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ROLES OF PROFESSIONALS IN CONSTRUCTION INDUSTRY

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Abstract
This paper is discussing the current affairs relating to law and management among the construction professionals. The construction professionals are defined as the architect, engineer and quantity surveyor. By doing references through publications, electronic sources and media, the report tried to indicate the scope of the professional registration, services and their professional etiquette in the construction laws perspective. The scope of paper covers the professionals' tasks and responsibilities and applying the concept of endeavour in carrying out their work. It also touches on the acts and rules concern and the relationship profession among the professionals, mainly between the client, contractor and the professionals themselves. The construction professionals are discussed in this paper as the most responsible person in a project especially when technical works are concerned. The expertise of each construction professionals must be carefully exercise as they are answerable to any sinfulness occurred during the constructions. Crime and tort in the professional services are the serious issues to both professionals and the client in construction industry. The negligence for giving advices and carrying out the duty may contribute to the client's economic loss and also to public safety. The results of this paper indicates that the construction professionals must be portray an excellent character as the skillful and technical person, in order to accomplish the main purpose of the construction industry which is to build sustainable construction to both, the client and the end users..

Key words: *Construction professionals, legal perspective, professional's task and responsibilities*

1. Introduction

Construction management is a challenging and demanding profession. Building construction requires many workers and many trades. From the perspective of realising a project, a professional project team is needed to make sure that project will be constructed successfully. In the modern industrialised world, construction usually involves the translation paper or computer based designs into reality. A formal design team may be assembled to plan the physical proceedings, and to integrate those proceedings with the other parts. The design usually consists of drawing and specifications, usually prepared by a design team including architects, interior designers, surveyors, civil engineers, quantity surveyors, mechanical engineers, electrical engineers and structural engineers. The design team is most and commonly employed by the property owner. These construction management professionals deal with time, money, equipment, technology, people and materials in managing a construction project. They organize these resources into activities, execute the activities in logical sequences and manage to complete the projects within the stipulated time and budget. They will also have to manage the construction process to meet the needs to clients with legal, cost and environmental constraints. They have to look into the whole building cycle from inception

to end of economic life, dealing with the procurement, construction, design or property management, recycling and disposal of building, and balancing the often conflicting requirements of clients, users and the community. The increasing complexity of construction projects creates the need for design professionals trained in all phased of the projects life-cycle and develop an appreciation of the building as an advanced technological system requiring close integration of many sub-systems and their individual components, including sustainability. Building engineering is an emerging discipline that attempts to meet this new challenge. Hence, it is the responsibility of these construction professionals to exercise all reasonable skill, care and diligence and display their expertise according to the professional standards in the modern building engineering world. The construction professionals that to be discussed regarding this issue, are the professions of an architect, engineer and quantity surveyor.

2. Construction Professionals Architect, Engineer and Quantity Surveyor Defined

Abdul Aziz (2006) explained that referring to the Article 3, Article of Agreement for Form of Contracts PAM 1998, Articles 3-5 for Form of Contracts PAM 2006, and Article 5, Article of Agreement for Form of Contracts CIDB 2000, "architect" (for that agreement means) is an architect named by the clients (including the person who replace the said architect if he/she dies or discontinue the services). Furthermore, for the definition of an architect practicing his/her professions in Malaysia, according to Section 2 Architect Act 1967, he/she must be a registered architect. An "engineer" as said by Jackson and Powell (1992), is referring to a person in the engineering construction contract performing the same function as an architect under the traditional construction contract. It means that engineers are someone who replaces the architects in the work of construction engineering or the building works that need the work of construction engineering. Referring to Memorandum of Agreement between client and consulting engineer of professional services, the meaning of "consultant engineer" is an engineer engaged by the client to provide the professional services as described and detailed in the Contract Terms. In the case of Holland Hannen & Cubitts (Northen) Ltd. v. Welsh Health Technical Services Organisation (1985) 35 Build. L.R. 1, also explains that "engineer", as a person appointed for matters regarding building project, based on the specific skills which are not acknowledged by an architect, for example a civil or structure engineer. In specific, referring to the Article 4, Article of Agreement for Form of Contracts PAM 2006 and Article 6 and 7, Article of Agreement for Form of Contracts CIDB 2000, "engineer" (a civil and structure engineer of a mechanical and electrical engineer) as named by the clients (including the person who replace the said engineer if he/she dies or discontinue the services). Furthermore, for the definition of an engineer practicing his/her professions in Malaysia according to Section 2 Engineer Registration Act 1967, he/she must be a registered engineer (Abdul Aziz, 2006). As what mentions by Abdul Aziz (2006), a quantity surveyor referring to Judge Morris's holding in Taylor v. Hall, it has to refer to his duties within the contract – the duty of preparing the costing, bill of quantity, setting of the lowest price by the contractor, negotiating with the contractor and to evaluate the work done by the contractor in order to produce the interim certificates and the final certificate by the architect. In specific, referring to the Article 5, Article of Agreement for Form of Contracts PAM 2006 and Article 8, Article of Agreement for Form of Contracts CIDB 2000, "quantity surveyor" (for that agreement means) is a person named by the clients (including the person who replaces the said quantity surveyor if he/she dies or discontinue the services). Furthermore, for the definition of a quantity surveyor practicing his/her professions in Malaysia, according to Section 2 Quantity Surveyor Act 1967, he/she must be a registered quantity surveyor.

3. The Task and Responsibilities of Architect, Engineer and Quantity Surveyor

In general, an architect is a person who is involved in the planning, designing and oversight of a building's construction. In the broadcast sense, an architect is a person who translates the user's needs into the builder's requirements. An architect must thoroughly

understand the building and operational codes under which his or her design must conform. That degree of knowledge is necessary so that he or she is not apt to omit any necessary requirements, or produce improper, conflicting, ambiguous, or confusing requirements. He or she must understand the various methods available to the builder for building the client's structure, so that he or she can negotiate with the client to produce a best possible compromise of the results desired within explicit cost and time boundaries (Wikipedia, 2007). The architect also observes the work at certain times during the construction phase, but on a much less frequent basis and for different purposes that the contractor, it is only the duty of the contractor to coordinate the subcontractors and develop a work plan for delivering a completed project that conforms to the architect's design. Architects are charged only with being generally familiar with the work and reporting the general progress and quality of the work, as completed to the owner. The standard of care is that the architect should be responsible for discovering and reporting nonconforming work that is available to be seen (Simson & Atkins, 2006). As for the engineers, construction engineers precisely, their scope of work involves planning and execution of the designs from transportation, site development, hydraulic environmental, structural and geotechnical engineers (Wikipedia, 2007). Construction engineers have a lot of responsibilities in their job. Certain tasks have to be completed everyday in order to get the job done correctly. Analyzing reports is a main part of their job description. They must analyze maps, drawings, blueprints, aerial photography and other topographical information. Construction engineers also have to use computer software to design hydraulic systems and structures while following construction codes. They have to calculate load and grade requirements, liquid flow rates and material stress points to ensure that the structure can withstand stress. Keeping a safe workplace is crucial to having a successful construction company. It is the construction engineer's job to make sure that everything is conducted correctly. In addition to safety, the construction engineer has to make sure that the site stays clean and sanitary. Surveying the land before construction begins is also a job of the construction engineer. They have to make sure that there are no impediments in the way of where the structure will be built and if there are any they must move them. They also must estimate costs and keep the project under budget. Construction engineers have to test the soils and materials used for adequate strength. Finally, construction engineers have to provide construction information, including repairs and cost changes, to the managers. A quantity surveyor is a professional person working within the construction industry. The role of the quantity surveyor is, in general terms, to manage and control costs within construction projects and may involve the use of a range of management procedures and technical tools to achieve this goal. The methods employed, however, cover a range of activities, which may include cost planning, value engineering, feasibility studies, cost benefit analysis, lifecycle costing, valuation, and cost estimation. A quantity surveyor can also be known as construction economists, cost engineers or construction managers. Quantity surveyors control construction costs by accurate measurement of the work required, the application of expert knowledge of costs and prices of work, labour, materials and plant required, an understanding of the implications of design decisions at an early stage to ensure that good value is obtained for the money to be expended. The technique of measuring quantities from drawings and specifications prepared by designers principally architects and engineers. In order to prepare Tender/Contract Documents, is known in the industry as taking off. The quantities of work taken off typically are used to prepare bills of quantities, which usually are prepared in accordance with a published standard method of measurement as agreed to by the quantity surveyor profession and representatives of the construction industry (Wikipedia, 2007).

4. Professionals and the Concept of Endeavour

One of the major tasks for the professionals in construction projects is to execute all his professional works, according to the terms of the contract of engagement. They cannot run away from the fact that they will face all

kinds of risks while carrying out their professions, whether in crimes, tort, the infringement of ethics and other more. According to the Oxford Advanced Learner's Dictionary (1995) endeavour means an attempt or effort. One of the professional's endeavours in avoiding or minimizing the risks in his/her profession is to carefully perform the duty according to the professional standard. Furthermore, professionals are encouraged to place within them the awareness of how important it is to present their duty at their best, which shall give positive or negative effect to themselves, profession, client and others including the end user of the project. In everyday life, the main part before starting a work is the intention. Construction professionals need to have the intention of accomplishing the duty towards a positive manner and avoid the negative ones. Without that kind of intention and determination at the beginning of the construction professional existence and during the project construction, the endeavour concept will not be able to apply. Abdul Aziz (2006) explains, issues that can be endeavoured for a better performance in construction industry are:

1. In architecture designing and innovating; effortless, easy to be constructed and user friendly.
2. In new technology of construction work which not only can avoid or reduce harmful situations to neighbours and workers, but also safe, fast and economical.
3. Applying latest, innovative and effective construction management methods.
4. Work procedure and alternative working tools which can avoid or reduce accidents risks to the construction workers.

Clause 1 (1) Code of Professional Conduct for Architect mentions:
An architect shall use the common reasonable skill and effort and is accepted by his/her professions.

Clause 5 Code Professional Conduct for Engineer states that:
A registered engineer shall conduct himself honourably, responsibly, ethically and lawfully so as to enhance the honour, reputation and usefulness of the profession.

Rules 26, Quantity Surveyors Rules 1973 mentions:
Every registered quantity surveyor shall at all time defend his/her nobility, high position and good name of the professions.

5. Kinds of Relationship between Professionals

A relationship between professionals in construction industry mostly based on contractual and agreement are written. There parties involves in construction project is called stakeholders. The stakeholders have relationships based on the needed factors to carry out the project such as civil engineer and architect related to design and drawing or the other example is the contractor and supplier to make agreement for procurement the materials.

These below are kinds of relationships profession in construction industry contexts.

1. Relationship between professional
2. Relationship between professional and client
3. Relationship between professional and contractor (and sub contractor)
4. Relationship between professional in turnkey contract

5.1 Relationship between Professional

There are two main things about relationships between professional. Firstly is the professional is taking the responsibility of others professional. Secondly is relationship between professional in different scope of work to manage the construction project. For relationship between professional in different scope of works involves relationships such as:

1. Relationship between architect and engineer
2. Relationship between architect and quantity surveyor
3. Relationship between engineer and quantity surveyor
4. Relationship between architect, engineer and quantity surveyor

Referred to PAM 2006 in article 3, 4, 5 and 6 clearly stated that the architect will be a

leader of project and has relationship directly to engineer and quantity surveyor. The engineer and quantity surveyor does not have relationship directly (just as a team work in construction project). Based on CIBD 2000 in article 5, 6, 7, 8 and 9 and also point 1.1 contract requirements stated that the position of architect, engineer and quantity surveyor are same as staff of client. Officer must a professional also involves engineer, architect and quantity surveyor or project manager. Thus, neither based on the contractual neither stated that professional does nor have relationship directly but them just as staff professional project except client staff. Referred to PWD 203, there are not things related to position and relationship of professional. Causes the project under the superintending officer and usually is Head of the Department or Head of Project of the Agency or Director General of Public Works Department. If professional is needed, they will take separate and under the superintending officer.

6. Problems and Conflict in Relationship amongst Professional, Client and Contractor

There are problem is faced in relationship with client and contractor was occur due to architect and engineer skills when carrying out the project. The focus of the problem is the authority between architect and engineer definitely. Based on N.M. Robinson and A.P. Lavers stated that whatever authority has given to architect and engineer in contract absolutely they are as agent or client. And referred to case of Neodox Ltd vs Borough of Swinton & Pendlebury (1958) 5 B.L.R. 34, court decided that if decision from engineer is honestly so the contractor is not paid anymore by client if some problem was occurred. The other hand is explained based on case of Snore & Triest Co. vs New York 191 A.D. 184; 233 NY 528 (1922) stated that if the contract is recommended to the architect and engineer decide decision, the contractor is not paid by client for additional and revised works. Based on PAM 2006, CIBD 2000 and PWD 203 clearly stated that all the change of design and drawing or additional work is made by architect or superintending officer by written so the contractor can claim the payment. But that problem above is not answered the relationship of responsibility between professional and client about task of professional likes below.

1. There are inconsistent between requirements of professional services and requirement of contract among client and contractor
2. There are over control of authority
3. The real position of professional must be placed
4. The communication scope/limit could they decided

Based on the N.M. Robinson and A.P. Lavers (1988), the decision was taken by architect and engineer to contractor and the contractor followed that direction will be describes below about the works is paid or not.

1. Intra vires or ultra vires
2. The authority of architect and engineer in work changed
3. The authority of architect and engineer in work changed stage
4. The authority of architect and engineer in limited term/contingent

Based on Abdul Aziz (2006), if the direction on authority scope and involved in work changing, the client must pay to the contractor for work charged and additional work. Or if the answered is reversed the client must pay also to the contractor and client can claim the agent of architect or engineer to pay again the client. Related to the additional work in the construction project, the case of Thomas Crimmins Contracting Co. Inc vs New York 138 AD2d 138 (1988) stated that additional works as needed to done which decided by architect and engineer. The architect and engineer authority is not related to the law and contractual. Thus the risk will be allocated to contractor to work together with architect and engineer carefully to prevent the additional work without payment. The professional was given tasks based their scope without pressure from other parties except client. Rodcliffee J. in case of R.B. Burden vs. Swansea Corporation ([1957] 1 W.L.R 1167 CA) stated that architect is has free authority for himself and also has responsibility to fairly to other parties. But referred to a case was emphasized by N.M. Robinson and A.P. Lavers stated that the way to give direction, architect (engineer or

quantity surveyor) has responsibility for his negligence or the wrong way on communicate.

7. Professionals and Tort Law

Most of the cases that are reported in the journal of law, many of professionals in construction project had involved in the tort of negligence. Negligence is defined in Winfield and Jolowicz on Tort (2000) as 'the breach of a legal duty to take care which results in damage undesired by the defendant, to the plaintiff'. Thus the ingredients of negligence are:

1. A legal duty on the part of A towards B to exercise care in such conduct of A as falls within the scope of the duty.
2. Breach of that duty.
3. Consequential damage to B

Professional negligence is a substantive area of law and is an ever-increasing area where our clients are seeking advice. All professionals owe a combination of contractual, tortuous, statutory and fiduciary duties to their clients as well as tortuous duties to third parties.

8. Is the Professional Person Liable in Both Contract and Tort?

In relation to whether these responsibilities are concurrent, there have been many cases, particularly in the medical field, which found doctors to have concurrent responsibility in contract and in tort to their patients for physical injury. However, in the case of *Henderson v Merrett Syndicates* (HL (E)). 1995 2AC 145), which was one of many cases involving the underwriting members of Lloyds Names suing their managing agents, concurrent liability was also extended to cover financial loss, which obviously had significant effect on bankers, auditors and accountants etc. In the vast majority of situations there will be sufficient proximity between the client and professional to find a coterminous duty of care in tort. It still does not over come or avoid the circular question as to the determination of the scope of duty in tort, which often focuses the inquiry on what was agreed to be done under the contract. Therefore, using tort to overcome deficiencies in the contract will not work. It is also worth noting that where a contract is, a claim in tort will not usually extend the duties of the professional. The authority for this comes from *Kensington and Chelsea*& Westminster *AHA v Wettern Composites Limited* [1985] 1 All E.R. 346, where the defendant structural engineers contractual duties included checking the adequacy of the drawings and fixing details but this did not extend to the actual supervision of the installation of the fixings. Their contractual duties were clear and a duty of care in tort did not extend these duties to include supervision.

9. Negligence in the Duty

9.1 Examination of Site

Based on Kemelfield (1983), architect, developer and engineer can become liable to another parties (client) for damages if he failed to examine the site using correct and accurate method. These are including excavation works that are in progress and break and remove soil outside the site. A prudent architect will examine the site of the proposed development in order to as certain whether there are any factors which may restrict the use the site and the nature of the ground upon which the project is to be constructed. Architects and engineers have been found to be negligent for failing to examine the nature of the soil before designing foundations and for failing to measure. In Earnes London Estates Ltd v North Hertfordshire District Council ((1981) EG 491) an architect designed foundations for an industrial building to be constructed on made up ground without making an examination of the soil, assuming that it was an old railway embankment. He was found to be negligent for two reasons. He specified pier loadings without ascertaining the grounds bearing capacity. He also failed to act upon a query as to the adequacy of the depth of foundations which was made by a practical man on the spot. The judge was critical of the architect's approach to his design function which seemed to be limited to finding out what would get by the local authority. An architect should be aware not only of obvious hazards such as those presented by a made up site but also the less obvious such as the recent removal from the site of tress and shrubs. In Balcombe v Wards Construction (Medway) Ltd (1981) 259 EG 765), an engineer was found to be negligent for failing to make enquiries as to

whether there had been trees on the site before it was cleared development. The judge said:

'I find the conclusion inescapable that in 1971 a competent engineer encounting London clay, as in this case, would have made enquiries whether there had been trees on the site, and finding that there had been would have caused moisture content and plastic limit tests to be carried out. Had that course been taken there can be no doubt that the defendant would have advised that the proposed foundations were inadequate.'

9.2 Design

Designing a structure including preparing the necessary plans and drawings and selecting the appropriate materials for its construction, may be viewed as one of the architect's main functions. Whether an architect has been negligent in implementing his design will depend upon the facts of the case in question and, in particular, upon the terms of his engagement. In the case of Carosella v Ginos and Gilbert 1982) 57 ALJR 315. 29 (1988) 164 CLR 539), engineers designed foundations without reference to the superstructure of the building. An Australian court held such a course to be negligent. In the case of Holland Hannen & Cubitts (Northern) Ltd v Welsh Health Technical Services Organisation (1981) 18 BLR 80), the court of appeal held that designers are not required to exercise due care and skill beyond the limits of their own discipline the case concerned the design of concrete floors for a hospital which were out of level. The majority of the court of appeal held that the engineers' design functions did not extend to the visual appearance of the floors. Dillon L.J. said:

'...matters of visual appearance or aesthetic effect are matters for the architect and are not within the province of the structural engineer. It is for the structural engineer to work out what the deflections of a floor will be; it is for the architect to decide whether the floor with those deflections will be visually or aesthetically satisfactory when the finishes chosen by the architect have been applied.' In a dissenting judgment, however, Robert Goff LJ expressed the view that the engineers should have ensured that the floor would have been acceptable.

9.3 Preparing Estimation

An architect, engineer or quantity surveyor may be asked by his client for an estimate of the likely building costs of the proposed project. In providing an estimate the architect is under a duty to give a figure that is reasonably close to the ultimate cost that takes into account the effect of inflation or is expressed to be current cost only. The estimate should also fall within any budget limit imposed by the client. An architect should therefore ascertain whether the client has any costs limit and prepare a scheme that is capable of being carried out within that limit. In any event the architect should ensure that the proposals can be executed for a reasonable cost having regard to the scope and function of the works. In Gordon Shaw Concrete Products Ltd v Design Collaborative Ltd Canadian architects were asked to investigate the possibility of constructing a house for C$ 60,000. They design a scheme that would cost over C$100,000 to build. The plaintiffs sued for negligence and claimed repayment of fees paid on the grounds that the work carried out was useless. The architects were found to be negligent and to have failed to provide any consideration for the fees paid to them. The judge said:

'The architect was under a duty to submit an estimate of construction costs that was reasonably cost to the ultimate cost and reason for that discrepancy. There was no reasonable explanation of the great discrepancy between the estimated and ultimate construction figure.'

In the light of the case of Nye Saunders & Partners v. Alan E Bristow (1987) 37 BLR 92 (CA) it seems unlikely that the effects of inflation can amount to a reasonable explanation of sizeable discrepancy between forecast and ultimate cost. In the case Bristow commissioned architects to renovate his Elizabethan mansion in Surrey. He gave a budget figure of £250,000 and the original estimate of £238,000 was given in February 1974. By the time the works were costed in September of the same year the likely completion costs were £440,000 and still rising. The defendant refused to continue with the project or pay the architects their fees on the grounds that had he been warned as to the effect inflation might have upon the original estimate he would not have commenced the project. The court of appeal

upheld the judge's decision that the architects had been negligent in failing to make it clear the extent to which they had taken inflation into account.

9.4 Preparing Bill of Quantity

Quantity Surveyor is a person whom is responsible to prepare a bill of quantity. Usually, the bill of quantity is prepared using a standard method. The mere fact that the mistake in question may be a simple mathematical error will not be sufficient to rebut an allegation of negligence. In Tyrer v District Auditor for Monmouthshire (WIT) 230 EG 973) there were a number of successful claims against the quantity surveyor, including the allegation that the quantity surveyor had approved excessive quantities to process which led to irrecoverable overpayments to the contractor. There was, in addition, a simple mathematical error in issuing an interim certificate. The judge found that the error could have happened at any time, but "the obligation was on the appellant to ensure that adequate checks were made". Tyrer v District Auditor of Monmouthshire (1974) 230EG 973. The local authority overpaid a contractor because Tyrer, a quantity surveyor who was an employee of the authority, had accepted rated for work, which he must have known were ridiculously high and had also made an arithmetical error when issuing an interim certificate. Tyre appealed against being surcharged by the District Auditor for the loss sustained by the authority, on the grounds that he was acting in a quasi-judicial position. The appeal was rejected. The quantity surveyor owed a duty to carry out his professional work with a reasonable degree of care and skill.

9.5 Selections of Contractors

Where the professional is responsible for recommending contractors, he may be under a duty to make reasonable enquiries as to their solvency and suitability for the work. In Equitable Debenture Assets Corp. Ltd v William Moss Group Ltd (1984) 2 Con. L.R. 1, the architects were found liable for failing to make sufficient enquiries about the sub-contractors who provided the curtain walling. In Pratt (Valerie) v George J Hill Associates [1987] 38 BLR 25 CA) the defendant architects obtained tenders from two contractors for the construction of a bungalow for Pratt. The architects described the contractors as very reliable and as a result Pratt entered into a building contract with one of them. In fact they turned out to be wholly unreliable; the Court of Appeal remarked that they appear have done almost everything wrong. The builders failed to complete the works and were required to leave the site. The commenced arbitration proceeding against Pratt and subsequently went into liquidation. Pratt claimed damages against the architects for negligently recommending the builders. The claim included sums paid to the builders upon certificates and the costs incurred in the arbitration proceedings. At trial the judge held that the architects were breach their duty to recommend a suitable, reliable builder and that the builders' lack of suitability led to the disastrous execution of the works. The Court of Appeal held that losses claimed by Pratt arose directly from the misrepresentation given by the architects which caused Pratt to make a contract with highly unreliable builders. In order to avoid liability for the cost of a contract that goes badly wrong, the architect should investigate whether the contractors have the resources and skills necessary to execute the proposed works. Architects should also take care at the tender stage of the contract. In Hutchinson v Harris (1978) 10 BLR 19) the architects were found to be negligent for failing to put house conversion works out to competitive tender. If the architect is considering and advising upon the tenders submitted by contractors, he should watch out for excessive quantities and inflated prices, and not recommend their accepted.

9.6 Supervision

Professionals owe his client duty to supervise or inspect the works with a view to ensuring that they are carried out to the standard contracted for. Reasonable supervision has been defined as such supervision as would enable the architect to give an honest certificate that the work had been executed according to the contract. The relationship between the architect and the quantity surveyor in the preparation of interim valuations and inspections was considered in detail by Judge Stabb QC in Sutcliffe v Chippendale and Edmondson 1971] 18 BLR 149). In particular he was concerned with the question: to what extent, if any, is a quantity

surveyor obliged to take into account the fact that the work is defective in certain respects when he comes to prepare a valuation of it? The trial judge had the benefit of a considerable body of expert opinion as to what in practice was required of an architect and quantity surveyor. He concluded:

'I readily acknowledge and accept that any prolonged or detailed inspection or measurement at an interim stage is impracticable and not to be expected. On the other hand, the issuing of certificates is a continuing process, leaving each time a limited amount of work to be expected. Furthermore, since everyone agreed that the quality of the work was always the responsibility of the architect and never that of the quantity surveyor and since work properly executed is the work for which a progress payment is being recommended, I think that the architect is in duty bound to notify the quantity surveyor in advance of any work which he, the architect classifies as not properly executed so as to give the quantity surveyor the opportunity of excluding it.'

Sutcliffe can be relied upon as authority for the following two propositions, namely first that the quality of the contractors work is the responsibility of the architect and not of the quantity surveyor of the defective work before the latter prepares his valuation.

10. Conclusion

A successful project is very much depends on the construction professionals to act as an effective manager. They should act as a generalist and a facilitator when coordinating projects. They must be a good communicator in handling mediation, managing conflicts and negotiating terms with various stakeholders in the project and so on. In fact, there are many kinds of relationship in construction projects. There are relationships between professionals, professionals and client and also professionals and contractor. The relationships of them have many assumption and issues emerged especially in construction projects. The milestones and pressure on the construction project is higher than others industries. That ways the relationships between them is needed to clarify based on duty and responsibility to achieving the objective of projects. The problem of responsibility and job description still unclearly. The act such as CIDB 2000, PAM 1998, and PWD 203 stated that their requirement of the professional in construction project. Professional services in construction are general and comprehensive. It is based one the guideline memorandum of Agreement between the client and the consulting for the professional services. This task is also to protect the right for profession industry including the negative impact for safety of the project. All this responsibility will be paid by the client based on the scale of fees set out by every Board likes BEM, LAM and BQSM. The professional in construction have to provide their services to the client with accordance to the professional code of conduct to ensure that negligence not occurred in the consultant services. In handing disciplinary case that involve professionals of construction project, several legal guidance need to be obeyed by the parties that handle disciplinary matters (Appeal Committee, Committee or Disciplinary Board and Disciplinary Appear Board). This is important in ensuring the professional rights are not jeopardized because any judgment imposed towards the suspected professional will give a great impact to the professional's future. For a fact, allocation in written Law (in the Acts) for all three professions is different, especially in term of procedure and types of disciplinary punishments.

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MATERIAL WASTE IN THE MALAYSIAN CONSTRUCTION INDUSTRY

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Abstract:
Construction waste has a major impact on the environment. With the demands in implementing major infrastructure projects in Malaysia, together with many commercial building and housing development programmes, a large amount of construction waste is being produced by the construction sector. The construction industry is responsible for producing a whole variety of waste, the amount and type of which depends on factors, such as the stage of construction, type of construction work and practices on site. Thus, waste minimization is an important area of concern in the implementation of construction waste management in the construction industry of Malaysia. Extra construction materials are usually planned due to the lack of consideration given to waste reduction during the planning and design stage to minimize the generation of waste. The excessive wastage of raw materials, improper waste management and low awareness of the need for waste reduction are common in the local construction sites. This paper was presented an overview on this issue. As results, it has found out the importance of materials control that is materials storage management able to increase profitability, minimizing the wastage, improve working efficiency and others.

Keywords: *Material waste, storage, construction industry, Malaysia.*

1. Introduction

Since the environmental issue is in concern globally, waste generated by industrial operations need to be categorized in list of concern too as waste levels indicate the appreciation of use of environment natural resources. Among those industry operations, construction industry also contributes a significant waste to the overall waste volume annually for majority country. Construction waste can occur at every stage of the activities but most of those involved in the operation do not aware of that. Waste level for initial stage of construction activities can be low and the most significant waste level can be observed during the construction phase especially on site where most of the resources are being used in this stage. New concepts of waste control are being applied in many countries nowadays. Material Storage Management (MSM) is in great concern. These are all done to ensure the waste is being controlled as well as the environmental condition is being protected. It is no longer a new and hot issue in the current local construction trend, but yet not all of the local construction company practicing fully the scope of this management system. Theoretically, MSM approaches do contribute to work

performance improvement and waste reduction. However, the extent on how much have the local contractors follow on this aspect in controlling their waste, it is really doubtful. Since this Material Storage Management with its aim to reducing waste and increasing performance production, this is an added advantage to the contractor in maximizing their profitability as waste can be reduced. Therefore, the focus will be aiming in clarifying the advantages provided by implementation of Material Storage Management and also the effect on waste minimization. The extent of implementation can be investigated among the local construction companies. This paper emphasised on some of the items in the material control system such as materials obtaining, materials planning, materials scheduling, materials purchasing, materials delivery and checking, materials handling and materials storage. In order to provide a clear understanding to the materials control, some details on this from literature reviews are provided in brief.

2 Literature Review

2.1 Issue of Waste in Malaysia

Some waste is unavoidable even under perfect conditions of design and construction. But excessive waste is common in the construction process and has received lack consideration by contractors or the industry. The waste levels in Malaysia is considerably high and from the Malaysia Environmental Quality Report 2005 we may find that waste may be generated and treated in many forms. "Based on notification received by the Department of Environment (DOE), a total of 548,916.11 metric tonnes of scheduled wastes were generated in 2005 as compared to 469,584.07 metric tonnes in 2004. Oil and hydrocarbon, mineral sludge and dross were the main categories of waste produced in the country. The breakdown according to waste categories and industry types are given in (Table 1, 2 and Figure1, 2 respectively). Of the total wastes produced; 85,734.92 metric tonnes (15.6%) were treated and disposed at Kualiti Alam Sdn. Bhd., 8,423.26 metric tonnes (1.5%) were treated and disposed at Trinekens (Sarawak) Sdn. Bhd., 17,650.01 metric tonnes (3.2%) of clinical wastes were incinerated at licensed off-site facilities, 5,224.00 metric tonnes (1.0%) were exported for recovery purposes, 149,569.99 metric tones (27.2%) of scheduled wastes were recovered at off-site facilities, an estimated 120,345.25 metric tonnes (21.9%) were treated on-site and 161,968.68 metric tones (29.5%) were stored onsite at waste generators' premises. Six land farms and 16 on-site waste incinerators had been licensed by DOE to allow for on-site treatment and incineration respectively." (Malaysia environmental quality report, 2005).

Table 1 DOE: Quantity of Scheduled Wastes Generated by Category, 2005

Waste Category	Quantity of Wastes (Metric Tonnes/Year)	Percentage (%)
Oil & Hydrocarbon	122,783.05	22.4
Mineral Sludge	86,007.31	15.7
Dross/Slag/Clinker	83,030.59	15.1
Heavy Metal Sludge	73,654.84	13.4
Clinical	37,507.57	6.8
Batteries	33,324.11	6.1
Spent Solvent	26,449.97	4.8
Used Containers	25,009.32	4.6
Acid & Alkali	17,884.45	3.3
Mixed Wastes	11,086.68	2.0
Paper & Plastic	9,968.84	1.8
Others	9,431.76	1.7
Catalyst	6,572.31	1.2
Ink & Paint Sludge	2,465.17	0.4
Rubber Sludge	2,031.15	0.4
Phenol/Adhesive/Resin	1,708.99	0.3
Total	548,916.11	100.0

Table 2 DOE: Quantity of Scheduled Wastes Generated by Industry, 2005

Type of Industry	Quantity of Wastes (Metric Tonnes/Year)	Percentage (%)
Electronic	129,861.89	23.7
Chemicals	124,285.57	22.6
Automotive/Workshop	67,259.12	12.2
Others	58,231.60	10.6
Metals	54,100.02	9.9
Industrial Gas	42,161.14	7.7
Pharmaceutical	33,238.81	6.1
Petroleum	23,283.25	4.2
Wood Based	8,320.94	1.5
Rubber & Plastic	5,534.46	1.0
Printing & Packaging	2,639.36	0.5
Total	548,916.11	100.0

Figure 1. DOE: Quantity of Scheduled Wastes Generated by Category, 2005

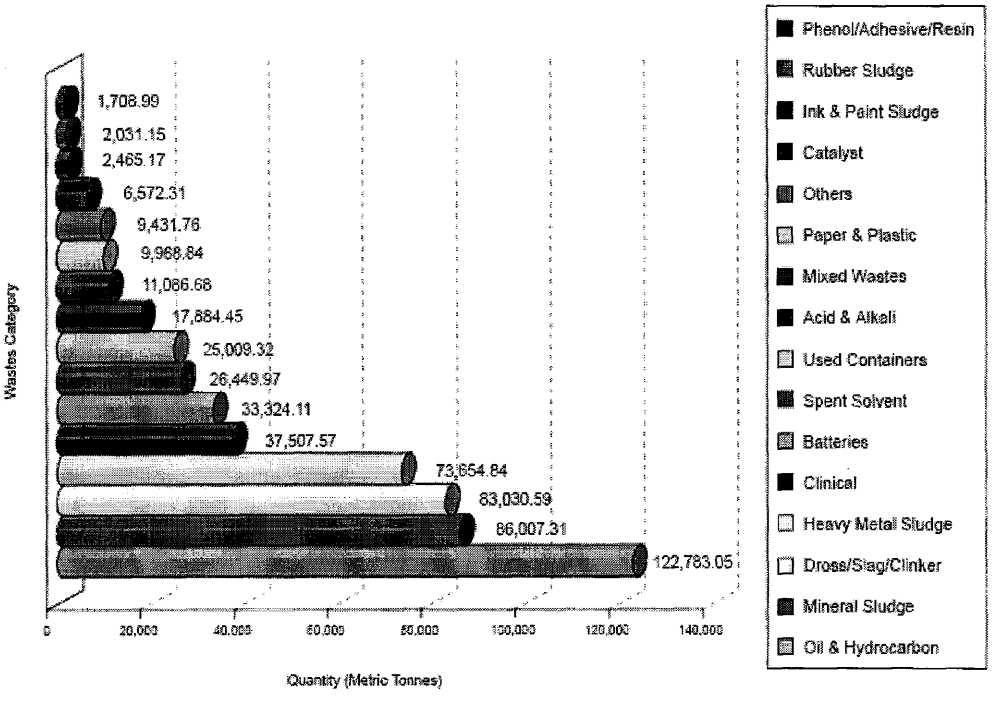
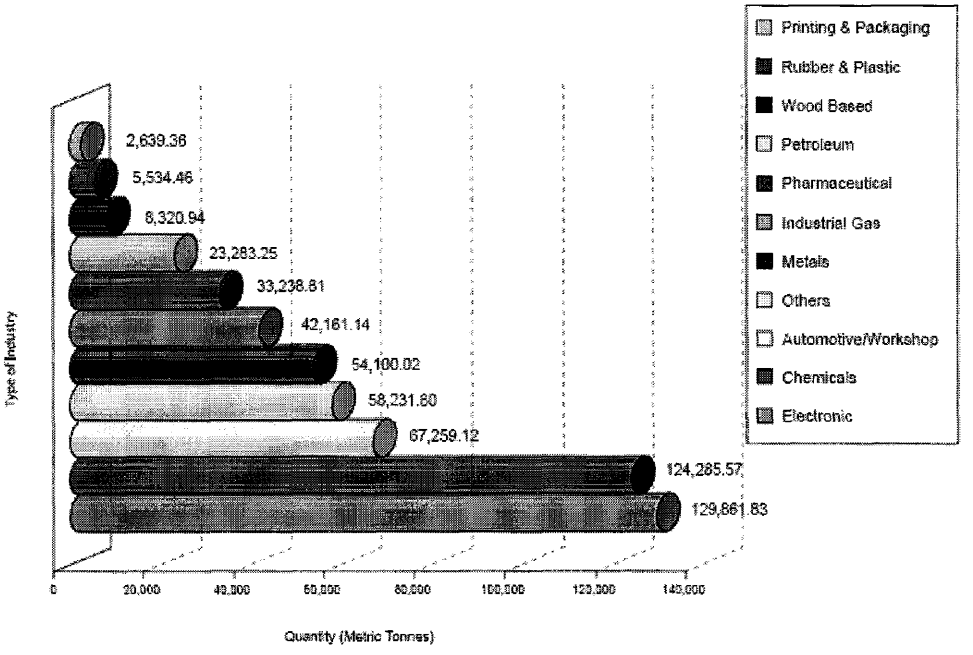


Figure 2. DOE: Quantity of Scheduled Wastes Generated by Industry, 2005



2.2 Material Waste

Generally, material waste has usually been understood to be the "difference between the material delivered to site and that placed or fixed properly in a building" (Englemere *et al.*, 1980). According to De Silva and Vithana (2008) cited by Skoyles (1987) "Material wastage means the different between material delivered to site and those fixed or placed in the building". Both statements above giving the same definition but they are unsatisfactory as it does not take into account of material waste before delivery or material not used for their intended purposes or may be used at other parts of the work. They are not a total loss. Therefore, the result is over-estimates of the true loss, for example, facing brick being used as common brick in brickwork. It also does not take account of subsequent or inefficiencies caused by waste, for example, delays and deterioration of work while damaged or missing materials are replaced. An acceptable definition of waste is "the difference between the value of those materials delivered and accepted at site and those properly used as specified and accurately measured in the work, after deducting the cost saving of substituted materials and any materials transferred elsewhere (Englemere *et al.*, 1980). It means that by having deducted for the quantity of materials delivered on site with the total material used for the construction activities with resulting the net wastage on site. Thus, it does not include the wastage that occurs before delivery except where improper i.e. damaged, deficient or wrong materials are accepted at the site. The loss is expressed as a percentage. It should be noted that the above definition includes waste from the "conversion" process but it does not includes waste occur before delivery except where improper materials are accepted at site, for example, damaged, deficient or wrong materials. It also does it include the consequential and indirect cost arising from waste. This indirect waste is excluded from the definition because it is difficult to assess the true values of waste. Therefore, it is required to define other forms of waste so that they can be accounted for, and the industry's true waste can be measured. According to the Institute of Civil Engineer, the construction industry is a major generator of waste, which generating more waste than the household sector. Waste occurs on site for a number of reasons, resulting from all building operations particularly from bad stacking at the work place. Such like misinterpretation of drawings, over estimating the quantity

during taking-off, faulty workmanship, carelessness in handling material, and etc. All these events will subsequently causing waste in money; scarce resources as well as time spend for making remedy and correction action.

The Environmental Protection Act 1990 UK (EPA 90) Section 75 defines waste as:
1. Any substance which constitutes a scrap material or an effluent, or other unwanted surplus substance arising from the application of any process.
2. Any substance or article which requires to be disposed of as being broken, worn out, contaminated or otherwise spoiled, but does not include a substance which is an explosive.
3. Anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste unless the contrary is proved. From the point of view of the contractors, wastage means the total loss of building materials or components arising from avoidable or unavoidable material waste however caused. Any handling deficiencies, misuse of materials and etc, which will cause extra cost for replacing the particular materials, will consider as wastes. In any construction project, no matter it is commercial or residential, high rise or low rise, building work or civil work, the concern will be put into how to minimize the wastage as little as possible so to achieve the optimum profit in return. However, this dissertation only covers the waste in materials storage.

2.3 Definition of Material Storage Management

Material Management can be defined as integrated management system for planning, controlling or redirecting efforts to achieve a smooth, timely, efficient flow of materials to the project in the required quality, the required time, and at an acceptable price and quality (Strukhart, 1995). Material Storage Management a sub part of Material Management. According to the American Production and Inventory Control Society (APICS), Material Storage Management is defined as the grouping of management functions supporting the cycle of materials flow, from material receipt, store, handling and distribute to point of use. Material Storage Management also can be defined as an organizational concept that includes the planning, organizing, coordinating and controlling the activities concerned with the flow of materials in the storage process, which includes in construction. With the reference to Crittenden& Kolaczkowski (1995)., they defined Material Storage Management as "the total of all those tasks, function, activities and routines which concern the transfer of external materials and services into the organization and administration of the same until they are consumed or used in the process of production, operations or sales." Although this definition is defining the general material management for the sake of manufacturing, not specify for construction industry. But the same concept can be relate to the construction, where it concern the guidelines of all the activities that carry out on site for which involving the storing and transferring of materials into the activities until the building has been properly built.

3. Discussion

Some waste is inevitable under ideal conditions of design and production. But excessive waste always occurs in the construction process and has never received proper consideration by most constructors or the industry at large. Responsibility for waste concerns all members of the building team. It concern general management as well as site management, while any solution to the problem must involve site practice, it involve all managers in building organization, which is not only the site manager. Waste is not only a site problem; it extends to every part of the industry and in some cases outside it. Considerable waste occurs if the design information available is inadequate or incomplete when construction work has to begin such a situation frequently occurs in the construction industry. Waste on site is not always avoidable by those who engaged in site operations. It may be caused by the nature of the site, the design priorities, the forms of contract used, the various terms and conditions of contract documents, the design and packaging priorities of the manufacturers and suppliers and the methods of materials handling provided. Therefore, the control of waste is vitally both on and off site. The designer and contractor can contribute towards a better

understanding of the need for positive action and direction in the restrain of material waste. The cause of waste is viewed and categorized under three stages in the construction process, which is: Documentation stage, Pre-contract stage and Construction stage.

4. Material Storage Management

The construction industry has changed considerably in recent years, influencing production rates, construction techniques and the total quantity of materials used each year. The more complicated the project, the larger volume of materials is being used. Therefore, effective Materials Storage Management is essential to suit the current trend. Some of the construction management still does not fully appreciate that materials waste means financial loss and unnecessary increase the production price. Without an effective Materials Storage Management being practiced, the problems associated with poor materials handling, delivery, wastage and storage arise consequently. As a result, Material Storage Management is indeed deeded in construction industries as shown in the following:

a) Low profitability
The profitability of a project can be influenced by the cost of materials. Large costs can be saved from the materials since it contributes to a substantial value of a project. As a rule of thumb, the higher level of wastage, the lower profitability of the project. Therefore, sound Material Storage Management is needed to maximize profitability of a project.

b) Construction time delay
The delay of construction work may occur when wrong types or quality of materials are used and the time spent for the re-construction and replacement for the goods. Another cause of delays is damages during the transit of materials, shortage of materials, and late delivery of materials and so on. Without proper planning in Material Storage Management, the project is likely to be delayed.

c) Low productivity
Poor Materials Storage Management will affect productivity. For example, a congested site with materials not properly allocated will create a lot of double handling works and obstruct the operation works. The productivity of the work will be reduced with shortages and delay of materials supply that disrupt program.

d) High level of materials wastage
Due to poor storage system, materials are exposed to damage, loss, vandalism etc. Higher level of wastage may be occurring due to over order or under supply of materials. A lot of materials are being wasted due to poor handling system and poor workmanship.

e) Poor materials storage
When the materials are not in properly arranged, it may cause damage to materials and obstruct the handling of mechanical plant. Materials should be unloaded and stored near to the point of use to prevent double handling of work. Without proper planning a location of materials storage, the site may be congested and affect site accessibility. There is always a tendency for some of materials to be stored in wrong place. For example small and valuable items like door closers and lockset, which are always stolen by workers or sub-contractors when stored in an open store.

f) Materials shortage or excesses on site
Without proper planning of ordering and delivering of materials, there is a high tendency facing the shortage of materials in site. Excess of materials delivered to site creates lot storage problems, if the materials are delivered too early on site; the risk of materials damaged by progressing works is high.

5. The Concept of Material Storage Management

Neither the terminology nor the concept of a totally integrated materials organization has so far been accepted by all business throughout the world. Companies use different names, such as "Materials Storage Management", "Logistics" or "Physical Distribution" for similar originations. Despite numerous names, the trend in recent year shows that local companies tend to adopt the Materials Storage Management or Logistics Management titles. The Materials Storage Management concept

involves planning, purchasing, storages or inventory, distribution and transport. The organization and its staff have to consider their decisions in relation to the effects of Materials Storage Management. Materials contribute a significant portion of the total cost of good and services. Therefore, increasingly companies are recognizing the need to implement effective Materials Storage Management in the organization to reduce wastage, maximize profits, establish needed controls and reduce costs. In a common Materials Storage Management concept there are a few key integrated areas:

a) Planning
Short and long term planning strategies are vital to every company. The primary objective is to maximize the use of company resources and provide for future demand.

b) Inventory Control
Inventory control includes activities and techniques required to maintain materials at desired levels.

c) Purchasing
Purchasing is responsible for procurement of materials from outside suppliers, in accordance with purchase requisition requirements.

d) Receiving and Stores
Receiving and stores is responsible for activities related to receiving, storing, storing handling, issuing and controlling materials.

e) Materials Handling
Materials handling involve physical movement. It is the function of developing and implementing appropriate manual, mechanized and automated systems to provide movement of materials throughout the company's various processes.

g) Physical Distribution
Physical distributing encompasses all the operations involved in the movement and flow of materials, from store yard to the point of use. Materials Storage Management rely on close cooperation and coordination of all these sub functions. If an individual sub-function fails or is ineffective, the effectiveness of the entire organization is tended reduced which mean bottleneck build up in the logistics chain.

6. Conclusion

Waste occurs throughout the industry irrespective of the size of the building organization, the value and duration of the contract or the variety of building type. Waste is not always avoidable. Well-established waste minimization model by construction companies and adoption of it will help much on it. It is difficult to determine the effectiveness of the materials control due to no best way to assess the effectiveness of the materials control. However, on a general note the effectiveness of a Material Storage Management scheme can be enhanced greatly, if the overall program is reviewed in advance against the characteristics of the project. Materials storage management had been introduced to increase the profitability of a project by reducing the construction wastage. It involves those activities such as planning, scheduling, purchasing, receiving and checking, handling, storing, distributing and etc. Attention should be given to each of these activities in order to minimise the construction wastage. Those individual activities in the materials control system shall co-operate with each other to make the materials control successfully. There is seemingly an endless variety of ways to organize and plan a project. We can only categories the approach adopted is good, better or best. Of course, the best system used can earned higher profits. Wastage is unavoidable in construction work, owing to materials contribute a major cost of a project; an effective control system of it. definitely will influence the profit margin. Especially, under the pressure of economic recession, a wisely approaches dealing with materials costs and good management on their resources will affect the contractor status in this competitive environment. After carried out this research, it has found out the importance of materials control that is materials storage management able to increase profitability, minimizing the wastage, improve working efficiency and others. Through working efficiency, materials control system also can increase productivity to be globally competitive with stable systems of rules, regulations and procedures in high level of initiative.

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CAUSES OF DELAY IN CONSTRUCTION INDUSTRY IN LIBYA

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Abstract
Delays are one of the biggest problems construction firms face. Delays can lead to many negative effects such as lawsuits between owners and contractors, increased costs, loss of productivity and revenue, and contract termination. Even though various studies have been considered into the causes affecting delays, these studies seldom discuss common and general causes of delays in construction projects. Thus, comprehensive study on these delays is essential. Since the problems are rather contextual, the study needs to focus on specific causes of delaying like insufficient coordination and ineffective communication between involved parties in construction projects located at Benghazi City in Libya. Literature review and a questionnaire survey targeted at construction projects in the Libya's country and have been used as the tools to carry out this study. This paper presents the findings of a survey aimed for identifying some of the most important causes of delays in construction projects in the above mentioned city. It is hoped that these findings will guide efforts to enhance the performance of the construction Industry. This paper also explores and provides some guidelines and actionable information which can be led to enhance the construction process.

Key words: *Causes of delay, construction projects, Integration mechanism, Al Zentan City, Libya.*

1. Introduction

The Libyan construction industry contributes less to the country's economy than do manufacturing or other services industries. Officially, construction accounted for only 2.1 % of the annual gross domestic product (GDP) (The Economist intelligence, 2003). However, the growth influenced the country's economic development. As defined in developed counties (Hillebrandt, 1985), construction is considered unique in that it can stimulate the growth of other industrial sectors. Hence to consider growth of the construction industry in terms of its contribution to GDP in isolation is somewhat misleading that is ,to do so understates the crucial role played by construction .Therefore ,improving construction efficiency by means of cost-effectiveness and timeliness would certainly contribute to cost saving for the country as a whole .Effort directed to cost and time-effectiveness were associated with managing time and cost, which in this study was approached via investigating causes of delay at construction projects in Libya. Like other developing countries ,such as Nigeria (Okpala and Aniekwu,1988; Elinwa and Buba,1993; Mansfield *et al.*, 1994), Saudi Arabia (Assaf *et al.*, 1995) and_Malaysia (Yong, 1988). Libya

suffers construction time and cost overruns the intentions of this paper therefore are:

1. To identify the major causes of delays in construction project in the city of Al Zentan, Libya.
2. To identify the effects of delays in construction project.
3. To recommend strategies for improving project delivery based on the findings of the study.

The construction industry is large, volatile, and requires tremendous capital outlays. A unique element of risk in the industry is the manner in which disputes and claims are woven through the fiber of the construction process. Delays occur in every construction project and the significant of these delays varies considerably from project to project. Bramble and Callahan (1987) have defined that ; " a delay is the time during which some part of the construction project has been extended or not performed due to an unanticipated circumstance. " An incident of delay can originate from within the contractor's organization or from any of the other factors interfacing upon construction project. Some projects are only a few days behind the schedule; some are delayed over a year. So it is essential to define the actual causes of delay in order to minimize and avoid the delays in any construction project. Many and various studies were carried to assess the causes of delays in construction projects. Ogunlana *et al.*, (1996) studied the delays in building projects in Thailand, as an example of developing economies. They concluded that the problems of the construction industry in developing economies could be nested in three layers: (1) problem of shortages or inadequacies in industry infrastructure, mainly supply of resources; (2) problems caused by clients and consultants; and (3) problems caused by incompetence of contractors. Kumaraswamy *et al.*, (1998) surveyed the causes of construction delays in Hong Kong as seen by clients, contractors and consultants, and examined the factors affecting productivity. The survey revealed differences in perceptions of the relative significance of factors between the three groups, indicative of their experiences, possible prejudices and lack of effective communication. Mansfield *et al.*, (1994) studied the causes of delay and cost overrun in construction projects in Nigeria. The results showed that the most important factors are financing and payment for completed works, poor contract management, changes in site conditions, shortage of material, and improper planning. Assaf *et al.*, (1995) studied the causes of delay in large building construction projects in Saudi Arabia. The most important causes of delay included approval of shop drawings, delays in payments to contractors and the resulting cash-flow problems during construction, design changes, conflicts in work schedules of subcontractors, slow decision making and executive bureaucracy in the owners' organizations, design errors, labor shortage and inadequate labor skills. Mezher *et al.*, (1998) conducted a survey of the causes of delays in the construction industry in Lebanon from the viewpoint of owners, contractors and architectural/engineering firms. It was found that owners had more concerns with regard to financial issues; contractors regarded contractual relationships the most important, while consultants considered project management issues to be the most important causes of delays. Abdullah & Battaineh (1999) evaluated the progress reports of 164 building and 28 highway projects constructed during the period 1996-1999 in Jordan. The results indicate that delays are extensive: the average ratio of actual completion time to the planned contract duration is 160.5% for road projects and 120.3% for building projects. Al-Momani (2000) conducted a quantitative analysis of construction delays by examining the records of 130 public building projects constructed in Jordan during the period of 1990-1997. The researcher presented regression models of the relationship between actual and planned project duration for different types of building facilities. The analysis also included the reported frequencies of time extensions for the different causes of delays. The researcher concluded that the main causes of delay in construction projects relate to designers, user changes, weather, site conditions, late deliveries, economic conditions, and increase in quantities. Ogunlana (1995) presented a paper on method for computing activity delays and assessing their contributions to project delay. The method consisted of a set of equations, which could be easily coded into a computer program that would allow speedy access to project delay information and activity contributions. There has been a considerable and continued interest on the effects of construction delays. The information available is diverse and widespread. Despite the necessity for such research, little work has been described in the literature concerning

public projects. The previously proposed factors contributing to construction delay were frequently observed in public projects. The actual frequency and magnitude of these factors is not known, which has proven to be a serious and very expensive problem for the construction industry. The main objective of this study is to identify the main causes of delays in construction projects in Al Zentan City, Libya through a survey and recommend few procedures to avoid it.

2. Delays in Project

Many construction projects suffer from delay. Suspension means stoppage of work directed to the contractor by a form from the client, while delay is a slowing down of work without stopping it entirely (Bartholomew, 1998). Delays give rise to disruption of work and loss of productivity, late completion of project increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to reduce the possibility of delay occurrence or identify it at early stages (Martin, 1976). Construction planning has to be a much more decentralized activity to cope with the inherently uncertain nature of task duration. However, Ballard and Howell (1998) argued that construction planners should make only "quality assignments" where tasks not meeting these criterias: (1) sufficiently well defined (to be coordinated with other work and the inputs to be identified and assembled); (2) are ready to start (material, design, and precedent works complete); (3) have priority in the critical path for delivery to the customer; (4) are commensurate in scale with the available labour for the coming week; and (5) are carried out within a system where the causes of incomplete or poor quality assignments are investigated and identified, should be deferred. Monitoring gives early warning of the possibility of contractor's delays and helps in anticipating the consequences of changes that may be needed (Cleland, 1999; Abdul-Rahman and Berawi, 2002). Young and Jinijoo (1998) explain that top management support is required and this can be defined as the willingness of top management to provide necessary resources, authority, and power. Decision making at the right time is important especially with a fast-trak project in preventing delays because the concept of using fast-tracking can be applied to traditional contract projects whereby construction starts prior to completion of the design/contract document (Ahuja et al., 1994). Decision making process is used as the key to effective project management especially in value and risk analysis (Stuckenburck, 1982).

3. Types of Delay Causes in Construction Projects

There are two categories of delays used in determining delay damages:

3.1 Inexcusable delays (Non- Excusable delay) are caused solely by the contractor or its suppliers. The contractor is generally not entitled to relief and must either make up the lost time through acceleration or compensate the owner. This compensation may come about through either liquidated damages or actual damages, providing there is no liquidated damages clause in the contact. Liquidated damages are generally expressed as a daily rate that is based on a forecast of costs the owner is likely to incur in the event of late completion by the contractor.

3.2. Excusable delays

3.2.1 Non-compensable delays are caused by third parties or incidents beyond the control of both the owner and the contractor. Examples typically include acts of God, unusual weather, strikes, fires, acts of government in its sovereign capacity, etc. In this case, the contractor is normally entitled to a time extension but no compensation for delay damages.

3.2.2 Compensable delays are caused by the owner or the owner's agents. An example of this would be the late release of drawings from the owner's architect. An excusable, compensable delay usually leads to a schedule extension and exposes the owner to financial damages claimed by the contractor. In this case, the contractor incurs additional indirect costs for both extended field office and home office overhead and unabsorbed home office overhead.

4. Methodology

The objectives defined in the preceding section were achieved through the accomplishment of the following tasks: The preliminary data for this research was collected through a literature review and the use of a

questionnaire survey targeted at some contractors, clients and consultants in some projects in Libya. The literature review was conducted through books, conference proceedings, the Internet, and international project management journals. In this step, some of the causes for delays that may be encountered in a construction project were identified. The causes of delays are then classified into six broad categories (acts of God, design-related, construction-related, financial/economic, management/ administrative, code-related) depending on their nature and mode of occurrence. The data collected though questionnaire surveys are analyzed and recommendations are made to mitigate the delays.

5. Results & Discussion

Table 1 presents the results of factor analysis of the items of contractor's factors that cause delay in construction projects and their ranking as a whole. Based on the mean value criterion, the first ranking seemed to capture the respondents' general felling that it is improper planning that are the major factor that causes delay in construction projects in Benghazi city. Followed by "lack of effective communication" as the second ranked factor which caused delays, this finding can be agreed with what found by Frimpong *et al.,* (2003). The factors "Shortage of Supply i.e. steel, concrete, etc." and "Design Errors" seem to be the third-ranked factors that cause delays in construction projects in Libya. Consequently, factors such as "Slow Decision Making" and "Financial Issues" were ranked fourth. Abdul-Rahman et al., (2006) conducted a stud on delay mitigation in the Malaysian construction industry; they proved that a financial problem is confirmed by the survey as the main causes of delay. The next important factor that causes delays in construction projects in Libya is "Shortage of Material", it was ranked as number fifth.

Table 1. Factors influencing delays in construction projects in the city of Zentan

Factors	Mean	SD
Improper Planning	5.0	0.3
Lack of Effective Communication	4.7	0.4
Design Errors	3.8	0.4
Shortage of Supply i.e. steel, concrete, etc.	3.8	0.4
Slow Decision Making	3.7	0.5
Financial Issues	3.7	0.5
Shortage of Material	3.6	0.9
Cash-Flow Problems During Construction	3.6	0.8
Increase in Quantities	3.5	0.8
Mismanagement by The Contractor (Financial, Supplier Support, Sub-Contractor)	3.5	0.7
Executive Bureaucracy in The Owners' Organizations	3.4	0.8
Notification of Extra Work	3.4	0.5
Changes in Site Conditions	3.3	0.8
Date of Notice to Proceed	3.3	0.5
Financing Matters	3.2	0.7
Payment for Completed Works	3.2	0.7
Indicative of Experiences	3.1	1.0
Conflicts in Work Schedules of Subcontractors	3.1	1.0
Contractors Regarded Contractual Relationships	3.1	0.8
Late Confirmation from Client and Consultant Regarding Cost, Quality and Time	3.0	0.6
Experience of Project Team	3.0	0.8
Quality Assurance / Control	3.0	0.8
Long Period for Approval of Tests and Inspections	3.0	0.8
Political Influence	2.9	1.0
Social Influence (Feedback From Resident) EIA	2.9	1.0
Failure of RIBA Plan Of Work Application	2.8	0.8
Site Accidents	2.8	1.0
Negligence	2.8	0.7
Project Management Issues	2.8	0.8
Late Deliveries of Materials and Equipments	2.8	0.9
Economic Conditions	2.7	0.9
Changes of Design	2.7	0.8
User Changes	2.6	1.2
Liquated Damage (LAD)	2.6	0.6
Negotiation During Construction	2.6	1.0
Designers	2.3	0.9
Mistakes During Construction	2.2	0.6
Possible Prejudices	2.2	0.7
Changed Orders and Mistakes and Discrepancies in Contract Documents	2.0	0.8
Dispute (Variation Order)	1.8	0.4
Religions Factors	1.7	0.7
Weather Condition (*Force-Marjue*)	1.6	0.5
Conflicts of the Drawing and Specification	1.6	0.0

5.2 Steps to avoid these delays?

Table 2 shows that making risk management is ranked as an important factor to avoid delays in construction projects in Libya. Followed by proper planning as the second factor which need to be considered to avoid delays. A research by Abdelnaser *et al.*, (2005) proved that in order to avoid delays during construction stage, you should make proper planning.

Table 2. Avoidance of delays in construction projects in the city of Zentan

Factors	Rank	Mean	SD
1. Making Risk Management	1	4.9	0.33
2. Proper Planning	2	4.7	0.67
2. Proper Payment from Client	2	4.7	0.48
3. Prepare Insurance Claims	3	4.2	0.58
3. Good Scheduling Programme	3	4.2	0.41
4. Client Representative for Project	4	3.5	0.50
4. Selecting Expert Understand Their Assignment	4	3.5	0.50
5. Clear Contract and BQ	5	3.3	0.48
5. Compute the Amount of Financial Damages	5	3.3	0.48

5.3 The Impacts of the delays on construction projects in the city of Zentan

An analysis is needed to identify the impact of delay on time and cost followed by taking the appropriate action to ease delay and minimise the cost required (Clogh, 1981). It is important to improve the estimated activity duration according to the actual skills levels, unexpected events, efficiency of work time, and mistakes and misunderstanding (Lock, 1996). However, from the study which curried out in Benghazi city in Libya, it was clear that "lost of interest by the stakeholder" ranked by the respondents as one of the most important factors which has an impact in construction project delays (Table 3).

Table 3. Impact of delays in construction projects

Factors	Rank	Mean	SD
1. Lost of Interest by the Stakeholder	1	4.9	0.3
2. Blacklist by Authorities	2	4.6	0. 8
3. Waste of Money and Time	3	4.3	0.7
4. Declination of Reputation	4	4.1	0.6

6. Conclusion

Construction delay is a critical function in construction projects. Projects investigated in this study exhibit a delay in some construction sites in Benghazi city in Libya. In practice, this phenomenon is expected to continue unless management actions are taken to control these causes within the planned element of the design and construction works. Thus, good practice in planning, coordination, and the change of the control procedures of the public institutions needs to be recognized and the implications understood. We believe that the arguments and findings presented in this study provide a good guidance for managerial intervention, and provide some guidelines and actionable information that managers can utilize to manage their projects. In summary, this paper summarized some reasons behind the delays caused in these sites and proposes some recommendation, which might enable the contractor organization to develop in house competitiveness for the achievement of one of the major goal in construction of a project, on 'time' completion. Further research is needed to investigate the limitations and potential improvements to causes of delays within each construction site.

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CONTRACTOR BUSINESS STRATEGY DECISION IN COMPETITIVE BIDDING: CASE STUDIES

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Abstract

The purpose of this paper is to examine the relationship between relevant parties and contractors regarding the bidding decision during bidding process. The game theory can be a tool for contractors' business decision. This paper will define the business strategies that are demonstrated by contractors and the bidding decision was determined by using the bid model based on game theory. A company might win a tender over its competitors basically because other competitor has submitted the dangerously lowest price or higher price. The bidding process us crucial problem for contractors because involving the complicated decisions and strategies. Bid / no bid decision and mark-up price/ bid price would be two critical items for contractors. Case studies been conducted and a game tree/ decision tree analysis on their current business strategies were undertaken. It is proposed that a bid model (game theory) would be able provide a systematic support system to help the contractors define their business strategies decision in competitive bidding.

Keywords: *Contractor; Business strategy; the game theory; Competitive bidding; Construction companies*

1. Introduction

The ability to understand bid or not decision and predict markup price to make profit is of fundamental importance for the survival and progress of any contractor. Business profitability is closely related to the willingness and ability of businessman to invest and employ. In order to increase the understanding of the bid decision and markup price, there are literature review have been made and examines these factors that influence the firm's business strategy in competitive bidding. As a result it is believed that the game theory is closely related to contractor's decision and that the bid decision and markup price have a vital impact on the contractor's business strategy. The concept of strategy in business is analogue to that in war. Strategy as an area management is concerned with the general direction and long-term policy of the business as distinct from short-term tactics and day-to-day operations (John, 1985). It used to be said that it was more important to 'do the right things' than to 'do things right'. In order words, strategy was more important than management of day-to-day operations. This was probably true during early 1990s when the economy was expanding and property boom of this period, even poorly managed companies found it easy to make profits. The financial crisis that started in July 1997 which affected currencies, stock markets, and other asset prices in East Asian, the market become more turbulent and competitive. While it is still true that a strategy which positions a company badly compared to its competitors can lead to its failure, it is also true that poor day-to-day management can have the same effect. Success will be achieved only by both good strategy and sound day-to-day management (Houlden, 1990). The methods are to be used by each of the functional areas of the organization in carrying out the business strategy is called functional strategies (Bryars, 1990). Functional strategies are direct to the specification and require much more participation of the staff. These are fulfilled by the contractor firms in term of

the competitive tendering process characteristic which are specific, technical and commercial process, Bryars indicated that the complement of each strategy for each of the functional is needed all the time to support the business strategy. The functional strategies are marketing, finance, production/operation, human resource and research and development. Liew (1994) highlighted 8 items important business factors taken into account in selecting the business strategies for contractors firms; risk, company image, market prospect, timing, long-term environment threat/ opportunities, profit potential, market growth and company strengths/weakness (see Table 1). There are not varying between Bryars and Liew in the business factors selection. **I** defined that Liew's business factor strategies are extension of Bryar's functional strategies. **I** placed Liew's business factor strategies can be incorporated into Bryar's functional strategies.

Table 1. Categories Liew's business strategies (1994) into Bryars's business strategies with features' explanation

Business Factor	Features	Functional Strategies
Risk	Risk is the potential harm that may arise from some present process or from some future event. Financial risk is often defined as the unexpected volatility or volatility of return.	Finance
Profit Potential	Profit potential helps business of all size in all categories maximizes profit by identifying issues.	Finance
Timing	Timing is a strategy of attempting to predict market.	Marketing
Company Image	Effort to reinforce company identity, build brand awareness and company good reputation.	Marketing
Market Prospect	Ability to increase company consumption to the client.	Marketing
Company Strengths and Weakness	The company strengths and weakness may give a signal deterring entry to certain market.	Marketing, Finance
Market Growth	Objective assessment of the market environment.	Marketing
Opportunities	Marketing	Marketing

2. Game Theory

Game theory has become an enormously important field to study. I is now a vital methodology for researchers and teachers in many disciplines, including economics, political science, biology and law. What is game theory anyway? I highlighted where game theory could be useful in analyzing and understanding the contractors' business strategy decision. There are several different answer to this question.

- the study of multi person decision problems (Gibbons, 1992).
- a bag of analytical tools designed to help us understand the phenomena that we observe when decision-makers interact (Osbeone and Rubinstein,1994)
- the study of mathematical models of conflict and cooperation between intelligent rational decisions-makers (Myerson,1997)

Game theory is a distinct and interdisciplinary approach to the study of human bahaviour. The discipline must involved in game theory are mathematics, economics and the behavioral science (Huang and Wu, 1994). Making business decisions requires many different skills and area of knowledge: financial, organizational, marketing, economic, legal and operational. Contractors increasingly have to make decisions will directly affect the profits of their firm's rivals or allies. In such strategic interactions, contractor must be able to think strategically. There are three assumptions that we made throughout the paper:

1. Each player in the market acts on self-interest. They pursue well-defined exogenous objectives; i.e., they are rational. They understand and seek to maximize their own payoff functions.
2. In choosing a plan of action (strategy), a player considers the potential responses/reactions of other players. He or she takes into account her knowledge or expectation of other decision makers' behaviour; i.e., his or her reasons strategically.
3. The rules of game are common knowledge, which is each player knows the rule of the game. The players know each others as well.

A game describes the outcome of each player depends upon the collective actions of all players involved. In order to describe the collective action, we need to know:

- The players who are involved.(Contractors)
- The rules of the game that specify the sequence of moves as well as the possible actions and information available to each player whenever they move.
- The outcome of the game for each possible set of actions.(bid/no bid decision and profit margin)
- The payoffs function based on the outcome.

The prisoners' dilemma is a well-known example and is motivated by the following story. Two suspects are taken into custody. The district attorney is convinced that they are guilty of a certain crime but does not have enough evidence to convince a jury. Consequently, he separates the suspects and tells each other one that he has two choices; to either confess or not confess to the crime. The suspects are told that if both confess, neither will receive special consideration and will therefore receive a jail sentence of five years. If neither confesses, both will probably be convicted of some minor charge and have to spend one year in jail. but if one confesses and the other does not, the suspect who confesses will be set free for cooperating with the state while the suspect that does not will have the book thrown at him and a ten years sentence. The game theory is the strategy application tool that can be applied everyday and everywhere. In a school mathematic competition, if the teacher wants to nominate the student in his class to take part of the event, he needed to choose one student among Malay, Chinese and Indian students in his class. He knows that other two classes were represented by Chinese student and Indian student, while the mathematic question is in Bahasa Melayu form. He noticed that Malay students are strong in Bahasa Melayu and a bit weak in Mathematic, while Chinese student are strong in Mathematic and weak in Bahasa Melayu. Indian student are weak in both. If he choose Chinese student in his class to participate the competition event, it was been 50-50 chance for each other to win the competition because both are strong in mathematic. If he choose Malay student, it might win the competition due to the mathematic question is in Bahasa Melayu form, the Indian student can be excuse in any case. Let me use the game theory to tell the story of the school Mathematic competition. We represent nodes by solid black circles and branches by arrows connecting the nodes. A properly constructed tree is called an extensive-form representation.

2.1 Representation of Game

The game studied by game theory is well-defined mathematical objects. A game consists of a set players (1,2 or more0),a set of move/information set (or strategies) and a specification of payoffs for each combination of strategies. There are two ways of representing game that are common in the literature; normal form and extensive form.

2.1.1 Normal Form

The normal (or strategic form) game is a matrix which shows the players, strategies and payoffs. Here there are two players; one chooses the row and the other chooses the column (Table 2). Each player has two strategies, which are specified by the number of rows and the number of columns. The payoffs are provided in the interior. The first number is the payoff receives by the row player (*Player 1* in our example); the second is the payoff for the column player (*Player 2* in our example).Suppose that *Player 1* plays top and that *Player 2* plays left. Then *Player1* gets 4 and *Player 2* get 3.When a game is presented in normal form, it is presumed that each player acts simultaneously or, at least, without knowing the actions of the other. If players have some information about the choices of other players, the game is usually presented in extensive form.

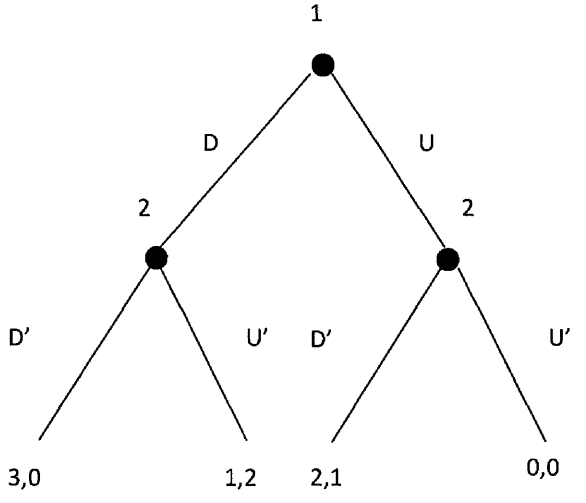
Table 2. A normal form game

	Player 2 Choose left	Player 2 Choose right
Player 1 Chooses top	4.3	-1,-1
Player 1Chooses bottom	0.0	3.4

2.1.2 Extensive Form

An extensive form game is a specification of a game in game theory and represented by a game tree. Each node called a decision node represents every possible stage of the game as it played. There is a unique node called initial node that represents the start of the game. Any node that has only edge connected to it is a terminal node and represents the end of the game (and also a strategy profile).Every non-terminal node belongs to a player in the sense that it represents a stage in the game in which it is that player's move. Every edge represents a possible action that can be taken by a player. Every terminal node has a payoff for every player associated with it. These are the payoffs for every player if the combination of actions required to reach that minimal node are actually played. The game on the below (Figure 1) have two players: 1 and 2. The numbers by every non-terminal node indicate to which player that decision node belongs. The numbers by every terminal node represent the payoffs to the players (e.g. 2, 1 represents a payoff of 2 to player 1 and a payoff of 1 to player 2). The labels by every edge of the figure 2.2 are the name of the action that edge represents. The initial node belongs to player 1, indicating that player moves first. Play according to the tree as follows: player 1 chooses between U and D: player 2 observes player 1's choice and then chooses between *U'* and *D'*. The payoffs are as specified in the tree. There are four outcomes represented by the four terminal nodes of the tree: (U, U'), (U, D') and (D, D'). The payoffs associated with each outcome respectively are as follows (0, 0), (2, 1), (1, 2) and (3, 1). If player 1 plays *D*, player 2 will play *U'* to maximize his payoff and so player 1 will only receive 1. However, if player 1 plays *U*, player 2 maximises his payoff by playing *D'* and player 1 receives 2.Player 1 prefers 2 to 1 and so will play U and player 2 will play D'.

Figure 1. An extensive form



4. Case studies

4.1 Case Study one

4.1.1 Contractor Profile

The construction company was found in 1997, specializing in general construction work. They had been completed over 50 contracts at all times in the south region. Their annual turnover volume exceeds RM 5,000,000. The company has been classified Grade 7 and Class A with CIDB and PKK representatively. The company current projects are housing development in Kempas, Kulai and Tampoi with the tender bid of RM 1 billion.

Table 3. The table of measurement of business strategies in bid/no bid decision and bid price in competitive bidding (Contractor C)

Business Strategies	Level of Measurement				
	5	4	3	2	1
	Critical	Strong	Average	Light	Poor
Bid/No bid: Marketing					
a. Market Prospect		/			
b. Market Range		/			
Bid/No bid: Finance					
a. Source of funds	/				
b. Project Profitability		/			
Bid/No bid: Total of Measurement	20-17 Critical	16-13 Strong	12-9 Average	8-5 Light	4-1 Poor
	17				
Bid Price: Production/ Operation					
a. Equipment/plant availability		/			
b. Equipment/plant size and capacity		/			
Bid Price: Human Resource/Manpower					
a. Organization	/				
b. Labor force		/			
Bid Price: R&D					
a. Alternative construction method			/		
b. Productivity improvement	/				
Bid Price: Total of Measurement	30-25 Critical	24-19 Strong	18-13 Average	12-7 Light	6-1 Poor
	25				

4.1.2 Business Strategies

Marketing: The company have been classified as big contractor because can bid for project above 10,000,000 in value. They able to declare their assumption to either existing or new client and agreed that many influence client to invite them for other project or other phase of the project. They tend to know the other competitors' strategies to cause competition in competitive bidding.

Finance: The company has strong financial backup. The company gained a good reputation along the southern part of Johor and ventured with Singapore company for some projects. The company interests in mix development. The development will attracted the local residents invest such properties. According to them, the sole housing will be less attraction compare with mix development and commercial project. They tend to bid for the projects which are consisting of commercial area.

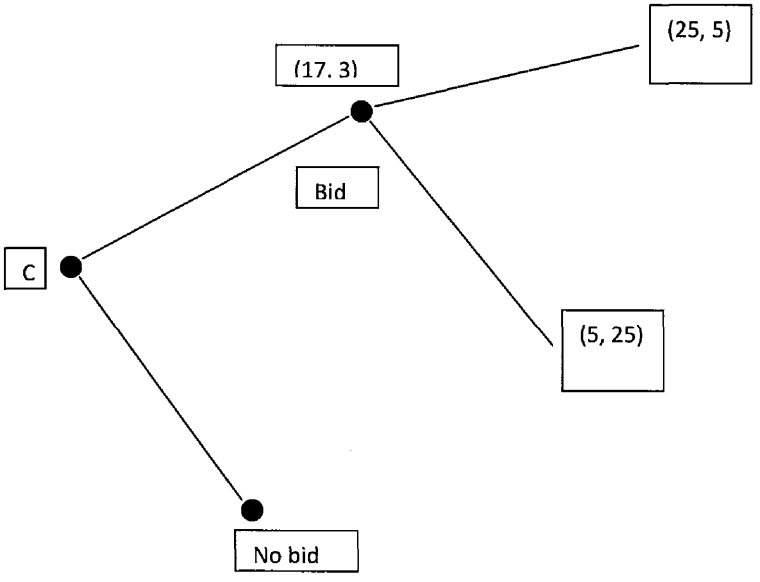
Production: The company has strong equipment and plant. Empire Construction Sdn Bhd is a general work contractor and able to do the general structural work for every project. Its availabilities are indicated available strong in the condition.

Manpower: The company has a proper hierarchy organization as well. The general manager, contract manager, quantity surveyor and estimator will evaluate and estimate the tender bid. The company has sufficient labor force can get from the subcontractor as well.

R&D: The company would conduct alternative construction alternative construction method if the original work can't process further. The company will inspect the entire subcontractor job before handing over. Productivity improvement is primary concerned by company.

4.1.3 Game Tree/ Decision Tree

Figure 2. Overall business decision in bid/no bid and markup price decision in extensive form (Contractor A)



Responding to the decision model, contractor C will most probably determine to select bid decision. The possibility of chance for them to bid high, about 85% for every project. During determining of bid price, contractor A would bid the possible low price due to the payoff (25, 5) is the availability of company ability to bid a low price (See Figure 2). The variance of the payoff is about +20, it means greater low bid price will be accepted for the company.

4.2 Case study two

4.2.1. Contractor Profile

The company was established in 1992 and specializing in general construction work. The company has been classified as Grade 6 and Class B with CIDB board and PKK representatively. The company actives in the southern region with the annual turnover volume exceed RM 5,000,000 in private and government job. The current projects under construction are Senai Hospital, mix development in Kulai and housing development in Tampoi Indah, Johor.

Table 4. The table of measurement of business strategies in bid/no bid decision and bid price in competitive bidding (Contractor B)

Business Strategies	Level of Measurement				
	5	4	3	2	1
	Critical	Strong	Average	Light	Poor
Bid/No bid: Marketing					
a. Market Prospect		/			
b. Market Range		/			
Bid/No bid: Finance					
a. Source of funds			/		
b. Project Profitability			/		
Bid/No bid: Total of Measurement	20-17 Critical	16-13 Strong	12-9 Average	8-5 Light	4-1 Poor
		14			
Bid Price: Production/ Operation					
a. Equipment/plant availability			/		
b. Equipment/plant size and capacity			/		
Bid Price: Human Resource/Manpower					
a. Organization		/			
b. Labor force				/	
Bid Price: R&D					
a. Alternative construction method				/	
b. Productivity improvement					/
Bid Price: Total of Measurement	30-25 Critical	24-19 Strong	18-13 Average	12-7 Light	6-1 Poor
			15		

4.4.2 Business Strategies

Marketing: The company have been classified as G6 as medium sized contractors that can bid for project no more than RM10, 000,000 in value. They agreed that business marketing prospect influence client for tender inviting. They will attempt t know who other competitors and their other consumption so that can create the competitive reasonable price to win the project.

Finance: The company has sufficient but not strong in financial. According to the Senior Engineer, his company's financial is capable of project cash flow currently. If the next project awarded, they might tender out again to get bid low to reduce the overall project cost. They would choose the government job rather than private due to the government job easy to get the period payment from client.

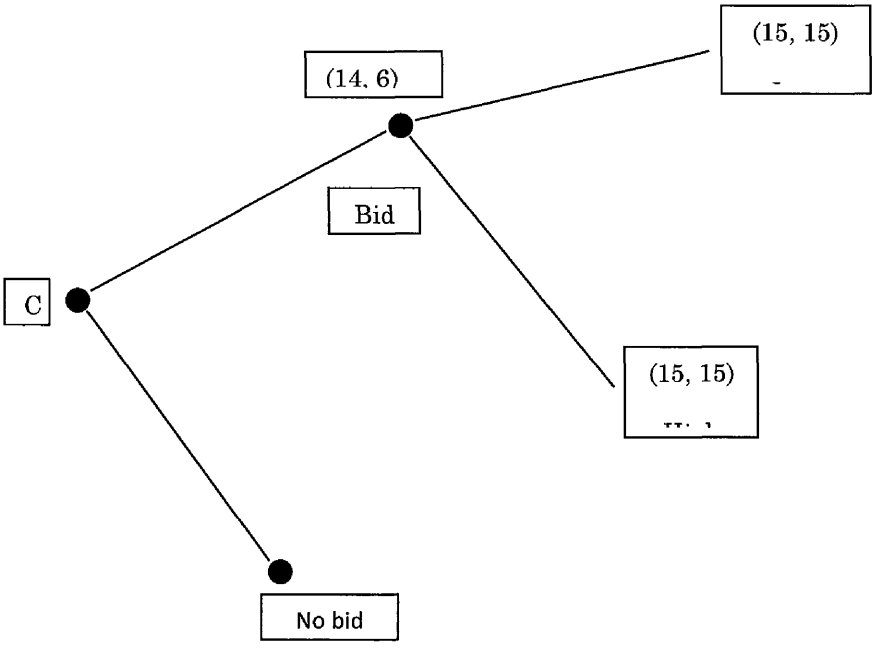
Production: The company has strong equipment and plant. Empire Construction Sdn Bhd is a general work contractor and able to do the general structural work for every project. The supply source of equipment/ material is strong due to the good interaction in industry relationship. The availability of equipment/plant is available strong in the company.

Manpower: The company has a proper organization which consists of none bumimputera executive and bumiputera executive for private job and government job representatively. The labor force depends on the scale of the project. If the project needs many labor forces, they will try to instruct the subcontractor and supplier to allocate more labor force.

R&D: According to the company, they seldom conduct alternative construction method and productivity improvement activity at the site. They claimed that inspection work done by the main contractor and architect will do.

4.4.2 Game Tree/Decision

Figure 3. Overall business decision in bid/no bid and markup price decision in extensive form (Contractor B)



The decision tree evolved from the business strategies measurement to determine the bid/no bid price decision. Contractor B would select to bid for next tender based on the payoff shows (14, 6), possibility of chance for them to bid is high, about 70%. The variance of payoff responds +/-0. They would not bid the price low; they only can bid the average bid price and hope to get the project win (See Figure 3).

4.4 Case study three

4.4.1 Contractor Profile

The company is an associated company with a listed company in KLSE main board. The company has been classified Grade 7 contractor and provides general construction work and project management. Their current project is likely biggest shopping mall in Penang.

Table 5. The table of measurement of business strategies in bid/no bid decision and bid price in competitive bidding (Contractor C)

Business Strategies	Level of Measurement				
	5	4	3	2	1
	Critical	Strong	Average	Light	Poor
Bid/No bid: Marketing					
a. Market Prospect				/	
b. Market Range				/	
Bid/No bid: Finance					
a. Source of funds		/			
b. Project Profitability				/	
Bid/No bid: Total of Measurement	20-17 Critical	16-13 Strong	12-9 Average	8-5 Light	4-1 Poor
			10		
Bid Price: Production/ Operation					
a. Equipment/plant availability			/		
b. Equipment/plant size and capacity		/			
Bid Price: Human Resource/Manpower					
a. Organization	/				
b. Labor force		/			
Bid Price: R&D					
a. Alternative construction method		/			
b. Productivity improvement		/			
Bid Price: Total of Measurement	30-25 Critical	24-19 Strong	18-13 Average	12-7 Light	6-1 Poor
		24			

4.4.2 Business Strategies

Marketing: The company is an associated company of listed company and registered as Grade 7 contractor with CIDB. The person in change cum resident engineer claimed that the company is acted as in-house contractor to the mother company in Kuala Lumpur. The project will only process when the associate company approves the project and issues the construction work.

Finance: The company has a strong financial backup. They no need to measure the project profitability because the company is only subsidiary company and the measurement of project profitability done by main and associate company.

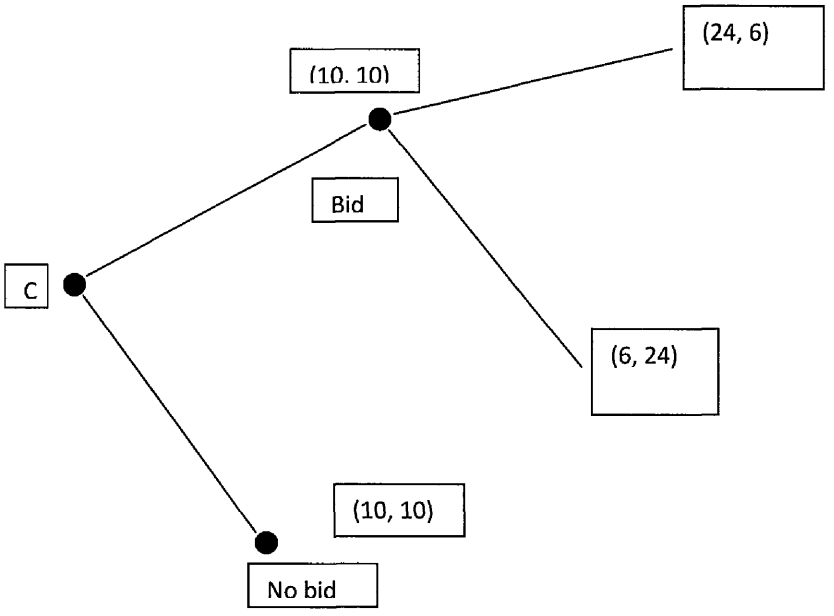
Production: The company indicated strong condition in equipment and plant. According to resident engineer, the company primarily focuses the time and cost management of construction work. All the work to be sub divided to other contractors. They responded the equipment / plant is available for the other project at the moment.

Manpower: The company has critical strong in organization. The decision and meeting need to transform into paperwork and to be reported to every level of organization. The team of the organization is mainly consists of profession like engineer, quantity survey and financial expert.

R&D: As project management team, the contractor will inspire the alternatively construction method and productivity improvement as long as within the cost budget and effective timely manner.

4.4.3 Game Tree / Decision Tree

Figure 4. Overall business decision in bid/no bid and markup price decision in extensive form (Contractor C)



The possibility of chance for contractor C is only 50%. This is because the company is only subsidiary company and in-house contractor; top management does almost the decision from main company. Although, the company reports unbalance performance in production strategies, but the company shows great performance in research and development strategies. These allow the company determines the bid price when they participate in competitive bidding (Figure 4). The variance reports greater low price, about +18.

4.3 Case study four

4.3.1 Contractor profile

The company commenced business in 2004 and classified as Grade 3 contractor. The company was established from conversion from manufacturer to contractor. The current project is their own factory with the cost volume less than RM 1,000,000. The company's key personnel is a Chinese family based organization

Table 6. The table of measurement of business strategies in bid/no bid decision and bid price in competitive bidding (Contractor D)

Business Strategies	Level of Measurement				
	5	4	3	2	1
	Critical	Strong	Average	Light	Poor
Bid/No bid: Marketing					
a. Market Prospect		/			
b. Market Range		/			
Bid/No bid: Finance					
a. Source of funds			/		
b. Project Profitability		/			
Bid/No bid: Total of Measurement	20-17 Critical	16-13 Strong	12-9 Average	8-5 Light	4-1 Poor
		15			
Bid Price: Production/ Operation					
a. Equipment/plant availability				/	
b. Equipment/plant size and capacity				/	
Bid Price: Human Resource/Manpower					
a. Organization				/	
b. Labor force				/	
Bid Price: R&D					
a. Alternative construction method					/
b. Productivity improvement					/
Bid Price: Total of Measurement	30-25 Critical	24-19 Strong	18-13 Average	12-7 Light	6-1 Poor
				10	

4.3.2 Business Strategies

Marketing: The contractor is the new comer and fresh on the construction field. They will only focus on the factory or warehouse construction work in the market. Their marketing strategies are to emphasis on the design and built or turnkey procurement. They will coordinate their own design team and offer their spec into drawing. The quotation will be made base on the final drawing to the client (Table 6).

Finance: The company has registered as Grade 3 contractor and has an average financial source. They have been persuaded that factory work could be advantage project profitability because the payment could be cleared easily.

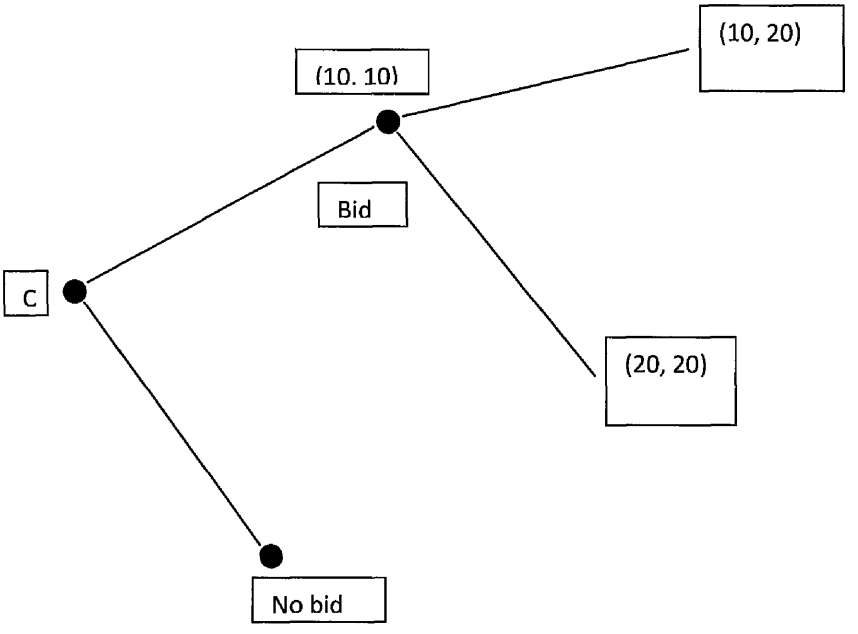
Production: The company shows poor in equipment/ plant and supply source because they subdivided the tender again. Therefore, they do not tend to have the relevant equipment on the site.

Manpower: The company has flat organization which means the scale of organization is less complicated. A few general clerks on the organization are needed to run the daily operation.

R&D: The alternative construction method and productivity will be less encourage by the company due to the costly reason. Light improvement will be considered as long as effective in term of cost and time. The company did not find it easy making breakthrough.

4.3.3 Game Tree/ Decision Tree

Figure 5. Overall business decision in bid/no bid and markup price decision in extensive form (Contractor D)



It would be possible of the company marketing strategies, the bid or no bid decision shows the surprising payoff; bid or no bid in 50% each. The company will only decide to bid at the pinch. Beside that, the payoff of markup price totally against with the conventional procurements' payoff. The contractor tends to bid the high price (Figure 5). The procurement system may the main reason to influence the mark up price because the quotation is under a package work to the client.

5. Conclusion

There are several analyses can be carried out base on comparative studies above:
a. The large scale firms which are grade 7 or class A contractors tend select bid decision in greater probabilities (more than 80%) and willing to bid a greater low price (variance = + 20).
b. The large scale firm which is in-house base contractor only decides the bid/no bid decision base on their top management. The relevant contractor would able to bid a greater bid price to compete other competitor as well.
c. The medium size contractors (grade 4-6 or class C-D) respond inconsistent in bid/no bid decision and bid price decision. The differences variance in decision base on their current business strategies decision performance (See table).
d. The small size contractor (grade 1-3 or class D-F) indicates intend to bid greater high price in competitive bidding (Table).
e. The unknown contractor's registration with CIDB or PKK, they most probably will bid low price and depends on the depth of the relationship with the regular client and experience in the industry.
f. The depth of the client relationship and experience in the industry may influence contractors to make their bidding decision (Table 7).

Table 7. A comparative studies for the contractors' registration, pay off of bid/ no bid and bid price

Contractor	Bid/No bid Payoff/ percentage (%)	Bid Price Payoff/ Variance
3. Contractor A	(17, 3) 85%	(25, 5) +20
4. Contractor B	(14, 6) 70%	(15, 15) +/-0
6. Contractor C	(10, 10) 50%	(24, 6) +18
7. Contractor D	(15, 5) 75%	(10, 20) -10

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