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Factors Contributing to Cost Escalation and Delay of Public-Private Partnership Projects in Maldives Construction Industry

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Abstract: The purpose of the research is to identify the factors that contributes to cost escalation and delay of PPP construction projects in Maldives and to identify the significant factors in the perspective of the actors (client, contractor and consultant). In this quantitative research, a survey comprising the actors who have had previous experience in the field of PPP construction projects were used. The data analysis was carried out using Relative and Important Index (RII). The key findings indicate that the most significant factor for cost escalation is scope changes, followed by schedule delay and technical challenges and the most significant factor for project delay was delayed payments, followed by financial process, changes in drawings and poor supervision. The study contributes to the body of knowledge in construction industry by identifying the most significant factor which contributes to cost escalation and project delay in Maldives. The study is particularly useful for policymakers as a guide for planning and implementing PPP projects in the construction industry of Maldives.

Keywords: Public-Private Partnership, Actor-Network Theory, Cost escalation, Project delay

INTRODUCTION

It is known that the construction sector contributes to a major percentage of an economy, more so in developing countries. In Maldives, a country known with its economy vastly dependent on the fishing and tourism industry [1], the role played by construction industry have been on a growth trajectory in the past 3 years and have significantly brought about development to the economy of the country [2] [3]. The factors which lead to growth of this sector includes large scale public infrastructure projects, development of islands, rapid urbanisation, changes in land regulations and introduction of housing financial schemes [2]. The development projects which is financed by bilateral and multilateral donors have also increased in the past years especially with the increase of massive reconstruction projects after the 2004 tsunami crisis [2] [4].

The main objective of the Maldivian government's construction projects is to support the people who migrate from small islands to Male' city, the capital of Maldives [5]. Most of the construction projects of Maldives are managed by Ministry of Housing and Infrastructure (MHI) and these projects are frequently handed over to private companies or public limited companies who act as contractors. It is evident from the annual records of MHI that most of the projects face delay or cost escalation, though the reasons are ambiguous. Delay and cost overrun are an increasing concern in the construction industry, notably in the developing countries [6] [7]. Many government construction projects, in Maldives were speculated to not only have various capacity constraints and but had difficulties meeting the required budget and schedule [2].

The current limited research papers on construction projects especially researches which addresses issues in PPP projects exacerbates the situation. There are no published papers on construction projects of Maldives which ascribes issues such as cost escalation and project delay. Hence, this research focuses on the PPP construction projects in Maldives, such as projects on road development, revetment, harbour, dredging and others that are mainly managed by MHI, specifically examining the factors that contribute to cost escalation and delay in PPP projects. The objectives of the research are (1) To identify the factors which contributes to cost escalation; (2) To identify factors which contributes to schedule delay; and (3) To identify the most significant factors based on actor's perspective.

In the researcher's effort to substantiate the findings, this research would be analysed using the rich picture Actor Network Theory (ANT) as ANT allows to

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describe the scientific claims and socio-technical claims by considering the interactions of human and non-human actors.

LITERATURE REVIEWS

Public Private Partnership (PPP) refers to a situation where public and private sector merge to provide a public service to contribute expertise and resources as well as share the risks, relationships and financings [8] [9]. It is about how a government works to bring solution to the financial issues in providing public facilities and services by working together with the private management to increase efficiency, effectiveness and quality of delivery [10]. PPP is especially used in managing infrastructure projects which requires huge investment and habitually becomes a burden for the government [11] [12]. It is a challenge to manage government projects as most of the time they are faced with multiple risks which are inclined to have extended durations, cost escalation, multiple stakeholders and different uncertainties. In numerous instances around the world, government projects are extended for years, which have resulted in failure to meet the main objective whilst wasting tax payers' money or worse still, led to termination of projects [13]. PPP is increasing in popularity especially in the infrastructure development and is adopted by many developed and developing economies such Pakistan, India, Nepal, Latin America and African countries like Nigeria, Ghana, Mauritius, Mozambique, South Africa and Egypt [8] [14]. Advantages of PPP is that it can save resources and utilize government assets, data and intellectual property more productively which can bring improvement in the quality of public facilities and services. However, there are also cases of cost overruns, unrealistic price and income projections and legal disputes between private operators and the government [15].

The construction industry of Maldives has developed 17.1 percent in the year 2016 [3] [16] and the growth of construction industry is predominantly driven from government ongoing mega projects for infrastructure development of the country, such as China-Maldives friendship bridge. Despite the rapid growth, the industry faces some setbacks resulting from the challenging business environment that hinders its growth. Some of the major hindrances cited include budget constraints on government infrastructure projects, price increment of construction raw materials due to fluctuations in global price, payment delays for contractors, difficulties to obtain finance, constraints in getting foreign exchange from formal banking sector and shortage in skilled staffs [2]. One of the key challenges faced by the government projects in Maldives is the delay in getting payments, which then leads to project delay and halts supplying construction materials on credit.

Cost escalations in projects

Cost escalation refers to the increment in the actual financial budget required to construct a project which happens when the actual cost exceeds the estimated cost value. Cost has an essential relationship with time, quality and value for performance in a project [17]. According to Touran and Lopez [18], if the project takes up more time to finish, the chance of cost escalation in a project is almost inevitable. Shane et al. [19], postulates that factors influencing cost escalation can either be internal or external. Internal factors are those which have direct control of project sponsoring agency or owner and external factors are those which does not have direct control or have little control over their impact. Flyvbjerg's framework (based on the works of Bent Flyvbjerg) classifies causes of cost overrun into four main group including political explanations, technical explanation, economic explanations and psychological explanations [19]. Technical explanation refers to false and unreliable data, which may have emerged during the project whereas Psychological explanations are based on theories from behavioural studies, mainly on positivity bias, Political-economic explanation is interpreted by strategic misrepresentation [19], organizational stability and impact of risk [20]. Although causes of cost overrun in different countries share similar characteristics in construction projects, they could differ from country to country as a result of political, economic, legislative, social and cultural factors inherent in the countries as well as the contrasting risks within projects [6].

Project Delay

Delay in construction projects affects the interests of stakeholders, including the owners, designers, contractors, users and other [21] [22]. Project delays in government is a common factor as they are constantly dependent on use of materials, which require numerous maintenances and at times involve permission from different government authorities requiring further planning and coordination [23]. Project delay and the direct and indirect costs associated with delay are studied by many researchers and it is proven that these factors are constantly evolving [7]. According to Toor and Ogunlana [24], there is a common pattern of problems that causes delays in the construction projects in all developing countries. The studies indicate that some problems arose only after the year 2000 which is when Asian economies reeled away from the financial crisis and move towards a boom in construction industry. It is, therefore, essential to find and implement the most appropriate solution to mitigate delay in project schedule. To do so, the

driving factors in the early stages for delay need to be identified and interpreted [25].

METHODOLOGY

A pre-existing questionnaire using Likert scale which is adapted from a research conducted on a similar topic on cost escalation and project delays by Kaliba, Muya and Mumba [21]. From the total population is 100, the total number of sample size should be 80 respondents. Survey questionnaires were given to a sample of 80 actors of PPP construction projects, including clients, contractor and consultants.

Since this study aims to identify the factors which contributes to cost escalation and delay specifically in PPP construction projects, the selected population for the research was actors who have had directly dealt with Maldives government construction projects. Hence, purposive sampling technique was used [25] [26]. Purposive sampling involves identification and selection of individuals who have knowledge and expertise with a phenomenon of interest [26]. The scale of projects within which respondents have been involved range from small to large projects and varies from projects conducted within the past ten years. The research uses statistical software Statistical Package for the Social Sciences (SPSS). The collected data was then analysed using the computed formula for Relative Importance Index (RII). RII analysis helps to identify the specific areas dominant in a survey data and helps to set priorities for a researcher [27]. To validate the research instrument, the questionnaire was given to stakeholders who have had previous experience in the PPP construction projects.

Additionally, explanation is done by the ANT diagram. The diagram is an adaptation from Ahmedshareef, Hughes and Petridis, 2014's ANT on project execution model [28]. ANT prime movers concept defined the collaboration as interaction and relationship within stakeholders or actors involved in achieving a one objective or implement joint decisions [29].

RESULT ANALYSES AND DISCUSSIONS

Out of the sample size of 80, a total of 64 responded, resulting in an 80% response rate. According to Baruch and Holtom [30], a benchmark of 30 to 40 percent is acceptable. The reliability of the two part of the questionnaire, namely cost escalation and delay factors were tested. The reliability of cost escalation factors was α of 0.820 and for delay factors it was an α of 0.880, hence both values are acceptable. As for actor distribution, most of the respondents are consultants who have had previous experience in a PPP with 37% of respondents, Clients consists 30% and Contractors 33%. It can, therefore, be concluded that the results obtained are equal from the three actors' perspective. Majority of the respondents (43%) had educational qualification of bachelor's degree and (64%) of them are project managers. This indicates respondents' ability to render reliable and credible information.

Relative Importance Index (RII)
RII was computed using the following formula:

$$\text{RII} = \frac{\Sigma W}{A \times N}$$

In the formula, w is the weight given to each factor by the respondents (ranges from 1 to 4), A is the highest weight (range 4 being the highest value in this research) and N is the total number of respondents. These rankings identify the relative significant of the factors alleged by the three groups of respondent's clients, consultants and contractors. The factors were ranked from most significant to least significant contribution to the cost escalation and delay in PPP construction projects, in the perspective of the actors.

	All responses		Client		Contractor		Consultant	
Factors	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Scope changes	0.867	1	0.842	1	0.881	1	0.913	1
Schedule delay	0.734	2	0.684	4	0.774	2	0.772	3
Technical Challenges	0.73	3	0.684	5	0.69	5	0.837	2
Local government pressures	0.723	4	0.724	2	0.738	4	0.739	4
Environment protection & mitigation costs	0.684	5	0.684	3	0.738	3	0.663	6
Inflation	0.68	6	0.684	6	0.69	6	0.696	5
Bad weather	0.551	7	0.566	7	0.583	7	0.532	7
Strikes	0.453	8	0.474	8	0.44	8	0.467	8

Table 1 - RII value for cost escalation factors

Factors	All responses		Client		Contractor		Consultant	
	RII	Rank	RII	Rank	RII	Rank	RII	Rank
Delayed Payments	0.883	1	0.934	1	0.869	1	0.891	1
Financial process	0.832	2	0.842	2	0.821	2	0.87	3
Changes in drawings	0.758	3	0.711	4	0.738	3	0.848	5
Poor supervision	0.758	4	0.697	6	0.726	4	0.87	4
Equipment unavailability	0.738	5	0.724	3	0.69	6	0.826	6
Poor coordination onsite	0.715	6	0.697	7	0.667	10	0.804	8
Contracted modification	0.711	7	0.671	8	0.667	8	0.815	7
Staffing problems	0.703	8	0.711	5	0.69	5	0.739	11
Changes in specifications	0.695	9	0.605	9	0.69	7	0.804	9
Construction mistakes	0.691	10	0.492	11	0.607	11	0.88	2
Economic problems	0.637	11	0.5	10	0.667	9	0.75	10
Labour disputes & strikes	0.512	12	0.434	12	0.464	12	0.641	12

Table 2 - RII value for delay factors

Cost Escalation RII ranked Factors

In Table 1, the all response (column 2 and 3) shows that the most significant factor for cost escalation in a PPP construction project of Maldives is changes in scope with RII = 0.867, followed by delayed schedule and technical changes as indicated by their descending RII's. Similarly, in the perspective of client, contractor and consultant, ranked top as the most significant factor which contributes to cost escalation in Maldives' project is the changes in scope. However, in the perspective of client, the second most significant factor is the local government pressure, followed by environment protection and mitigation costs. From the viewpoint of the contractor, second significant factor is schedule delay, followed by environment protection and mitigation costs. In the perspective of the consultant, it is technical changes followed by schedule delay. With the coincidence of all the actors, inclusive of the all response column, the least significant factor which contributes to a cost escalation is strikes.

Project Delay RII factors

Table 2 lists the project delay factors ranked in the descending values of RII's. It can be seen from the table that there is clear agreement between all the actors that the most significant factor which contributes to project delay is the delayed payments (All responses column, RII = 0.883). The next top ranked factor for client and contractor, as well as the one indicated in the all response column is the financial process. However, the consultants refer to construction mistakes as the second most significant factor which contributes to project delay. The third most significant factor depicted in the all response column is the changes in drawings, followed by poor supervision both with a RII value at 0.758. In the perspective of client, the next most significant factor is unavailability of equipment, whereas in the perspective of contractor it is changes in drawings and for consultant it is financial process.

To further explain the most significant factor contributing to cost escalation and project delay, the factors were categorised into Ishiwaka's 6 Ms. [31].

Ishikawa 6M	Factors	RII	Rank
Man	Local government pressures	0.723	1
Man	Strikes	0.453	2
Measurement	Technical Challenges	0.73	1
Method	Scope changes	0.867	1
Method	Schedule delay	0.734	2
Mother Nature	Environment protection & mitigation costs	0.684	1
Mother Nature	Inflation	0.68	2
Mother Nature	Bad weather	0.551	3

Table 3 – Ishikawa's 6M: Cost escalation factors

Ishikawa 6M	Factors	RII	Rank
Man	Delayed payments	0.883	1
Man	Poor supervision	0.758	2
Man	Poor coordination onsite	0.715	3

Man	Staffing problems	0.703	4
Man	Labour disputes & strikes	0.512	5
Material	Equipment unavailability	0.738	1
Method	Financial process	0.832	1
Method	Changes in drawings	0.758	2
Method	Contracted modification	0.711	3
Method	Changes in specifications	0.695	4
Method	Construction mistakes	0.691	5
Mother Nature	Economic problems	0.637	1

Table 4 – Ishikawa's 6M: Delay factors

In Table 3, overall the most significant factor contributing to cost escalation is a factor related to methods (Scope changes at RII = 0.867). Whilst, the most significant factor for project delay (Table 4) is a factor related to man (Delayed payments at RII = 0.883). In addition to this, the most significant factor from the factors related to man was also recorded as Delayed payments. Only one factor was related to measurement and material, and none for machines. Among factors related to method, scope changes were the most significant factor, which contributes to cost escalation and financial process were the most significant factor which contributes to project delay. Among the factors for mother-nature, inflation had the highest value of RII at 0.68, contributing to cost escalation.

As proposed by Mahamid [32], Spearman rank correlations were used to identify if there is an agreement or disagreement among the three actors (client, contractor and consultant). A positive correlation (r2 = +1) indicates identical ranking whereas a negative correlation (r2 = -1), depicts an inverse relationship. According to Pallant [33], the strength of the correlation can be identified using the following; Weak r2 = 0.10 to 0.29, Moderate r2 = 0.30 to 0.49 and Strong r2 = 0.50 to 1.0.

	Cost escalation factor	Sig.	Delay factors	Sig.
Client – Contractor	0.714**	.002	0.531	.000
Contractor – Consultant	0.761*	.001	0.538	.003
Consultant – Client	0.905**	.002	0.908**	.000

**. Correlation is significant at the 0.05 level (2-tailed)*
***. Correlation is significant at the 0.01 level (2-tailed)*

Table 5 - Spearman rho correlation results

The results (Table 5) illustrate that there is a strong agreement between three actors in ranking the factors which contributes to cost escalation and project delay. This is more prominent especially between consultant and client, where for cost escalation factors the correlation is at 0.905 and for delay factors the correlation is at 0.902. All p-value are below 0.05 indicating a strong significance level. Hence, the results indicate that the identified factor are highly relevant to the research problem and estimates the accuracy of the identified factors for cost escalation and project delay for PPP construction projects in Maldives.

Discussion

The analysis of the survey revealed that there is a high degree of agreement between clients, contractors and consultants which depicts the dependability of the identified factors for cost escalation and project delay in PPP construction projects of Maldives.

For cost escalation in construction government projects of Maldives, ranked 1st is scope changes, followed by schedule delay, technical challenges, local government pressures, environment protection and mitigation costs, inflation, bad weather and strikes. The scope changes (RII = 0.867) were found to be the most significant factor which contributes to cost escalation in Maldives PPP construction projects. This is in line with other researchers, scope changes were found to be one of the most significant factors contributing to cost overrun, including construction projects of Korea and Zambia as well [20][23][34]. From identification, implementation and evaluation process of project cycle, changes to scope ensues due to uncertainty, thus leading to cost overrun as well as schedule delay [34][35]. According to Durdyev et al.,[36], a clear understanding of the scope in the pre-construction stage helps to avoid pricing disputes in the later stages of a project cycle.

All 3 (Client, Contractor and Consultant) seems to agree that the most significant factor which contributes to cost escalation is scope changes. This is evident from the ranking; Client (RII =0.842), Contractor (RII = 0.881) and Consultant (RII = 0.913). Schedule delay is ranked 2nd. Schedule delay and cost overrun have a symbiotic relationship, whereby when a project takes more time to complete, the cost increases [17][18]. Correspondingly, the findings of the research indicate that schedule delay (RII = 0.734) is the second most significant factor which contributes to cost escalation in Maldives PPP construction projects. According to Gonzalez et al., [20], delay in a project is usually accompanied by cost escalation in project, which can also affect stakeholders' interests. The perception of Contractor (RII = 0.774) ranked schedule delay as the second most significant factor for cost escalation, whereas Consultant (RII = 0.772) ranked schedule delay at third and Client (0.684) ranked at fourth. This indicates that there is a slight disagreement between

three actors, depending on their role in a PPP project. As depicted from the results, even though for a client a delay in schedule might not have the most significant impact on cost escalation compared to a contractor or consultant. Nonetheless, in the perception of client, the second most significant factor for cost escalation is local government pressures. Whilst for consultant, the second most significant factor is technical changes.

Ranked 3rd was the Technical challenges. According to Kaliba, Muya and Mumba [21], technical challenges is one of the factors which contributes to cost escalation in Zambia, correspondingly, it is the third most significant factor for cost escalation in Maldives (RII = 0.730). Siemiatycki [37] postulates that cost overrun, and technical challenges can be defined together. Technical challenges can be described in many forms which also includes changes in scope, together with problems coordinating with contractors, increased labour or material cost, false forecasting and poor monitoring. This indicates that scope changes being the most significant factor, have allied with the third most significant factor for cost escalation technical challenges. From the perception of consultant (RII = 0.837), technical challenges are the second most significant factor which contributes to cost escalation. However, clients (RII = 0.684) and contractors (0.690) ranked technical challenges at fifth most significant factor which contributes to cost escalation. Clients and contractors simultaneously ranked environment protection and mitigation costs at third most significant factor.

As for Delay, ranked 1st is Delayed Payments. In the researchers conducted by Al-Khalil and Al-Ghafly [22], Toor and Ogunlana [23] and Kaliba, Muya and Mumba [21], problems related to finance, including delayed payment were denoted as one of the most significant factors which contributes to project delay. The results echoed in the case of Maldives (RII = 0.883). According to Jameel [38], the Maldives government have had issues when it comes to timely payments to private construction companies, which have further led to other issues. In the construction industry, payments involve dealing with huge amounts of money and contractors usually find it difficult to handle the daily expenses when the payments are delayed. Generally, this happens because there is an inadequate cash flow from the clients which support the construction expenses [39]. The perception of Client, Contractor and Consultant concurred. The result shows Client (RII = 0.934), Contractor (RII = 0.869) and Consultant (0.891), the most significant factor which contributes to delay in a project is delayed payments.

Financial process (RII = 0.832) was ranked as the second most significant factor which contributes to project delay in Maldives. In the context of PPP construction projects, it is an issue when it comes to obtaining permits from government authorities, thus leading to a longer financial process [22]. Likewise, according to Kaliba, Muya and Mumba [21], a complex financial process in client organizations causes difficulties dealing with contractors, thus causing project delay in Zambia. Toor and Ogunlana [23] ranked problems related to finance as one of the significant factors which contributes to project delay in Thailand. Whilst in Saudi Arabia, cash flow and financial difficulties by contractors lead to project delay [22]. In this stuty, in the perception of clients (RII = 0.842) and contractors (0.821), financial process is ranked as the second most significant factor which contributes to project delay. In the perception of consultant, the second most significant factor is construction mistakes (RII = 0.880). It is noted that, construction mistakes (RII = 0.691) has a low significance level in all responses.

Changes in drawings (ranked 3rd) can be classified as a compensable delay which is usually caused by the owners [39]. Inadequate design or drawings were found as one of the most common factors which could lead to project delay, especially in the view of contractors [40] [41]. In a research done on United Arab Emirates (UAE), construction industry, preparation and approval of drawings were ranked highest [42]. In Maldives PPP construction projects, changes in drawing (RII = 0.758) were ranked as the third most significant factor. As for the perception of the Client, Contractor and Consultant, changes in drawings were ranked at 3rd most significant factor for contractors (RII = 0.870) as well. However, it was ranked at 4th for clients (RII = 0.711) and 5th for consultants (RII = 0.848). The 3rd most significant factor for clients were equipment unavailability (RII = 0.724) and financial process (RII = 0.870) for consultants. In all responses, equipment unavailability (RII = 0.738) is the 5th most significant factor and as referred before, financial process is the 2nd most significant factor.

Poor supervision was ranked 4th, although it has the same RII value as the third most significant factor, changes in drawings (both RII = at 0.758). Correspondingly, Kaliba, Muya and Mumba [21] and Samarghandi et al., [7], agrees that poor supervision contributes to project delay. One of the most influencing factors which lead to project delay in Saudi Arabia is poor site management and supervision by contractors [43]. Likewise, on a research conducted on Hong Kong construction projects, clients, contractors and consultants ranked poor supervision as the most significant factor in causing project delay [44]. As far as the perception of

client, contractor and consultant is concerned, Poor supervision was ranked as the fourth most significant factor for contractor (RII = 0.726) and consultant (RII = 0.870). However, clients (RII = 0.697) ranked poor supervision as sixth most significant factor. The fourth most significant factor for clients were changes in drawings (RII = 0.711).

Application to Actor Network Theory (ANT)

Figure 1 illustrates a rich picture of the interactions between the factors and elements contributing to cost escalation and project delay. The nodes are linked to 'black boxes' of the research including the main problem, actors, factors related to method, man, mother nature, measurement and material (details provided in Table 6). Black boxes are referred to the actors which are measurable in ANT, those that builds together a network converting a claim to a fact [45]. The black boxes are distinguished by the different shapes as indicated.

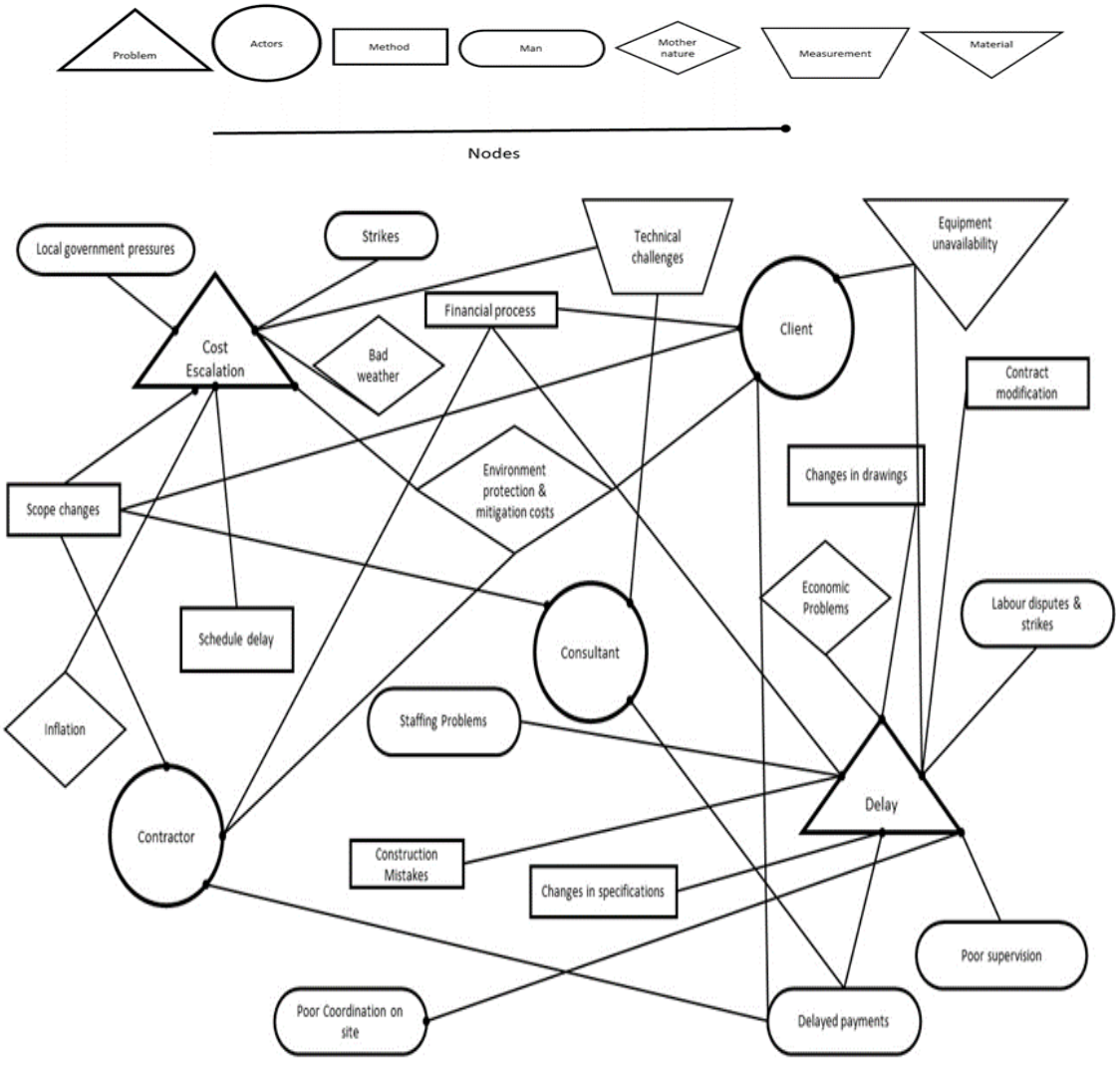

Figure 1 - Application to ANT: Adaptation (Ahmedshareef, Hughes and Petridis, 2014)

Ishikawa 6M	Factors to	Factors
Man	Cost escalation	Local government pressures
Man	Cost escalation	Strikes
Man	Delay	Delayed payments
Man	Delay	Poor supervision
Man	Delay	Poor coordination onsite
Man	Delay	Staffing problems
Man	Delay	Labour disputes & strikes
Measurement	Cost escalation	Technical Challenges

Material	Delay	Equipment unavailability
Method	Cost escalation	Scope changes
Method	Cost escalation	Schedule delay
Method	Delay	Financial process
Method	Delay	Changes in drawings
Method	Delay	Contracted modification
Method	Delay	Changes in specifications
Method	Delay	Construction mistakes
Mother nature	Cost escalation	Environment protection & mitigation costs
Mother nature	Cost escalation	Inflation
Mother nature	Cost escalation	Bad weather
Mother nature	Delay	Economic problems

Table 6- Summary of Ishikawa's 6M categories

The Figure 1 suggests that the factors contributing to cost escalation and project delay can be reinterpreted as a network of actors, both human and nonhuman. Actors and factors related to man are human related, whereas other elements (method, mother -nature, measurement and material) are nonhuman actors. The human and nonhuman elements (referred as nodes) and the relationship between one element to another (referred as links). Project delay and cost escalation being the prime research problem, the links are connected by nodes which directs the factors which contribute to the research problem. The stakeholder's black box is linked to the most significant factors for each of the stakeholder. Relating the ANT concept to this study, Table 7 summarises the possible indicators.

ANT Concept	Possible indicators
Actor	The construction industry with a large number of actors is likely to be more complex.
Black-box	Main problem, Actors, the factors related to method, man, mother nature, measurement and material.
Alignment	Strongly aligned according to Spearman rho correlations. Actors strongly agree on the factors which contribute to cost escalation and delay in PPP construction projects in Maldives.

Table 7 – Summary of ANT concepts and possible indicators for the findings (Adaptation of Ahmedshareef, Hughes and Petridis, 2014)

Using ANT on a research may be interesting, but it is highly complex at times. Besides the ANT can strengthen the analysis, this is because human actors are not enough to portray the complex reality. Non-human actors along with human actors are useful when explaining a social scope [46]. Similarly, to explain the factors contributing to cost escalation and project delay in PPP construction projects of Maldives, ANT was applied, to explore the relationship between the human actors and non-human actors.

CONCLUSIONS

The aim of the paper is to identify the factors which contribute to cost escalation and delay in PPP construction projects of Maldives. The study concludes that the factors which contribute to cost escalation in Maldives are scope changes, schedule delay and technical challenges. The most significant factor for project delay in Maldives is delayed payments, financial process, changes in drawings and poor supervision. Judging from Ishikawa's 6M category, the findings indicate that the most significant factor for cost escalation and project delay were related to 'man'. Correlations further indicated that there was strong agreement between actors, resulting in a reliable outcome from the identified factors.

The third objective was also achieved; where the study classified the most significant factors based on actor's perspective. In the perception of client, contractor and consultant the most significant factor contributing to cost escalation was scope changes. All actors were incongruent on delayed payments being the most significant factor contributing to project delay. In identifying the most significant factor for cost escalation, clients ranked local government pressure and environment mitigation cost, contractors ranked schedule delay and environment protection and mitigation costs, meanwhile consultants ranked technical challenges and schedule delay. For most significant factor for project delay, clients ranked financial process and equipment unavailability, contractors ranked financial process and changes in drawings, whilst consultants ranked construction mistakes and financial process.

The study proposes application of ANT concept as a diagram using the main findings. The diagram illustrated the interactions between nodes and links to 'black-boxes'. The main black boxes used in the ANT diagram indicated the main problem, actors, factors related to method, man, mother-nature, measurement and material.

The present study contributes to the growing body of knowledge related to factors for cost escalation and project delay of PPP construction projects in Maldives. While the data provided in the findings are based on Maldives, the results are in congruent with previous studies conducted on factors for cost escalation and project delay of PPP projects in developing countries. ANT concept was also used to converge the factors in one holistic rich picture. Thus, the study also contributes to construction industry

literature by means of ANT to investigate the factors which contributes to cost escalation and project delay in Maldives. The significant insights provided by the study can be used for future reference by public and private construction companies to understand the encounters which may lead to project failure in Maldives due to cost and schedule overrun.

The study is limited to the construction industry of Maldives and the methods used to analyse the data is limited to RII. To compare the study to the current situation of Maldives was a challenge due to lack of information availability in Maldives. The study is also limited to selection of clients, contractors and consultants who have worked in a PPP construction project. There is a need for further investigations on the identified and ranked factors by clients, consultants and contractors, to avoid further cost overrun and delay as much as possible. The results of the study can be employed by project managers to overcome the identified factors as well. Furthermore, the ANT concept can be used for future research in diverse areas, to examine the human and non-human actors, whether the ANT concept can be further expanded by assumptions in network building.

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