. Plumbing and electrical works bear lesser recurring maintenance costs. As per the authors,

recurring maintenance costs play a vital role which causes cost overruns for facility management costs. Siddiqi et al. (2015) further state that maintenance costs can be minimised by controlling the unplanned maintenance cost which occurs after the system failure, including repairs to be done to correct the damages.

As per a study carried out by Yusuf, Mohamed, Yusof, and Misna, (2013) in the Malaysian construction industry, M&E services contractors have the freedom to choose the brand and country of origin of most equipment. In such a case, difficulties occur when calculating efficient life cycle costing as there are substantial variations when there are several equipment types with similar design capabilities (Yusuf et al., 2013). The authors further state that the manufactures can be fixed as per quality and marketplace attributes by considering the maintenance, repair, and replacement cost.

MECF (2014) recommends keeping the records of repair and maintenance to avoid the rejection of claims.

Further to Templeton and Haldrup (2014), typical building and mechanical system claims and the ingredients to prove the claims are given in Table 2.3. The table indicates the likely heads which could include in the claims under the MEP trade. The claim calculations should include the costs to solve the problems and validate the activities as per the solutions given in the table. Said calculations should also include the remedies for any damages or losses incurred by any party as indicated. Record types need to arrange to prove the liability of given damages and further the cost of rectifying damages in line with the given solutions required to be justified with the aids of resources consumption records.

Table 2.3: MEP systems claim types and claim components

(Source: Templeton & Haldrup, 2014)

System	Claims types	Claims include	Solutions
HVAC	Bad ecological situations in internal areas affect the condition of inside air	Damages due to bodily injury or property harm (typically heat and wetness impact)	Ductwork cleaning, vibrant screen cleaning, altering fan rates, tuning driving mechanisms, and incorporating humidity management devices.
	Adverse or inadequate stresses in air	Lost production, broken product, and lost sales	
	Access to outdoor air comprising bacteria	Quality issues negligence	
	Extra dampness inside the conditioned areas	acquisition defects, product defects	
	Contaminated ductwork		
	Air conditioning unit with insufficient capacity		An associate in additional careful analyses is going to be needed to work out an acceptable answer.
	Disputes in compartment pressurisation		Require altering or redesign current managing devices which adjust the functional properties of HVAC scheme like variances in inside environments and tracking stress development in the building
	Disputes in air particulate control		
	Disputes in performance of HVAC equipment and distribution systems		
Plumbing	Water damage produced by the failed pipe or tubing connections, to the building components	Property damages	Restore replace the faulty items. Whatever faults are concealed and under the footprint of the structure, consistent with large initial fees
	Installations plumbing fixture do not comply with regulatory standards	Material replacement charges	
	Usage of improper materials in wastewater delivery pipes as such waste flow may have active chemicals and acids	Repair charges	

System	Claims types	Claims include	Solutions
Electrical	Electrical faults (short circuits)	Property harm to terribly serious electrical injury or death	Electrical wiring needs a complete replacement
	Fire security matters caused due to service infiltration through fire-rated partitions	Losses in the electrical scheme can be comprised with,	The requirement of power and repair voltages require various maintenance places and control the influence of the supply. Costly and complex remedies may be available sometimes requiring extensive-conclusion time
	Segregation of electric appliances on the other side of the walls which are common for apartments	remedies for the breaches of life safety requirements	
	Differences in initial predictions about the reasons for change and associated capacities	Equipment restoration or losses in serving as an instrument	
	Mismatches in power data charts utilized in planning status		
	Mismatches manufacturing and erecting central managing place for controlling electrical motors		
	Bad installation works of electrical paths and links		
	Matters that effects breakdowns or causes harm to apparatus		

2.4.4 The necessity of Contemporary record-keeping for claim establishment

As there are very limited studies about MEP related claims, details of contemporary records specifically related to establishing MEP claims were not available. However, the general contemporaneous information related to records required to prove the claims were investigated as below.

A properly organised document structure can be treated as a keystone of a sound claim management process. As an initial step, claim preparation personals would refer to the available documents to understand the depth of recorded information (Baram, 1992). As stated by Scott (1990), recorded documents may comprise, photographic evidence indicating progress statements, communications between the parties, recorded notes of the meetings, site journals, supply notices, and various onsite information. The most significant factor is that the start of a venture of record-keeping at the beginning of a claim event (Ingram, 2004). Support of such record-keeping is probably going to accelerate the preparation and justification of commercial claims as well as time-related claims.

Moreover, the formation of a sound record-keeping system enables the contract administrators to promptly assess the preliminary data and take immediate actions in the event of a problem occurrence (Keane & Caletka, 2008, p.68). As described by Scott (1992), said recorded data are required for the contractor to prepare detailed substantiation of extension of time and prolongation cost claims. Further to the author, said details are also used by the Engineer to determine the claims. Contractual notifications can be treated as appropriate claim supporting particulars, as the contractor can record, assess time and cost implications by notifying the employer and consultants as and when an event happens (Dobbin, 2006). Oral directions from Engineer or clients are treated as weak forms of documental evidence as sometimes contractor's site staff may forget to keep evidence against such instruction. In practice, it is common evidence that the contractors are complying with the Engineer's directions and carry out the works with no substantial backups as well as failing to fulfill the notice requirement by the contractor's contractual management team. In

such a situation, contractor rights to claim cost and or time implications could be at a risk.

Landon and Khan (2018), commented that advanced technological problems can be generally evidenced in construction development sites, and in such sites, we can also observe that numerous groups engage in collaborative works for longer periods. The authors further describe that contemporaneous records play a vital role in any construction dispute as it provides more reliable proof for the claiming party as well as the determiners.

In the event of the arbitration process, proper management of documents is required well before the occurrence of the incident and to be effectively monitored up to the completion of the event.

As indicated by Landon and Khan (2018), recorded documental proofs can comprise of different forms stored as hard evidence or soft computerised copies such as drawings, printed papers, snapshots, and any graphically represented charts. The authors further commented that the disputes which occur in the construction industry are different from one another, the correspondences required to maintain can be different from case to case.

As identified by Landon and Khan (2018), a typical list of such documents is given below,

- Tender correspondences, standard/ particular specifications with drawings, and pre-contractual communication among the sides
- Contract related correspondences comprising all types of drawing records, specifications, annotations, schedules, and any additional supporting documents
- Tender intent of the time programs and it is updated with reasons for any delays
- Delay or legal notifications, and contractual details related to contracted parties

• Daily activity and resource records with progress tracking reports, meeting minutes, and site diaries

• Invoice or payment evidence for the incurred costs

This will give an intention about the value of retaining the information. A higher responsibility for record-keeping will apply to all contracted sides according to recent editions of the FIDIC contract conditions, contemporaneous record-keeping could be considered as a liability of both client and contractor. Further to FIDIC Sub-clause 20.2, the contemporary records should start simultaneously at the occurrence of the event or after happening of the incident which leads to a claim situation. Parties to the contract should be agreed for the record types to be maintained with resource allocation for such record-keeping.

Under FIDIC contract conditions, tracking of records may be carried out by the Engineer and the Engineer may direct the contractor to maintain any further timely records.

The SCL guide set out a procedure for record-keeping with guidance to remove disputes where the employer's agent and the contractor are expected to agree and sign the records.

The SCL procedures identify the involvements in the costs (disputes can be minimised as an advantage of keeping proper documental backup) and mainly indicate that contracted parties should spend time and cost for keeping good records.

The tender document should state the obligations and procedures for record-keeping. The procedures set out under the SCL subsequent versions bear no litigation influence unless especially specified and included under the contract.

Said protocol mainly under the view of common law principles.

The recorded details should be clear and should solve or stop any dispute incurred. Said protocol provides directions to establish best practices.

2.5 Chapter summary

This chapter discussed the existing record-keeping methods, the theoretical background of the claim management process, and to understand the information available for the DLP in the MEP trade projects. Contemporary record types required for establishing claims could also be treated as vital factors. The above factors can be treated as important in developing a record-keeping guideline.

CHAPTER THREE-RESEARCH METHODOLOGY

3.1 Introduction

This subheading provides a detailed explanation of the empirical investigation process implemented under this research. The data collection and analysis process, data gathering techniques, design of the study, and its limitations are described in more detail.

3.2 Research design

Further to Harrell and Bradley (2009), in expert opinion surveys, a fixed set of questions are processed as a web form and the interviewees should answer by complying with the given framework. The authors further elaborate the interviews as one on one discussions among interviewees and experts to get the macro-level details on a definite topic. Said interviews could be organised face to face or over the phone and the degree of interaction represent the difference between interviews and surveys (Harrell & Bradley, 2009).

Sounders, Lewis, and Thornhill, (2009) explain the snowballing sampling as a procedure where respondents are found from the information received from the first participants. Further to the authors, this technique is used for scarcity samples. As the MEP experienced personnel could be considered as scare recourses said snowball sampling method was adopted in this research interview sample selection.

In this research project, parallel execution of questionnaire survey and semi-structured expert interviews with domain experts were selected as the most appropriate research methods as the research requires a high degree of information from the construction professionals.

Accordingly, the data collection was done in two (02) ways. A web-based questionnaire survey was conducted along with expert interviews where industry professionals, who are specialised in MEP trade representing the contractor and consultant/Engineer, were participated in the semi-structured interviews.

3.3 Data Collection

3.3.1 Questionnaire survey

The questionnaire was used as a key process to satisfy the objectives of critically review the importance of proper record keeping for claims management in MEP projects and thereby to develop a guideline for record-keeping in assisting MEP related claims at the DLP. The questioner survey was conducted to collect data from local experts as well as experts abroad online since a larger population of competent specialists can collect in mid-eastern countries like Dubai. The questionnaire survey was circulated among 120 personnel and 48 responded in return. Accordingly, 36 responses were acceptable. The questionnaire study intended to collect the information/ opinions from industry experts representing the parties of employer, contractor, consultant and other parties as the designated subject title requires vivid viewpoints from experts.

The questionnaire was developed in two (02) stage format. The first part collects the common details of the survey participants. The later part of the questionnaire comprised questions to obtain in-depth detail addressing research objectives. All the questionnaire participants in the construction sector were subdivided into four (04) categories i.e. (i) client, (ii) contractor, (iii) consultant, and (iv) others. Persons not representing the employer, contractor, or consultant were incorporated in the “others” section. When dealing with the variations, different approaches were followed by the above sub-divided groups. As such, separate sets of questions were organised and presented to each four (04) groups as given in the questionnaire template in Appendix B.

The open-ended questions (refer Appendix B) were incorporated into the question design to collect appropriate opinions. Upon making the survey questions, the same was forwarded to a peer plus an expert to get reviews for fine-tuning of the questions. Stratified sampling was used for the questionnaire survey. It was observed that some participants have ignored the questions asked in an open-ended manner, however, the collected data are considered sufficient for concluding. Such ignorance of answering

the question can happen due to the busy job schedules of the participants. Said reasoning also may be the case for receiving a low rate of questionnaire feedbacks.

3.3.2 Expert Interviews

Experts can be termed as the personals having technical knowledge about the researcher's concern areas. Under the view of expert opinion, the greater accuracy outcome can be obtained from a group of experts as some people may have an extra understanding of the selected subject. Financial, technological, echo friendly and community favour explanations can be obtained from a cluster of specialists and it is hard for the researchers to collect such information on their efforts. As the experts have a greater understanding and historical data about the progression of certain subject matters, they can be treated as vital resources for the research developments.

The expert interviews were carried out as a qualitative analysis among the selected professionals working in the MEP construction industry. The guideline (refer Appendix C) was prepared as questions based on the scenarios to achieve the research objectives. The professionals were categorised as contractors, consultant and engineers and their general information were collected as the initial stage. Thereafter, more detailed questions related to MEP claims in DLP were carried out as the next stage to collect the data of existing record types, important factors, and performance in successful claims.

The selected sample for the expert interviews in the present study comprised judgementally selected qualified experts who are currently involved in the MEP claim management process. Professionals working in the local construction business were selected to carry out the interviews. The selected group comprised of two (02) experts from the contractor's end, one (01) expert from the consultant, and one (01) expert from the Engineer's side.

The interviews were designed for obtaining experts with in-depth views on the chosen subject matter. The guidelines for semi-structured interviews contained similar questions used in the questionnaire investigations. Questions related to additional information were asked at the interview executing time to achieve success in the data collection purposes.

The questions were prepared in a way that giving more freedom to the respondents. As the questions were designed to get knowledge and shared experience, interviews of professionals can be considered as the best method for data collection. The respondent's confidence level, responding rate, and facial expressions can be experienced and enhanced the credibility of the outcome.

3.4 Data analysis

Data analysis plays a key role after collecting the data. Under the data analysis, the collected data were labeled and presented employing statistical explanations (Tulli, 2014).

3.4.1 Quantitative data analysis: Statistical Analysis

As stated by Denscombe (2008), quantitative data takes numerical forms and can be used to analyse data from close-ended questions from questionnaire survey responses. The author further elaborates that ordinal scale forms like Likert scales were used to compare peoples attitude ratings based on more positive than other coded categories and can be presented in an ordered relationship. Joshi, Kale, Chandel, and Pal, (2005) highlighted that under the Likert scale, respondents were requested to present their level of agreement on a set of given data in metric scale. Proportion measurements like percentage calculations can be used to interpret quantitative data and further can order the data on the basis that one item was bigger or small than the other (Blaxter, Hughes, & Tight, 2008). The Likert scale is a common way of asking the level of agreement and disagreement the visitor has for a question and should be familiar to anyone used to making surveys. The basic format of the Likert scale is a 5-column answer, which choices like; strongly disagree, disagree, neither agree nor disagree, agree, and strongly agree. More answers give the ability to indicate the level of agreeing or disagree. Under this research, responders were asked to rate the given record types in 5 scales of very low, low, medium, high, and very high levels of the applicability to the success of MEP claims at the DLP. Ranking items allow the viewer to rank the choices in order of preference. Generally, the highest preference indicates the very high and high rankings. As such the percentage of the combined ranking of "very high"+ "high" ratings was calculated and the data was priority ordered based

on percentage value ranking. The record types with higher percentage rankings were considered as the higher priority requirement for the MEP claim success at the DLP.

3.4.2 Qualitative data analysis

As explained by Hakkus, NurSari, and Uner, (2012), researchers consider the ways people communicate through means of written or verbal announcements under the content analyses. Further to the authors, the main objective of content analysis is to arrange similar data based on certain theories and topics and present it to the readers in an understandable way.

3.5 Summary

This chapter explained the research methodologies applied for the dissertation. The research process was further elaborate on the research design and data collection methods within the framework of the identified problem. The collected data were analyzed in a meaningful manner to achieve the objective.

CHAPTER FOUR-DATA ANALYSIS, FINDINGS, AND DISCUSSIONS

4.1 Introduction

This section provides the analysis of information collected, subsequent findings, and necessary arguments generated from semi-structured interviews and the questionnaire survey.

4.2 Results obtained from Expert Interviews

Appendix A shows the questions and answers from the interviewed experts as enlisted in Table 4.1

Table 4.1: Details of interviewed experts.

Responders coding	Qualification & experience	Party represented
R1	CIDA Adjudicator- BSc, MSc-CL&DR, AIQSSL- Charted Quantity Surveyor -22 years' Experience in MEP trade and 10 years' experience in claim management.	Consultant
R2	Commercial Manager, MRICS, MSc-CPM, Charted Quantity Surveyor -19 years' experience in MEP trade and 12 years' experience in claim management	Contractor
R3	Senior MEP Project Manager-TKMEC, PMP- 24 years' experience in MEP trade and 10 years' experience in claim management	Contractor
R4	Deputy General Manager -Claims - BSc, MICCP, MAIQS, APAWE, ICIOB, IIESL - 20 years' experience in MEP trade and 10 years' experience in claim management	Engineer

As per the interview answers attached in Appendix A, all the respondents were fully involved in the claim management process in MEP projects.

4.2.1 Relationship with record keeping and claim management

All respondents confirmed that record-keeping has a very close or direct connection with claim management. In line with the contractual background, R1 stated that according to Clause 20 of FIDIC 1999 emphasised the requirement of claim notice, the said clause itself describes the contemporary records must be kept as per the Engineer's requirement.

R1 further highlighted the condition precedence requirement under Clause 20 in the FIDIC 1999 for the claims. The respondent stated that under SBD, contract notice is not conditioned precedence and the claims to be discussed from aspects such as contractors' side as well as the employers' side. Employer's claims are referred to Clause 2.5 of the FIDIC 1999, employers are not required to provide the notice except FIDIC 2017. The respondent stated that,

> *"In other contract types such as FIDIC 1999, FIDIC1987, and SBD we are having separate clauses for the contractor which is clause 20 and clause 2.5 for the employer. In FIDIC 2017, one clause facilitates the employer and the contractor and as per the FIDIC 2017, the contractors must be notified by the clients"*

As per the FIDIC 2017, the claiming clause is common for the contractor and the employer.

4.2.2 Most important record types

All of the respondents highlighted that contemporary records are more important. R2 pointed out that agreed contractual records are most important. R3 pointed out the importance of attendance, cost, time records. Further, R4 specified the records as all the communication between contracted parties and Engineer record for changes, details, and scope of the initial contract, request for information's, inspection request, clearance records, MAS records, document register including emails records, claim notices, all the records to prove the changes for the abortive works, shop drawing approvals, and the record of working drawings approvals.

4.2.3 Common MEP claims in the Defect Liability Period (DLP)

Three (03) respondents were comprehensively involved in the claims in DLP. Another respondent R1 has also been involved in the MEP claim evaluation in the DLP period

but said claim events occur during the construction phase. However, being a CIDA certified Adjudicator, his views were considered as an industry expert opinion.

Respondents stated malfunctions of MEP systems, equipment failures, claims related to warranty issues, claims for the contractor was not attending whilst workmanships, lack of maintenance of equipment, or lack of proper housekeeping as the common claims in the DLP.

4.2.4 Requirements of claim success

R1 highlighted that record keeping is a requirement for claim success where timely notice, contemporary records, material approvals, approved method statements, RFIs, testing, and commissioning records from both contractors, employers, and proper handing over procedures become crucial. R2 pointed out the importance of validating the warranties for claim success. R3 stated that claim success depends on documentation, knowledge of the equipment, records of maintaining the works, cost records, complaints, contractor's attendance, the record of communications between the parties, and properly sign off records for the works. R4 also pointed out the importance of keeping approved documental records for claim success. The respondent further specified the requirements as shop drawing approvals, signed off testing records from the Engineer, as-built records, records for proper onetime attending for clients' complain.

4.2.5 MEP Claim submission procedure and substantiation

From the contractor's point of view, R2 and R3 both stated that the claim submission procedure is being done as per the condition of the contract. Further to the respondents, the claims must be forwarded to the consultants or clients representative through the prime contractor, and sometimes nominated subcontractors could submit claims directly to the Engineer or employer.

As per R2, proper records to be provided to substantiate the claim. The respondent highlighted the importance of some records such as weather reports and photographic evidence. R3 stated that contract document records would be useful to contest the Engineers' specifications and third-party independent agency decisions could also be used as substantiation backups. He further pointed out that documentation should be

in place to show these trials of events that happen with the reason for the claim. As per the respondent, parties should prove that they have acted with due diligence and fulfill their duties.

4.2.6 MEP Claim Evaluation procedure

From a consultant/Engineer's point of view, R1 stated that "contractual framework, do not have any guideline for a claim evaluation. However, in practice FIDIC, SBD the employer must compensate the cost which is actual". The respondent further commented that claims to be evaluated according to the procedure set out in the SCL protocol. R4 highlighted that the notice timeline checking as a priority and a root cause analysis should follow for the claim incident. He further stated that root-cause analysis could be done by independent 3rd party MEP specialists by visiting the site to investigate the reasons for the faults. The respondent further elaborated on the importance of checking as-built records to verify the correct installation procedure as approved by the Engineer and the actual cost incurred to be considered as compensations which should include business effect as well as the impact of the delays from contractor's attendance.

4.2.7 Records as evidence in certifying MEP claims

R1 stated that the notice as an important factor and documental backups like design documents, standards RFIs, operation manuals, handing over documents could be used for further verification. As per the view of R4, the contractor should maintain a log for attendance for maintenance and complaint register. He further pointed that operation manuals and spare parts list of records, as-built drawings are also important evidence, and contractors should give the proof of training the client's staff in the event of the MEP equipment was operated by the client.

R1 stated that records like design records, material approvals, method statements, material selections standards, design standards for fabrication, records of testing, and commissioning to be considered as important. R2 highlighted that the employer should follow the guideline given by the manufacturer and specified spare parts, the specified type of oils to be used with records. The respondent further specified that the filter to be changed promptly and the MEP contractor should monitor and record

whether the employer follows the procedure as per the guideline from the Manufacturer. R3 stated the required record types as a callout for the maintenance, specifications, material costs, labour cost, and labour timings witnessing by the Engineer. R4 highlighted the importance of keeping records for proper handing over and initial snag list as the contractor's duty to complete those snags only. Respondent further stated that approved final inspection reports, MAS approvals, approved plant as-built drawings, proper completion records, room wise photos, otherwise MEP equipment room wise photos or video backups and records on proof of staff training are very important for claims. He further pointed out the importance of keeping a proper mechanism to maintain the MEP equipment and the employer's maintenance team to be given proper operation manuals with proper training guide or otherwise, the maintenance should be given to an expert company and all the activities shall be recorded as backups for claims.

4.2.8 Essential records for claim success

R1 highlighted the photographic record as an additional requirement. The respondent further elaborated that as per the client's vision, the importance of maintaining the MEP system with the manufacturers' authorised maintenance service providers. The respondent further comments that government certifications and proper maintaining records shall be benefited for the employer to prove that he has done service and maintained equipment properly. R2 recommended a monitoring system from a remote area for the MEP equipment and system to minimise or avoid the failures. R3 also highlighted the importance of photographic evidence. He further pointed out that the employer's maintenance team should follow the procedures set out in the O&M manuals and record the works. Respondent further stated that during the DLP, the first inspection request to be sent to the contractor stating the reasons for any failure or defective works, and then the contractor has to investigate further and attend to the issue followed by the claim situation from the suffering party depending on the situation. R4 highlighted that if the client engaged 3rd party for any repair or modification after handing over, then contractor's records like built drawings material brand approvals, testing report approvals, testing and commissioning reports could be considered as good evidence in verifying claims.

Based on the results obtained in the expert interviews, record types identified and classified against each respondent's view were summarised in Table 4.2. Herein, the priority of record types was indicated by considering the number of respondents who agreed with their reasoning provided. Further, the outputs are highlighted in two (02) different colours to showcase the High priority record types and Medium priority record types.

Table 4.2: Summary of record types identified by the interviewed trade experts with literature citation reference

S.No	Respondents reference - Interview	Identified Record type	Reference
1	R1, R2, R3, R4	The original contract document-original contract	Sulbaran (2011), Wideman (2001), CACM (2013)
2	R1, R2, R3, R4	Progress, milestone photographs with each milestone name, date, and time of completion	Wideman (2001), Sulbaran (2011)
3	R1, R3, R4	O&M manuals records	
4	R3, R4	Filing Record of all the Record with tracking index of the documents (all filed by topic) (written communications between the parties including memos and faxes)	Sulbaran (2011), Castell (2007), CACM (2013), Wideman (2001)
5	R1, R4	Anticipated variation instructions from clients indicating additional or extra works, estimates on variations, work direction from the engineer to contractors	Wideman (2001), CACM (2013)
6	R1, R4	Requests for information for contractor or subcontractor of the project	Sulbaran (2011), NL-PUC (2013), Wideman (2001)
7	R1, R4	Testing and commissioning reports	
8	R3, R4	Proper completion records	
9	R1, R4	Proper handing over records	
10	R1, R4	Material approvals	
11	R3, R4	Maintain a log for attendance for maintenance	
12	R3, R4	Complaint register	
13	R4	Quotations related to suppliers, sub-contractors, or any other service provider with purchase orders, contract agreements, or any other communication backups	Sulbaran (2011), Wideman (2001)

S.No	Respondents reference - Interview	Identified Record type	Reference
14	R4	All shop drawings including revisions done by Contractors, Sub-contractors, producers, and suppliers. Said submissions to be recorded with submittal log indicating the dates submitted	Sulbaran (2011), Wideman (2001)
15	R4	Work inspection reports from Engineer /consultant/Government authorities	CACM (2013), NL-PUC (2013)
16	R3	Cost records for daily resource usage/ budgeted and actual costs and man-hours.	Sulbaran (2011), Castell (2007), Wideman (2001), CACM (2013)
17	R3	Work records which demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time	NL- PUC (2013)
18	R4	Requests for material testing & test reports	CACM (2013), NL-PUC (2013)
19	R1	Records of maintenance work done by the owner	
20	R2	Equipment product warranties contract with inclusions and exclusions	
21	R4	Records of damages/defects	
22	R4	Approved as-built drawings, approved plant details	
23	R4	Material brand approvals	
24	R3	First inspection request for defeats	
25	R2	MEP equipment and system monitoring records	
26	R1	Manufacturers approval for MEP service maintenance provider	
27	R4	Video backups records	
28	R4	Records of proof of staff training mentioning	
29	R4	Poof for giving proper operation manuals as a training guide	
30	R4	Keeping a proper mechanism to maintain the MEP equipment	
31	R3	Callout for the maintenance	
32	R2	Monitoring record whether the employer follows the procedure as per the guideline from the manufacturer.	
33	R2	Filter to be change records	

S.No	Respondents reference - Interview	Identified Record type	Reference
34	R2	Records on using manufacturer specified spare parts	
35	R2	Records of using the specified type of oils	
36	R1	Design document records.	
37	R1	Method statements	
38	R1	Material selections standards,	
39	R1	Design standards for fabrication	
40	R4	Spare parts list of record	
41	R2	Weather reports	
42	R3	Records on trials of events that happen with the reason for the claim	
43	R4	Clearance records	
44	R4	Records to prove the changes for the abortive works	

	High priority record types
	Medium priority record types
CACM (2013)-	"Contract administration construction manual" (2013)
NL- PUC (2013)-	"Newsletter - Proving up claims (2013 August)"

A summary of the important records identified by the interviewed respondents is given in Table 4.2. Literature review citation reference in which the same records were cited under the literature survey by analysing the data content mapped under Table-2.1- Existing record types in the construction industry. Interview outcome was arranged in priority order as per the record types referred to in the interviews. Record types that were mentioned by all four (04) responders, treated as priority category, and record types referred by two (02) or more parties were considered as highly applicable record types.

The record types of original contract document-original contract and progress, milestone photographs with each milestone name, date, and time of completion were rated by industry expert interview respondents as high priority requirement for establishing MEP related claims in DLP. Said record types were found under common record-keeping practice with less priority as traced by the literature findings. O&M

manuals records were considered as the third priority by the interview responders however said record type was not identified under the literature survey.

The following record types were ranked 4th to 6th priority from the interview rankings and the same was supported by literature as common practice record keeping.

- Written communications between the parties (including memos and faxes), work direction from the engineer to contractors
- Anticipated variation instructions from clients indicating additional or extra works, estimates on variations
- Requests for information for contractor or subcontractor of the project

The record types of testing and commissioning reports, proper completion records, proper handing over records, material approvals, maintenance of a log for attendance for maintenance, and complaint register were rank from the 7th to 12th place in the priority list as identified only by the interview responders.

4.3 Findings obtained from the Questionnaire survey

The total 36 satisfactory responses comprised seven (07) representing employer, eleven (11) from consultants, 18 from contractors, and one (01) representing other parties. Concerning the disqualified responses, it was identified that the results were impacted as the responders were reluctant to read detailed headings. Further, some responses indicate that responders did not understand the instruction given at the beginning of each questionnaire sheet. The demographics of the active sample is presented hereon.

4.3.1 Sample Demographics

The nature of the profession of respondents in percentages is given in Figure 4.1.

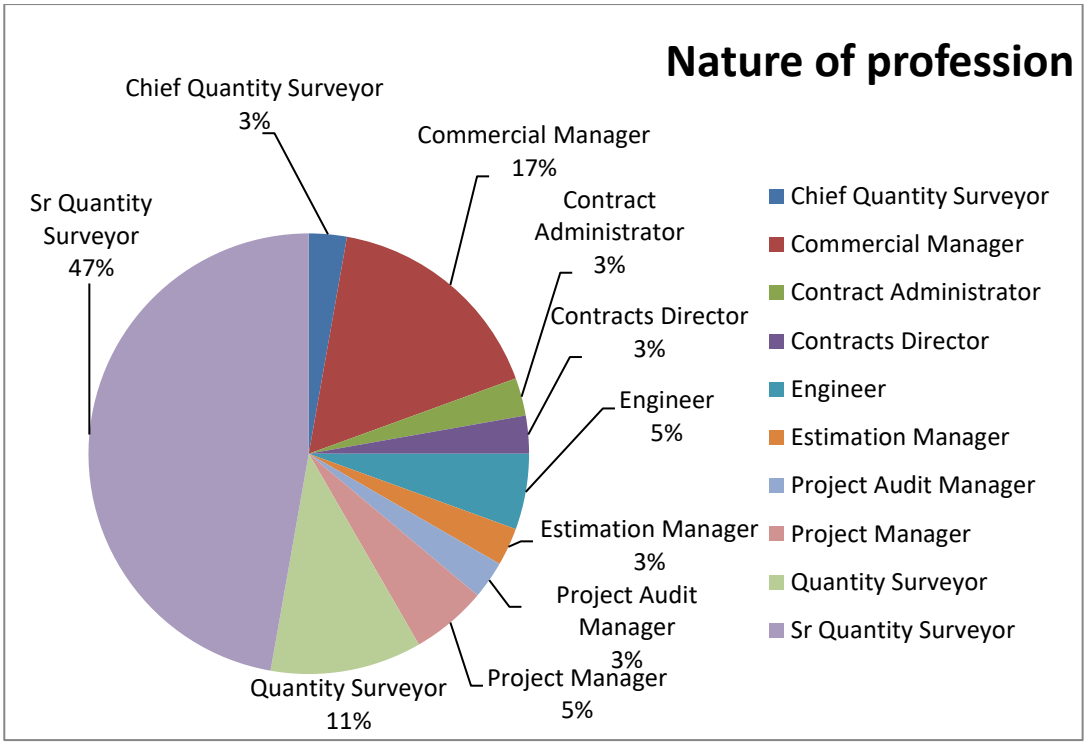

Figure 4.1: Nature of professionals contributed to the questionnaire survey

Quantity surveyors, senior quantity surveyors chief quantity surveyors, commercial managers contracts directors, and contract administrators could be considered as the key personnel involving in the claim situations. As 84% of the selected population is comprised of said key personnel, a credible outcome could be expected from the surveyor.

The nature of business types of respondents is given in Figure 4.2

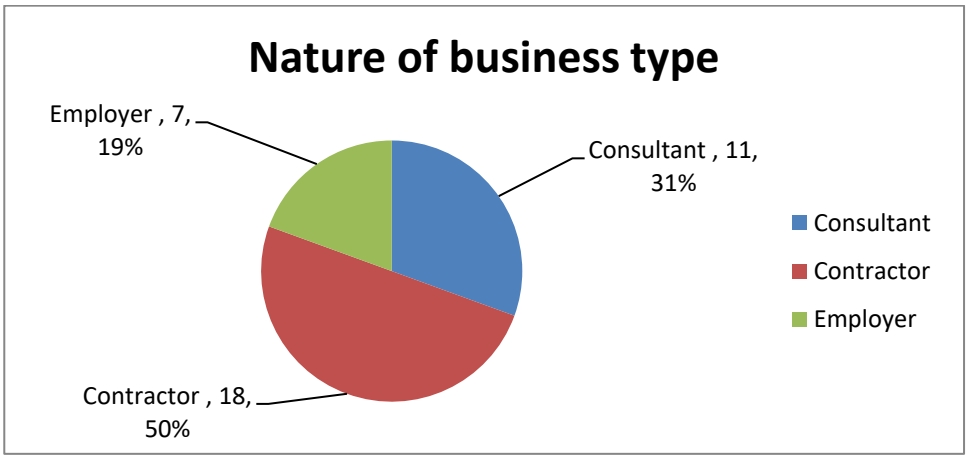

Figure 4.2: Nature of business of questionnaire survey responders.

The majority of the respondents represent the contractor's party. However as the consultant could be considered under the employer's agent, the respondent's view could be considered as equally contributed.

Figure 4.3 The participants experience in the construction business

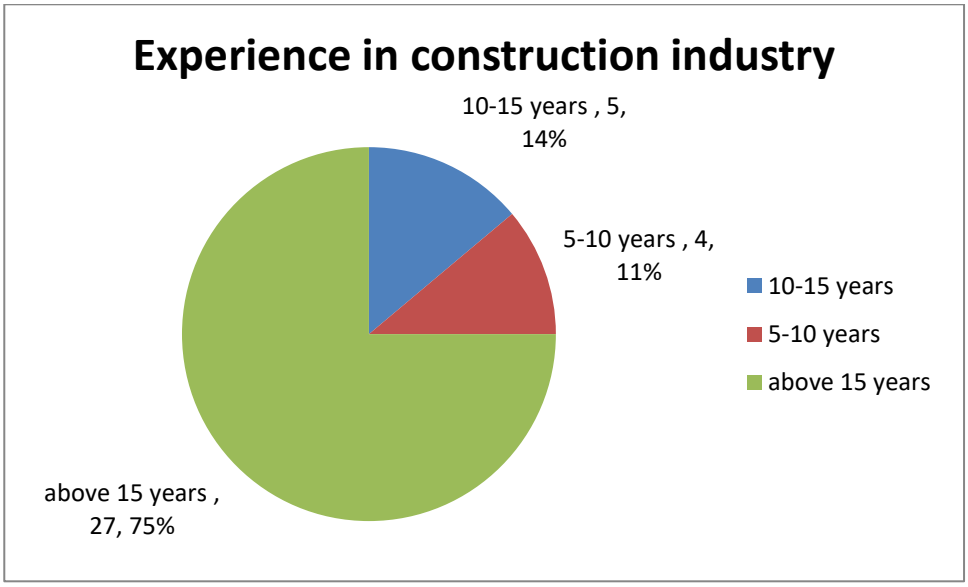

Figure 4.3: construction industry experience of questionnaire survey responders.

The majority of the respondents were well-experienced experts with 75 % over 15 years of experience in the industry.

Q4) Experience in MEP projects

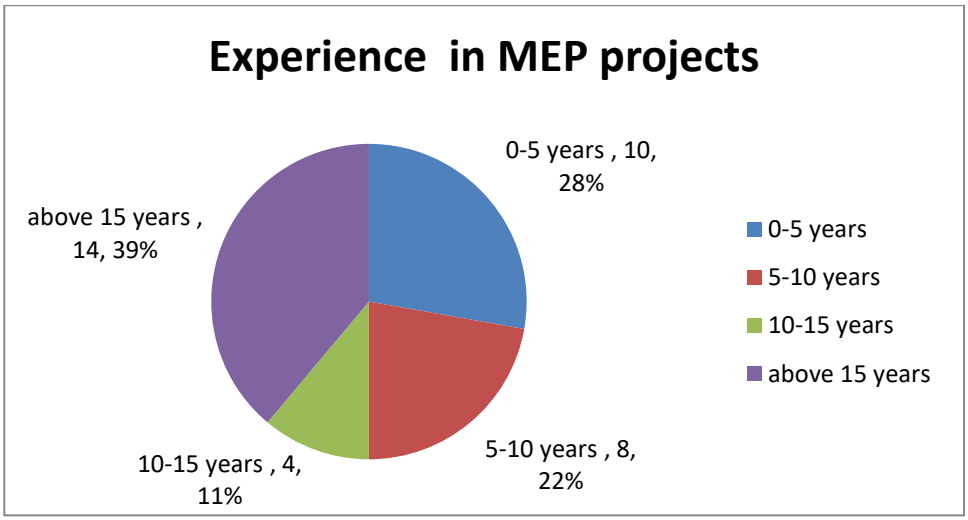

Figure 4.4: MEP project experience of survey responders

Only 28 % of the participants have MEP experience of less than five (05) years. As such the majority (72%) can be considered well-experienced personals.

Q5) Involvement in Claim management process in the Defect Liability Period (DLP)

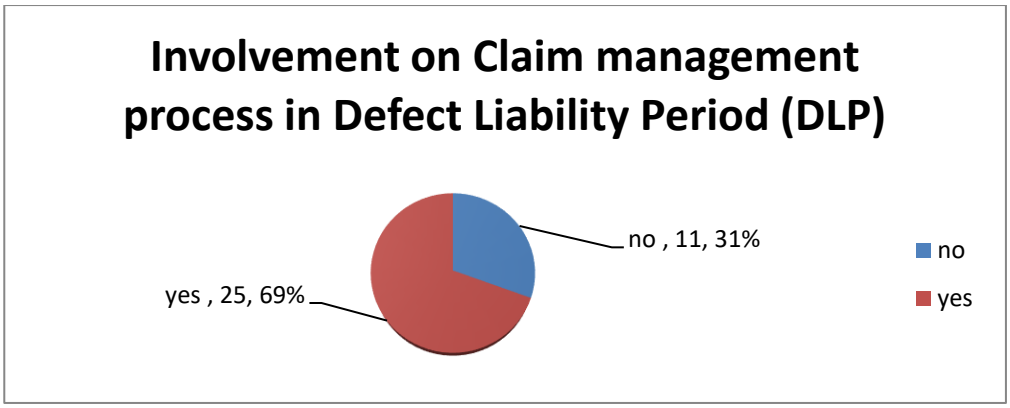

Figure 4.5: Survey respondents' involvement in claim management in DLP.

69 % of the respondents were involved in the claim management process in the DLP.

Figure 4.6 shows the claims experiences of respondents.

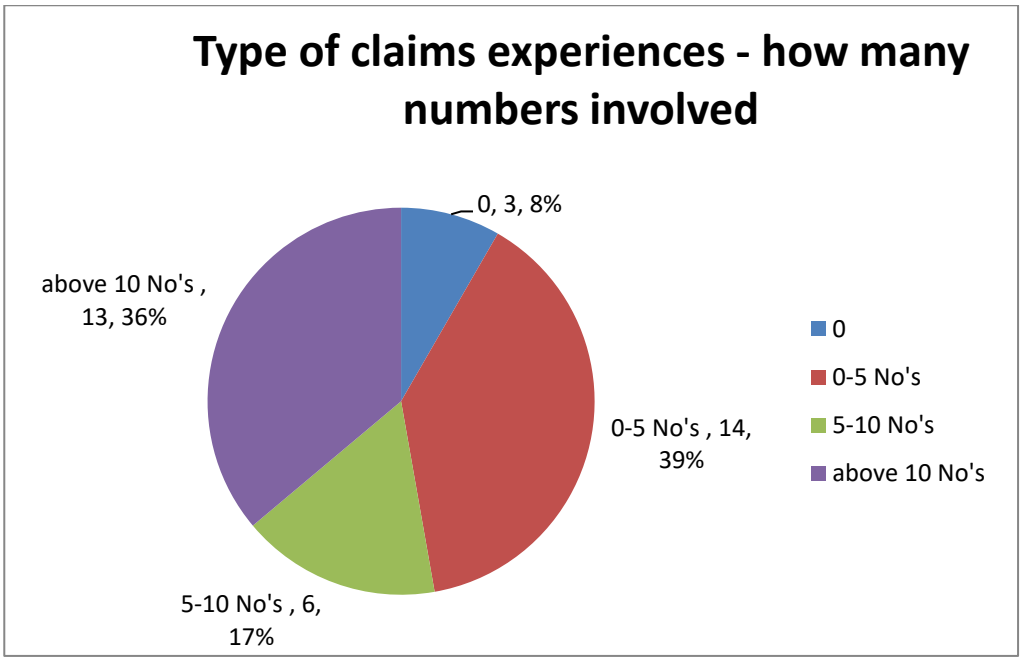

Figure 4.6: Claim experience of Survey responders.

92% of the respondents have the claim experience. As such, the sample strength could be considered as sufficient for getting a viable outcome under the selected research topic related to claims management.

4.3.2 Core data analysis

The record types identified under the literature survey were tested among the MEP trade professional through a questionnaire survey. Key factors related to claim success and claim types related to proving claims were incorporated into the survey for the rating. The main focus was given towards the applicability of the record types to manage the MEP claims at DLP as the same was used to develop the guideline. Combinations of data and formation of the guideline were further elaborated under the discussion section. Finally, The applicability of the proposed guide for different contract types was overviewed under the last subsection.

4.3.2.1 Key factors for successful claims

Table 4.3 summarises the key factor for a successful claim, obtained from the data collection against the open-ended question.

Table 4.3 presents the open-ended question outcome from the questionnaire respondent, related to the key success factors required for successful claims. The majority of respondents – 64% of the respondents ranked contemporary records are the key success factors for the success of the claims. Additionally, three (03) more responders referred to the record-keeping as important along with some other important factors. As such table 4.3 outcome proves the achievement of 1st objectives related to the importance of the proper record keeping required for the claim success

Table 4.3: Key factors for a successful claim

Key factors for a successful claim	**No of the responders confirmed**	**%**
Contemporaneous record keeping	23	64%
Serving notices to inform the clients of the intention of the claim at the correct time for the client to take any necessary remedial actions to avoid such a claim	8	22%
Timely response to notification of a defect claim, analysis of the defect	1	3%
Contractual basis logical presentation, substantiations	1	3%
Logical presentation of entitlement and calculation	1	3%
Programs, quality of documents	1	3%
Proper Substantiations and application of correct Clauses of the Contract	1	3%
Periodically updated the project plan as the project runs.	1	3%
Proper documentation & proper handing over process	1	3%
Organised and thorough record-keeping, submission of contractual notices promptly, logical, and reader-friendly drafting, and presentation	1	3%
Documentation, contractual knowledge	1	3%
Integrity, technical knowledge	1	3%
1. Collation of pieces of evidence, paper works by an expert in claims (As-built drawings, MASs, approved construction master program(s), correspondences by subjects and parties, value engineering reports, etc.) 2. Contractual interpretation assessment by an experienced contract engineer and a lawyer, if possible. The legal department could be a key role player in several types of claims 3. Collaboration and brainstorming on the chronology of events trigger the claim by stakeholders	1	3%
Inform the clients of the intention of the claim at the correct time for the client to take any necessary remedial actions to avoid such a claim	1	3%

Key factors for a successful claim	No of the responders confirmed	%
Details of the construction team and its usage record for each site activities, comparisons of money planned provisions against actual incurred costs, subcontractor management records, site planning to achieve require quality and safety, details on monitoring and development procedures	1	3%
*Proper organisation of facts and supportive documents *Logical arguments based on Contractual grounds * Proper compilation with a flow in chronological order * Ease of reading and understanding by the evaluator	1	3%
Ensure the Works in DLP are over and above the Contract requirements, Timely notifications, sign-offs from the client reps and Engineers after work completion, Maintenance of materials and labour usage, and its signoff if the worksheets	1	3%
Keeping proper records of testing, commissioning, specifications, allowable tolerances, etc... which can prove the spot approvals, confirmations, compliances at the time of construction	1	3%

The majority of the respondents have identified proper contemptuous record keeping as the key factor for claim success. Compliance with the notice procedure was recognized as the next important factor. Establishing a contractual basis referring to correct contract clauses, presenting logically, integrity, and sound technical knowledge is also identified as further claim success factors for contractors. For justification of a claim, contractors periodically updated the project plan as the project runs, approved construction master program(s), collation of pieces of evidence (such as As-built drawings, MASs, correspondence by subjects and parties, value engineering reports) were highlighted by the respondents as important. Further, proper documentation and proper handing over process were identified as vital and respondents stated that the claim preparation to be done by an expert in claims following the terms of references as per contract.

In light of the view of some respondents, details of the construction team and its usage record for each site activities, comparisons of money planned provisions against actual incurred costs, subcontractor management records, site planning to achieve

require quality and safety, details on monitoring and development procedures can also be considered as important records. Some respondents especially highlighted the importance of tracking the record-keeping on testing, commissioning, specifications, and allowable tolerances supported by the client's reps' signoff approvals, confirmation, and compliances at the time of construction. As stated by the respondents, further records to be kept ensuring the works in DLP which are over and above the contract requirements and maintenance of materials and labour usage and its signoff with the worksheet backups.

From the consultant's point of view; timely response to notification of a defect claim, analysis of the defects is important for claim evaluation success. Further contractual interpretation assessment to be done by an experienced contract engineer and a lawyer. The legal department could be a key role player in several types of claims. Collaboration and brainstorming on the chronology of events trigger the claim by stakeholders.

4.3.2.2 Applicability of different records types particularly to manage the MEP claims in the Defect Liability Period

The record types are available in current record-keeping practice which was identified through the literature survey. The same was requested to rank based on applicability to managing the MEP claims in the defect liability period, vide Likert scale rating in the questionnaire survey. The results were presented by order of applicability as given in Figure 4.7

Figure 4.7 represents the priority ratings of the applicability of the record types required for establishing the MEP claims at the DLP. The questionnaire respondents' Likert scale ranking based on the applicability was observed under the survey outcome. The percentage of the combined ranking of "very high"+ "high" ratings was calculated for the priority ordering of record types according to the respondents' rating for applicability. Accordingly, the highest priority was observed in the written communications between the parties. The record types available at the higher hierarchy show the important record types which require for the success of claims.

Figure 4.7: Applicability of different record types to manage the MEP claims in the Defect Liability Period.

Further to the feedback received from the questionnaire survey Likert scale, the given record types were ordered based on the practical applicability of the record types to achieve MEP claim success at DLP. Environmental reports and pile driving records were ranked as less applicable.

4.3.3 Important record types for evaluating/proving claims

The questionnaire respondents were asked to rate the record types based on importance to prove the claims in generally under question 9 of the survey. The results were presented by order of importance as given in Figure 4.8.

Figure 4.8 refers to the respondents' rankings of the record types based on the importance of record types required for establishing any claims in general. The intention to incorporate such a question into the questionnaire survey is to identify the additional information about the difference of record types required for MEP claim events in DLP against the establishment of general claims. It can be observed the original contract document record was ranked as the highest important record type of the success of any claim type and the same was ranked as 4th highest applicability ratings of the record types required for the success in MEP claims at DLP. The written communications between the parties were ranked as the highest applicable record types for the success of the claim types required for MEP claim success at DLP. As such it can be observed that there are deviations of the record types required for MEP claim success at the DLP against general the types of records required to establish general claims.

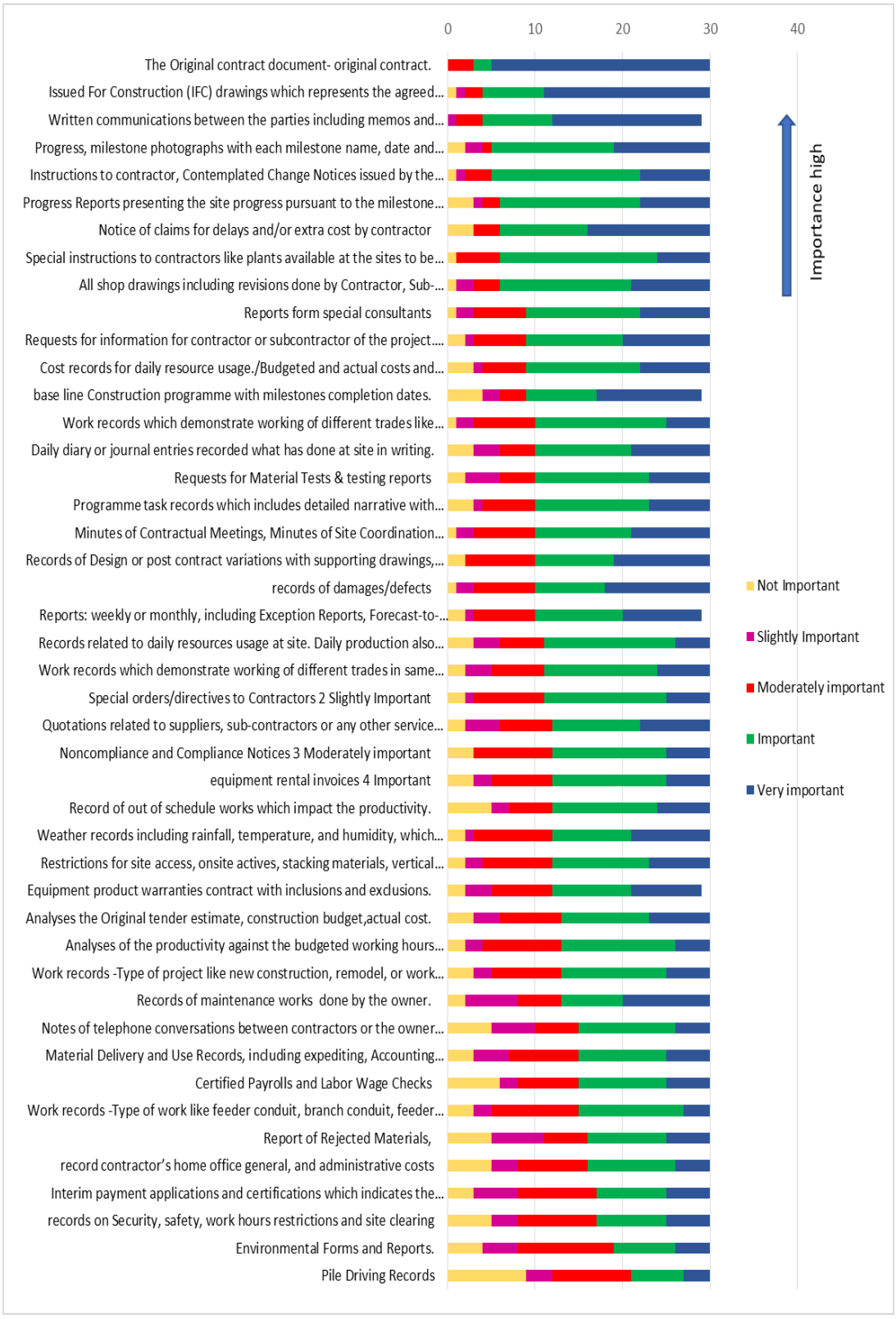

Figure 4.8: Importance of Keeping following record types for evaluating /proving claims

Under Question 9, respondents ranked the importance of the record types for proving claims. Environmental reports and pile driving records were ranked as less important record types.

The majority of the respondents did not add any additional record types to the proposed list. However, there were nine (09) responses. As per their view, the additional records are trade specialist consultants reports, instruction, and contemporary records related to DLP, end-user call out forms, defect notification log correspondences, records of submitted manuals, training carried out, testing and commissioning records, document in the procurement process (like LC, Performa invoices, BOI approval, CUSDEC, commercial invoice, vesting certificates), supply chain management records for oversees materials, insurances, warranty and guaranty, risk register and records regarding the occupants' usage during defect liability period.

One respondent observed that Asbuilt drawings and Operation and Maintenance manuals need to submit and maintained which could keep incorporating most of the above info in it. Once approved any changes during the DLP period, may need to be incorporated which would serve as records for additional Works done.

4.4 Discussions on Findings

From both the questionnaire survey and interviews, it was found that the record types found from the literature review are important for the MEP claim success as well.

The original contract document was ranked as a high priority most important record type required to MEP claim by the interview respondents and the same was ranked 3rd high priority by the questionnaire respondents. Progress, milestone photographs with each milestone name, date, and time of completion record, was in 2nd by the interview responders, and the same was ranked in 6th place in priority list by questionnaire respondents. O&M manuals records-3rd place of interview responder's priority list and the same was confirmed as an additional record type by questionnaire survey outcome. The highest priority of the questionnaire survey rating was given to written communications between the parties, which was ranked as the 4th highest important record types in the priority list by interview responders. Instructions to the contractor, contemplated change notices issued by the owner (orders for extra and additional

work), change estimates bear the 5th priority record types by the interview responders, and the same was ranked in 2nd place of the questionnaire survey priority ratings. Requests for information for contractor or subcontractor of the project, testing and commissioning reports, proper completion records, proper handing over records, material approvals, maintain a log for attendance for maintenance and complaint register were among the other highly important record types, which was ranked by interview responders.

Quotations related to suppliers, sub-contractors, or any other service provider with purchase orders, contract agreements, all shop drawings including revisions recorded with submittal log indicating the dates, work inspection reports from Engineer/consultant/government authorities, cost records for daily resource usage/ budgeted and actual costs and man-hours, trade wise work records, requests for material tests & testing reports, records of maintenance work done by the owner, equipment product warranties contract with inclusions & exclusions and records of damages/defects, were ranked under the medium priority ratings by interview responders and said records were also referred with medium priority rating by the questionnaire responders.

Further to the questionnaire survey Question no 8 outcomes, pile driving records were considered least applicable for MEP claim success. Environmental forms and reports were considered as the second least applicable. Certified payrolls and labour wage checks, interim payment applications and certification details work records- Incoming wires, Incoming conduits, subdivide conduits and details on terminations, record on contractor's home office general and administrative costs, records on security, safety, work hours restrictions and site clearing, analyses the original tender estimate with construction budget vs actual costs, analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints, type of the project records (like new construction, remodel or work while occupied) and rejected materials records were also considered as medium or less applicable record types for the MEP claim success during the DLP. Further to Question 10 of the questionnaire survey, few respondents have added some additional record types which could be considered as

important, and the same was confirmed for some of the records at expert interviews. As such the list of record types tested for applicability for the claimed success during the DLP under Question 8 of the Questionnaire survey was further developed as a record-keeping guideline by incorporating the views of interview expert respondents.

4.5 Development of guideline

Record types observed from the experts were treated as high priority as the experts have the required technological knowledge, a good understanding of the selected subject area, and also have experience based on historical data. Questionnaire responders ranking was ordered based on high and very high priority order rankings and considered as the basis of the guideline development. High priority record types identified from the expert interviews were mapped on the top of the questionnaire survey outcome and were compiled as per the same record types referred by experts and questionnaire respondents. Additional record types observed from the Questionnaire open-ended question outcome and balance record types observed from priority ordered applicability ranking record types were incorporated to the guideline as least applicable record types as per the priority order calculation basis.

Table 4.4 shows the data mapping used to develop the guideline.

Table 4.4: Data mapping of the summaries of record type collected from expert interviews and questionnaire survey applicability ratings outcome arranged in priority order

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
1	Sulbaran (2011), Wideman (2001), Contract administration construction manual (2013)	R1,R2,R3,R4	The original contract document- original contract	79.4%
2	Wideman (2001), Sulbaran (2011)	R1,R2,R3,R4	Progress, milestone photographs with each milestone name, date, and time of completion	72.7%
3	Additional record types as per questionnaire survey Q10	R1, R3, R4	O&M manuals records	
4	Sulbaran (2011), Castell (2007), Contract administration construction manual (2013), Wideman (2001)	R3, R4	Filing record of all the record with tracking index of the documents (all filed by topic) (written communications between the parties including memos and faxes)	88.2%
5	Wideman (2001), Contract administration construction manual (2013)	R1, R4	Instructions to contractor, contemplated change notices issued by the owner (orders for extra and additional work), change estimates	82.4%
6	Sulbaran (2011), Newsletter - Proving up claims (2013 August), Wideman (2001)	R1, R4	Requests for information for contractor or subcontractor of the project	67.6%
7		R1, R4	Testing and commissioning reports	
8		R3, R4	Proper completion records	
9		R1, R4	Proper handing over records	
10		R1, R4	Material approvals	
11		R3, R4	Maintain a log for attendance for maintenance	
12		R3, R4	Complaint register	

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
13	Sulbaran (2011), Wideman (2001)	R4	Quotations related to suppliers, sub-contractors or any other service provider with purchase orders, contract agreements, or any other communication backups	61.8%
14	Sulbaran (2011), Wideman (2001)	R4	All shop drawings including revisions done by contractors, sub-contractors, producers, and suppliers. Said submissions to be recorded with submittal log indicating the dates submitted	67.6%
15	Contract administration construction manual (2013), Newsletter - Proving up claims (2013 August)	R4	Work inspection reports from Engineer / consultant/ government authorities	67.6%
16	Sulbaran (2011),Castell (2007) Wideman (2001), Contract administration construction manual (2013)	R3	Cost records for daily resource usage/ budgeted and actual costs and man-hours	61.8%
17	Newsletter - Proving up claims (2013 August)	R3	Work records which demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time	55.9%
18	Contract administration construction manual (2013), Newsletter - Proving up claims (2013 August)	R4	Requests for Material Tests & testing reports	54.5%
19	Record type was added as per expert advice on questionnaire design	R1	Records of maintenance work done by the owner	55.9%
20	Record type was added as per expert advice on questionnaire design	R2	Equipment product warranties contract with inclusions and exclusions	58.8%
21	Record type was added as per expert advice on questionnaire design	R4	Records of damages/defects	73.5%

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
22	Additional record types as per questionnaire survey Q10	R4	Approved as-built drawings, approved plant details	
23		R4	Material brand approvals	
24		R3	First inspection request for defects	
25		R2	MEP equipment and system monitoring records	
26		R1	Manufacturers approval for MEP service maintenance provider	
27		R4	Video backups records	
28		R4	Records of proof of staff training mentioning	
29		R4	Proof for giving proper operation manuals as a training guide	
30		R4	Keeping a proper mechanism to maintain the MEP equipment	
31	Additional record types as per questionnaire survey Q10	R3	Callout for the maintenance	
32		R2	Monitoring record whether the employer follows the procedure as per the guideline from the manufacturer	
33		R2	Filter to be change records	
34		R2	Records on using manufacturer specified spare parts	
35		R2	Records of using a specified type of oils	
36		R1	Design document records	
37		R1	Method statements	

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
38		R1	Material selections standards,	
39		R1	Design standards for fabrication	
40		R4	Spare parts list of record	
41		R2	Weather reports	
42		R3	Records on trials of events that happen with the reason for the claim	
43		R4	Clearance records	
44		R4	Records to prove the changes for the abortive works	
45	Additional record types as per questionnaire survey Q10		Document in Procurement process like LC	
46	Additional record types as per questionnaire survey Q10		Performa Invoice, BOI approval, CUSDEC, Commercial invoice, vesting certificate	
47	Additional record types as per questionnaire survey Q10		Supply chain management records for oversees materials	
48	Additional record types as per questionnaire survey Q10		Details of insurances and validity	
49	Additional record types as per questionnaire survey Q10		Risk Register	
50	Sulbaran (2011), Wideman (2001)		Notice of claims for delays and/or extra cost by the contractor	82.4%
51	Sulbaran (2011), Wideman (2001)		Issued For Construction (IFC) drawings which represents the agreed scope as confirmed by employer and Engineer	79.4%

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
52	Sulbaran (2011)		Progress reports presenting the site progress according to the milestone or project completion	79.4%
53	Wideman (2001)		Any reports form special consultants	75.8%
54	Sulbaran (2011), Wideman (2001)		Baseline construction programme with milestones completion dates	73.5%
55	Wideman (2001)		Reports- weekly or monthly, including exception reports, forecast-to-complete	70.6%
56	Sulbaran (2011), Castell (2007) ,Wideman (2001), Contract administration construction manual (2013)		A daily diary or journal entries recorded what has done at the site in writing	70.6%
57	Castell (2007)		Records of design or post-contract variations with supporting drawings, instructions with a detailed narrative of the incident	70.6%
58	Sulbaran (2011)		Special instructions to contractors like plants available at the sites to be protected by the contractor and the like statements	61.8%
59	Newsletter - Proving up claims (2013 August)		Weather records including rainfall, temperature, and humidity, affect the progress	61.8%
60	Newsletter - Proving up claims (2013 August)		Restrictions for site access, onsite actives, stacking materials, vertical movements of material and equipment are by using cranes and elevators, special material handling needs which hindrance the efficiency	61.8%
61	Sulbaran (2011), Castell (2007) Wideman (2001)		Records related to daily resource usage at site. Daily production also recorded against the resources used	58.8%

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
62	Wideman (2001), Sulbaran (2011) Contract administration construction manual (2013)		Material delivery and use records, including expediting, accounting records (payroll, accounts payable and receivable, etc.)	55.9%
63	Wideman (2001), Sulbaran (2011), Contract administration construction manual (2013)		Minutes of contractual meetings, minutes of site coordination meetings, meeting minutes especially related to Contractual issues and site coordination issues	55.9%
64	Contract administration construction manual (2013)		Special orders/ directives to contractors	55.9%
65	Sulbaran (2011), Wideman (2001)		Programme task records which include a detailed narrative with resources planned and actual usage, required clothing and equipment's, durations, environmental conditions	54.5%
66	Newsletter - Proving up claims (2013 August)		Any out of schedule works that impact the productivity	52.9%
67	Newsletter - Proving up claims (2013 August)		Equipment rental invoices	50.0%
68	Contract administration construction manual (2013)		Noncompliance and compliance notices	50.0%
69	Sulbaran (2011), Wideman (2001)		Notes of telephone conversations between contractors or the owner which linked to changes	47.1%
70	Contract administration construction manual (2013)		Report of rejected materials	41.2%
71	Newsletter - Proving up claims (2013 August)		Work records -the type of project like new construction, remodel or work while occupied	39.4%
72	Newsletter - Proving up claims (2013 August)		Records on security, safety, work hours restrictions, and site clearing	38.2%
73	Sulbaran (2011), Wideman (2001)		Analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints	38.2%

S.No	Reference author -literature	Respondents reference - Interview	Record type	% of High+Very high applicability Questionnaire survey rankings
74	Wideman (2001)		Analyses original tender estimate, construction control budget, the actual cost	38.2%
75	Newsletter - Proving up claims (2013 August)		Record contractor's home office general, and administrative costs	38.2%
76	Newsletter - Proving up claims (2013 August)		Work records -the type of work like feeder conduit, branch conduit, feeder wire, terminations.	36.4%
77	Sulbaran (2011), Wideman (2001) Contract administration construction manual (2013)		Interim payment applications and certifications which indicates the monthly completed works according to the condition of the contract including supporting documents	35.3%
78	Contract administration construction manual (2013)		Certified payrolls and labour wage checks	32.4%
79	Contract administration construction manual (2013)		Environmental forms and reports	29.4%
80	Contract administration construction manual (2013)		Pile driving records	18.2%

Colour codes -legends

	Colour
High priority record types	
Medium priority record types	
Low priority record types	

4.6 Proposed Guideline:

Guideline for proper record-keeping for establishing MEP related claims at the defect liability period

After investigating the existing record-keeping types in the construction industry practice, the following record types can be considered as important to achieving claim success in the MEP related claim at the defect liability period. Record-keeping plays a vital role in claim substantiation to the contractor and also it would help the Engineer to give a fairly accurate determination. As such, the contracted parties are requested to keep record types given in Table 4.5 in a contemporary manner as directed.

Table 4.5: Proposed Guideline for proper record-keeping for establishing MEP related claims at the defect liability period.

	Guideline for proper record keeping to establish MEP related claims at the defect liability period	For remeaurement contracts	For Design & Build or turnkey contracts
S. No	**Record type**	**Records to be Maintained BY**	**Records to be Maintained BY**
1	The original contract document- original contract	Contractor/Engineer/Employer	Contractor/Engineer/ Employer
2	Progress, milestone photographs with each milestone name, date, and time of completion	Contractor /Employer	Contractor /Employer
3	O&M manuals records	Contractor	Contractor
4	Filing records of all the records with a tracking index of the documents. (all filed by topic) (written communications between the parties including memos and faxes)	Contractor	Contractor
5	Instructions to contractor, contemplated change notices issued by the owner (orders for extra and additional work), change estimates	Contractor /Engineer/Employer	Contractor /Engineer/Employer

S. No	Record type	Records to be Maintained BY	Records to be Maintained BY
6	Requests for information for contractor or subcontractor of the project	Contractor	Contractor
7	Testing and commissioning reports	Contractor	Contractor
8	Proper completion records	Contractor	Contractor
9	Proper handing over records	Contractor	Contractor
10	Material approvals	Contractor	Contractor
11	Maintain a log for attendance for maintenance	Contractor	Contractor
12	Complaint register	Contractor	Contractor
13	Quotations related to suppliers, sub-contractors or any other service provider with purchase orders, contract agreements or any other communication backups.	Contractor	Contractor
14	All shop drawings including revisions done by contractors, sub-contractors, producers, and suppliers. Said submissions to be recorded with submittal log indicating the dates submitted	Contractor/Engineer	Contractor/Engineer
15	Work inspection reports from Engineer /consultant/government authorities	Contractor	Contractor
16	Cost records for daily resource usage/ budgeted and actual costs and man-hours	Contractor	Contractor
17	Work records which demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time	Contractor	Contractor
18	Requests for material tests & testing reports	Contractor	Contractor
19	Records of maintenance work done by the owner	Employer	Employer
20	Equipment product warranties contract with inclusions and exclusions	Employer	Employer
21	Records of damages/defects	Employer	Employer
22	Approved as-built drawings, approved plant details	Contractor	Contractor
23	Material brand approvals	Contractor /Employer	Contractor /Employer

S. No	Record type	Records to be Maintained BY	Records to be Maintained BY
24	First inspection request for defeats	Contractor /Employer	Contractor /Employer
25	MEP equipment and system monitoring records	Contractor	Contractor
26	Manufacturers approval for MEP service maintenance provider	Employer	Employer
27	Video backups records	Contractor	Contractor
28	Records of proof of staff training mentioning	Contractor	Contractor
29	Proof for giving proper operation manuals as a training guide	Contractor	Contractor
30	Keeping a proper mechanism to maintain the MEP equipment	Contractor	Contractor
31	Callout for the maintenance	Contractor	Contractor
32	Monitoring record whether the employer follows the procedure as per the guideline from the manufacturer	Contractor	Contractor
33	Filter to be change records	Contractor	Contractor
34	Records on using manufacturer specified spare parts	Contractor	Contractor
35	Records of using a specified type of oils	Contractor	Contractor
36	Design document records	Employer	Contractor
37	Method statements	Contractor	Contractor
38	Material selections standards	Contractor	Contractor
39	Design standards for fabrication	Employer	Contractor
40	Spare parts list of record	Contractor	Contractor
41	Weather reports	Contractor	Contractor
42	Records on trials of events that happen with the reason for the claim	Contractor	Contractor
43	Clearance records	Contractor	Contractor
44	Records to prove the changes for the abortive works	Contractor	Contractor

S. No	Record type	Records to be Maintained BY	Records to be Maintained BY
45	Document in procurement process like LC	Contractor /Employer	Contractor /Employer
46	Performa invoice, BOI approval, CUSDEC, commercial invoice, vesting certificate	Contractor /Employer	Contractor /Employer
47	Supply chain management records for oversees materials	Contractor	Contractor
48	Details of insurances and validity	Contractor /Employer	Contractor /Employer
49	Risk register	Contractor	Contractor
50	Notice of claims for delays and/or extra cost by the contractor	Contractor	Contractor
51	Issued For Construction (IFC) drawings which represents the agreed scope as confirmed by employer and Engineer	Contractor/Engineer	Contractor/Engineer
52	Progress reports presenting the site progress according to the milestone or project completion	Contractor	Contractor
53	Any reports form special consultants	Contractor	Contractor
54	Baseline construction programme with milestones completion dates	Contractor/Engineer	Contractor/Engineer
55	Reports- weekly or monthly, including exception reports, forecast-to-complete	Contractor	Contractor
56	A daily diary or journal entries recorded what has done at the site in writing	Contractor	Contractor
57	Records of design or post-contract variations with supporting drawings, instructions with a detailed narrative of the incident	Contractor	Contractor
58	Special instructions to contractors like plants available at the sites to be protected by the contractor and the like statements	Contractor/Engineer	Contractor/Engineer
59	Weather records including rainfall, temperature, and humidity, affect the progress	Contractor	Contractor
60	Restrictions for site access, onsite actives, stacking materials, vertical movements of material and equipment are by using cranes and elevators, special material handling needs which hindrance the efficiency	Contractor	Contractor

S. No	Record type	Records to be Maintained BY	Records to be Maintained BY
61	Records related to daily resource usage at site. Daily production also recorded against the resources used	Contractor	Contractor
62	Material delivery and use records including expediting, accounting records (payroll, accounts payable and receivable, etc.)	Contractor	Contractor
63	Minutes of contractual meetings, minutes of site coordination meetings, meeting minutes especially related to contractual issues and site coordination issues	Contractor	Contractor
64	Special orders/directives to contractors	Contractor	Contractor
65	Programme task records which include a detailed narrative with resources planned and actual usage, required clothing and equipment's, durations, environmental conditions	Contractor/Engineer	Contractor/Engineer
66	Any out of schedule works that impact productivity	Contractor	Contractor
67	Equipment rental invoices	Contractor	Contractor
68	Noncompliance and compliance notices	Contractor	Contractor
69	Notes of telephone conversations between contractors or the owner which linked to changes	Contractor/Engineer	Contractor/Engineer
70	Report of rejected materials	Contractor	Contractor
71	Work records - the type of project like new construction, remodel or work while occupied	Contractor	Contractor
72	Records on security, safety, work hours restrictions, and site clearing	Contractor	Contractor
73	Analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints	Contractor	Contractor
74	Analyses original tender estimate, construction control budget, the actual cost	Contractor	Contractor
75	Record contractor's home office general, and administrative costs	Contractor	Contractor

S. No	Record type	Records to be Maintained BY	Records to be Maintained BY
76	Work records - the type of work like feeder conduit, branch conduit, feeder wire, terminations	Contractor	Contractor
77	Interim payment applications and certifications which indicates the monthly completed works according to the condition of the contract including supporting documents	Contractor	Contractor
78	Certified payrolls and labour wage checks	Contractor	Contractor
79	Environmental forms and reports.	Contractor	Contractor
80	Pile driving records	Contractor	Contractor

High priority record types

Medium priority record types

Low priority record types

The outcome from Question 8 of the questionnaire survey: respondents ranking for applicability of the records types for managing MEP claims at the defect liability period was used as the basis for developing the basic guideline. Record types in which the combined ranking of high to very high applicability is less than 50 %, were considered at the end of the guideline by considering those as not important. The outcome was further developed by cross-checking the similar record types verified by literature review findings and confirmed by industry experts during the interview.

Additional record types that were only identified by industry experts collected from the interviews and open-ended question no. 10 from the questionnaire survey, were compiled to the similarities and added further to the guideline to cover the total record-keeping requirement for the claim success.

4.7 Applicability of Guideline for contract types

As per the views of Saram, Sirimane, Abayaratne, and Saram, (2018), in the Sri Lankan context following contract forms were widely used for construction projects.

- FIDIC -Red Book 1999 edition.
- ICTAD Conditions of Contract for Major Contracts (ICTAD/SBD/2 Second Edition January 2007).
- ICTAD Conditions of Contract for Contracts (ICTAD/SBD/1 Second Edition January 2007).
- ICTAD Conditions of Contract for Minor Contracts (ICTAD/SBD/3 Second Edition January 2007).
- FIDIC Conditions of Contract for Plant and Design-Build 1999 (Yellow Book). ICTAD SBD/4
- The silver book under FIDIC contract for turnkey or EPC contracts.
- The gold book under FIDIC which used for managing contract types of Design-Build and Operate.

As explained by 3D Fold Education center (2016), Remeasurement, Cost Plus, and Lump Sum are the three main types to decide the price under the FIDIC (1999) Contract forms.

Further to the article, there are two (02) possibilities for the design responsibility such as,

1) The Employer is responsible for the detailed design with details of drawings, specifications, and Bill of Quantities.

2) The contractor prepares the design as per the employers' requirement where there is a small number of details, the contractor must design as fit for the purpose by satisfying required technical standards.

For MEP projects also, the above two (02) design responsibilities could be applicable as per the employer's decision.

The record-keeping procedure may change as per the design responsibility of the parties. If the design responsibility is with the employer, then the employer shall keep the backup records to ensure the design criteria was done at an acceptable level with the use of approved design standard. This was confirmed by the interviewed expert respondent R1. If the design responsibility lies with the contractor as in the case of Design & Build (D&B), Turnkey forms of contract, then the contractor has to keep records for the proof of satisfactory completion of design obligations for MEP systems including equipment.

CHAPTER FIVE-CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section presents the objective-based decisions to the study, further suggestions, limitations, and further research directions.

5.2 Conclusion

As per the literature findings existing record-keeping methods and systems were identified. The results were used to develop the guideline as indicated under the objectives. The objective-based conclusions are presented hereon.

The importance of proper record-keeping for claims management in MEP projects

The claim management process generally can be considered as similar for both civil engineering and MEP projects. The industry experts' views were considered in ranking the applicability and importance of the record types. The significance of proper record keeping concerning the claim management process elaborated using literature findings.

The global results indicated the role of record-keeping in the claims management in MEP projects. The importance of proper record keeping for claims management in MEP projects was confirmed by literature findings, expert interviews, and questionnaire survey outcomes. Questionnaire survey rankings were further confirms record-keeping as the key factor for successful claims management. The experts also confirmed that record-keeping plays a vital role in managing MEP claims and also highlighted the written communications between the parties as the highest-ranked record type required for achieving success in MEP claims at DLP.

The nature of the MEP related claims at the DLP

MEP related claims during the DLP was identified by the literature survey and expert interviews. Most claim events occur due to poor quality workmanship and equipment operations and maintenance problems during the DLP. The nature of the claims mainly relates to the defects and the liability of the defects required to be verified

properly. Parties must bear the consequences resulting due to a neutral event. The operation and maintenance of MEP equipment were identified as a key concern which leads to MEP claims at the DLP. Further, MEP related claims occur due to malfunction or not properly working of equipment which leads to the liability of the manufacturer that deals with the insurance schemes.

The process of claims management in MEP related projects with special reference to claims establishment in the DLP

The claim management process was elaborated by the literature findings and experts explained the claim management and evaluation procedure with the aids of records. The process of claims management in MEP related projects relies on record-keeping and the proposed guideline of record-keeping arranges required record types in priority order. Recurring maintenance costs depend on the quality and marketplace attributes by considering the maintenance, repair, and replacement cost. As such the claim management process of MEP related projects requires to verify such maintenance costs with the actual records and specifications, maintenance guidelines provided by the manufacturers. Documents related to design concepts, proper handing over records, method statements, O&M manual, material selections approvals, and testing and commissioning related records were considered as important for the MEP claims management process at DLP. In DLP claims, the root cause analysis was used in determining the parties' fault for damages, which can be a third-party expert view from MEP specialists. The government certification on annual tests of the machines which relate to the safety of the people and proper maintaining certificates were considered under the MEP claims to prove the satisfaction of employers' liability.

Guidelines for record-keeping in assisting MEP related claims at the DLP

The objective of developing a guideline was achieved by combining the data received from expert interviews and questionnaire survey outcomes. The guideline was developed in light of the findings of important record types based on expert interviews and questionnaire survey ratings.

Highly referred record rankings from the expert interview outcome were treated as a priority list in the developed guideline. The record types of Original contract document- original contract and Progress, milestone photographs with each milestone name, date, and time of completion were rated as high priority requirement by industry experts at interviews for establishing MEP related claims in DLP. Said record types were found under common record-keeping practice with less priority as traced by the literature findings. O&M manuals records were considered as the third priority by the interview respondents. Nevertheless, said record type was not identified under the literature survey.

Record types - written communications between the parties (including memos and faxes), clients notifications for anticipated variations, (Orders for extra and additional work), Engineers directions for the works, change estimates, and Requests for information for contractor or subcontractor of the project were ranked 4^{th} to 6^{th} priority from the interview rankings and the same was supported by literature as common practice record keeping.

The record types namely testing and commissioning reports, proper completion records, proper handing over records, material approvals, maintain a log for attendance for maintenance, and complaint register was rank from the 7^{th} to 12^{th} place of the priority list as identified only by the interview respondents. Balance records found out from expert interviews were treated as a medium priority and the applicability rating records from questionnaire survey results were incorporated into the guideline as low priority.

According to the findings of the present study, the most relevant record types which were required to claims success for the Claim management process for MEP related project at the DLP were listed in the proposed guideline given in Table 4.5 In light of the views of industry experts, it can be concluded that contracted parties could use said guidelines and arrange their company in house record management system to ensure the success of the claims occurred during the DLP period for MEP projects. The contracted parties could use the guideline based on their contract types as per design responsibility.

The majority of record types used in the existing record-keeping methods and systems were confirmed as applicable to MEP claim success by experts and questionnaire survey respondents. Additional record types recommended by experts were considered as a high priority in the proposed guideline.

The guideline can be beneficial for the MEP contractors to identify the record types to be retained to ensure the success in the claims at the defect liability period. The said guideline would be benefited for small scale MEP contractors as they don't have claim experts as in-house resources. As per the directions of the guideline they can identify and preserve the records required for claims and further can hire claim consultancy services which can help to reduce the administrative cost.

The Engineer and consultants could identify the record types required to evaluate the MEP claims raised at the DLP. In terms of employers' claims for defects, employers can identify what are the defenses that could raise from the contractor's end and also check the defenses available for the employers to show that the employer has fulfilled his obligation successfully. Further, the investigation should be carried out for the applicability of the new guideline among the MEP claims.

5.3 Recommendations

The proposed Guideline under Table 4.5 can be recommended to identify the record types to be maintained for the MEP project to ensure successful claims during the defect liability period. As per the expert views of the interview respondents, the research would be further extended to develop an online monitoring system for the MEP system equipment, which could be operating from remote areas. Both parties could be benefited by developing such a system as it would create an effective communication system and the damages could be kept at a minimum level with the involvement of manufactures and prompt preventive measures could be taken during the maintenance phase.

REFERENCES LIST

Abdul-Malak, M. A. U., El-Saadi M.M.H., Abou-Zeid, M.G. (2002). Process model for administrating construction claims. *Journal of Management in Engineering 18*(2), 84–94.

Abdulnabi, H. M., & Agarwal, V. C. (2016). Claims in construction projects "Design errors and change orders". *International Journal of Civil Engineering and Technology, 7*(6), 2016, 123 – 130. Retrieved from: http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=7&IType=6

Adewunmi, C. A., Odesola, I., & Ugochukwu, S. (2019), Appraising the state of procurement of mechanical and electrical services on selected public building projects in Delta state Nigeria. Retrieved from: https://www.researchgate.net/publication/339777777_APPRAISING_THE_STATE_OF_PROCUREMENT_OF_MECHNICAL_AND_ELECTRICAL_SERVICES_ON_SELECTED_PUBLIC_BUILDING_PROJECTS_IN_DELTA_STATE_NIGERIA

Aibinu A.A. (2006). The relationship between distribution of control, fairness, and potential for dispute in the claims handling process. *Construction Management and Economics, 24*(1), 45–54.

Aibinu, A. A., Ling, F. Y. Y., & Ofori, G. (2011). Structural equation modelling of organizational justice and cooperative behavior in the construction project claims process: contractor's perspectives. *Construction Management and Economics, 29*(5), 463–481.

Alloh, K.O. (2014). *Investigating of factors causes' claims creation in construction projects in the Gaza strip- Palestine* (Master's thesis, The Islamic University -Gaza). Retrieved from: http://library.iugaza.edu.ps/thesis/112889.pdf.

Amr, A. G., Hassanein, & Nemr, W. E. (2008). Claims management in the Egyptian industrial construction sector: a contractor's perspective, *Journal of Engineering, Construction and Architectural Management, 15*(5), 456 – 469

Arditi, David, Pattanakitchamroon, Thanat, (2006). Selecting a delay analysis method in resolving construction claims, *International Journal of Project Management, 24*(2), 145-155. doi: 10.1016/j.ijproman.2005.08.005

Arias, R. P. (2015). *Mechanical, Electrical and Plumbing systems in construction management: A literature review of existing MEP textbooks*. Retrieved from: https://www.asee.org/public/conferences/56/papers/11565/download

Badenfelt, U. (2011). Fixing the contract after the contract is fixed: A study of incomplete contracts in IT and construction projects. *International Journal of Project Management*, 29(2011), 568–576. Retrieved from: file:///C:/Users/Toshiba/Downloads/badenfelt2011.pdf

Baduge, S. & Jayasena H. S. (2012). Application of concurrency in delay claims. In *Proceedings of the World Construction Conference* (pp. 69-78), Retrieved from: http://docs.suranga.net/publications/2012_concurrent_delays.pdf

Bakharya, N.Z., Adnan, H., Ibrahimc, A. (2015) A study of construction claim management problems in Malaysia, *Procedia Economics and Finance*, *23*(2015), 63 – 70. doi: 10.1016/S2212-5671(15)00327-5

Banwo, O., Parker, K., Sagoo, A. (2015). Principles of contract claims management – a review of the Nigerian construction industry. In *Proceedings of the International Conference on Industrial Engineering and Operations Management (IEOM)*, (pp. 1–9). doi: 10.1109/IEOM.2015.7093726

Blaxter, L., Hughes, C., and Tight, M., (2008), *How to research* (3rd ed.), England: Open University Press

Claim (2018), Business Dictionary.com. Retrieved from: http://www.businessdictionary.com/definition/claim.html (December 31, 2018)

Cambridge business English dictionary. (2011). Cambridge: Cambridge University Press. Retrieved from: https://dictionary.cambridge.org/dictionary/english/record-keeping

Carmichael, D. G. (2009). Comments on delay analysis methods in resolving construction claims, *International Journal of Construction Management, 9*(1), 1-12. doi: 10.1080/15623599.2009.10773118

Carmichel, S., Murry, M. (2006). Record keeping for contemporaneous delay analysis: a model for effective event management, *Construction Management and Economics, 24*, 1007–1018, Retrieved from: http://criticalpath-uae.com/wp-content/uploads/2010/04/Record+Keeping+for+Delay+Analysis.pdf.

Castell, M. (2007). *Management of change within construction contracts*, Retrieved from: http://fidic.org/sites/default/files/6%20Management%20of%20Change%20within%20construction%20contracts.pdf

Chappel, D. (2011). *Building contract claims* (5th ed.). West Sussex: Wiley-Blackwell.

Chappel, D., Powell-Smith, V., & Sims, J. (2005), *Building contract claims* (4th ed.). Retrieved from https://www.blackwellpublishing.com/content/BPL_Images/Content_Store/WWW_Content/9781405117630/145011763X.pdf

Chester, M., & Hendrickson, C. (2005). Cost impacts, scheduling impacts, and the claims process during construction. *Journal of Construction Engineering and Management*, *131*(1), 102-107. doi: 10.1061/(ASCE)0733-9364(2005)131:1(102)

Chovichien, V., & Tochaiwat, K. (2006). *A Survey of construction claims and claim management process in Thailand*. Retrieved from: ttps://www.researchgate.net/publication/233400972_A_SURVEY_OF_CONSTRUCTION_CLAIMS_AND_CLAIM_MANAGEMENT_PROCESS_IN_THAILAND.

China, L. S., & Hamida, A. R. A. (2015). The practice of time management on construction project, *Procedia Engineering*, *125*, 32-39. doi:10.1016/j.proeng.2015.11.006

Coltman, T., Bru K., Perm-Ajchariyawong, N., Devinney, & Benito, G. T. (2009). Supply chain contract evolution. *European Management Journal*, *27*(6), 388–401. doi: 10.1016/j.emj.2008.11.005

Construction Manual (2010), *Volume 1 contract administration*, Retrieved from: http://www.ct.gov/dot/lib/dot/documents/dconstruction/construction_manual/1-3_project_documentation.pdf

Contract administration construction manual (2013), *Project recordkeeping and documentation*, Retrieved from: https://www.ct.gov/dot/lib/dot/documents/dconstruction/construction_manual/constmanual_ver2_3_chap_1-3_project_documentation.pdf.

Corbett & Co International Construction Lawyers Ltd, (2016), *Clause 11*, Retrieved from: www.corbett.co.uk › wp-content › uploads › Clause-11

Cunningham.T (2017), *What causes cost overruns on building projects? - an overview*. Retrieved from: https://arrow.tudublin.ie/cgi/viewcontent.cgi?article=1070&context=beschreoth

Cushman, R. F., Carter, J. D., Gorman, P. J., & Coppi, D. F. (2001). *Construction disputes: representing the contractor*, New York: Aspen Publishers

Data .J (2012). *How do you define a good claims management system*, Retrieved from: https://jdidata.com/blog/how-do-you-define-a-good-claims-management-system

Demirel, H¸ C., Leendertse, W., Volker, L., Hertogh, M. (2016). Flexibility in PPP contracts – dealing with potential change in the pre-contract phase of a construction project. *Construction Management and Economics*, *35*(4), 196-206, doi:10.1080/01446193.2016.1241414

Denscombe, M. (2008), *The good research guide* (3rd ed.), England: Open University Press

Dolage, D. A. R. & Pathmarajah, T. (2015). Mitigation of delays attributable to the contractors in the construction industry of Sri Lanka -consultants' perspective, *ENGINEER, XLVIII* (01), 21-30.

Ekhator, O. J. (2016). Investigating causes of disputes in building construction projects in Nigeira, *International Journal of Science, Environment, 5*(5), 3583 – 3595.

Enshassi, A., Choudhry, R. M., & El-Ghandour, S. (2009). Contractors' perception towards causes of claims in construction projects. *The International Journal of Construction Management, 9*(1), 79–92.

Fenn, P., Lowe, D., & Speck, C. (1997). Conflict and dispute in construction. *Construction Management and Economics, 15*(6), 513–518.

FIDIC. (1999) Conditions of contract - building and engineering works designed by the employer. (1st ed.). Geneva: International Federation of Consultant Engineer.

Gilliss, D. D., Kahn, B. W., Loewke, M., McLaughin, L. P., & Thomas, G. (2016). *Mechanical Electrical Plumbing (MEP) trades-divisions 15 and 16*, Retrieved from: https://www.briglialaw.com/wp-content/uploads/sites/97/2018/07/Plenary-6-MEP-Paper-for-2016-ABA-Midwinter-Meeting-FINAL.pdf

Gulf News (2018), *What is a defect liability period?*, Retrieved from https://gulfnews.com/business/property/what-is-a-defect-liability-period-1.2211186.

Hakkus, H., NurSari, S., & Uner, S. (2012), The content analysis of graduate theses written between 2000 and 2010 in the field of chemistry education, *Procedia - Social and Behavioral Sciences, 47*(2012), 729 – 733.

Harmon, K. M. J. (2003). Conflicts between owner and contractors: proposed intervention process. *Journal of Management and Engineering. 19*(3), 121–125.

Harrell, M. C., & Bradley, M. A. (2009). *Data collection methods, semi-structured interviews and focus groups*, Retrieved from: https://apps.dtic.mil/dtic/tr/fulltext/u2/a512853.pdf.

Hassanein, A. G., & Elnemr, W. (2007). Management of change order claims in the Egyptian industrial construction sector, *Journal of Financial Management of Property and Construction, 12*(1), 45-60. doi: 10.1108/13664380780001093

Hewitt, A. (2011). *Construction claims & responses-effective writting & presentation* (2 nd ed.). West Sussex: Willey-Blackwell.

Ho, S. P., & Liu, L. Y. (2004). Analytical model for analysing construction claims and opportunistic bidding. *Journal of Construction Engineering and Management, 130*(1), 94-104. doi: 10.1061/(ASCE)0733-9364(2004)130:1(94)

IlonaBray, J. D. (2019). *New-home defects: holding your builder responsible under a warranty*, Retrieved from: https://www.nolo.com/legal-encyclopedia/new-home-defects-builder-responsibility-30211.html.

Jayasena, H. S., & Johnson, J. (2013). Frequently challenged determinations of the Engineer in Srilankan construction contracts. In *Proceedings of the Second World Construction Symposium 2013: Socio-Economic Sustainability in Construction*, (pp 235-243), Retrieved from: http://docs.suranga.net/publications/2013_engineers_determination.pdf

Jayasena, S., & Alwis, P. (2011). *Disruption claims in Sri Lankan construction industry*, Retrieved from: https://www.google.lk/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0ahUKEwjgisqLp77aAhULto8KHae5CUQQFggnMAA&url=https%3A%2F%2Fengineer.sljol.info%2Farticles%2F10.4038%2Fengineer.v46i3.6780%2Fgalley%2F5279%2Fdownload%2F&usg=AOvVaw18XevEQ7KuN3sBVvZuUcfP

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2005). Likert scale: explored and explained, *Journal of Applied Science and Technology 7*(4):396-403, doi: 10.9734/BJAST/2015/14975

Kamble, K. S., & Kambekar, A. R. (2013). *Analysis of factors contributing delays and claims in construction projects*, Retrieved from: http://www.academia.edu/7710701/ANALYSIS_OF_FACTORS_CONTRIBUTING_DELAYS_AND_CLAIMS_IN_CONSTRUCTION_PROJECTS

Keane, P. J., & Caletka, A. F. (2008). *Delay analysis in construction contracts* (1st ed.). West Sussex: Blackwell Publishing Ltd.

Keegan, R, (2014). *The continued evolution of construction defect*, Retrieved from: https://www.atminsurance.com/wp-content/uploads/2019/10/Const-Defect-White-Paper-CP-8333.pdf

Kent/McBride, (2019). *Construction defect and accident claims*, Retrieved from: https://kentmcbride.com/practice_areas/construction-defect-and-accident-claims.

Klwtlaw.com (2019). *Plumbing & Electrical*, Retrieved from: https://klwtlaw.com/plumbing-and-electrical-defects/

Kolonne, T. (08th December 2017) *Seminar on contractual and legal aspects of claims* (handout), Organized by Australian Institute of Quantity Surveyors (Sri Lanka branch)

Kululanga, G. K., Kuotcha, W., & McCaffer, R. (2001). Construction contractors' claim process framework, *Journal of Construction Engineering and Management, 127*(4), 309-314.

Kumaraswamy, M. M., & Yogeswaran, K. (2003). Substantiation and assessment of claims for extensions of time. *International Journal of Project Management, 21*(1), 27-38. doi: 10.1016/S0263-7863(01)00052-7

Kurunduwage, S. K. (2016). *Overview of disruption claim in road construction industry during last five years- (srilankan experience)*. Retrieved from http://dl.lib.mrt.ac.lk/bitstream/handle/123/12355/pre-text.pdf?sequence=1

Landon, T., & Khan. A. (2018). *Practical tips for handling construction claims and disputes: managing documentary evidence*. Retrieved from: http://arbitrationblog.kluwerarbitration.com/2018/09/07/practical-tips-for-handling-construction-claims-and-disputes-managing-documentary-evidence/

Levin, P. (1998). *Construction contract claims, changes & dispute resolution*, (2nd ed.). New York: ASCE Press.

Levitt, R. E. (1987). *Expert systems in construction: state*, Retrieved from: https://doi.org/10.1061/9780784402764

Lian, L. Y., Hassim, S., Muniandy, R., & Ling. T. M. (2012). *The Assessment of applications for extension of time claims in Malaysian construction industry.* Retrieved from: http://www.ijetch.org/papers/407-P015.pdf

Liyanage, D. (2018). *Claim management attributes* (study material-handout.), Department of Building Economics -University of Moratuwa-Srilanka.

Maduranga, J. A. M., Palamakumbura, A. P. W. M. G. M., & Dissanayake, P. B. G. (2016). Preparation of Extension of Time (EOT) claims and delay analysis techniques used in construction industry. *The 7th International Conference on Sustainable Built Environment*, Sri Lanka

Mbachu, J. (2011). Sources of contractor's payment risks and cash flow problems in the New Zealand construction industry project team's perceptions of the risks and mitigation measures. *Construction Management and Economics. 29*(10), 1027–1041. doi: 10.1080/01446193.2011.623708

Metropolitan Engineering, Consulting & Forensics (MECF). (2014).*Subrogation of construction defects, fire losses, surety losses, and losses caused by defective Electrical Mechanical and other equipment*. Retrieved from: https://sites.google.com/site/metropolitanforensics/subrogation-of-construction-defects-fire-losses-surety-losses-and-losses-caused-by-defective-electrical-mechanical-and-other-misc-equipment

Mohsin, M.A., Claim analysis of construction projects in Oman, *International Journal on Advanced Science Enginering Information Technology, 2*(2), 73-78. Retrieved from: http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.1000.7540&rep=rep1&type=pdf

Naoum, S. G. (2007). *Dissertation research and writing for construction student*, (2nd ed.). United Kingdom: Elsevier Ltd

O'Connor, C. J. (2003). "Presenting a claim". Retrieved from: http://www.apeg.bc.ca/prodev/business/documents/presentingaclaim.pdf

Project diaries-contract administration manual (2011). Retrieved from http://www.dot.state.mn.us/const/tools/docs/sec-390.pdf, (Assessed on 23 May 2019)

Proving Up Claims - The proof is in the paper: Record keeping for effective construction claims (2013, August). *Under Construction*. Retrieved from: http://www.kenrichgroup.com/wp-content/uploads/ProvingUpClaims.pdf. (Assed on 20th May 2019)

Ramachandra, T., Rotimi, J. O., & Gunaratne, S. (2014). Reasons for contractors' delay claims failures in Sri Lanka In: Raiden, A B and Aboagye-Nimo, E (Eds) Procs *30th Annual ARCOM Conference*, 1-3 September 2014, Portsmouth, UK, Association of Researchers in Construction Management, 475-484.

Rawlinson, S., & Dedman, A. (2010). *Specialist costs: M&E services*, Retrieved from: https://www.building.co.uk/data/specialist-costs-mande-services/5001903.article

Ren, Z., Anumba, G. J., & Ugwu, O. O. (2001). Construction claims management: towards an agent-based approach, *Engineering, Construction and Architectural Management, 8*(3), 185-197, do: 10.1108/eb021181

Revay, S. G. (1993). Can construction claims be avoided? Building owners and engineers frequently occurring claims identified, *Building Research & Information, 21*(1), 56-58. doi: 10.1080/09613219308727256

Salwa, A., Fawzy, & Islam, H. E. A. (2012). Contract administration guidelines for U.S. contractors working under World Bank–funded projects, *Journal of Legal Affairs and Dispute Resolution in Engineering and Construction, 4*(2), 101-110. doi: 10.1061/(ASCE)LA.1943-4170.0000091

Samantha, I. P. (2002). *An overview of construction claims: how they raise and how to avoid them*, Retrieved from: file:///C:/Users/Toshiba/AppData/Local/Temp/AN_OVERVIEW_OF_CONSTRUCTION_CLAIMS_HOW_T.pdf

Saram, S. D., Sirimane, M., Abayaratne, H., and Saram, D. L. & F. D. (2018), *Construction and projects in Sri Lanka: overview*, Retrieved from: https://uk.practicallaw.thomsonreuters.com/w-017-6138?transitionType=Default&contextData=(sc.Default)&firstPage=true&bhcp=1

Scl-delay-disruption-protocol-second edition (2017). Retrieved from https://www.fenwickelliott.com/research-insight/annual-review/2017/scl-delay-disruption-protocol-second-edition

Scott, S. (1990). Keeping better site records. *International Journal of Project Management, 8*(4), 243–249.

Semple, C., Hartman, F. T., & Jergeas, G. (1994). Construction claims and disputes causes and cost/time overruns. *Journal of Construction Engineering and Management, 120*(4), 785–795.

Shadid, M. S. R. (2015). *Construction claims management in United Arab Emirates construction industry;* Retrieved from: http://i-rep.emu.edu.tr:8080/jspui/bitstream/11129/2189/1/shadidmosab.pdf

Sibanyama, G., Muya, M., & Kaliba, C. (2012). An overview of construction claims: a case study of the Zambian construction industry, *International Journal of Construction Management, 12*(1), 65-81. doi: 10.1080/15623599.2012.10773185

Siddiqi, Khalid, & Hunt, A. (2015). Construction claims: impact of defective construction on long-term facility maintenance costs. (Faculty Publications, Kennesaw State University) Retrieved from: http://digitalcommons.kennesaw.edu/facpubs/3658

Singh, D., & Tiong, L. K. (2005). A fuzzy decision framework for contractor selection, *Journal of Construction Engineering and Management*, *2005*(131), 62-70. doi: https://sci-hub.st/10.1061/(ASCE)0733-9364(2005)131:1(62)

Stamatiou, Dimitrios, R. I., Kirytopoulos, Konstantinos, A., Ponis, Stavros, T., Gayialis, Sotiris; Tatsiopoulos, Ilias, (2018). A process reference model for claims management in construction supply chains: the contractors', *International Journal of Construction Management*, 1-19, doi:10.1080/15623599.2018.1452100

Stojadinovic, Z. (2018). Claims on construction projects – quantification and prevention, In *proceedings of the "Contemporary Construction Practice 2018"*, (pp. 83-112). Retrieved from: https://www.researchgate.net/publication/325846239_CLAIMS_ON_CONSTRUCTION_PROJECTS-QUANTIFICATION_AND_PREVENTION

Sulbaran, T. (2011). *Case study: ten document needs for schedule litigation support* Retrieved from: http://se.asee.org/proceedings/ASEE2011/Papers/FP2011sul148_159.PDF

Sounders .M, Lewis.P, Thornhill.A, (2009), *Research methods for business students* (5th ed.). England: Pearson Education Limited

Tochaiwat, K., & Chovichien, V. (2004). Contractors' construction claims and claim management process, *Research and Development Journal 15*(4), 66-73. Retrieved from: https://www.researchgate.net/publication/215908277_Contractors%27_Construction_Claims_and_Claim_Management_Process_Published_in_Research_and_Development_Journal_154_66-7

Tulli, M. (2014, September 10). Auditing practices and organizational efficiency in local government authorities: A case study of Tanzania. *Journal of Finance and Accounting, 2*(4), 100-114. doi:10.12691/jfa-2-4-3

Tweeddale, A. (2016), *Clause 11*, Retrieved from: http://corbett.co.uk/wp-content/uploads/Clause-11.pdf

Vidogah, W. N. I. (1998). Improving the management of claims on construction contracts: consultant's perspective, *Construction Management and Economics, 16*(3), 363-372. doi: 10.1080/014461998372385

Walltempleton, & Haldrup, (2014). *Common types of construction defects*, Retrieved from: http://www.walltempleton.com/wp/wp-content/uploads/2014/01/Common-Types-of-Construction-Defects-v12.pdf

Wenfang, Z. (2013). Research on the legal claim in large-scale Mechanical and Electrical Engineering in construction project, *Applied Mechanics and Materials, 416-417,* 1818-1821. doi: 10.4028/www.scientific.net/AMM.416-417.1818

Williams, T. (2003). Assessing extension of time delays on major projects. *International Journal of Project Management, 21*, 19-26.

Wideman, R. M. (2001). Construction claims identification, communication & record keeping. In *proceedings of TUNS/Revay seminar in 1990,* Retrieved from: http://www.maxwideman.com/papers/construction/construction.pdf

Wood, R. (2006). Building and civil engineering claims. *The estates Gazette Limited*, London.

Yang, S. S., & Xu, J. (2011). Construction claims management of civil engineering. *Advanced Materials Research. 243–249*, 6348–6351. doi:10.4028/www.scientific.net/AMR.243-249.6348

Yates, J. K., & Epstein, A. (2006). Avoiding and minimizing construction delay claim disputes in relational contracting. *Journal of Professional Issues in Engineering Education and Practice, 132*(2), 168-179.

Yusuf, G. A., Mohamed, S. F., Yusof, Z. M., & Misnan, M. S. (2013). *Adoption of standard based pricing method for the procurement of Mechanical and Electrical Engineering services in Malaysia*, Retrieved from: http://www.iaeng.org/publication/WCE2013/WCE2013_pp459-464.pdf.

Zaneldin, E. (2005). Construction claims in the United Arab Emirates: types, causes, and frequency. In: Khosrowshahi, F (Ed.), *21st Annual ARCOM Conference*, 7-9 September 2005, SOAS, University of London. Association of Researchers in Construction Management, 2, 813-22.

Zaneldin, E. K. (2006). Construction claims in United Arab Emirates: types, causes, and frequency, *International Journal of Project Management, 24*(5), 453-459. doi: 10.1016/j.ijproman.2006.02.006

Zhou, & Yi-Hong, T. W. (2012). Study on construction claim for international project based on contract status analysis, *Applied Mechanics and Materials, 174-177*, 3356-3359. doi: 10.4028/www.scientific.net/AMM.174-177.3356

Zubaida, N. M. (2012). Claims management and substantiation in the United Arab Emirates construction sector. (Masters dissertation, The British University of Dubai), Retrieved from: https://bspace.buid.ac.ae/bitstream/1234/285/1/110159.pdf

Zubair, A. M., Zaimi, M., Majid, A., & Mushairry, M. (2006). A systematic approach for monitoring and evaluating the construction project progress. *Journal - The Institution of Engineers, Malaysia, 67*(3), 26-32. Retrieved from: https://www.researchgate.net/publication/49910415_A_systematic_approach_for_monitoring_and_evaluating_the_construction_project_progress

3D Fold Education center (2016), *Contracts management and administration (Based on FIDIC*, FIDIC-seminar-presentation_ver-1.0.pdf, Retrieved from:

https://vdocuments.mx/contracts-management-and-administration-based-on-fidic-management-and-administration.html

Appendix A: Details of Interview responders

Responders coding	**Qualification & experience**	**Party represented**
R1	CIDA Adjudicator- BSc, MSc-CL&DR, AIQSSL- Charted Quantity Surveyor -22 years' Experience in MEP trade and 10 years' experience in claim management.	Consultant
R2	Commercial Manager, MRICS, MSc-CPM, Charted Quantity Surveyor -19 years' experience in MEP trade and 12 years' experience in claim management	Contractor
R3	Senior MEP Project Manager-TKMEC,PMP- 24 years' experience in MEP trade and 10 years' experience in claim management	Contractor
R4	Deputy General Manager -Claims - BSc, MICCP, MAIQS, APAWE,ICIOB, IIESL - 20 years' experience in MEP trade and 10 years' experience in claim management	Engineer

Interview Answers

Q1) Can you please explain your involvement in claim management for MEP projects

R1)-I have involved MEP typical claims like the evaluation of prolongation cost and evaluation of time in Grand Hyatt project. When I work in Indonesia claim type- rail track earthling, rail track tolerance-interfacing problem, the civil contractor had to

make suit to MEP contractor. I have involved in MEP claims however mostly I have involved in civil claims.

R2)-I was working with a long time with MEP projects. Keep the record with all the time for a transaction or contract things is the main thing in the claim management. Therefore, we gave the notice and keep the records and asking the engineer what record we must keep. Then we go to the claims. If some dispute occurs which leads to a claim I involve from the submission of the claim and then go to the claim's evaluation. We must attend to the negotiation meeting and the engineer is asking the record accordingly I attend those clarifications to get the success of the claim.

R3)-I am being involved in the project as the project manager. So, claims being introduces as a regular course naturally comes through the project. In the defect liability period, we have a separate team looking after defect liability issues. So, the claims are not directly through project manager at that time since we have a different team and we also have a commercial manager and a commercial QS team which takes care of this. When such claims do arise in the project, the project manager also provides a loop so that he can keep contributing to any points that would help the case. That's my involvement for the claims.

R4)-I have been working last 20 years as a quantity surveyor now we are doing a separate claim division in our company. So, of cause, we are involving a lot of MEP claim also. I have spent 100 % of the last 3 years only for claims. So I have done about 30 claims related to MEP.

Q2) Do you think record-keeping has a relationship to claim management?

R1)-What I can say claim management is record keeping. It was very important. Without records, I think nobody can talk about the claims. For example, the beginning of a claim is a claim notice under Clause 20 (FIDIC 1999). It is a record-keeping. If the contractor did not keep that record, within 28 days or whatever days specified in the contract, the contractor will lose the entitlement for the claim. That means it is the 1st record-keeping and after that clause 20 also imprecise that after the notice claim itself describes the contemporary records must be kept as per the engineer's

requirement. Then it also explains how those contemporary records should be kept. I think all those things are record-keeping. The records may be hard copy or soft copies electronic copies, photographs verbal instructions and it should be confirmed by the engineer. There are a lot of types of records and they are very important for the claims.

R2)-Yes of course there is a direct relationship. If we come to the dispute and go to the claim whether contractor or employers' side, we must keep the records. Those records will help you to guide the claims.

R3)-Yes, record-keeping has a very important role to play during claims management because most of the claims are retrospective which looks back after the event has happened, they are looked back. During the event, both the parties are looking to a solution to the problem and the claims come at little later. Hence it is very important to keep all records of such cases, all expenses attendance fees, approvals, previous approvals, timelines agreed, methodology agreed all these must be kept during defect liability period. So, the records keeping during the project do a very little contribution towards the defect liability period. A very few data are taken may be MEP specifications the way of installation is explain or maybe the way of certain installation explain by the Engineer to the contractor. So, if he does this work during the defect liability period, he is bound to look at these records.

R4)-Of cause, the record-keeping is a must and lots of claims are failing because of lack of records by the contractor. Therefore, it is important to keep records.

Q3) IF records are required, please explain what records are most important?

R1)-for the claim, a very important record is the notice- in my opinion. In FIDIC conditions there are some conditions that without claim notice, the contractor cannot proceed with the claim. It is a condition precedence requirement. I think in SBD contracts notice is not condition precedence however it is very important from the contractor's side. As we must discuss both sides, we must consider the employer's side as well. Employers claims are referred to clause 2.5 of the FIDIC 1999, Employers not required to provide the notice except FIDIC 2017. As per the FIDIC 2017, the claim clause is common for the contractor and employer. In other contract

types like FIDIC 1999, 1987, and SBD we are having separate clause for the contractor which is clause 20 and clause 2.5 for the employer. In FIDIC 2017, one clause facilitates to the employer and the contractor and as per the FIDIC 2017, the employer must give notice to the contractor. You are asking what records, so the notices are very important and the contemporary records. Which means all the records at any time which contractor should keep establishing his claims. The base of those contemporary records only the claim administrator will quantify the claim or evaluate the claim. Without contemporary records, I think the contractor cannot get any success or quantification.

R2)-The most important are contractual records. As an example, if you go for EOT claim or any claim according to the contract the contractor should notify the employer or the engineer that it is going to be a delay or something. If not, how the contractor going to prove that the claim incident happens at that time. Everything should be kept as records. After notifying such incitements both parties should agree to the records and put signatures. The notification should reach to engineer or employer. These things can be treated as records.

R3)-As explained in the previous question also, we must keep all those documents attendances cost time records, all these must act as support to the claim for the claiming party. If the claim is by the client, the records to be provided by the client and if the claim comes from the contractor the contractor must provide the records.

R4)-With related to MEP, If I start from the beginning, most of the MEP contractors are starting without a proper agreement. So, the first thing is they should have to get the contract related document. Because the MEP contracts usually start on the partly developed design, so they must prepare the detail design. From that stage sometimes clients are requesting changes from the original scope. For that stage, contractors must keep all the communication between the employer and the Engineer to the contractor for the record for requesting of changes and related to how the contract was signed. After that when every the project is going on usually contractors have to follow the right procedure like a request for information, we call RFI, then inspection request we call IR. Because when civil works and MEP works are running together Main

contractor has to give the site clearance to the MEP contractor. We call that the clearance record. For example, once the blockwork is completed then civil contractor handing over the site for the conduiting at that time there should be a record called clearance record. That record should be kept. Then for the materials contractor have MAS approval, we call material approval submittals. All the MAS approval records should be kept with the contractor because later the client will come and tell the material used are not up to the standard or not approved, it is like that. So, the contractor must keep MAS records. After that usual correspondences, we call the document register, if the contractor maintains proper document register, what I can advise, the contractors must record all the emails also. not only the letters, other than that contractors must record any claims in the construction stage like delay claims contractual claims anything contractor need to keep their notices also the contracts have 14 days notices or 7 days notices. So, these claim notices need to be issued. Say example when the execution stage comes, I will get one example from the HVAC system. In one claim client want to change a split AC to ducting AC. on that time, in a meeting client has told that we need to change this, and the client needs to add some more partitions. After that what happens, the client changes the diffuser locations. With this all, again the contractor must redesign the ducting also. Initially split AC and revised design for ducted AC. After that, because of partitions, a new room added again the ducting routes changed. But what happened between these two instructions, the contractor started the work without drawing approval, the first instruction. Then later contractor was claiming abortive works. Then the contractor was struggling to prove the changes of this abortive works. Like that the contractor must keep all the records. What I mean to say if the contractor receives any instruction or verbal instruction or if the contractor started any part of the works without proper formal approval, because usually with the client they don't give approval within a short period. Therefore, considering the timeline, contractors are starting the works. But there should be a method for record-keeping like what we are doing, we call it request for inspection, shop drawing approvals. Instead of this shop drawing approvals, I can suggest keeping a record of working drawings approval. That means if the contractor doesn’t have the formal approval for drawings when the contractor is going to start

the work at the site on that time the site supervisor or the engineer and the client can sign one working drawing. That can be used in the future for any claim. It was happened in one case, in an airport project. What happens, MEP CCTV contractor last MEP contractor to execute the CCTV conduits. That CCTV contractor also was the 16th one. Initially, the drawing issued after that other MEP contractors came to the site. Then they have already occupied the spaces for trunking and conduits. Therefore what happens, the approved shop drawing was useless. That means if the electrical cables already installed and after that the other contractors' like AC ducts already occupied above the ceiling, then the CCTV contractors cable route again wanted to change, In such situation, what contractor did, the contractor went to the site with already approved drawing then he marked on the drawing what is the most practical way to lay the cables. Then he got the approvals from the site supervisor and the Engineer and employer. They agreed on the site saying this is the way we can do. So, we have the approved drawing so that case was won by CCTV subcontractor because of this report as he was able to prove it.

Q4) Have you involve in MEP claims in Defect liability period (DLP)?

R1)-In my Jakkartha project I have involved claim evaluation during the defect liability period but those are claim incidents which occur during construction. MEP claims at the defect liability period mean something related to maintenance and, malfunction of the equipment and machines. I have not involved such claims.

R2)-Yes, I have involved. In the current market claims related to defects liability are rear. It is interesting to hear these claims types in the defect liability period. The contractors losing their rights to claim because as MEP contractors are not keeping proper record-keeping during the defect liability period and they cannot prove that the event happens due to employer mistakes. For example, like pumps, the employer should carry out the proper preventive maintenance if such maintenance not done then the contractor will suffer as the contractor have to remedy the defects and cannot prove the employer’s failure in maintenance procedure without records.

R3)-Yes, I have been involved some claims that were by the client on us which required me to investigate into the issue and find out what was the root cause. 90 %

of the chances it was because of poor housekeeping. Poor maintenance schedules by the maintenance team by the client or the operator. So, we had to demonstrate that. 10 % of the time it is because of the issues with the equipment which was dully attended by the supplier which is covered under warranty. Very seldom we had any case of a machine break down.

R4)-Yes, I have involved.

Q5) Can you give some examples for the claims which can occur during the DLP?

R1)-We must go with the system by system. During the defect liability period, in my opinion, most of the claims can be raised from the employer to the contractor. When we are discussing the claims, we feel that always the contractor is claiming some money from the employer, but in defect liability period I think it is in otherwise or the other way. The employer is finding some problems in the MEP system and thinking that the responsibility is with the contractor and employer trying to raise the claim from the contractors. The examples typically malfunctioning of the system say in lifts, the speed of the lifts some lifts not properly landing to the specified floor some tolerance between the lift level and the floor. When we are discussing with the air condition system, cannot keep proper temperature or more electricity power consuming which expiated from the design stage. Also, some hygienic problems could occur. Basically, it is a malfunction or not properly working. That time only the employer thinks that this may be a contractor's fault and it should be rectified by the contractor and employer don't want to spend any money on that.

R2)-In contractor end, they may face for extension of the warranty period. As an example, the MEP contractor is not a manufacturer. We are buying machines from the international market, the equipment comes with 5 years warranty period, but in case of a delay due to the other reasons MEP contractor may suffer from the delay, but he cannot claim that from the manufacturer. That type of difficulties is there.

R3)-In the defect liability period, a claim can occur predominately due to poor workmanship. That is one. Second, in our cases, we have seen this is predominantly

due to lack of maintenance of equipment or lack of proper housekeeping. They don't keep the plat rooms well which is going to affect. Then the surveillance, when the property is hand over, we should ensure that the system is running at its optimum. If it is not, then issues might crop up which can be monitored only by the operating team or the maintenance team. In our experience, most of the claims have come because of this. Poor workmanship yes, we have not seen much. Because most of the works that have been done as per the consultant's requirement. His approvals are there. In event of such a case coming out from workmanship, we always keep the record for material approvals, we have the work inspections and records and we have the client take over or the consultant's inspection, so all these records will help you during the claim.

R4)-When we come to the DLP stage there is an example, it was a project for supply of a generator for power supply. What happens, they brought the generators from China, for the initial testing the client's representative visited china, they did the testing at china with the control environment that means inside of a factory, and so it was 8 MW generator. What happened, at the factory test generator was successful then they brought the generator to Oman and the factory test was signed by the client. I am talking about this factory acceptance test. That is one type of record. Then once they brought the generator to Oman, installing time, the technician from china came and they have installed the generator. But unfortunately, the contractor has no records of fix duration or how they test that initially. Then the commissioning with the client started that is 72 hrs. Continuous testing the generator must work. Then the generator must generate 8 MW, 7.6 MW at last after 48 hrs. On that time after 48 hrs. the generator starts to heat and generator reduce the power supply, instead of 7.6, it becomes 5.MW. So, this matter has happened. So that time they have kept joint records. After that, the generator was working but all the power generated by the generator was less than 5MW. This fine by the client for the winter period. When it comes to the summer, the generator wanted to generate more than 5MW. It has happened after 6 months of commissioning. At that time, the client complained that the generator is not giving the correct required level of power generation. This matter went to arbitration. So the thing here is if the contractor is diligently worked because as what we have seen, this power generation company was sending monthly report to

the contractor because winter what they are sending is the generator it is power generated as 5.6 MW it is the demand but later it needs to go up on that time the power supply company requested to the contractor to increase the power. After a few months, the power supply company hired an additional generation and they have supplied the power to the grid. Then after one year, this power supply company put a claim against the contractor. The reason was the contractor was not attending. Because of every winter generator can give the required power. So, the point here is if there are requests from the clients, they must attend for those.

Q6) Please specify the requirements for claim success?

R1)-There are two types of claims. Contractor's claims and employers' claims. The requirement for claim success I think is record keeping, timely record keeping, that is very important. If you not given notice on time then the contractor will lose his rights for claim. Timely notice is very important. You must keep those records on time. Get certification of those records on time. Notice on time, contemporary records on time for the claim. Those contemporary records mean all the records from the design to taking over for the contractor. Design manuals, design standards design concepts design approvals from each level. When the design comes to each level the contractor has to get the employer and engineers consent for that. After design completed, material approvals and method statements. After finalizing the design and after getting the material approvals and method statement then the contractor starts the installation. Then during the installation process, the contractor must keep all the copies of RFIs-. Internal RFI process and external RFI process is there that means quality maintaining then all those records should be kept. After installing there will be internal testing and commissioning and employers testing and commissioning. Those records should be kept properly and when taking over those manuals' maintenance procedures should be handed over to the employer properly. All those said records are the requirement as contemporary records. Without those documents, it will be very difficult to prove.

R2)-In the event of such delay, The contractor then should make a claim for his protection and he should notice that one and he go to the claims by saying that he cannot maintain the warranty period other than given by the manufacturer as the

manufacturer is responsible for the product. If the contractor extends warranties, then he should claim that from the employer.

R3)-Documentation is one, the second is the knowledge of the equipment and the works that you installed at the site, because if you don't know what is the root cause or if you don't have the experience you will find it difficult in finding the root cause. Unless you found the root cause you cannot establish whose fault it is. So, you must have some experience in maintaining such an MEP project after hand over. Records should be another one. Bills, complains, your attendance, when this maintenance call was given out, when did we go back to install, what recommendation we had given, did we take a signoff work. All these are very important during the DLP. These must be recorded and kept to. So that any claims that come after later stage, can review or assessed properly.

R4) -For claim success, approved proper documental records are required. Say for examples inspection approvals, shop drawing approvals signed off testing records from the engineer, as-built records, records for proper onetime attending for client's complains.

Please select one set of below Q7 & Q8 questions as per the respondent's representation as Contractor or Consultants.

As Contractor

Q7) What is the MEP Claim submission procedure?

R2)-Normally MEP contractor works under the Main contractor. Then he should follow the same procedure as the Main contractor. If MEP contractor is a subcontractor, then he should submit the claim through the main contractor to the Engineer of Employer. If it is a nominated subcontractor also the procedure is the same but sometimes nominated subcontractors are submitting the claims directly to the Engineer or Employer as directed in Conditions of Contracts.

R3)-Claim submission procedure is the same as we are submitting during the project. Inevitably the office is not there. You don't have staff there. Then you have the

contractors office, engineers office and the clients office or the operator's office who eve make the call to the contractor's office asking assistance and once an assessment is made by the contractor and if there is a dispute between the two parties of the contract. Both parties are free to call the Engineer asking a view on assessment. So, this is the protocol of how you should be working. Once the defect and work are determined then all the record you do in a normal project time, the same should follow. Then it should be submitted on time to the Engineer with a copy to the client. Should you intend to make a claim it should be forward likewise.

Q8) How the MEP claims are substantiated?

R2)- It also the same thing. He should give the notifications; he should keep the records. The records should be proved by the document backups like weather reports or whatever the records available in the industry or sometimes we notify and get the photographs. These things the contractor can give as evidence for substantiating the claims.

R3)-claims should be substantiated with all these documents we discussed. In additions to this, contract documents, which may act as a support to your claims. Because some of the equipment of some of the specifications that the Engineer specified to the project may turn out to be not appropriate for the project. We may find out during the DLP period. Such time you need the specifications and the Engineers recommendation then approvals and all those to be brought in to act and show to the consultant and the Engineer. If you wish to contest Engineers specification that time you may have to get a third party to come and do a review and give an independent decision. The third-party can be an independent agency or a supplier or a contractor. Any of the third party or an institution can be a third party. So, on all these assistants have been taken out, documentation should be there to show these trials of events that happen. So, these are very important for your case. There should be a trail of documents that shows that both parties have done due diligence to the event at hand or to the problem at hand after which they have ascertained that this is the reason and then they have gone for the claim. Inevitably it goes to the engineer for

the evaluation. Should the engineer feel that this is not to be paid or once he made his recommendation either party is entitled to escalate the issue with the Engineer.

As Consultant/Engineer

Q7) What is the MEP Claim Evaluation procedure you adopt?

R1)-For the claims, whether it is MEP or Civil the procedure is the same. What I want to say, in my experience for the local construction industry and the international construction industry we don't have a set of procedures for the claims. For example, in the contract, within the contractual framework, we don't have any guideline. For the variations, we are having a guideline. In the contract for the variation, using a set of clauses, a guideline is properly established. But for claims within the contractual frame, we don't have any guideline to evaluate a claim, whether it is a time extension of cost claim. Basically, in the international construction industry, we are using SCL protocol. In conditions of contracts also there are some instructions on how to evaluate the claims. The most important point is, in the conditions of contracts it says the contractor must compensate his cost, the employer must compensate the contractor his cost, not the profit. In most conditions of contracts, it says like that, there may be some condition of contracts with profit. But in practice FIDIC, SBD the employer must compensate for the actual cost. In SCL protocol it cleanly describes the type of cost claims. If referred to the protocol, prolongation costs, disruption cost and acceleration costs. Normally we are adopting the SCL protocol claim evaluation procedure. Even for the claims in the defect liability period, we must use the same evaluation procedure.

R4)-When we are evaluating the claim, we start with checking the timeline and those things, notice requirements. In general, I will explain. There should be notice issued by the contractor or the client. Now especially if we go to MEP, we must find out what is the real problem for example if it is about DLP claim, then what we need to check is what the root cause is. There will be a root cause analysis for that particular defect. It can be checked through a third-party expert view. We did one case, what we did is we sent one MEP specialist to visit the site to check what the fault was and we obtain a report from him. Otherwise, when you have a vender, then from that time the

main contractor tries to get a report from the particular generator supply company. Then they came and they gave a report telling the cooling system is not working in the generator so therefore the cooling system needs to be replaced. So, one way is actually the evidence point of view, what we can see there are numbers of evidence. I can say third party evidence, it's like a person to go to the site to check and give his independent opinion. Then the as-built records. Sometimes we need to see as-built records to check whether the way of execution was not correct, then we can check with the IR, approval of the inspection request. On that time there might be comments from the Engineer. We must check those. Otherwise timely attending of the site complains. that is another one because if the contractor not attending to the Employers request for repair or maintenance, that might be a case for a long-term defect, initially what we do we check and identify what is the reason for the cause. once we establish what is the cause or the reason for the fault then we must check what are the remedies that mean whether it needs to be replaced or it can be repaired that king of things. After that, we go to the claim evaluation. If we have the reason for the defect or fault then we have the remedy, remedy usually replacement keeping backup example like that additional generator. We can use that additional until completing the repairs. Those cost part will be calculated based on what is the additional cost incurred to the repairer or replace and what is the additional cost incurred to the client because of the fault because that also needs to be compensated. After that, there might be some business effect from the client if so that also needs to be taken in to account.

Q8) What records you looked for certifying the MEP claims?

R1)-This is very subjective. The first thing is notice. But in the defect liability period, the claims come from the employer. Then documents mean all the documents what we discussed earlier are required. Any documents, which means design documents, standards RFIs, operation manuals, handing over documents. I cannot specifically say, but any party should keep all the relevant records and for the claims then we have to select what are the records we have to pick and submit and what are the documents to be submitted, what are the document that claim-examiner may lookup.

R4)-In record point of view basically when the client is requesting to attend to these repairs on that time contractors should try to maintain a log. If you see some specifications in airports, that specifications require maintenance procedures. There may be urgent basis maintenance. If that happens like within half an hour or one hour need to be attended. Such kind of categories, contractors need to attend within one day. Other categories within seven days just like that. So that will be checked against the contractor's performance. That means there is a checklist to check whether this has happened and also, a project like an airport, the maintenance is very important. Some maintenance is promptly attended. That is one thing the attendant log, and the complaint register. Other than those operation manuals another important on is there spare parts list of record that also required. Because like that airport like regular operation projects contractor supposed to provide the spare parts for different percentages so that stock managing also affects the maintenance point of view. Other than that, mostly as-built drawings operation staff training records because the contractor must train the client's staff. If the client is operating the MEP equipment, client's staff must be trained. Usually, what happens like electricity plant on the contract itself there is a staff to be appointed. I have seen one contract, in that one, the contractor must recruit a maintenance engineer then the contractor must transfer him to the client. So that also one good option. Then that person is involved in the operation and maintenance phase and finally, he will be transferred to the client.

Q9) Please explain the record types required for successful MEP claims in the defect liability period.

R1)-In my opinion, we should keep all the document from the design concept to the handing over. Because during the defect liability period, if there is any claim it is due to the malfunction of some particular machine or a system. Then to find out the exact reason for the actual reason of that malfunction whether it is a design problem, or it is s installation problem or material problem we must look at previous records. If it is a design problem, we must look at design records. If it is a material problem, we must look we should have all the material approval records. If it is a fabrication procedure problem, we should have all the method statements and what are the standards we

used for the material selections, fabrications also we have design standards and testing and commissioning. We are getting readings when doing the testing and commissioning. All those to be kept as records.

R2)-Defect liability period means something like the maintenance period. For that maintenance, the employer should follow the guideline given from the manufacturer because the manufacturer knows the specified things to do to the maintenance of the machines. If the employers do not follow these things definitely the machines will fail. As an example, the manufacturer may give that these types of spare parts to be used and may also specify the type of oils to be used and filter to be changed on specified time. So, if the employer misses that then the machine will not function fully as specified. So, these things the employer should keep the records and the MEP contractor should monitor these things whether the employer is following these things as per the guideline from the manufacturer. If not, machines will fail and collapse and then the dispute will arise. Then the employer will sue the MEP contractor then it will come to legal issues or claims like things. So, the employer should follow the guideline given by the manufacturer.

R3)-These are the documents, what I have explained in the previous problem are the documents the types of records. It starts from the callout for the maintenance, the time for attendance, the time for observations, inferences and from there on if you required to call the Engineer then correspondences with the Engineer. Coming back, copies the specifications and copies of all those attached. if your claim against the client then your records of having all these plus the material cost plus the labour cost plus labour timings and witnessing by the Engineer all those should be along with the claim documents.

R4)-So if we go especially for the defect liability period, I think in the last question as I say in the defect liability period basic thing, we have now we have a maintenance contract. Now it depends on the situation. See if it is a big project in defect liability period there will be teams of contractors who appoint for attend to defect throughout the period. Then most of the problems can be attended by the contractor that staff. But in small projects that time client only will operate the building like Ac systems and

mechanical systems will be operated by the client only. If the client doesn't have the expertise to maintain or use the building then there are lots of problems. Then for the recording, it is better the contractor to have a proper handing over records from the beginning. Say we are calling the snag list. When you are handing over then there is a document called snag list. In snag list all the balance work or any more rectifications to be completed in defect liability period to be identified. Say example, if these items not recorded in snag list may be client may be concerning about something on that time disputes could occur. As the parties supposed to inspect the site and list out those snags and the contractor's duty to complete those snags only. But any additional complain of additional work coming apart from the snag list will have to review that there is an operational fault. Like if the client has not operated the equipment properly so damage happens after taking over the client by any other reasons. So, what is important here is to keep proper handing over records. We have snag list other than that there will be final inspection reports which are approved by the Engineer. Final inspection reports should be supported with the MAS approvals. Approved plant as-built drawings proper completion records. What I suggest it is better to keep the photos also now say room wise photos otherwise MEP equipment room wise photos. That photos if you can keep and any fault happen then they can refer that to the photos record. I have seen come contractors used to keep the videos. What usually happening when there is a critical project is going, for instance, they have a typical plan what contractor supposed to give a record of videos of each room then the use that to next payment application it's a matter of, say one hour-recording or something in the building. This can be used to show as an evidence in a time what was executed. Other than that, as I said the complaint log. That will be important how the complaint handled, and that attendance is important. Then operation manuals are important. I suggest including for every project record of training. In big projects, there are special training to be given to the client staff. But in small general projects there no such training specified in the contracts. Especially MEP contractors need to train the client's staff. For example, most of CCTV projects are getting problems after two months when they come and see and CCTV camera is not working. Mostly the problem might be the client's staff doesn't know how to operate the CCTV system, so

proper record operation manuals and staff training is important. When doing the staff training, better to do the staff training in two or three sessions. After the first training, there should be one week or two weeks gap for second training. Third maybe after three months so the problems experience from operating also can be solved. The cost for that needs to include in the tendering also contractors must keep the records of proof of staff training mentioning that this staff has been trained for this particular area. Then if a problem comes, we can prove whether the problem attended by those particularly trained staff. Therefore, to keep that record better the contractor to establish a form, when such fault comes, ask that particular trained persons to attend the problem. If other people attend the fault, then there will be a problem. What contractor needs to do is to set up a mechanism to ensure the trained staff attended for the matters and his attendance to be recorded. That is one-way, other things about the defects when transferring the project after defect liability period there should be a proper mechanism to maintain the MEP equipment. On that time if another vendor comes, now usually that happens in annual maintenance also done by the trained contracting company but sometimes client has in-house facility management team or sometimes the client have different companies as a maintenance contractor. So, when the building handing over the interface, on that time though the maintenance team are trained or expert company it is better to give proper operation manuals with the records. They must hand over operating manuals with one- or two-day workshop training telling that we have done this record for this purpose like this training is given to this purpose and it was for the maintenance and understood by the facility management team. This record is very important when it comes to the matter of faulty operation or faulty installation or something like that.

Q10) What more records you suggest keeping for claim success, which specifies in the current practice

R1)- As for more records, we must keep photographs. Full system photographs. even joints of the systems, machines everything should keep photographs hard copy and soft copy, better to keep soft copies, hard copy also important and we can see how it fabricated. At the beginning condition and the present condition and clearly, we can

have an idea whether it is a problem in the fabrication or material or whatever, or maybe we can have a good chance to understand the reason for the defects. In the point of employers, when handing over time, the employer can ask for all those records. design documents material approvals, method statements and everything, but even though also having a copy with the contractor, for the methods statements, originals go to the employer and material approvals originals go to the employer, design approvals also one copy goes to the employer. So, the employer can keep those records, maybe with the photographs. When the employer taking over the project it is very important to maintain those mechanical or MEP systems with the manufacturers approved service maintenance provider, otherwise, the employer will lose the rights to claim for the warranties. Then the employer can keep those records saying that he had maintained the proper and maintenance with the consent of the manufacturer that is the employer has done his duties properly. As I said earlier the government certification of the machines especially for the machines there are annual tests to be done for the safety of the people. That procedure is doing by the labour departments for only for the safety of the people. There are two types of records, those government certifications and proper maintaining certificates to be kept and then the employer can prove that he has done service and maintained equipment properly. Otherwise, the employer in problem if he has not maintained those record and if there is any fault comes then it will fall on the employer's shoulder. The possibility is more.

R2)-Normally we should keep the record books together with the machine of somewhere in the office. Those machines always should be updated, and those records should be updated every day and that procedure should help the contractor or manufacture to make sure that the machine is functioning fully or not. In such a case, the manufacturer also can directly advice the employer that the machine is not functioning properly, and these areas are going to fail. As an example, we can use modern technology, something like compressors of a big machine, if the manufacturer could monitor all functionality of the machines from a remote area. This is like using internet facility or something like that, I am suggesting these things. Those records of functionality or any changes that happen in the machines the manufacturer of MEP contractor can directly identify and advice employer to do necessary precautions to

avoid those failures and follow preventive actions. The employer also can ask questions from the MEP contractor or the manufacturer when failure indication comes about the actions they must do. So, it is better to have such a monitoring system from a remote area. If the manufactures could monitor the machine from remote areas they can help to minimize or avoid the failures in most of the time.

R3)-Basic things are you need the approvals; you need the timesheets, cost sheets are required. Other than that, photographs are required. It will support your claim but will not give substantial benefits. In terms of employer's point of view, when we give the O& M manuals there is a schedule inside which will tell what to do. What is the maintenance schedule you need to follow? These O & Manuals to be handed over to the maintenance team who will keep records of due works being done as per that schedule and these works to be recorded. So, the moment we go for, during the defect liability period the contractor always insists for the first inspection request like an FIR. This should be forwarded to the contractor before we send the team, just because if you see a problem you don't call the contractor. You need to find out whether it is caused by a block or is it caused by something. There are some works, that can be done by the maintenance team and it should be done by them. However, if it is due to poor workmanship resulting in such a fault and then yes you can call the contractor. You should report that to the contractor stating that this has been found defective because of such and such reasons. Then the contractor goes in and he doesn't waste time to find all of this and he investigates the report try to identify the problem based on it. So, should it found to be a problem due to defective workmanship, he goes immediately to correct it out. Once the correction is done and there are no damages then the client may forgo charges against it, and we may forgo charges on it. So, it may depend on case to case depending on how big the problem is.

R4)-When there is any repair or modification done by client with any other third-party contractor. If such situation happens again must go back to the contractor's records at that time it is important to see the record. as an example when you have ducting AC system if the client needs an additional partition for a room at that time client will ask some another contractor to come and do the ducts then if there is a fault for overall

system on that time contractor have to use their previous records. The contractor has properly recorded what is the brand of material used what is the layout plan of the ducting, that all will be important on that time to establish if the client has done any modification that we have properly handed over. On that point of view, you need to keep as-built drawings material brand approvals, testing report approvals. Testing and commissioning reports are very important because what the client has checked what the measurements are, we have taken that all can be double-checked with that situation.

Appendix B: Questionnaire Template

DEVELOP A GUIDELINE FOR PROPER RECORD KEEPING FOR ESTABLISH MEP RELATED CLAIMS AT THE DEFECT LIABILITY PERIOD

Please fill the pages depending on your claim management experience.

This research intends to find out the record types required to manage the MEP systems related claims in the Defect Liability Period.

Q 1). Nature of your Profession

- ○ Commercial Manager
- ○ Sr Quantity Surveyor
- ○ Quantity Surveyor
- ◉ Contract Administrator
- ○ Contract Manager
- ○ Project Manager
- ○ Engineer
- ○ Other (please specify)

Q 2). Nature of your business types of respondent's organization

- ○ Employer
- ○ Consultant
- ○ Contractor
- ○ Other (please specify)

Q 3). Experience in Construction industry

◉ 0-5 years ○ 5-10 years ○ 10-15 years ○ above 15 years

Q 4). Experience in MEP projects

○ 0-5 years ○ 5-10 years ○ 10-15 years ○ above 15 years

Q 5). Involvement on Claim management process in the Defect Liability Period (DLP)

○ yes ○ no

Q 6). Type of claims experiences - how many numbers involved

○ 0 ○ 0-5 No's ○ 5-10 No's ◉ above 10 No's

Q 7). What are the key factors for successful claims?

Please fill this page depending on your MEP Claim management experience.

This research intends to find out the record types required to manage the MEP systems related claims in the Defect Liability Period. The research is mainly focused on the MEP claims related to defects, maintenance, workmanship, equipment related issues and incorrect usage by the end-user. However, responders are requested to comment on their different views and opinions under Question 10

Top of Form

Q8). Kindly rate (√) the applicability of the below mention records types particularly to manage the MEP claims in the defect liability period

	INDEX	1	Very low	2	Low	3	Medium	4	High	5	Very High

S.No	Record type	Kindly rate (√) the applicability				
		1	2	3	4	5
1	The original contract document- original contract					
2	Issued for Construction (IFC) drawings which represents the agreed scope as confirmed by employer and Engineer.					

3	Filing record of all the record with tracking index of the documents. (all filed by topic) (written communications between the parties including memos and faxes)					
4	Progress, milestone photographs with each milestone name, date, and time of completion.					
5	any reports from special consultants					
6	Progress reports presenting the site progress according to the milestone or project completion.					
7	Reports: weekly or monthly, including exception reports, forecast-to-complete					
8	Notes of telephone conversations between contractors or the owner which linked to changes.					
9	Instructions to contractor, contemplated change notices issued by the owner (Orders for extra and additional work), change estimates					
10	Notice of claims for delays and/or extra cost by the contractor					
11	Special instructions to contractors like plants available at the sites to be protected by the contractor and the like statements.					
12	Quotations related to suppliers, sub-contractors or any other service provider with purchase orders, contract agreements or any other communication backups.					
13	All shop drawings including revisions done by contractor, Sub-contractors, producers, and supplier. Said submissions to be recorded with submittal log indicating the dates submitted.					
14	Requests for information for the contractor or subcontractor of the project.					
15	Work records which demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time.					
16	The daily diary or journal entries recorded what has done at the site in writing.					

17	Records related to daily resources usage at site. Daily production also recorded against the resources used.					
18	Cost records for daily resource usage/ budgeted and actual costs and man-hours.					
19	Work records which demonstrate working of different trades at the same time.					
20	Material delivery and use records, including expediting, accounting records (payroll, accounts payable and receivable, etc.)					
21	Requests for material tests & testing reports					
22	Report of rejected materials,					
23	Interim payment applications and certifications which indicates the monthly completed works pursuant to condition of the contract including supporting documents					
24	Baseline construction programme with milestones completion dates					
25	Programme task records which include a detailed narrative with resources planned and actual usage, required clothing and equipment's, durations, environmental conditions					
26	Analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints					
27	Analyses original tender estimate, construction control budget, the actual cost					
28	Minutes of contractual meetings, minutes of Site coordination meetings, meeting minutes especially related to contractual issues and site coordination issues					
29	Records of design or post-contract variations with supporting drawings, instructions with detail narrative of the incident					
30	Pile driving records					

31	Special orders/directives to contractors					
32	Noncompliance and compliance notices					
33	Certified payrolls and labour wage checks					
34	Environmental forms and reports					
35	Record contractor's home office general, and administrative costs					
36	Equipment rental invoices					
37	Work records – the type of work like feeder conduit, branch conduit, feeder wire, terminations					
38	Work records –the type of project like new construction, remodel or work while occupied					
39	Any out of schedule works which impact the productivity					
40	Weather records including rainfall, temperature, and humidity, which affect the progress.					
41	Restrictions for site access, onsite actives, stacking materials, vertical movements of material and equipment's using cranes and elevators, special material handling needs which hindrance the efficiency					
42	Records on security, safety, work hours restrictions and site clearing					
43	Records of maintenance work done by the owner					
44	Equipment product warranties contract with inclusions and exclusions					
45	Records of damages/defects					

Please fill this page depending on your General Claim management experience.

Q 9). Please mark (√) as per the Importance of Keeping following record types for evaluating /proving claims

	INDEX	1	Not Important	2	Slightly Important	3	Moderately important	4	Important	5	Very important	
	Record type							Please mark (√) as per the Importance				
								1	2	3	4	5
1	The original contract document- original contract											
2	Issued for Construction (IFC) drawings which represents the agreed scope as confirmed by employer and Engineer											
3	Filing record of all the record with tracking index of the documents. (all filed by topic) (written communications between the parties including memos and faxes)											
4	Progress, milestone photographs with each milestone name, date, and time of completion											
5	Any reports form special consultants											
6	Progress reports presenting the site progress according to the milestone or project completion											
7	Reports: weekly or monthly, including exception reports, forecast-to-complete											
8	Notes of telephone conversations between contractors or the owner which linked to changes.											
9	Instructions to contractor, contemplated change notices issued by the owner (Orders for extra and additional work), change estimates											
10	Notice of claims for delays and/or extra cost by the contractor											
11	Special instructions to contractors like plants available at the sites to be protected by the contractor and the like statements											
12	Quotations related to suppliers, sub-contractors or any other service provider with purchase orders, contract agreements or any other communication backups											

13	All shop drawings including revisions done by contractor, sub-contractors, producers, and supplier. Said submissions to be recorded with submittal log indicating the dates submitted					
14	Requests for information for contractor or subcontractor of the project					
15	Work records which demonstrate working of different trades like electrical, mechanical, plumbing including work done at the same time					
16	The daily diary or journal entries recorded what has done at the site in writing					
17	Records related to daily resources usage at site. Daily production also recorded against the resources used					
18	Cost records for daily resource usage/ budgeted and actual costs and man-hours					
19	Work records which demonstrate working of different trades at the same time					
20	Material delivery and use records, including expediting, accounting records (payroll, accounts payable and receivable, etc.)					
21	Requests for material tests & testing reports					
22	Report of rejected materials					
23	Interim payment applications and certifications which indicates the monthly completed works according to the condition of the contract including supporting documents					
24	Baseline construction programme with milestones completion dates					
25	Programme task records which include a detailed narrative with resources planned and actual usage, required clothing and equipment's, durations, environmental conditions					
26	Analyses of the productivity against the budgeted working hours recorded with any hindrance or constraints					
27	Analyses original tender estimate, construction control budget, the actual cost					

28	Minutes of contractual meetings, minutes of site coordination meetings, meeting minutes especially related to contractual issues and site coordination issues					
29	Records of design or post-contract variations with supporting drawings, instructions with detail narrative of the incident.					
30	Pile driving records					
31	Special orders/directives to contractors					
32	Noncompliance and compliance notices					
33	Certified payrolls and labour wage checks					
34	Environmental forms and reports					
35	Record contractor's home office general, and administrative costs					
36	Equipment rental invoices					
37	Work records –the type of work like feeder conduit, branch conduit, feeder wire, terminations					
38	Work records –the type of project like new construction, remodel or work while occupied					
39	Any out of schedule works which impact the productivity					
40	Weather records including rainfall, temperature, and humidity, which affect the progress					
41	Restrictions for site access, onsite actives, stacking materials, vertical movements of material and equipment's using cranes and elevators, special material handling needs which hindrance the efficiency					
42	Records on security, safety, work hours restrictions and site clearing					
43	Records of maintenance work done by the owner					
44	Equipment product warranties contract with inclusions and exclusions					
45	Records of damages/defects					

Q 10). As per your experience, kindly state any further record types required to manage the MEP systems related claims in the Defect Liability Period

Appendix C: Interview guideline

DEVELOP A GUIDELINE FOR PROPER RECORD KEEPING, TO ESTABLISH MEP RELATED CLAIMS AT THE DEFECT LIABILITY PERIOD.

Interview guideline

General Information: -

a) Name of the Interviewee (Optional) ----------

b) Name of the Organization (Optional)----------

c) Designation ----------

d) Experience in MEP industry ----------

e) Involvement of claims preparation/analyzing/evaluation ----------

f) Date of Interview ----------

g) Venue ----------

h) Duration ----------

j) Contact Details TP ----------

Email ----------

Q1) Can you please explain your involvement in claim management in MEP projects?

Q2) Do you think record keeping has a relationship to claim management?

Q3) IF records are required, please explain what records are most important?

Q4) Have you involve in MEP claims in Defect liability period (DLP)?

Q5) Can you give some examples for the claims which can occur during the DLP?

Q6) What are the requirements for claim success?

As a Contractor's point of view,

Q7) What is the MEP Claim submission procedure?

Q8) How the MEP claims are substantiated?

As a Consultant/Engineer's point of view,

Q7) What is the MEP Claim Evaluation procedure you adopt?

Q8) What records you looked for certifying the MEP claim?

Q9) Please explain the record types required for successful claims under the defect liability period.

Q10) What more records you suggest keeping for claim success?