King Fahd University of Petroleum and Minerals
Construction and Engineering Management

CEM520 Construction Contracting and Administration

Term Paper

Contract Documents Discrepancy in the Royal Commission Building Projects at Jubail

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Content

1- Abstract

This paper depicts the causes, effects and controls that result and lead to contract discrepancies in the Royal Commission building projects. A survey has been deducted by distributing a list of questionnaire to the Royal Commission Building contractors in Jubail. As such questionnaire were set out on the basis of common practice that depict the causes and effects leading to the contract documents discrepancies and the control to be utilized to eliminate such a problem. The study of this paper comes out with a conclusion that the main cause for such discrepancy is to the changing in one of the contract documents and fails to do so in others, noting to the relation of the contract documents with each other. As it comes out with a conclusion that the main effect in such discrepancy is to the delay occurring in completing the contract schedule. And this study comes out with a conclusion that by providing adequate budget for drafting the specification can minimize or eliminates the discrepancy occurring in the contract documents.

2- Introduction

2.1- Background:

It's well known that construction industry is one of the most important industries in all over the world starting from the capital expended in this field to the number of workers engaged and being one of the major capital wealth to any country.

And if talking at the scale of Saudi Arabia, it can be clearly noticed that construction industry has been facing a boom for the last thirty years. Especially of the wealth created by oil industry that have been lead to an economic rapid development and lead simultaneously to the need in infrastructure and cities expansion.

Unlike other types of industries, construction industry final product is manufactures and assembled at its place. And such issue and due to the uniqueness of each item requires a proper management related to coordination, progress and quality control.

The construction industry in Saudi Arabia in general and JUBAIL specifically is affected by many factors such as material delivery, weather, standards and codes, etc. noting that the weather in JUBAIL is quite sever and mainly during summer time as the humidity reaches up to over 90%. And this results a lot of conflict in duty hours, coordination etc.

Due to the wealth created by oil industry and the results of that (mentioned previously) and it's affect in Saudi Arabia market, the one of the results of that is the Royal Commission for JUBAIL & YANBU that was established in 1975 by a Royal Decree M/75, for developing the infrastructure facilities necessary to transform JUBAIL & YANBU cities into planned industrial complexes and associated urban communities. And due to that, large and complex projects have been built, attracting contractors and construction companies from all over the world.

The Saudi Construction Industry uses the common international industry standards such as ISO, ASCE, BSI, ASTM, and etc. plus the national code, which has been developed on the basis of international standards and local expertise. The Royal Commission of JUBAIL & YANBU follows the international codes and standards. Also, it developed it's own guideline specification that each of it's contractor has to respect and follow.

The contract documents in construction industry, are intended to direct the contractor in executing the project in a way meeting the client's needs and requirements and respecting the international and local codes.

For that, the discrepancies in the contract documents and mainly between specs and drawings in particular, should be expected to happen during the construction stage. Many reasons lead to such discrepancies can be listed as follows but not limited to:

- Changes and correction in one of the contract documents and fail to do so in the others

- Improper use of superseded drawings or specifications.
- Inadvertent omission of necessary instructions.
- Lack of agreement and coordination between specification and drawings.
- Updating one of the documents and the rest documents are kept outdated.

The foregoing items are causes that will be leading to discrepancies in contractor documents resulting in site construction conflict.

For that, such causes should be taken into consideration to eliminate any conflict that will be leading to site progress delay.

And the goal of the study run out under this paper is to find out the causes and effects leading to the discrepancies in the contract documents related to royal Commission of JUBAIL & YANBU Industrial City Projects and the solution recommended to avoid so.

2.2- Statement of Problem:

As explained previously discrepancies in the contract documents are to be expected in the construction works.

This kind of discrepancy leads to the contractors right to ask for change order. For that, identifying the discrepancies causes is very important to avoid potential changes in future projects and eliminate the conflict will be occurred due to that during the construction stage which always work against the client benefits.

2.3- Objectives of this Paper Study:

The main objectives of this study is as follows:

- Rank the causes of discrepancies in the contract documents in the Royal Commission of JUBAIL & YANBU projects on the basis of importance.
- Rank the effects of discrepancies.
- Rank the common procedures utilized in the Royal Commission to control or eliminate the discrepancies.

NB: The paper study is limited to the Royal Commission building construction projects in JUBAIL Industrial City executed by local contractors.

2.4- Research Methodology:

The target of the study was to identify the causes and effects resulting in the discrepancies in the contract documents related to Royal Commission of JUBAIL & YANBU and the procedures being utilized to eliminate so. A research of questionnaire was designed and distributed to the Royal Commission building contractors to determine, from their experience, the prevalence of each cause, effect and control. As the contractor has the flexibility to add any cause, effect or control they see it visible to highlight and not mentioned under the questionnaire. At the end the causes, effects and controls were ranked on the basis of their importance.

3- Literature Review

In order to understand the subject of the paper study it has been included this clause that will be describing the components of construction contracts, the specification and its purposes and the different types of contracts.

3.1- Components of Construction Contracts:

The construction contracts are typically drafted by the owner or his representative (consultant) and contain the subject matter and terms and conditions:

- Bid Form
- Agreement Form
- General Conditions or Standard Specifications
- Special Provisions
- Plans (Drawings)
- Addenda

This study will be mainly concentrating for the discrepancies between specs and drawings in particular.

3.2- Drawings:

The drawings show the plans, sections, elevations, wall sections, etc. and are drawn to show all details needed to understand the project for execution purposes and are prepared by engineers. The drawings and specification are the basis for the contractor's project cost and time estimate.

3.3- Specifications:

The specifications are the part of the contract documents that describes and define the quality requirement of the project to be built.

Purpose of Specifications:

- To clarify the thoughts and ideas of the designers and their vision of a complete project to the people who will assist in construction the project.
- To provide a specific document on which legal contract can be based and executed.

Content of the Specification:

The specifications usually consist of general conditions, standard construction provisions and special provisions.

General conditions refer to the basis legal and operating rules under which contractor and agency will work.
Standard construction provisions (Standard Specifications) set forth the

requirements for items commonly used in construction.

Special provisions are used to state modifications, additions or deletions.

One often-misunderstand characteristics of a set of specifications is that it consists of the technical provision or standard specifications only. As it should be clear that the term "specifications" is not necessarily limited to the technical provisions only.

Another often-misunderstand characteristics of a set of specifications is that 'the size of a specifications is in no way related directly to either size or cost of the project'.

Construction Specification Institute of America (CSI) together with the Construction Institute of Canada (CSC) has generated the specification master format.

It contains of 16 divisions and has been developed to contain 49divisions covering all aspects and different disciplines might be occurred in the building construction.

Many international institutes as for example AGA, NSPE, etc have adopted the Specification Master Format.

3.4- Causes, Effects and Controls of Contract Documents Discrepancies:

As mentioned in the previous sections the contract documents of typical construction project consist of the Agreements itself, the General Conditions, Technical Specifications, and Drawings, in addition to the provisions that are covered by reference to other documents. Unfortunately, but it's the real fact contract documents often fail to adequately describe, define or delineate the work to be performed. This generates what we call work disputes.

Many of the Architect-Engineer firms do not repeat the same data on both documents. As for example things shown in technical specifications are not shown in drawings and vise versa. And this is to avoid the conflict might be raised due to changes may be occurred in one of the documents.

As generally well known, in case of any discrepancy between the drawings and technical specification the latest takes the precedence unless stated the opposite.

Conflicts between the various clauses in the specifications are the cause of much trouble in construction work.

As a result of a conflict, it would be possible for a contractor to claim to miss conflict so as to furnish or perform the cheaper, resulting in site work dispute between owner or his representative and the contractor. As any modification from the original design for an activity already executed will be leading to the contractor's right to claim for additional compensation to comply or implements the modifications.

After reviewing the literature, it can be easily ready to summarize and define the study targets and formulate the questions, basically it's requires to investigate three areas, namely, causes, effects and controls and to find out these discrepancies and how it's treated by the Royal Commission building contractors.

3.4.1- Discrepancies Causes:

Below is a list of the major causes of discrepancy in contract documents:

1- Change one document and fail to change the other.
2- Repetition of information in more than one document.
3- Lack of specifics in specifications and sufficient details in drawings.
4- Specifications are not well prepared.
5- Lack of specification writer experience.
6- Human errors.
7- Typographical errors.
8- Lack of coordination.

3.4.2- Discrepancies Effects:

There are numerous effects of discrepancy in contract documents; some of these effects are commonly encountered as listed below:

1- Initiation of a change order.
2- Decrease in productivity.
3- Delay in completion schedule.
4- Dispute between owner and the contractor.
5- Decrease in quality.
6- Increase in project cost.
7- Delay in materials and tools.
8- Work on hold.
9- Increase in overhead expenses.
10- Delay in payment.
11- Demolition and re-work.

3.4.3- Discrepancies Controls:

This item highlights the common control procedures used to minimize the effects of discrepancy in contract document.
Listed as below:

1- Providing adequate budget for specification drafting.
2- Work only with a set of carefully prepared and coordinated front-end document.
3- Qualified specification engineers shall control the sets of

project specifications.

4- Master specification document shall be used to create a set of job specification.

5- Update the master specification at least annually.

6- Legal and construction management personnel shall review changes to documents.

4- Survey Questionnaire

4.1- Questionnaire Design:

The questionnaire design has been set out taking into consideration the study objectives and to highlight the causes, effects and control for the discrepancies occurring in the contract documents related to the Royal Commission contractors, the main target of the case study.

4.1.1- Contents of the Questionnaire:

The questionnaire is divided into five sections:

1- The first section includes instructions to respondent defining the key term in the study and providing respondents with instructions on completing the questionnaire.
2- The second section contains general information about the respondents such as contact address, company size, etc. plus their expertise in the field of construction industry.
3- The third section addresses the causes of discrepancies, by defining a list of major causes.
4- The fourth section addresses the possible effects of discrepancies.
5- And the last fifth section addresses the normally adopted controls of discrepancies.

NB: Samples of the section forms will be seen in the following section of RESULTS AND FINDINGS.

4.1.2- The Statistical Sample:

Two restrictions were imposed on the selection process of respondents:

1- Restricted to Royal Commission, JUBAIL.
2- Restricted to building projects (excluding industrial, highways and other types of construction).

The size of the sample required was determined on the basis of statistical principles for this type of exploratory research. For such research, sample size was determined as follows (Farooq, 1997):

$$No=(PxQ)/V^2 \qquad (1)$$

$$N=No / [1+(No/N')] \qquad (2)$$

Where:
No : First estimate of sample size
P: The proportion of the characteristic being measured in the target population.
Q: Complement of 'P' or '1-P.

V: The maximum standard error allowed.
N: The population size.
N': The sample size.

To maximize N, P is set at 0.5. the target population N is 16 for contractors. To account for more error in qualitative answers of this questionnaire, maximum standard error V is set at 10% or 0.1. Substituting in equations 1 and 2 above, minimum required sample is calculated to be 9.76. This means that minimum sample size is 10.

4.1.3- Gathering Data:

Questionnaires have been carried to the contractors, as the latest to fax back to the researcher after responding to the questionnaire forms. The response was poor and visiting the contractor's site offices, which was the perfect method to collect the data, has followed up another data collecting. After one month there was a response from twelve contractors.

4.1.4- Scoring:

The main sections of the questionnaire on causes, effects and controls use basically an ordinal scale. This ordinal scale does not offer in its qualitative 5-point scale a direct quantitative comparison between its intervals. This scale will be transformed into an interval scale by assigning a weight to each interval. Therefore if we think of intervals from 'NEVER' to 'VERY OFTEN' as an interval scale from zero to 100, this can lead to transformation which will enable carrying out the required parametric statistics.

The questions in section 2 of the questionnaire are either ordinal scale, nominal or ratio scale. Ordinal scale questions will be transformed into interval scale as above. Ratio and interval scale questions will be used directly in the analysis.

No scoring will be used for questions in section 2 of the questionnaire, since this section contains general information and characteristics of the market.

Sections 3, 4 &5 on causes, effect and controls respectively will be scored as follows to come up with an Index to indicate the prevalence:

- **VERY OFTEN = 100**
- **OFTEN = 75**
- **SOMETIMES = 50**
- **SELDOM = 25**
- **NEVER = 0**

Prevalence Index of each causes, effects or controls will be calculated as follows:
IIci=100X1 + 75X2 + 50X3 + 25X4 + 0X5 / (X1+X2+X3+X4+X5)
Where:

IIci	:	Importance Index (C1 denotes cause 1 in this case)
X1	:	Number of respondent answering (VERY OFTEN)
X2	:	Number of respondent answering (OFTEN)
X3	:	Number of respondent answering (SOMETIMES)
X4	:	Number of respondent answering (SELDOM)
X5	:	Number of respondent answering (NEVER)

Causes, effects and controls will be ranked on the basis of their indexes with the first rank assigned to the highest index.

5- Results and Findings

In the analysis of obtained data, the same order used in the questionnaire will be followed. Refer to the previous section concerning the explanation of each of the sections under the questionnaire list.

5.1- General Information and Industry Characteristics:

The distributions of size and level of experience for contractors are shown on below tables' 5.1.1 & 5.1.2. Size of companies are categorized according to the number of employees as follows:

- Very Large (more than 1000 employees)
- Large (between 500 and 1000 employees)
- Medium (between 200 and 500 employees)
- Small (less than 200 employees)

Table 5.1.1: Size of Contractors

No. Of Employees	No. Of Contractors
<200	0
200-500	2
500-1000	6
>1000	4

Table 5.1.1 shows that 83% of the contractors have more than 500 employees and non less than 200 employees.

The level of experience among participating contractors and consultants are classified as follows:

- Very Long (more than 15 years)
- Long (between 10 and 15 years)
- Short (between 5 and 10 years)
- Very Short (less than 5 years)

Table 5.1.2: Contractors Years of Experience

Years of Experience	No. Of Contractors
<5	0
5-10	0
10-15	4
>15	8

Over 66% of the contractors reported over 15 years of experience. None of the contractors participating in the survey has experience less than 5 years.

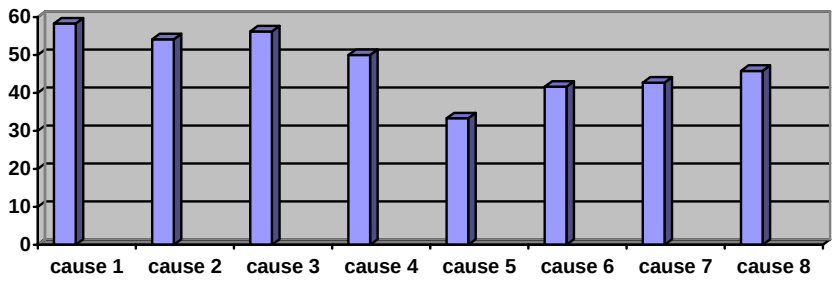
5.2- Causes of Discrepancy:

Table 5.2.1 below lists the results of responses of contractors on the causes of discrepancy:

Table 5.2.1: Prevalence Index (PI) of Causes

Cause of Discrepancy	No. Of Respondent					PI
	Very Often	Often	Some times	Seldom	Never	
1- Changing one document and fail to change other	0	5	6	1	0	58.33
2- Repetition of information in more than one document / drawing	0	4	6	2	0	54.17
3- Lack of specifics in specifications and sufficient details in drawings	1	2	8	1	0	56.25
4- Specifications are not well prepared	0	0	12	0	0	50.00
5- Lack of specifications writer experience	0	0	4	8	0	33.33
6- Human errors	0	0	8	4	0	41.67
7- Typographical errors	0	0	8	4	0	41.76
8- The lack of coordination between contractor and consultant or other contractors	2	1	2	7	0	45.83

The results in table 5.2.1 are depicted graphically (see below). It's apparent that the contractors rank cause no. 1 'changing one document and fail to change the other' as the prime cause of discrepancy in the building construction.



The ranking of the discrepancy causes is as follows:

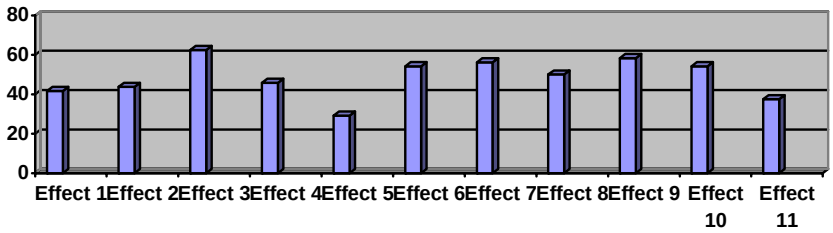
1. Changing one document and fail to change the other.
2. Lack of specifics in specifications and sufficient details in drawings.
3. Repetition of information in more than one document / drawing.
4. Specifications are not well prepared.
5. The lack of coordination between contractor and consultant or other contractors.
6. Human errors.
7. Typographical errors.
8. The lack of specification writer experience.

5.3- Effects of Discrepancy:

Table 5.3.1 below summarizes the results of responses of the contractors participated in the survey on the effect of discrepancy on the building projects.

Table 5.3.1: Prevalence Index (PI) of Effects

Effects of Discrepancy	No. Of Respondent					PI
	Very Often	Often	Some times	Seldom	Never	
1- Initiate a change order	0	2	4	6	0	41.67
2- Decrease in productivity of workers	0	1	7	4	0	43.75
3- Delay in completion schedule	2	4	4	2	0	62.50
4- Disputes between owner and contractor	0	3	4	5	0	45.83
5- Decrease in quality of work	0	0	6	2	4	29.17
6- Increase in cost of project	2	0	8	2	0	54.17
7- Delay of material and tools	4	1	1	6	0	56.25
8- Hold on work in other areas	2	2	2	6	0	50.00
9- Increase in overhead expenses	2	2	6	2	0	58.33
10- Delays in payment	2	2	6	0	2	54.17
11- Demolition and re-work	0	2	4	4	2	37.50



The ranking of discrepancy effects in the building projects listed in the descending order is;

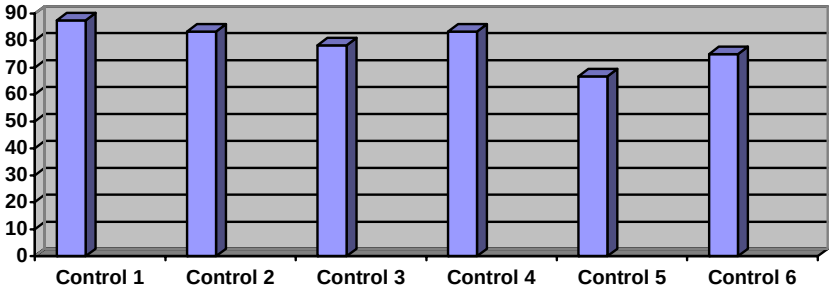
1. Delay incompletion schedule.
2. Increase in overhead expenses.
3. Delay of material and tools.
4. Increase in cost of the project.
5. Delays in payment.
6. Hold on work in other areas.
7. Disputes between owner and contractor.
8. Decrease in productivity of workers.
9. Initiate a change order.
10. Demolition and re-work.
11. Decrease in quality of work.

5.4- Controls of Discrepancy:

Table 5.4.1 shows the summary of the results of survey responses from the contractors participated in the survey.

Table 5.4.1: Prevalence Index (PI) of Controls

Effects of Discrepancy	No. Of Respondent					PI
	Very Often	Often	Some times	Seldom	Never	
1- Provide adequate budget for drafting specifications	8	2	2	0	0	87.50
2- Work only with a set of carefully prepared and coordinated front-end document	6	4	2	0	0	83.33
3- Place the control of each set of project specification in the hands of a single qualified specification engineer.	6	2	4	0	0	79.17
4- Use only a copy of master specification documents to create a set of job specification. Don't use a previous job specification documents.	6	4	2	0	0	83.33
5- Update the master specification at lease annually.	4	2	4	2	0	66.67
6- Project engineers should not edit the front-end documents	6	2	2	2	0	75.00



The ranking of the controls utilized by contractors to safeguard against occurrence of discrepancy or to minimize their impacts if they occur is as follows:

1. Provide adequate budget for drafting specifications.
2. Work only with a set of carefully prepared and coordinated front-end document.
3. Use only a copy of master specification documents to create a set of job specification. Don't use a previous job specification documents.
4. Place the control of each set of project specification in the hands of a single qualified specification engineer.
5. Project engineers should not edit the front-end documents.
6. Update the master specification at least annually.

5.5- Comments from Respondents:

The following comments are made by contractors on the questionnaire forms and are documented here for reference. The comments are documented here as written on the forms with slight correction if necessary.

1. As an additional cause of discrepancy, it has been noticed that the technical specification sections are developed and issued in the early stage of the Royal Commission establishment and are still being included without modifying them. They shall be modified taking into consideration the development of the local industry, manufacturer and other international standards (other than American).
2. Asking for materials that are not in the specification is an additional cause of discrepancy.
3. As an effect of discrepancy, contractor is forced to bear the additional correction effort of the discrepancy.

6- Conclusion and Recommendation

The cause of discrepancies in contract documents and their effects are influenced by numerous interrelated factors. As the objective of this study as stated before is to highlight the cause and effect of such discrepancy and the controls for that, which are adopted by the Royal Commission building projects at JUBAIL Industrial City.

Based on the field survey conducted and the results presented, the following can be concluded:

1- The contractors involved in the Royal Commission are large in size and most of them reported over 15 years of experience.
2- Failing to change of documents when one is changed and the lack of specifics and sufficient details in the specification and drawings are the two main causes of contract documents discrepancy. As lack of specification writer experience is the least important cause.
3- Delay in completion the project schedule and the increase in project overhead expenses is the two main effects for discrepancy. As the decrease in work quality and demolition and re-work scored lower and are less prevalent.
4- Finally providing adequate budget for drafting specifications ranked the first among controls update. As updating the master specification at least annually ranked last.

Based on the findings of this research with the main conclusion listed previously, it's recommended to avoid the repetition of information since it is the common source of errors and contract documents conflict causing. The requirements should not be repeated after it's once stated. Similarly a cross check shall be conducted once there are revisions made in the drawings.

7- References

This term paper has been conducted on the basis of a Master of Engineering Report and presented by Ahmad Said Al-Khamis and dated May 2003.

Noting that, such Masters report has been referred to many resources / references and has been supervised by Dr. Saadi Assaf who has been advised for the questionnaire forms layout and content.

In addition, the questionnaire has been conducted at almost 16 numbers of Royal Commission contractors who have responded properly to the questionnaire forms.