

## IMPACTS OF DISPUTE ON PROJECT COST: CONTRACTORS' PERSPECTIVE

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**ABSTRACT:** This research aims to investigate impacts of construction disputes driven from particular root causes on the project cost faced by Thai contractors. Both qualitative and quantitative research methodologies were employed in order to achieve the study goals. Individual in-depth interview as a qualitative method was used to comprehend dispute evolution and its impact. Factor analysis and relative importance index were respectively used to categorize and quantify priorities. Results show that there are 17 significant root causes. They had been grouped into 3 categories, namely “Project owners’ withholding payment and defective construction documents”, “Contractors’ inadequate and incompetent project staff and workers”, and “Contractors’ inefficient project management”. Ranking of each factor group was then explained according to its important level on the impact of project cost. The category of “Project owners’ withholding payment and defective construction documents” was found to be the most important. After that, discussion and recommendations were asserted to eliminate, minimize, and control the non-value-added costs of the project budget.

*Keywords: Construction disputes, Contractors, Factor analysis, Relative important index*

### 1. INTRODUCTION

Dispute in construction projects is common when project stakeholders fail to manage conflicts driven by their divergent interest, demand, or goal [1], [9], and Thai construction industry is in no exception. It is at present struggling with dispute settlements. Outstanding evidences are demonstrated in Fig 1. Using “construction” as a keyword to search the number of dispute settlement cases from 2005 to 2014 in the website of the Thai Supreme Court, 223 settled cases were listed, and there must be thousands still in the process that are not shown. Default in payment, breach of agreements, and project delay could be listed as the majority of the root causes in construction disputes. The average time spent in resolving these disputes was approx. 8 years. This implies that the Thai construction industry is currently suffering from chronic disputes. Reported damage to each of some 81 settled cases is more than one million bath; litigation costs and expenses not inclusive. Unsettled cases could not be quantified due to inaccessibility and confidentiality.

Contractors - responsible for the performance of all work in accordance to the contract documents [2] and liable to the work of subcontractors [3] - are subject to massive pressures in terms of quality, service, and cost [4], and are challenged to prevent and resolve disputes. This is because they hold a relatively weaker position in the construction industry comparing to that of the project owner [1].

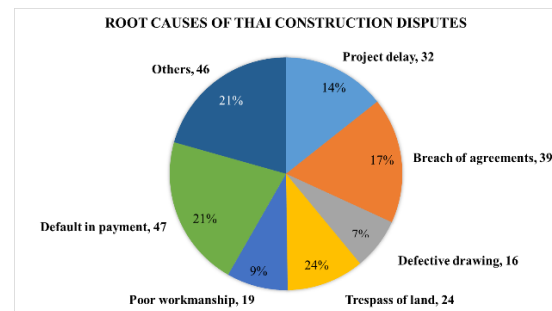


Fig.1 Cases and share of major root causes of dispute in Thai construction industry

Under complex and competitive working environments [5], they initially have to pay for work and materials. In addition, when they face disputes, their reputation is often dented [1], [6]. Their standing in bidding competitiveness is then lowered. This includes losing future venture with other parties [1]. Consequently, contractors are one of the most vulnerable stakeholders in the construction industry.

There are several researches on the root causes of dispute and conflict [5] – [7]. Some indicated that contractors are classified as a source of dispute or conflict. A few specified conflict/dispute root causes that affect contractors’ sustainability despite the fact that contractors are the major stakeholder to deliver standard performance of the project in order to satisfy the project owners and also to pass benefits to subcontractors.

This study aimed to investigate what dispute

root causes bring about the contractors' project cost increment based on contractors' perspective. Evolution of dispute and its impacts on the project cost that affect the contractors' capital venture were also prioritized.

## 2. LITERATURE REVIEW

### 2.1 Evolution of Conflict and Dispute in Construction Project

Conflict and dispute are two distinct notations though they have been interchangeably used, particularly in the construction industry [5], [7]. A logical framework [7] is quoted here to explain these two words; their relationship and distinction are shown in Fig. 2.

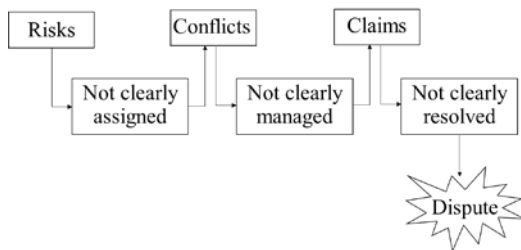


Fig.2 Risk, conflict, claim and dispute continuum model [7]

A conflict is derived from many factors which could be known or unknown at the start of the project and the consequences of their occurrence impose a negative effect on the project. These factors are called risks. When risks are inappropriately or unclearly resolved, they transform into conflict [7]. Moreover, conflicts can arise over the distribution of resources, access to information, disagreement about decisions, or interpretation by an individual [2]. A conflict is any action or circumstance resulting from incompatible or opposing needs [8]. In addition, a conflict exists wherever there is incompatibility of interest [5], [7], and therefore is a disease [7]. However, for their work, conflict means a serious difference between two or more beliefs, ideas, or interests [7].

A claim is a disagreement as an extension of conflict [7] and is a legitimate request by a construction party to another party for compensation over and above the agreed-upon contract amount for extra work or damages that may have resulted from events that are not included in the initial contract [8], [9]. This compensation composes of time and money, or both [9]. In other words, a claim presents the causes and effects, explains the contractual and legal basis for payment (entitlement), and quantifies the resulting damages [12]. A dispute is a result from a conflict that is unable to be managed [1], [5], [7] and the claim that

is totally or partly denied [9]. Disagreement, extended from a conflict and developed into a claim, is difficult to interpret and is affected by a number of interrelated factors [9]. As a result, a dispute is associated with distinct justiciable issues [5], [7]. The need of a final determination is unavoidable and requires intervention of a third party [8].

Consequences of dispute result in a decline in project productivity and delay [6] - [9], create non-value-added cost to the project [1], [8], ruin business relationship between the parties [9], lose future cooperation with the other parties [1] and incur the company notoriety [1], [6]. Some root causes of dispute or claim or conflict are represented in Table 1. These root causes are classified in a conventional manner according to the sources of disputes. Their consequences have an impact on project stakeholders' sustainability because competitiveness of a project organizations depends on its ability in conflict management and dispute resolution.

The objectives of this study were to investigate dispute root causes that bring about project cost increment based on contractors' perspective, and to prioritize disputes that impact on the project cost affecting the contractors' capital venture. Reasons of incurring conflicts, disputes, and claims having an effect on contractors' performance were studied.

### 2.2 Contractors' Role, Responsibility, Duty

A construction project is implemented by various stakeholders having divergent interests, demands, or goals [1], [6]. They, having different views, talents, and levels of knowledge of the construction process, they work together [5]. In studies of construction dispute/conflict or other related issues, most researchers agree that main stakeholders of construction projects compose of contractors, owners, and consultants or Architect/Engineer (A/E) designers [1], [7], [10] - [12], [14]. Among the stakeholders, it is found that contractors hold a relatively weaker position comparing to the project owners [1] despite the fact that they are responsible for the performance of all works in accordance with the contract documents [2].

The role of the traditional contractor has been regarded as "the guy who comes along with men and machines and, for a price against a set of specifications and drawings, offers to build the structure (bridge, dock, building, whatever) that is required." The contractor is employed on a fee basis and uses his skills and knowledge to the client's advantage. The contractors' role in the construction process is therefore crucial to its success from time, cost and quality considerations. However, a contractor's interest in giving high quality construction is always tempered by the commercial

Table 1 A summary of dispute root causes

Cakmak and Cakmak [5]	Cheng et al. [6]	Acharya et al. [7]
<b>1. Owner related</b>	<b>1. Caused by owner</b>	<b>1. Owner evoked conflict</b>
1.1 Variations initiated by the owner	1.1 Unclear tender document	1.1 Confusing requirement of owner
1.2 Change of scope	1.2 Unclear blueprint	1.2 Excessive change order
1.3 Acceleration	1.3 Tender Qualification process	1.3 Supremacy of owner/consultant
1.4 Unrealistic expectations	1.4 Tender decision	1.4 Project scope definition not clear
1.5 Payment delay	1.5 Land not available on schedule	1.5 Site access delay
<b>2. Contractor related</b>	1.6 Inspection delay	1.6 Financial failure of owner
2.1 Delays in work progress	1.7 Co-operation delay	1.7 Lack of space in construction site
2.2 Time extensions	1.8 Pipeline re-location	1.8 Unbalanced risks
2.3 Finance failure of the contractor	1.9 Contract terminated unilaterally	1.9 Owner furnished material
2.4 Technical inadequacy of the contractor	1.10 Site ambit changed	1.10 Delay in decision by owner
2.5 Tendering	1.11 Advance use	1.11 Late handover of construction site
2.6 Quality of works	1.12 Payment dispute	1.12 Owner-furnished Equipment
<b>3. Design related</b>	1.13 Payment delay	1.13 Delay in running bill payment
3.1 Design error	1.14 Doubt about related laws	<b>2. Consultant evoked conflict</b>
3.2 Inadequate/incomplete specification	1.15 Contract time dispute	2.1 Defective design
3.3 Quality of design	1.16 Construction acceleration	2.2 Errors and omission in design
3.4 Availability of information	1.17 Quality identification	2.3 Excessive extra work
<b>4. Contract related</b>	1.18 Inspection disputes	2.4 Differing site condition
4.1 Ambiguities in contract document	1.19 Unreasonable limitation	2.5 Excessive quantity variation
4.2 Different interpretations of the contract provision	1.20 Unclear contract content	2.6 Specification related
4.3 Risk allocation	<b>2. Caused by general contractors</b>	<b>3. Contractor evoked conflict</b>
4.4 Other contract problem	2.1 Unsuitable illustration	3.1 Financial failure of contractor
<b>5. Human behavior related</b>	2.2 Down tick tender	3.2 Slow work for contractor
5.1 Adversarial / controversial culture	2.3 Collusive tender	3.3 Incompetent contractor
5.2 Lack of communication	2.4 Delayed contract time	3.4 Major defect in maintenance
5.3 Lack of team spirit	2.5 Tender decision process	3.5 Local people interruption/protests
	<b>3. Caused by both parties</b>	
	3.1 Related laws	
	3.2 Default on contract	
	3.3 Payment dispute	
	3.4 Contract time delay	
	3.5 Compensation responsibility	

Table 1 A summary of dispute root causes (Cont'd)

Cakmak and Cakmak [5]	Cheng et al. [6]	Acharya et al. [7]
<b>6. Project related</b>	3.6 Unclear tender documentation	3.6 Subcontractor inefficiency
6.1 Site conditions	<b>4. Caused by acts of God</b>	3.7 Non-payment to subcontractor
6.2 Unforeseen change		3.8 Mentality of contractor
<b>7. External factors</b>	4.1 Tender decision process	3.9 Defective construction (quality)
7.1 Weather	4.2 Quality identification	<b>4. Third party evoked conflict</b>
7.2 Legal and economic factors	4.3 Related laws	
7.3 Fragmented structure of the sector	4.4 Severe weather	
	4.5 Unanticipated site condition	
	4.6 Unanticipated	
	4.7 Rising cost index	
	4.8 Policy change human factor	4.1 Change in government code
		4.2 Labor disputes/ union strike
		4.3 Adverse weather/Acts of god
		4.4 Market Inflation
		4.5 Public disorder
		4.6 Third party delay

pressures of winning work, carrying it out and making a return for the company shareholders [13].

The construction contractor is responsible for continually transfers the risks to the contractors [7]. Therefore, his duty is to perform the construction work according to relevant technical, management, and construction specifications [14]. He also initially has to pay for work and materials and is still liable for the work of the subcontractor [3] subject to massive pressures in terms of quality, service, and cost [4] under the dynamic nature of the construction project environment [2] as well as complex and competitive high-risk business [5], [11] – [12].

Under the energetic, multiparty, complicated and competitive high-risk business [5], [11] – [12], conflict and dispute are inevitable [1], [5], [7] – [10]. The conflict and dispute deteriorate hospitality between the project owner and contractor, damage the contractor’s reputation and the contractor’s bidding competitive [1]. This includes project delay, project cost overrun and defective work. Moreover, the contractor loses the opportunity to reinvest since his capital venture is suspended for dispute resolution [1] [6], [8]. Consequently, the contractors were one of the most vulnerable stakeholders in the construction industry.

### 3. RESEARCH METHODOLOGY

To accomplish the study objectives of investigating of dispute root causes that bring about

the performance of all work in accordance with the contract documents [2] since owner or consultant

project cost increment based on the contractors’ perspective and prioritizing disputes impact on the project cost affecting the contractors’ capital venture, intensive literature reviews that involve dispute, claim, and conflict in the construction industry, together with rigorous scrutiny of Thai construct dispute cases found in the Thai Supreme Court website were conducted. These reviews and scrutiny aimed to arouse awareness and to develop questions for the semi-structured in-depth interview (IDI) methodology. Proliferous information were gathered from key informants and the IDI protocol was created in order to overcome the research reliability [15].

Four project contractors with more than 10-year experience in the construction industry were then invited to detail their experiences, attitude, and perception toward causes of disputes and conflicts in construction projects. Time spent on each interviewee was around 1-2 hours. Information gathered from literature review, from the Thai Supreme Court, and from the IDI were subsequently examined. This examination aimed to eradicate redundancy of those root causes of dispute, conflict, and claim. Eventually, 36 root causes were listed.

After that, 16 professionals comprised 4 owners, 4 contractors, 4 academicians, and 4 consultants were invited to validate the given contents of those

causes. These professionals have had at least 10-year experience or knowledge in the related industry, and are in a separate group from those of the IDI panel.

For the overall complete research project, each of academician and consultant was given two sets of questionnaire. Each person was requested to do one set, role-playing himself/herself as a project owner; and another set, role-playing as a contractor. This is because academicians and consultants normally can work as representatives of either the project owner or the contractor. For the actual project owner and the contractor, each was given a single set of questionnaire to answer as himself/herself. The rationale of this research design is that some root causes of conflicts/disputes are bias in nature. For example, the cause of "owners' default in payment" is often waived if it is evaluated by the project owners because they would normally deny them.

In this research, however, with the goals to investigate the *contractors'* root causes affecting their project cost, all opinion expressed by the project owners and those role-playing as owners were not taken into consideration in the data analysis; only those of the contractors, the academicians and the consultants as contractors, were.

Those professionals were requested to validate the content of dispute root causes by rating only -1, 0, or 1 to each of the items on the list. A rating of -1 means "I have never encountered this issue", 0 means "I have encountered this issue but it did not have an effect", and 1 means "I have encountered this issue and it had had an impact." This principle of content validation is basically applied to calculate the agreement percentage among judgment of experts since it does not account for contribution of coincidental arrangements. The percentage represents the significance level of each item based on the professionals' standpoint [16]. Once the agreement percentage of each item was calculated, only agreement percentages of the lists ranging from 50% upwards were selected in order to develop a research questionnaire as a tool of survey research approach. As a result, only 17 dispute root causes were chosen. Since this research is only a part of the study of root causes of construction disputes in Thailand [17], root causes that were excluded before from this study were appended to the questionnaire in order to investigate and to better understand the contractors' perception according to particular root causes.

After that, the questionnaire, as a tool to collect data in the survey research methodology method, was randomly sent to some 300 contractor firms. The list of contractor firms was gathered from the Thai contractor website.

Each questionnaire consists of four sections, as follows:

- In the first part, the questions are related to respondents' profiles such as age, position, education, workplace, types of project, and so on.
- In the second part, questions are related to the frequency of validated dispute root cause occurrence and their impacts on the project cost. For the frequency, respondents were asked to rate against a five-level Likert Scale as follows: 1 = never happened, 2 = rarely happened, 3 = sometimes, 4 = often, and 5 = frequently. For impacts of dispute root causes on the project cost, respondents were also asked to rate against a five-level Likert Scale as follows: 1 = having an impact on the project value less than 5 %, 2 = having an impact on the project value between 5-10%, 3 = having an impact on the project value between 10-15%, 4 = having an impact on the project value between 15-25%, and 5 = having an impact on the project value more than 25%.
- In the third part, questions are related to preferred construction dispute resolution based on validated dispute root causes.
- In the fourth and final part, open-ended questions were asked on the respondents' opinion, best-practice experiences, and suggestions to prevent, to minimize, and to resolve disputes.

After that, the questionnaires were subjected to peer evaluation and then tested in terms of internal consistency or reliability by using Cronbach's alpha ( $\alpha$ ) function in the Statistical Package for the Social Sciences (SPSS) version 17.00. The result yields an  $\alpha$  value of the impacts of root causes of 0.939. The questionnaire was considered satisfactory since the  $\alpha$  value was more than 0.7 [18].

Factor analysis and relative importance index (RII) techniques were employed in this study. Both these techniques are normally used in the field of construction studies. For example, factor analysis technique has been used in researches related to transaction cost of dispute [1], critical success factors [11], and relationship between key stakeholders [14] in the construction industry. The rationale to the use of this technique is "to identify a relatively small number of factors that can be used to represent relationships among sets of many interrelated variables" [11]. RII technique have been used for study in the field of construction in order to rank the importance of interested topics [5, 19, 20, 21]. The rationale of RII technique, used in our study, is to determine the rank of fundamental issues [19]. Factor analysis was applied to categorize the root causes which were ranked in accordance to the RII.

#### 4. DATA ANALYSIS AND RESULTS

In our survey, 69 questionnaires were responded. The respondents' profiles in terms of experience and position are illustrated in Table 2. Most of the respondents ( 87% ) are engineers, project managers, project directors, and managing directors who are directly managing, inspecting and supervising their projects. More than half (55%) of the respondents had more than 10-year experiences in construction work. The quality of data and results gathered was deemed reliable and trustworthy to attain the research goals.

Table 2 Sample characteristics

Characteristics	Number	%
<b>Years of working experience</b>		
Less than 10 years	31	45%
11-20 years	14	20%
21-30 years	14	20%
30 years upwards	10	14%
Total	69	100%
<b>Positions</b>		
Engineer	30	45%
Project Manager	13	19%
Project Director	2	3%
Supporting Project Manager	2	3%
Managing Director	10	15%
Supervisor	1	1%
Head of Construction Supervision	0	0%
Procurement committee	0	0%
Others	9	13%
<b>Total</b>	<b>67</b>	<b>100%</b>

##### 4.1 Factor Analysis

Factor analysis was conducted using SPSS version 17.00. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett test of sphericity to evaluate applicability of the data were firstly investigated. The KMO value was 0.853, higher than the threshold value of 0.5 [1], and the Bartlett test of sphericity result was 633.364 with significance of 0.000. Therefore, the data were appropriate to be applied with the factor analysis technique. The extraction method of principal axis factoring with Varimax rotation was used. The results indicated that the three factors were able to explain 69.81 % of the variance with shares of 23.66%, 23.17%, and 22.98% respectively. All of these loading values were greater than 0.5. These loading value and interpretation of the factors extracted were considered reasonably consistent

[11]. The final factor loading matrix are shown in Table 3. According to meanings of root causes categorized to be factors, factor 1 was designated the 'Project owner's withholding payment and defective construction documents'; factor 2, the 'Contractors' inadequate and incompetent project staff and workers'; and factor 3, the 'Contractors' inefficient project management'.

##### 4.1.1 Factor 1: Project owners' withholding payment and defective construction documents

Factor 1 comprises "Owners' payment delay", "Owners' change order with no compensation", "Owners' default in payment", "Project delay and cost overrun due to defective drawing", and "Inappropriate construction method affecting nearby building."

A project owner is responsible for the setting up of operational criteria for the entire project and other parameters on total cost, payment of cost, major milestones, and the project completion date [3]. Owner's withholding payment or compensation has a huge effect to the contractors in terms of project cash flow. They would have to slow down their progress and dedicate their resources to other projects since they could not be sure that expenditures of the project would be paid. Consequently, the contractors would suffer from the dilemma of liquidated damages driven from project delay and unrecovered expenditures.

In traditional Thai construction contract, the owner, moreover, would provide drawings and construction method descriptions in specifications developed by A/E designers as parts of the contract documents [22]. If the drawings are not clear, solutions to the problems of constructability and consistency would require the owners' decision. Request for approval (RFA) and request for information (RFI) procedures take time. Furthermore, contractors committed to specified construction method often feel the pain from consequences. Site conditions related to natural surroundings and laws affecting project neighborhood could have been overlooked or neglected from the owners' designer team. In a worst case, the project could be suspended. These are some of the results the contractors have to face beyond the construction documents.

##### 4.1.2 Factor 2: Contractors' inadequate and incompetent project staff and workers

Factor 2 comprises "Contractors' lack of project staff and workers", "Time extension due to weather", "Disparity of quality acceptance", "Ineffective communication resulting in misunderstanding", and "Contractors' lack of quality supervision".

The Thai construction industry is currently facing a labor shortage, since fertility is declining

while aging dependency is increasing [24]. Furthermore, contractors have to work in a very dynamic, competitive and high risk business. Underbidding and multilevel subcontractors force

operating contractors and supervisors to stringently control the cost. Having inadequate and naive supervisors would often result in substandard

Table 3 Factor analysis of the variables

Root causes of dispute	Factor		
	1*	2**	3***
Owners' payment delay	0.901		
Owners' change order with no compensation	0.818		
Owners' default in payment	0.802		
Project delay and cost overrun due to defective drawing	0.696		
Inappropriate construction method affecting nearby buildings	0.600		
Contractors' lack of project staff and workers		0.868	
Time extension due to weather		0.797	
Disparity of quality acceptance		0.705	
Ineffective communication resulting in misunderstanding		0.614	
Contractors' lack of quality supervision		0.563	
Construction materials against specification			0.863
Project delay due to delay in work progress			0.748
Disparity of contractual interpretation			0.704
Substandard quality performance resulting in reworking			0.585
Delay in construction materials and equipment delivery			0.543
Contractors' lack of progress report			0.541
Project time due to mechanical, electrical and plumbing (MEP) works			0.528

Note: \* Project owner's withholding payment and defective construction documents.  
 \*\* Contractor's inadequate and incompetent project staff and workers.  
 \*\*\* Contractor's inefficient project management.

performance and inability to timely handle negative effects of weather and not to mention comprehending owners' requirements. As a result, owners' requirements are either not effectively fulfilled or they would have to experience poor work quality. Contractors are also liable to their previous projects from burden overloading on experienced supervisors and/or lack of skills from green supervisors, and hence their performance. In short, problems relating to contractors' inadequate and incompetent staff coupled with poor communication in the construction industry have frequently resulted in poor work quality.

4.1.3 Factor 3: Contractors' inefficient project management

Factor 3 comprises of "Construction materials against specification", "Project delay due to delay in work progress", "Disparity of contractual interpretation", "Substandard quality performance resulting in reworking", "Delay in construction materials and equipment delivery" "Contractors' lack of progress report" and "Project delay due to Mechanical, Electrical, and Plumbing (MEP) works."

This third factor could actually arise from

consequences of the first two factors. Lack of project cash flow and contractors' insufficient/incompetent staff brings about ineffectiveness of contractors' project management and delay in construction materials and equipment delivery and delay in work progress are driven by project owners' withholding payment. Problems of material management and equipment allocation lead to project delays [22]. Project time delay due to MEP works is often a result from defective construction documents and contractors' insufficient/incompetent staff. In addition, the contractors' insufficient/incompetent staff leads to substandard quality performance resulting in reworking, construction materials against specification, disparity of contractual interpretation, and eventually the contractors' lack of progress report due to project schedule pressure.

4.2 Relative Importance Index (RII)

The RII technique was employed following the use of factor analysis. Results of RII calculation are tabulated in Table 4. Calculation of a weighted average (W) for each type of the root causes, for a start, is as follow:

$$\text{Weighted Average} = \sum(Wi \times Xi)/N \quad (1)$$

Where *Wi* is the weight assigned to the *ith* issue; *Xi*, the number of respondents who select the *ith* issue; and *N*, the total number of respondents in each issue.

The RII, subsequently derived, is computed as follow:

$$RII = \text{Weighted Average}/5 \quad (2)$$

Where 5 is the maximum rating possible.

A calculation example, for the owners' payment

delay in Table 4, is thus the weighted average equals  $(1 \times 14 + 2 \times 16 + 3 \times 11 + 4 \times 9 + 5 \times 7)/57 = 2.63$ . RII for this root cause is thus  $2.63/5 = 0.53$ . Ranking, for this particular root cause – which is 4 in the last column, is obtained after all RII values for all root causes are listed in descending order.

RII values based on impact on the project from Table 4 was categorized and grouped according to results from factor analysis. An average was calculated from each group, and sorted again in descending order. The final outcome is detailed in Table 5.

Table 4 Frequency of each root cause of disputes based on impact on the project, together with associated RII and Ranking

Root cause of dispute	Impact on the project (% of project value)					RII	Ranking
	1 (<5%)	2 (5-10%)	3 (10-15%)	4 (15-25%)	5 (>25%)		
Owners' payment delay	14	16	11	9	7	0.53	4
Owners' change order with no compensation	13	13	16	6	9	0.55	2
Owners' default in payment	22	9	11	7	8	0.49	9
Project time delay and cost overrun due to defective drawing	9	18	13	10	8	0.57	1
Inappropriate construction method affecting nearby buildings	20	14	12	7	4	0.46	14
Contractors' lack of project staff and workers	17	12	13	15	5	0.53	4
Time extension due to weather	17	21	14	4	5	0.47	11
Disparity of quality acceptance	19	16	13	10	5	0.49	9
Ineffective communication resulting in misunderstanding	18	13	12	6	12	0.54	3
Contractors' lack of quality supervision	20	17	5	10	5	0.47	11
Construction materials against specification	22	13	16	7	4	0.46	14
Project time delay due to delay in work progress	17	10	18	12	4	0.52	7
Disparity of contractual interpretation	19	14	14	7	4	0.47	11
Substandard quality performance resulting in reworking	18	15	12	9	7	0.51	8
Delay in construction materials and equipment delivery	20	19	11	9	3	0.46	14
Contractors' lack of progress report	25	16	11	5	2	0.41	17
Project time delay due to MEP works	12	17	16	4	9	0.53	4

Table 5 Relative importance index of dispute root cause based on the project impact by category

Main Category	Average RII of the category	Root causes of dispute	RII of each root cause of dispute based on the project impact
Project owners' withholding payment and defective construction documents	0.52	Owners' payment delay	0.53
		Owners' change order with no compensation	0.55
		Owners' default in payment	0.49
		Project time delay and cost overrun due to defective drawing	0.57
		Inappropriate construction method affecting nearby buildings	0.46
Contractors' inadequate and incompetent project staff and workers	0.50	Contractors' lack of project staff and workers	0.53
		Time extension due to weather	0.47
		Disparity of quality acceptance	0.49
		Ineffective communication resulting in misunderstanding	0.54
		Contractors' lack of quality supervision	0.47
Contractors' inefficient project management	0.48	Construction materials against specification	0.46
		Project time delay due to delay in work progress	0.52
		Disparity of contractual interpretation	0.47
		Substandard quality performance resulting in reworking	0.51
		Delay in construction materials and equipment delivery	0.46
		Contractors' lack of progress report	0.41
		Project time delay due to MEP works	0.53

It is not surprising from the Table that, in contractors' perspective, high negative impacts on the projects are driven from the project owners. The highest average RII value of 0.52 was found in the main categories of "Project owners' withholding payment and defective construction documents", followed by 0.50 for "Contractors' inadequate and incompetent project staff and workers", and 0.48 for "Contractors' inefficient project management". It is worth noting here that within the highest average RII group, lay the first ranking (Project

time delay and cost overrun due to defective drawings), the second ranking (Owners' change order with no compensation), and the fourth ranking (Owner's payment delay). Moreover, the root cause of "Project time delay due to MEP works" in the main category of "Contractors' inefficient project management", which is partly driven by the defective drawings, ranked fourth as well. In short, in a contractor's viewpoint, major root causes of disputes/conflicts are due to the project owner's faults.

## 5. DISCUSSION

According to the research finding, contractors perceived the project owners as the major root cause of dispute/conflict; that project owners' requirements were not practical, and that they pressured contractors to speed up project progress under unclear drawings and impracticable construction method (s) provided by the A/E designers directly contracted with the owners. In addition, owners often issued verbal orders with no mention of accepted standard performance of the change and compensation in terms of time extension and costs. As a result, the progress payment milestone was perceived by the contractors that it is too far to attain. Delay in payment was thus inevitable. Furthermore, in some circumstance, owners were unable to pay for work immediately after they have approved the work progress since they had to inform and request for progress payment from their creditors.

According to the main category of "Project owners' withholding payment and defective construction documents", the RII value of the subcategory of "Project delay and cost overrun due to defective drawing" was highest, at 0.57. Factors involving owner's payment were outstandingly important under this main category, as shown in Table 3. The result implied that unclear drawings are the hidden variables leading to the project owners' withholding their payment. Owners, however, perceived that the certain works based on project milestone were not properly completed or had varied from what they had expected.

Besides Thailand, the dispute/conflict/claim root cause of "Owners' payment delay and defective drawings" have also been reported in Turkey [5], Taiwan [6], and the United Arab Emirates (UAE) [20]. As for Thailand, incomplete drawings had resulted in a certain project delay of 75% of the contract schedule [22], and were listed as the second rank in influencing Thai construction productivity [21]. Impracticable construction method affecting to the neighborhood, moreover, had resulted in a total work stoppage [22].

Since delay would mean losses of revenue for the owners if a Commercial Operation Date (COD) is to be postponed, when certain contractors in China were not paid, they slowed down the progress of their work in order to pressure the project owners [1]. To prevent disputes/conflicts driven by the owners' delay in payment and non-compensation, regular consultations and responsiveness to the project owners or their representatives are necessary. In addition, rigorous site condition investigations before a contract should be a must. Under a principle of fair risk sharing, change order and compensation clauses in contract documents should be specified in terms of scope of work,

schedule, measurement method of work performance, and RFA/RFI periods.

The issue of incomplete drawings in Thailand was mentioned since 1996 [22], this trend is still continuing in the construction industry. Therefore, during the construction phase, shop-drawing and modeling of complicated construction buildings should be implemented and examined by contractors in terms of consistency and constructability in advance and approved by the project owners' technical representative(s). These implementation, examination, and approval are aimed to protect disparity of quality acceptance between the owners and the contractors as well as misunderstanding, due to ineffective communication, even if regular consultation and being responsive are implemented. This disparity is driven from design error. These kind of models could be better visualized and explained, comparing to a verbal and written messages.

Contractor related disputes are common in the construction industry [5]. Substandard performance and defective materials directly result in reworks. Delay, or lack of progress in reporting has a marked effect on reworks as well. Some project owners, or their representatives, only occasionally inspect works according to progress reports. The slower a progress report, the more defective works could crop up. Moreover, the more the rework, the more the time and budgets are required. Reworks result from not only incomplete drawings, but also incompetent craftsmen and supervisors. Inability to understand drawings, lack of experiences and skills, specification negligence, cost-saving orientation, overconfidence, and over workloads are derived from incompetent craftsmen and supervisors. Furthermore, the incompetent supervisors are usually negligent on construction material against specification, delay in work progress and construction resource delivery, and delay due to MEP works.

Contractors' inadequate and incompetent project staff and workers in the Thai construction industry has also been mentioned since 1996 [22]. Although rationales of project staff and workers' inadequacy and incompetence were changed, these adequacy and incompetence still exist and tend to continue. In this case, contractors should learn and utilize advanced construction technology in order to resolve these situations. For example, an application on prefabrication could reduce staff and worker involvements, improves the quality of work, and increase the project productivity.

In addition, a project manager/project leader and a project team with knowledge, experience, and expertise should be recruited as it is essential for the project success [24]. Under bidding award criterion based on the lowest price, contractors are automatically enforced to rigorously control the

project cost including the number of staff. Lessening of the number of foremen has been employed in order to decrease expenses [21]. Nevertheless, the costs of rework, the inability to handle with day-by-day problems, liquidated damage due to project delay, and the opportunity cost of contractors' capital venture suspension are usually higher than human resource cost saving. Recruiting competent project manager, hiring independent engineers for special works, and in-house training by learning-by-doing for green staff could prevent the contractors from the dispute root cause of negative project schedule variation and substandard performance.

## 6. CONCLUSIONS

Disputes in the construction industry are unavoidable since project stakeholders have divergent interests, demands, or goals. Contractors, having to pay in advance for work and materials and being responsible for the performance of all works in accordance to the contract documents under a complex and competitive working environment, are one of the most vulnerable stakeholders resulting from disputes.

This study has aimed to investigate, based on the contractors' perspective, what dispute root causes have brought about the increase in the contractors' project cost. Evolution of disputes, and their impacts on the project cost affecting the contractors' capital venture have been prioritized. Individual in-depth interview (IDI) and content validity through an approach on agreement percentage among expert judgment were used in order to understand and select the significant root causes based on the contractors' viewpoints.

Factor analysis and relative importance index (RII) were then applied in order to respectively categorize and prioritize those causes. Results show that there are 17 significant root causes that had been categorized into 3 groups, namely "Project owners' withholding payment and defective construction documents", "Contractors' inadequate and incompetent project staff and workers", and "Contractors' inefficient project management".

The main category of the first group was found to be the most imperative group since it imposed the most negative impact to the contractors' project cost. These root causes of disputes based on these main categories could be prevented and mitigated through human resource management methods such as proper recruitment, on-the-job training, outsourcing of specialists, clear drawings, and regular communication between the contractors and the project owners in order to achieve the project goals.

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