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Choosing the Right Payment methods in Modern Contracts

Cost Management and BIM in Project Control

Procurement and new payment trend

Developers and investors of public and private sectors are increasingly preferring contract types that offer greater collaboration, innovation, and risk-sharing with more efficient and cost-effective payment methods which helps to procure and deliver their business, project and/or developments. This trend is due to various factors, including uncertainty in the global market and local economic conditions and reliance to finance.

The risk landscape of the payment models differs to the general public, stakeholders and third-party developers who will in favor to engage incentivized or target contracts, Integrated Project delivery (IPD), and concessionary methods-like PPP (Private Public Partnership). The trends are becoming more popular in the post-Covid era, especially for large-scale public infrastructure such as power, renewable energy, and foreign direct investment in real-estate development projects, such as the port city, Sri Lanka.

On the other hand, Concession procurement (BOOT, PFI, PPP or DBFO) involves collaboration between the public and private sectors, with the private sector

providing financing, design, construction, and operation. These types may help to reduce the financial burden on the public sector, while ensuring that the project is delivered to high standards and with a focus on long-term sustainability.

Design and build and EPC or EPIC (Engineering, Procurement, and/or Installation, and Construction) and turnkey procurement methods are widely adopted Lump sum payment method and popular choices for major projects related to power, water and energy, oil & gas exploration, and mixed-use city and real estate asset development. These contract types offer a streamlined approach to project delivery, with a single point of responsibility for design and construction and certainty of the price in advance. This can help to reduce project risks and improve efficiency, as there is no need for the clients or end-user to manage multiple contracts and contractors.

This trend is globally on the rise due to increased market competition and budget constraints, as well as challenges such as material or labor shortages, limited access to capital finance, presence of enhanced digital technology, and need for alternative proposals due to uncertainty.

On the other hand, Building information modeling (BIM) plays a crucial role in collaborating and integrating data of personals, design, construction and operational information of an asset in a digital data format. It's gaining popularity and momentum in the computer and mobile software applications, especially in the post-Covid era, for: integrated project/asset-management; cost planning and estimating; project cost control and delivery; procurement and contract management; as well as managing the asset through cloud and blockchain systems, particularly for buildings and infrastructure projects.

In addition, increase in the use of digital technology and payment system, such as enhanced or increased online and mobile payments applications and blockchain-based payments. These payment models may relatively offer greater convenience and transparency, and can help reduce errors in payment processing than traditional system.

Therefore, conducting thorough research on payment methods, system and trends is essential for successful project control, resolution and outcome whether an existing project or future one is adapted to. Payment terms and models can have a significant impact on the success of a project, as they can affect cash flow, risk allocation, and overall project cost.

Researching and analyzing payment methods and trends can also help construction professional stay up to date with emerging payment technologies and methods, such as mobile payments, blockchain, and digital currencies. By incorporating these technologies into their payment models, project participants can improve efficiency, reduce costs, and enhance the overall project experience for all stakeholders.

Cost managers are involved in suggesting most appropriate payment models for their client's project, negotiate favorable payment terms, and ensure that the project is financially sustainable. For example, if a project involves in a significant amount of risk, a payment model that shares risk and reward among all parties, such as Incentivized contract, may be more appropriate than a traditional fixed-price Lump sum contract.

Some developers and contractors may propose to modify or change the payment method from lump-sum to Cost Plus/re-measurement or from re-measurement to guaranteed maximum quantity, depend on the circumstances. In practice it's however requires due care for agreement to consider any risk

allowance for escalation, accuracy of estimate and contingency for foreseeable risk, as the entirety of the pricing mechanism is unique for each method and also would depend on the rest of the provision of the contract and the contract documents.

Clients, contractors, and subcontractors can choose the following essential components to select the most suitable payment method, based on the:

- project goals and objectives;
- budget and financial risk;
- contractor and subcontractor qualifications;
- timeframe and schedule;
- dispute resolution mechanisms; and
- collaborative and transparent project culture.

The payment terms and conditions specified in a construction contract may be more detailed and specific than in other types of contracts. In Construction contract, Lump sum, measured term, and Cost-reimbursement, are most common payment methods and BoQ, Schedule of Rates/Prices/Activities are tools which helps to determine the detail breakdown of the quantities, rates and prices and its adjustment as agreed-upon the contract.

Progress payments are typically made throughout the project at various milestones or stages of completion. These payments are typically based on a percentage of the work completed or part of the contract price. Progress payments provide a way for the contractor to receive payment throughout the project, rather than waiting until the project is complete.

Time and materials payments, on the other hand, are based on the actual time and materials used to complete the work, plus a fee or percentage markup. This payment method is typically used when the scope of work is not well-defined or when there is a likelihood of changes to the scope of work commonly used for provisional sum and dayworks.

Before research on the payment methods, the payment terms generally included in the construction contract have briefly reviewed below, so the link and the relevancy of each payment methods and their inter relationship with the payment terms could be more understandable and traceable among other things.

Payment terms in construction contract

The payment terms and conditions specified in a construction contract may be more detailed and specific than in other types of contracts. There are important payment related provisions generally included in the construction contract, notwithstanding the followings:

Mobilization Payments: This payment is made to the contractor at the start of the project to cover the initial expenses such as setting up the site office, mobilizing equipment, and hiring personnel.

Progress of work: one common approach is to pay the contractor upon completion of each trade or element or items based on the agreed contract price and according to the schedules for example BoQ with unit rate and Schedule of activity or Schedule of Prices etc. This approach may involve paying the contractor at specific period, milestones or stages in the project, such as by weekly or monthly interim period, completion of the design phase, completion of the excavation phase, or completion of the structural phase etc. or based on the actual measurement and actual cost incurred.

Another approach is to pay the contractor based on a percentage of contract price for completion of each component or individual item of work based on the agreed payment schedule.

In either case, the payment schedule should be clearly spelled out in the contract documents to ensure that both the contractor and the client understand when payments will be made and what work must be completed to trigger each payment and the consequences of not complying with the payment process. This can help to ensure that the project stays on track and that the contractor is paid fairly for the work that has been completed.

Another approach to payment in construction contracts is relevant is to pay the contractor upon production or supply/delivery of a certain plant, equipment, material, or workmen. This approach may be used when the contractor is responsible for providing specific equipment or materials for the project, or when they are hiring additional workers to complete the work. In this case, the contractor would be paid when they deliver the plant or materials to the project site or when the additional workers begin work on the project. This approach can help to ensure that the project has the necessary resources to move

forward and that the contractor is compensated fairly for their expenses.

Retention: A retention amount may be withheld from each payment to ensure that the contractor completes the work to the required standard. This retention amount is typically released upon completion and acceptance of the work.

Variations: If there are any changes or variations to the scope of work during the project, the payment terms may be adjusted accordingly.

There may be circumstances where changes to the scope of work are necessary due to unforeseen circumstances or changes in project requirements. In such cases, a variation clause can be used to allow for adjustments to the contract price to reflect the changes in scope.

The variation clause may specify the process for requesting and approving variations, as well as the criteria for determining the cost of the variation. The clause may also specify any limits or conditions on the amount or type of variation that can be made.

Liquidated Damages: This is a penalty payment that may be imposed on the contractor if they fail to complete the work within the agreed-upon timeframe.

Advance Payment Guarantee: This is a guarantee provided by the contractor to the client to ensure that the advance payment made to the contractor is repaid if the contractor fails to fulfill their obligations under the contract.

A performance bond payment: This is a type of financial guarantee that ensures that a contractor will complete a project according to the terms of a contract. If the contractor fails to meet their obligations, the bond provider will pay the bond amount to the project owner to cover any losses or damages incurred as a result of the contractor's default. The payment is typically a percentage of the contract value and is held in escrow until the project is completed. Once the project is finished, the bond provider releases the payment back to the contractor, provided that all conditions of the contract have been met.

Payment for prolongation cost: Payment for prolongation cost may be applicable in certain circumstances where a project takes longer than expected to complete, and the contractor incurs

additional costs as a result. Prolongation costs can arise due to a variety of factors, such as changes in the scope of work, unforeseen delays or disruptions, or adverse weather conditions.

In some cases, the contract may include a provision for payment of prolongation costs for Relevant events and matters. This provision may specify the circumstances under which prolongation costs are payable, as well as the process for requesting and approving such costs. The provision may also specify the criteria for determining the amount of prolongation costs, such as the actual additional costs incurred by the contractor.

It is important to note that the specific terms of payment for prolongation costs will depend on the contract and the parties involved, and may be subject to negotiation between the parties, if any lack of or no notice and time bar for claim for loss and expenses.

Final Payment: A final payment is made upon completion of the project and acceptance of the work by the client. This payment may be a percentage of the total contract value or a fixed amount.

Payment methods

Lump sum

Lump sum payments are widely adopted method for construction projects in many parts of the world, including Sri Lanka, UK, Australia, Middle East, and Asia-Pacific. The main advantage of lump sum payment is that they provide certainty for the client in terms of the final cost of the project. This is particularly important in situations where the client has a fixed budget or needs to secure financing for the project.

Lump sum payments can have both advantages and disadvantages for different parties involved in the supply chain. For example, a lump sum payment can provide a sense of financial security for the supplier, as they receive the full payment up front. Additionally, it can simplify the payment process and reduce administrative costs for the buyer.

However, lump sum payments can also create conflicts in the supply chain. If the supplier experiences unexpected costs or delays, they may not have the financial flexibility to manage these issues. Additionally, if the market or economic conditions

change dramatically, the buyer may be at risk of overpaying for the product or service.

To mitigate these risks, it's important for both parties to have a clear and detailed contract that outlines the terms and conditions of the lump sum payment and its risk allocation as opposed to other types of payment for example re-measurement or cost reimbursement or incentive or target-price/quantity.

It's essential for a contract to include provisions for handling unexpected costs and delays, as well as for adjusting payments if circumstances change. This is particularly important in the context of a lump sum payment, where if the contractor is expose to the risk of any cost overruns.

There are various types of lump sum payments that can be used for construction projects.

- The pure lump sum with firm quantities of BoQ (is one of the most common methods. This involves preparing a detailed BoQ with fixed quantities and prices for each item, and then agreeing on a lump sum price for the entire project based on that BoQ.
- A fixed/firm price lump sum, with or without a provision for price adjustment, is another common method. This involves agreeing on a lump sum price for the project, with the possibility of adjusting the price based on certain conditions specified in the contract, such as changes in the scope of work, market fluctuations, or other factors that may affect the cost and time of the construction work.
- Another type is the contract which silence about the price adjustment but agreed to a fixed-price lump sum.

It is important to note that a lump sum contract places a greater degree of risk on the contractor, as they are responsible for completing the work within the agreed-upon budget, regardless of any unforeseen circumstances that may arise during the project. As such, it is important to ensure that the contract documents are as detailed and comprehensive as possible to minimize the risk of misunderstandings or disputes during the project.

Following section briefly review and compare the alternatives use of the Lump sum payment to other

methods, due to the event (s) change the substantial conditions and circumstances or hardship or force majeure.

Lump sum v Cost plus

Lump sum is mostly used payment methods when the scope is clear and when the client wants to know the probable cost in advance. Hence, there are circumstances and changes dramatically affect the final fixed price due to the changes and critical circumstances.

It's vital for the contract to clearly define the scope of work and deliverables, as well as any quality standards that must be met. This can help to prevent disputes or misunderstandings later on, and can ensure that both parties have a clear understanding of what is expected. The contract should also specify how disputes will be resolved, such as through mediation or arbitration.

One way to address unexpected costs and delays is to include a contingency allowance in the contract. This can be a percentage of the total contract price that is set aside to cover unexpected expenses that may arise during the course of the project. The contingency allowance should be clearly defined and agreed upon by both parties, and any funds that are not used should be returned to the owner.

If market conditions or other circumstances change during the course of the project, it may be necessary to adjust the payment. For example, if the price of materials increases significantly, the contractor may need to request a change order to adjust the payment to reflect the increased costs, again this depends on the wording of the contract, jurisdiction, applicable law.

It's important for the contract to include provisions for handling change orders, including how they will be requested, reviewed, and approved, and how they will impact the overall project schedule and budget and if any risk allocated for such unforeseeable events by an experienced contractor.

Additionally, it's important to regularly review and assess the market and economic conditions to ensure that the lump sum payment remains fair and reasonable for both parties. In public project context, this can involve either negotiating adjustments to the payment as needed or exploring alternative payment mechanisms that better align with the existing

conditions or else hold the project or program, until the circumstances come back to normal conditions.

For example, in a situation where there is a high level of uncertainty and risk, a cost-plus contract may be more appropriate than a lump sum contract. In a cost-plus contract, the owner pays for the actual cost of the work, plus a percentage or fixed fee for the contractor's profit and overhead. This type of contract can help to mitigate the risk for the contractor, as they are not responsible for cost overruns or delays that are outside of their control.

Whereas the employer may require additional budget to cope with the actual expenditure and administration cost effective to the change of payment method and proceed to complete the project without being on hold, as a result of inflated material prices, abrupt change in exchange rate, shortages, time at large situation and crises of many forms.

If the client aware that the likely overall cost is beyond the agreed lump sum price, it is rare that they would entertain such alternative arrangement to go for a cost-plus contract and agreed to continue to do so.

Therefore, client may try to negotiate the price level down or may go for re-tender later on when the circumstances come to normal. Since if the project demanded an early progress and completion makes holistically a positive scenario, then probably as a middle ground solution they may come down to agree to alter the payment mechanism. But again, this depends on many more factors.

Lump sum v Guaranteed maximum Quantities (GMQ)

An incentive-based target contract - for example Guaranteed Maximum Price, where the contractor is incentivized to complete the project on time and within budget and avoid unnecessary wastages. In this type of contract, the contractor may receive a bonus for early completion or for staying within budget, and may face penalties for delays or cost overruns.

Guaranteed Maximum Quantities (GMQ) is another type of payment for which the quantity is incentivized rather than price by the Employer or contractor. This payment method is helpful for accurate quantity takeoff in circumstances where there is likely shortages or stoppage of materials is highly likely, as this in turn resulted a reduce traditional quantity/rate allowance for wastage.

The quantification can be done through innovative exercise and digital quantification such as via BIM or QS Software like CostX, BIM Vision, PriMus, and etc. This can help to align the interests of the Employer and contractor and encourage them to work together to mitigate risk in association with quantity, where Consultant/Engineer and Contract Managers/Administrators validate the quantities on **net** measurement or mapping it to the New Rules of Measurement -NRM/ *International Construction Measurement Standard* -ICMS basis, during the design development or preparation of Bill of Quantity (BoQ) or evaluation of bid.

GMQ can be a useful approach in subcontracting prime contract works, especially when the scope of work is not clearly defined or when there are likely to be shortages or volatility in the market. In such situations, it may be challenging to identify a firm quantity of items or components to include in the contract due to intrinsic errors and omissions during estimation or external factors that can impact market conditions, global economic conditions, and site conditions which impact the likely actual quantities.

A GMQ can provide flexibility to accommodate these uncertainties while still ensuring that the subcontractor is not exposed to excessive risk:

- Where the contractor agrees to complete a project for a fixed amount, regardless of the actual cost of the work. In such a contract, the drawings, models, and specifications must be sufficiently detailed and complete to enable the contractor to accurately estimate the cost of the work and complete it within the agreed-upon budget.
- A firm Bill of Quantities (BoQ) or activity schedule can be included in the contract documents to provide a detailed breakdown of the estimated items or components and their associated costs. This helps to ensure that the work is carried out systematically and provides a framework for dealing with any future changes that may be necessary.

Lump sum v Measurement

Measurement contracts can be more complex than lump sum contracts because they require careful measurement and documentation of the work completed, but they offer more flexibility and transparency in the payment process. They can also

help to ensure that the contractor is compensated fairly for the work that has been completed, as payment is based on actual measurements rather than a fixed sum basis.

The final contract price of this type of contract will only be known at the completion of the work or part of the work. For example, measure & pay, re-measurement/unit rate/ad-measurement. The re-measurement contracts normally includes both unit rate and lump sum items in the BoQ and the quantities are indicative and estimated only and the actual measurements are added and or a rate may be modified to suit the actual conditions and quantities, if substantially varied site conditions, design etc are later on realised additional payment and time.

In certain situations, the main developer or joint venture contractors or their sub-contractors attempt to sub-contract the work in order to mitigate the inherent risk in specialised nature of work or provisional sum or overcome their lack of technical or financial capacity in order to perform the agreed main contract with their client.

It is important for the parties involved to thoroughly review and negotiate the terms and conditions of the contracts to ensure that they are back-to-back and consistent with each other. This will help to avoid any potential conflicts that may arise due to discrepancies in the standard method of measurement or non-agreed method of measurement for a work or a part of work.

The parties should also ensure that the risk balance between them is appropriate and that the clauses in the contracts do not contradict applicable law. If conflicts do arise, the parties should seek legal advice to resolve the issues and ensure that their rights and obligations are protected.

It is important for the supply chain to have clear and consistent terms and conditions to ensure that all parties involved understand their roles and responsibilities. This will help to avoid any misunderstandings or disputes that may arise during the course of the project.

However, most of the bespoke re-measurement payment contract discovered to circumvent the situation in the contract by including the expressed provision dealing with errors or omissions from the quantity or any discrepancy or ambiguity within the contract documents and what extent those

circumstances and situation would be treated as valid variation, in the situation when the changes occur. But it wouldn't be the case for instance a fixed price Lump sum is considered as when there are likely changes in the scope lead to costly variation. Therefore, some form of contract includes

Fixed price Lump sum & Covid-19 (FM)

Regardless of any type of payment method agreed at the outset, certainty of price will probably depend on various external and internal risk factors, events and matters, which might or might not envisaged during the agreement.

These risks may be mitigated or controlled through inclusion of provision, or allowance or treated as variation, for instance;

- a) A risk cannot be easily controlled by both parties as a result of loss or damages caused by fire/defect or COVID-19 or virus threat, then, a mechanism to indemnify by a third party through the insurance provisions. For example, Contractor All risk insurance, professional indemnity insurance, health/medical insurance etc.
- b) Inclusion of the matters and risk events expressly provides remedy, for example, the extension of the time for completion of a project is granted in the event of employer's risk event occur, where such event listed as an employer risk event or under no circumstances the Contractor liable for any delay which affect the critical path. Where in such circumstances, whether contractor liable or not, if exclude the liability of the employer by a clear wording, saves to that effect not to grant extension of time - which must not in any way contradicted to the governing law of the contract.

The contractual provision and notes do attempt to cover exhausted list of such matters and events allocating the risk towards the parties who are in the better position to cater those risk and would have capacity to manage it efficiently, thus some are not.

a fixed/firm price lump sum payment is typically the most appropriate payment method when the scope of work and design are well-defined and there is a high degree of certainty in the market conditions for the forecasted period. In this case, the consultant and client can accurately estimate the cost of the project and agree on a fixed price for the work.

However, if the design or model of the project is not suitable for the specific location and requires significant amendments or modifications, it may be difficult to accurately predict the cost of the project. In this case, a fixed price lump sum payment may not be the most appropriate payment method and a different payment structure, such as a cost-plus or time and materials payment, may be more suitable.

Similarly, if the currency of the contract depreciates substantially, it may impact the cost of the project and make a fixed price lump sum payment less appropriate. In this case, the parties may need to consider adjusting the payment structure or incorporating appropriate currency hedging measures to mitigate the impact of currency fluctuations on the cost of the project.

Unlike in a re-measurement/cost reimbursable method, in the fixed price Lump sum payment an economic situation would arise while performing the agreed quantity of the item/ work which would either make them grave loss or significant increase of the as planned cost, time to time, upon procuring those items or performing the tasks or works, vice-versa, for example:

- Increased cost of shipment or air freight, following to the pandemic or invasion
- Delay in permit to land the delivered material at port and from port to store/site
- A governmental action that restricts the critical imported materials and the like
- Uncertainty surrounding the interruption of local power supply due to increment of oil & gas prices or conflict rises on the energy investment priorities with zero carbon target
- Increment of commodity prices at global and local monopoly supplies
- High global inflation rate and disruption in the global supply chain
- Reform in policy settings

Similarly, significant increase in the major commodity prices still on the rise globally since late Q1/2022 despite to the increase already showed during the COVID-19 period and as a result a project may possibly get prolonged suspension or termination before completion or soon at resumption from further agreed extension period or omission of the part of the work as a common scenario, in particular in the context of Sri Lankan construction industry among

others, faced highly elevated prices and inflation with further increased due to exchange rates implications and shortages.

As a result, substantial increase from the agreed price makes the parties impossible to financially perform the contract for the allocated risk at the time of its estimation and pricing.

For instance, the client financing from a third party in a situation where constraints to continue to funding or Contractor's allocated overheads and profit become null and zero, whilst continue to do performing so the contract as specified for the price is not viable, without altering or due regards given to minimize the impact of variant. As a result, parties would also try to figure out some of the conditions for the easy escape of the contractual performance to seek termination. If this would always possible, then no contract would way forward in re-negotiation.

Therefore, due to the volatility of the global and local market, the accuracy of the forecast of the probable cost of a project will substantially deviate - where the unprecedented series of events which may reasonably not foreseeable to see such new disruptions during the recovery of the economy or during the execution of the project.

It must be then revisited by all the stakeholders to cope with the changes to accommodate fairly and most economically to complete the work, by applying value management principles and facilitation or mediation techniques at the outset of the project is inevitable, rather expecting to a legal remedy invoking the damages of the breach of contract, but the allocated contingency in the estimation might be exhausted in those circumstances any way, generally.

The client and the Contractor must carefully consider the situation in attempting to use or convert a payment method and contract type, negotiating with Contractors, similarly with sub-contractors, sub-sub-contractors, suppliers taking in to account a balance approach in allocating the risk without altering the express agreement or clear intention of the risk level, so that the successful completion of the project goals ensured and desired profit or outcomes are achievable in the re-negotiation or revising the contract price.

Challenges may come up in dealing with a purely a Lump sum payment with/without BoQ, which may have unaltered in practice to allow the new circumstances and situations fairly between the party

bearing risk on the matters listed, beyond contractual agreement, but without altering the intention of the parties at the outset of the contract formation, so the change in the economy is adopted for non-contingent allowance.

Still the new circumstances might fully unaware to a reasonable and or an experience - business person / Contractor who may or may not at the bidding stage could reasonably have foreseen an event or series of event that would occur in a future date which impact on the price level. For example, a qualified force majeure or exceptional event- a project awarded at pre-pandemic time prior to COVID-19.

Therefore, those contracts following to or during post-pandemic should reasonably have been allow to cope with the consequences by increase the contingency allowances for the pandemic for example COVID-19, omicron variant and intermittent waves of virus spread or opt to analyse case to case basis that Covid-19 indeed meet the criteria as set-out in the contract or qualify as a force-majeure event to a specific project under consideration was, including any effective notice is served to mitigate the event.

Hence, broadly aligned as a force-majeure event as such event ever been experience in the business before, a party invoke force-majeure must be proved to be impossible to perform some or whole of the works which was not due to financially or economically not feasible is irrelevant yet coexist or co-incident, but the consequences cannot be mitigated reasonably possible and cannot be control by the parties, some other means, felt hardship.

However, it may hard for a contractor to compete the price at bid during the deep global recession and continues ramification rising the confrontational issues between world power, war in Ukraine, geopolitical tension in eastern Europe, disrupted supply chain due to several rounds of COVID-19 waves.

Allowing the necessary contingency in to the contract value/sum, the apparent cost of works is appeared to increase dramatically whereas the extent of inflation is uncertain unlike before at the state level varying with its own economic condition in contrasting with supply chain and ramification at the global level.

That's mean the working culture and elements should change to adopt the economic situation. Like high % of contingency for mega/giga-project generally would have allowed for example infrastructure project of the

public nature which would not make big deal when the funders are align with the project budget during the longer terms on the progress whereas short to medium-terms projects generally not feasible with such contingency allocation and therefore would falls quite risk in the uncertain price hike which might not able to manage through supply chain effectively.

With the forgoing trend, in the Construction context, a re-measurement or fixed price Lump sum payment modified to a re-measurement- so the quantity variance (omission), would be ideal to consider, irrespective of exclusion of price fluctuation clause (consider not to trigger a loss of profit)

The likely future situation where as the availability of the materials and plants for the permanent works are uncertain up to which extent the allowed contingency saves its base price for a foreseeable period or the shortages of material or hybrid-inflation of specific raw materials, resulted to prolonged delay or terminate the contract itself, unless otherwise finding an alternative to continue with it.

For example, what extent the equipment for the temporary works, say a tower crane or Concrete 3D digital wall printer should made available for the disrupted period, would the cost incurred in such period can be recoverable, are some of the concerns where such equipment cannot be utilized elsewhere.

These matters are some ways link to the contract type for instance no preliminaries items might have priced for specific interim period in a way how much included for the entire contracted period as a total or the preliminaries could have included under the entire item rates / components rates of the BoQ for such temporary works, where no actual record of expenses unable to produce to claim for actual cost or profit, in case that equipment may impracticable to relocate.

There will also be a situation where employers could have already cause major delay events, placed both parties in concurrent delay situation before or at the time of pandemic. This scenario should objectively look in to the matter at which the event was the dominant cause of such effect.

Mostly covid-19 were considered as the dominant cause when there is concurrent delay, since carryout a case-to-case basis analysis would be appropriate in the circumstances before concluding the common-sense approach if it were considered and employed a proper

delay analysis method to produce the claim for EOT and quantum that dealt the case appropriately.

Unlike in re-measurement/cost reimbursement/target cost, due to the volatility of the market, the pure Lump sum payment, with/without BOQ, being not altered in practice. However, in the event of following scenario proved to be unforeseen at the estimation or bidding stage must further qualified as a legitimate variation, through a:

1. Clarification raised on any discrepancy or ambiguity of the documents to have reasonably allowed in the contract price for business efficacy.
2. Clear instruction to bids were given where a Contractor was requiring to clarify as to the doubt or obscurity for the adjustments of any errors or omissions in the BoQ and such conditions are fulfilled.
3. Where any errors or omission found, a provision given for adjustment in quantity or account in to the rates and prices, then the Contractor were given reasonable time to review the exact quantity for make any necessary adjustment during the estimation stage.
4. A clear provision to consider that the compensation for unforeseen events should be an additional to the contract sum, in procuring and delivering as planned or agreed or accepted or approved programme - most of the law of the contract contradict the Lump sum payment where a fixed price nevertheless be agreed but liberty to re-negotiate when the rates and prices inapplicable due to the changes of economic conditions are proved to be not envisaged during the estimation)
5. A Cristal clear contractual EOT provision that overrides prevention principles, where an employer or authority inadvertently or due to the unpromised situation the act or omission prevent or impediment the progress of the work, therefore, if such EOT provision had not included what consequence if the EOT not granted for such situation, whereas the Contractor incur additional cost during the selected period and a notice was served in that effect to fulfil.
6. A prolonged suspension occurred after the original time for completion were past, whereas the progress of work halted for supply shortage of a critical finishing material and or a major or long lead plant component

due to COVID-19 pandemic disruption of the supply chain.

- a) In doing so the Contractor delivered half of its ordered finishing material followed by COVID-19 with increased quoted price; and
- b) the balance material desired further rise due to the supply chain disruption due to Ukraine war and geopolitical tension in eastern Europe, which was not envisaged during the bidding stage.
- c) Uncertain that the specific material and major plants are envisaged disrupted to follow the same.

Therefore, these provisions generally cover in practice mainly under the five categories to accommodate to overcome the issues/risk or situation where a bidder to price and the client/ consultant trying to include these in to the contract data or in preamble notes or special provision, or during execution of the works, such as:

- a) With adjustment at the end of each trade/element or selected element of BOQ for any errors or omission in the quantity to be adjusted by the bidders
- b) No adjustment provision allowed in the bid; therefore, the rates and prices shall not be adjusted except expressly agreed or contrary to the context – a Pure lump-sum payment.
- c) With adjustment of the rate or price as a rise or falls under the specific trade/element where the range of rates/prices substantially would increase or reduce
 - i. Which may be reasonably unforeseeable at the contemplation
 - ii. Which may reasonably unforeseeable but no prima-facie to prove that the mere facts and circumstance would have arisen at the outset
 - iii. Which may unforeseeable by an experienced Contractor
- d) Fixed/firm price where no price adjustment shall be made or no formula included under the contract data or to the special provision, to that effect
- e) Fixed/firm price where formula included under the contract data or to the special provision, whereas the situation that the actual purchase was within the claimed EOT but likely not falls under the granted period.

There are different consequences due to the choice of the one of the category or combination of it, and vice-versa.

Asymmetric information or incomplete contracts mostly cause rise to claim where there is any errors or omissions for which there is no allowances have made for the negligence in the calculation of the quantity or estimating in the rate and prices under the contingency of the estimate, despite to the payment types and selection of the standard form of contract or modifying a different contractual arrangement viz-versa.

Therefore, a prudent Bidder should give due regards to the tender price for the likely existing trends of the price in most appropriately applying the commercial common sense for each item which could be foreseeable by a similar Contractor of the same customs and jurisdictions which practicing the same trade and similar capacity level, proving as a prima-facie, that a contractor was or will allow it, until to the contractual period and for the contractual abeyance. This exercise should be however carried out during the tender evaluation by the expert and consultants.

This is an important step in the planning process as statistics on topics such as disputes in the construction industry and international arbitration/ ADR, exposure to geological position, natural hazards, foreign financing and the like demonstrate that the construction projects are sensitive to many forms of risk.

In addition, likely increase pace of the global commodity prices and technology advancement, pandemic or existing invasion or war & sanctions are now again not a new phenomenon to the Construction industry and beyond.

Contractor, whether at a domestic or international level, know the risks involved in the construction process and will prepare their bid accordingly. Therefore, the client/Consultant should be aware of the appropriate allocation of the risks at planning stage to ensure that his ultimate costs will reflect that allocation. Therefore, the current estimate reflecting the global economic growth or recovery, inflation rate, commodity prices, shortages of materials, plants and equipment or professionals supplies as a known matters that cause the project cost.

Quantity Surveying and BIM QTO

Quantity take off (QTO) is an extremely important task with direct implications for the many estimating tasks that follow it. The unit prices and the total prices of materials, plants to procure, labour and equipment requirements to allocate, and the scheduling of each activity are all based on the quantity take off or quantity survey.

Therefore, it is clear that quantity take off is the core and the basis for all other estimating work and ultimately affects the total cost estimate of a project. A Quantity surveyor must be very careful and vigilant in their work in order to produce the most accurate calculations for the quantities of all the materials using a standard method of measurement, advanced QS Software and BIM applications.

It is important to note that calculated quantities obtained from a quantity take off may not always reflect the actual material quantities required for a project. This is due to factors such as waste, traditional allowances for bulk, spacing, laps, fittings, and more. Therefore, it is necessary to consider the following:

- a) If the quantities are based on a "NET" basis, the allowance is already factored into the rates and prices.
- b) If the quantities are based on a standard measurement method (SMM), the allowance may be deemed included or not included, as specified by the measurement rules.
- c) If the BoQ includes pricing preamble notes, any amendments to the SMM must be reflected in the rates and prices accordingly.

Whereas, waste factor is used to increase material quantity, so as to ensure that enough material is procured to realistically complete the work based on the existing industrial standard and customs and the efficiency of handling and installation of the materials and components, which mostly based on the reflection of the actual quantity as per the drawings, specification and models.

The above process of questioning is central to the work of Quantity Surveyors in the modern era, as they are responsible for taking off quantities and estimating project costs. This role is distinct from that of BIM Managers, who primarily focus on coordinating and collaborating with various stakeholders.

When Quantity Surveyors are working with 2D drawings that are typically used for contract agreements, they may need to remodel the project and extract quantities themselves. Alternatively, they can use QS software to measure the quantities from the 2D drawings. If a BIM model is part of the contract, the quantities can be extracted from the model and converted to the relevant SMM more efficiently.

Industry practitioners and investors have come to recognize the potential benefits of BIM application in the construction industry. BIM has proven to save time and overall costs throughout the procurement process and the life cycle of an asset, in line with the circular economy concept. This momentum toward BIM adoption is increasingly gaining traction.

It is uncertain whether all clients and stakeholders are willing to acquire sufficient knowledge of the BIM process and adopt it quickly. While there are real concerns around copyright and intellectual property rights, as well as the responsibility matrix of the parties involved, the positive trend and technology for BIM application are also evident. Therefore, although these issues can be a real deterrent, the interest and acceptance of BIM among clients and stakeholders varies.

Conventional wisdom holds that quantity take off is a straightforward process of reading dimensions from drawings and performing basic calculations to determine quantities. However, the quantity take off problem is much broader and more complex than this. It involves a wide range of considerations and challenges that must be addressed in order to accurately estimate the required quantities for a project.

In addition to requiring a thorough understanding of construction drawings and corresponding specifications to produce a reliable cost estimate for a project, a quantity surveyor must also determine the quantities of materials that are not directly shown in the drawing. This includes earth or reclamation works, site modification works, and support works such as concrete formwork and shoring. Comprehensive knowledge of these aspects is essential for accurate quantity take off and cost estimation.

The less prominent components of a construction project make cost estimating a challenging and complex undertaking. Additionally, when the role or responsibility of the Quantity Surveyor does not delineate from the automatic generation of quantities

from a BIM model, a threefold interrogative process is required:

- The disparity of BIM-produced quantities and their certainty, as no software manufacturer provides a license with a guarantee for the accuracy or mapping to NRM or ICMS, reimbursement of loss for any errors or omissions in the quantity extracted from the BIM model in a single click. For example, quantities derived from REVIT.
- Re-modelling to produce quantities is an additional task that requires due care and design expertise, with chances of missing elements, scaling, and calibrating, especially if a non-design expert is involved in modelling 2D drawings needs adequate training from BIM expertise. For example, using REVIT or CUBICOST.
- When the BIM software does not come with an in-built Standard method of Measurement that is required for the quantity take-off demands of the bidding process, it can be challenging to allow element take-off according to the actual SMM clauses, which can save time checking the BoQ. For example, quantities derived from REVIT or TEKLA.

Therefore, it's necessary to find what fundamentally BIM influence on Quantity Surveyors duties and how to adapt better in delivering the conventional services with most effective way. Therefore, possessing basic level of knowledge in BIM is indispensable for A Q S.

BIM Levels

BIM Landscape

BIM is an object based digital representation of the physical and functional characteristics of a facility. It serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its life cycle from inception onward. A collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model.

According to BIM fundamentals there are seven recognized “dimensions” are generated which allows to manage a series of information regarding materials,

cost and time. some of the already set 7 dimensions and new 3 dimensions open to debate as follows:

- ✓ 3D modelling: geometrical, graphical information
- ✓ 4D time-related information: construction sequencing by means of Gantt charts and timelines
- ✓ 5D cost analysis: cost management, construction cost estimating, etc.
- ✓ 6D sustainability: environmental, economic and social sustainability impact studies
- ✓ 7D life cycle and maintenance: Facility Management: planning and management of maintenance operations throughout the building's lifecycle.
- ✓ 8D safety during design and construction
- ✓ 9D – lean construction
- ✓ 10D – construction industrialisation.

BIM- Level 1 and requirements

BIM digital maturity level 1 requires the use of 2D and 3D CAD technologies and a Common Data Environment (CDE), the shared online repository where all project data is collected and managed.

More specifically, the use of 3D CAD tools is reserved for the design phase, while 2D is used for documentation and information management. Furthermore, despite the presence of a common data environment (CDE), at this stage, generated models are not shared between the different design disciplines and project stakeholders.

In practice, level 1 is a step up from the more basic level L0, which does not involve collaborative exchanges of information. Currently, L1 is the most popular level of collaboration among AEC sector professionals and companies that have already gone to the next level of digital collaborative workflows but have not yet approached BIM fully.

BIM maturity Level 1 is illustrated in the Bew-Richards diagram below. The adoption of standards and norms that set out the requirements that need to be followed, ensures accountability and proper management of information systems, data exchanges, collaboration, etc.

Any project will benefit from having well-planned and implemented project management systems with sharing and collaboration methods and tools.

To satisfy the requirements of BIM maturity level 1, the following basic workflows and processes need to be addressed:

- ✓ agreeing on roles and responsibilities;
- ✓ adopting naming and file storage conventions;
- ✓ specifying and determine the project elevation and spatial coordination system;
- ✓ using a ‘Common Data Environment’ (CDE) for managing shared documents and information among all project team members;
- ✓ establishing an appropriate information hierarchy to structure the CDE.

At the heart of the BIM Level 1 process, are the principles for collaboration set out in BS 1192:2007 that assume the use of standard methods and procedures (such as a Common Data Environment approach, defined naming conventions, etc.

BIM- Level 2 and benefits

BIM maturity level 2 have some important benefits for the construction sector notwithstanding the followings:

Increased productivity: The ability to share information faster and more easily can offer a significant increase in productivity. Collaborative work can reduce the time it takes to incorporate and edit new information. Increased productivity also means lower costs and, by extension, greater efficiency in terms of project planning.

Big Data: BIM will offer significant help in managing large amounts of data. The most effective management of big data will change the way many of the professionals’ work within the construction industry (e.g., technicians, companies, etc.)

New possibilities for smaller markets: BIM can play an important role in optimising the construction process. This could soon lead to the opening up and development of new markets that until now did not have the right tools to expand. Thanks to a fully or partially integrated collaborative model, they will be able to face a large number of difficulties that they face daily at the moment.

Higher quality buildings: The greater amount of data combined with the ability to handle it more accurately will ultimately lead to a noticeable improvement in the quality of our buildings. To put it simply, more complex buildings will be designed and built with much more to offer to residents and owners.

Parameters such as the environment and the modernization of the designed structures will be easier to take into account during the construction procedure.

Improved interference detection: the interference detection process improves significantly.

The term “clash” refers to potential errors that emerge during the design and construction of a building. BIM can help in detecting interferences and consequently increase the efficiency of the project. IFC files offer great assistance during this process.

Time Saving – In Level 2, time saving translates into early delivery of work resulting from several factors (for example, the use of a Common Data Environment and collaboration tools that allow easier working arrangements and faster exchange of information);

Cost Savings: Higher cost savings result from fewer changes, better detection of interferences, and optimization of asset management and maintenance activities;

Improved health and safety: The use of BIM Level 2 can help improve health and safety at all stages of the works and execution life cycle. For example, a 3D model provides the visual basis for direct staff training, including 4D simulations and immersive virtual reality. The benefits are quantified by analysing the reduction in the number of work-related accidents and diseases attributable to BIM level 2;

Improving the utilization of quality resources: Optimal understanding of project choices by team members including designers, clients, companies, etc. This ensures higher quality of the final product compared to the end-user needs. For example, 3D and 4D visualization help in the creation of a comfortable environment because they allow to evaluate many aspects not easily identifiable with traditional methods (2D drawings, etc.). The higher the architectural quality of the finished product, the better the response from clients and investors. For example, a comfortable working environment influences the productivity of workers, etc.

BIM level 3 & Adoption

At this level, the information model is filled with real-time data that can be used not only in the design and

construction stages, but also at a more operational stage, covering the entire lifecycle of a built asset.

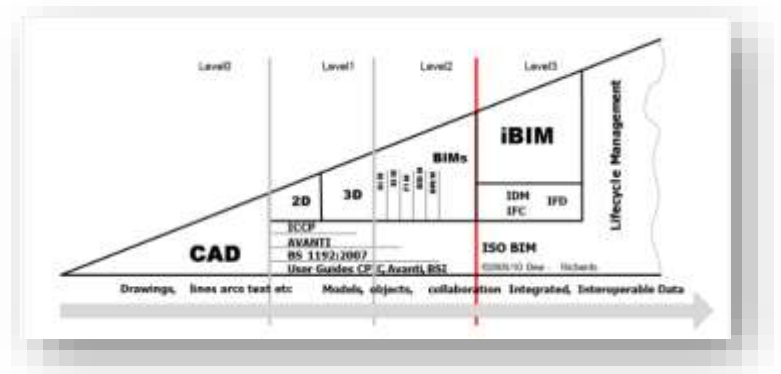
BIM Level 3 enables all participants to work on the same model simultaneously which drastically reduces the risk of information conflicts. The building process is fully interconnected from design to construction management, allowing material waste and delivery times to be minimised, while maintaining (or even increasing) the quality of the final result.

The development of the entire process is based on the complete (or almost complete) standardisation of the different phases and contents. In fact, the concept of “Open data” and, specifically, Open BIM is fundamental here. This feature leads to maximum interoperability between all the disciplines involved in the different phases as the constraint dictated by proprietary files is absent.

Another key requirement to deliver BIM Level 3 projects is the use of the IFC (Industry Foundation Classes) an open and non-proprietary file format (therefore not controlled by a single vendor). The idea is that IFC models can be easily exchanged between different software without having compatibility issues. This aims to resolve the current challenges when exchanging data between stakeholders.

To be fully compliant with BIM level 3, a cloud-based model management is required. This fully IFC-certified online collaboration platform supports open BIM workflows by allowing seamless data sharing and visualisation with real-time change updates. A Common Data Environment (CDE), incorporates these functionalities providing widespread usage to all project stakeholders using any device and above all from anywhere to manage projects and promote collaboration between users.

As mentioned earlier, BIM level 3 refers to the entire building lifecycle, from design to demolition. Consequently, interoperability and full management must be ensured at all stages through a single BIM model accessible to all project members. This methodology helps prevent errors, optimizes project costs and accelerates the entire construction process.



BIM Maturity level: Bew-Richards

IFC (Industry Foundation Classes)

BIM authoring software allows a generated file to open and view it online and verify all object properties using a simple BIM viewer, anywhere and using any browser enabled device - such as a pc, tablet or smartphone.

In order to exchange the models and information or collaborate with other professionals, design firms and construction companies are often finding it necessary to use an openable, non-proprietary file format so that everyone can access, view and manage the project content regardless of the software used to create those files.

By definition, that is what an IFC file is: an open, non-proprietary file format designed by building SMART International to support interoperability workflows between construction professionals and registered as an official international standard ISO 16739:2013.

A CDE is a digital data sharing environment where information from construction projects is stored and accessible to project participants. It is an essential part of an engineering or construction project, having as its primary purpose, the collection, sharing and management of data and information exchanges (including documentation, graphical models and non-graphical assets) between the various professionals involved. Within the CDE, each professional figure has their own task and certain “permission” levels to access information. Information and model transfers, from one section to another, are achieved with the usage of special “gates” after document or informative resources have been verified and validated by the person in charge.

This data sharing environment provides real time updates and the records of the entire project workflow meanwhile reducing loss of information.

- ✓ constant interconnection between collaborators and sharing of all data in a single environment;
- ✓ access to information only with the necessary authorisations. In this way, the entire archive (and sub-groups) of information remains organised;
- ✓ saving of time and resources for information production activities, with verification and control;
- ✓ possibility of having files updated in real time;
- ✓ actions tracking and evidence of the historical succession of events (knowing who created a type of information and when they did it);
- ✓ easy access to different data formats and archiving;
- ✓ easier comparison between different models to identify interferences;
- ✓ use of the tool from anywhere with any type of device.
- ✓ advantages of a Common Data Environment
- ✓ lead to better process and information management (file sharing, phases coordination, data storing, etc.).
- ✓ It must be tested that the BIM collaboration platform service for CDE management compliant with the highest range of cloud security standards by choosing a suitable cloud infrastructure, with all the necessary guarantees and certifications, such as ISO 27001, CSA, etc. This is a crucial aspect must also be taken into account to avoid possible loss of data due to cyber-attacks, unauthorised share and access, expose password and pin code, legal or illegal hacking, and ransomware attacks.

BIM Adoptability

Most challenges are unlikely to be significant where there is commitment. What is likely to be critical at this point of time is the development of proper BIM knowledge base within the industry; and identification and elimination of barriers of integrating BIM enabled procurement strategies like Integrated Project Delivery. (Jeyasena & Weddikara, 2012) ⁱ

Despite to the expert views, the necessary to adopt BIM demands increasingly visible over the decade due to the remote working culture and of the technology advancement of internet & clouding system. However, the pace is very slow or not very much progressive in the last decade in Sri Lanka, where numerous mega-projects has been progressed island wide with various

funding authorities and institutions assistance. A very few numbers of projects appeared to be BIM has been applied among them.

Having said that, among other barriers and resistance, it is further emphasis that the prerequisite to amalgamate systematic protocol for open BIM based projects and government's initiation is essential for the adoption of BIM. (Epasinghe, Jayasena, Kolugala, Wijewickrama, 2018) ⁱⁱ

Whereas, the Sri Lankan Construction Industry pragmatically readily adopt and re-produce model for automated quantification and estimating for quantity surveying function in advance but has no mandate for the BIM level 2 in the project delivery system yet for neither for public project nor even for privately funded project from various institutions. This may due to contractor not willing to use the method or fear with the capacity on the one hand and the resistance to change on the other hand by the rest of the stakeholders and industry in confidence with BIM.

Various research and case studies are conducted and found that the BIM adoption is slowly increase but the benefits of cost and time saving is at great extent. For example, despite that around 80 % of the AEC companies neither using BIM nor involve in the adoption process in any capacity including in Sri Lanka and also in Middle East where mega-projects construction took place, the pandemic increases the digitization and thus the BIM application expected to increase in the digital era.

The research also highlighted that most professionals still look at BIM as an advance AutoCad tool that gives 3D model of the structure, hence that the perceived obstacles to BIM Implementation was: Comparison of BIM to CAD, Resistance to change and the Contractors looks at BIM as additional cost. This shows that better awareness and training is critical for successful achievement.

There are various countries utilize BIM level 2 as a mandatory for government project, namely UK, and UAE has the highest number of BIM projects involved in the Middle east region seems under BIM level 2 category projects. It's been very rare that the BIM adoption in to Sri Lankan projects adopted vastly in the past.

However, with projects becoming more challenging in terms of scale, cost and complexity and external uncertainties the only way in which the industry

achieves this will be through better collaboration, investing innovation and working differently than before. BIM is an ideal solution in this respect that the current trend in the industry as a result of Pandemic which activated remote work culture and collaborating approach.

BIM allows for improved collaboration between all stakeholders involved in the project, including architects, engineers, contractors, and clients. This can help to ensure that everyone is on the same page and that the project is completed more efficiently. There are various benefits apparent when using BIM from the client or investor's point of view.

- ✓ Precise results with improved accuracy
- ✓ Saves over all time and money at the Project or corporate or government level
- ✓ 3D visualization gives views close to reality with scheduled time and cost
- ✓ It reduces the disputes which can be arise between builder/developers and contractors
- ✓ Accurate and faster design decisions can be done at early stages
- ✓ Accurate and faster quantity take-off can be obtained automatically
- ✓ Material & labour wastes can be minimized due to early clash detection in design & schedule
- ✓ Design conflicts can be determined before construction starts on site and errors enhanced design options and innovative solutions
- ✓ Improves the coordination of documents between the various designers and engineers involved in the design phase of a project, as well as the coordination of structural elements, and with building services systems.
- ✓ Easy to market early of the project's stakeholder involve in the Asset Management
- ✓ Energy Saving (Sustainable) Design Time Saving Utility Design
- ✓ Prefabrication that reduces accidents, increases efficiency, and reduces labour time in the field.
- ✓ Able to adopt supply chain at early stage and assisting in planning approval.

However, the Quantity Surveyors are slowly adapting in through re-modelling to produce quantity calculation. The following matters are limiting of adopting BIM to Organization level:

- ✓ BIM projects versus non-BIM projects happening within the organization.
- ✓ BIM experience and capabilities issues of various members of the projects team and adoptability
- ✓ Copyright and intellectual property rights issues based on content development and use
- ✓ Contractual issues pertaining to BIM services, Commercial terms for BIM services and selection of service providers are potential risk
- ✓ Cost of training and education in BIM (not just model authoring but also model usage and information extraction and processing)
- ✓ Cost and reliability of hardware and software selection for organization wide BIM implementation (including compatibility issues).
- ✓ Compatibility between Software Platforms due to the software competition in the market.

Quantity Surveyors are slowly adapting to BIM and re-modelling their processes to produce quantity calculations. However, there are several factors that may be limiting the adoption of BIM at the organizational level. Some of these factors include:

- ✓ Lack of awareness: Many organizations may not be aware of the potential benefits of BIM, or may not fully understand how it can be implemented in their workflow.
- ✓ Cost: Implementing BIM can require a significant investment in technology, training, and software. For some organizations, the cost of adoption may be prohibitive.
- ✓ Resistance to change: Some individuals or organizations may be resistant to change and may prefer to stick with traditional methods of construction and project management.
- ✓ Lack of expertise: Implementing BIM requires specialized expertise and training, which may not be readily available within the organization.
- ✓ Legal issues: There may be legal issues related to ownership and liability when using BIM, which may need to be addressed before adoption can occur.

Overall, the adoption of BIM requires a significant investment of time, money, and expertise. However,

as the benefits of BIM become more widely recognized, it is likely that more organizations will begin to adopt it as a standard practice.

Design consultants, contractors, and their supply chain organizations are increasingly using BIM, which requires an in-depth understanding of the risks inherent with its application:

- ✓ Economic and or financial crisis may impact on demand of potential services required.
- ✓ If the Government flexible on BIM adaptation to all its projects, difficult to reverse in short to medium-terms.
- ✓ Return and profit on Investment in short-run might be uncertain due to pandemic or other disruption.
- ✓ Direct competitor's trend and immediate adoption of BIM services might affect long-term relationship of the potential Clients.
- ✓ Copyright and intellectual property rights issues based on content development and use.
- ✓ Legal Liability and Mutual Reliance.
- ✓ Ownership of models and data embedded in the models.
- ✓ Question would arise who owns the model?", "Who is responsible for creating, analysing and updating project information, including the model?", "What is the priority of documents?" some model may difficult to physically build.
- ✓ Insurance and liability issues on BIM projects.
- ✓ Risk allocation, risk mitigation and additional risk due to model exchange.

There are plenty of benefit in adopting BIM at an Organization cannot be undermine as the new procurement or otherwise assisting in the cost management.

- ✓ Long-term Return and profit are certain with remote work culture is added advantage.
- ✓ Accurate Cost Estimating and Cost Management would appeal more potential Clients in the region.
- ✓ Improved Coordination and Clash Detection ensure least variation to Client's budget.
- ✓ It will reduce errors and omissions (E&O) which are in turn reduce E&O claims and professional liability.
- ✓ Reduction in insurance costs, positive impact and bonding fees on firm reputation should increase the number, scale and variety of

opportunities available to design and integration firms.

- ✓ The use of BIM allows quantity surveyors to accurately estimate building costs, which is based on the quantities and schedules generated from the BIM model. These measures were also automatically updated by the BIM software whenever changes are made in the model ensuring schedules of quantities are always accurate.
- ✓ If this 5D data are incorporated into the BIM model in the early concept design stages of a project, it helps to show clients financial effects of change requests and other variations. The accuracy of cost estimating with the BIM depends on the BIM model being modelled accurately by the designers.

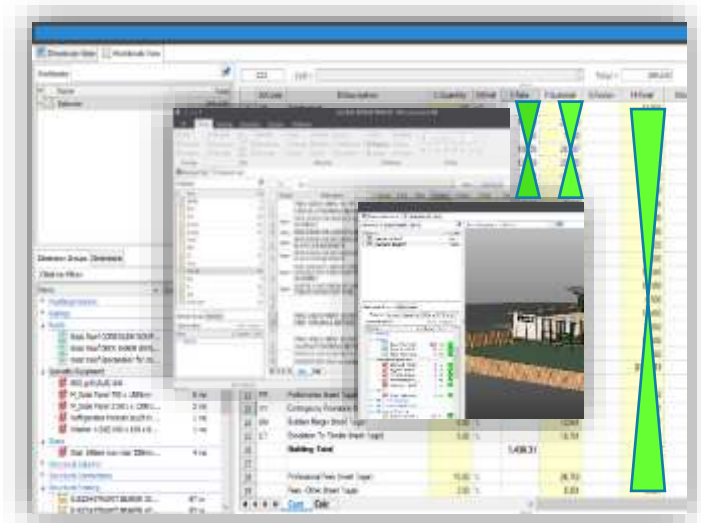
When implementing BIM in to AEC's Organisation level, the outcome of its have twofold this requires different skills-set and additional resources.

- ✓ Full implementation of BIM can be adopted or with combination of manual processes
- ✓ This may achieve by approximately say 30% of reduction of existing staffs
- ✓ Cost for salaries of the rest of the staffs and upskilling BIM Capabilities
- ✓ Appoint BIM Specialist and coordinators and legal resource for terms and agreement
- ✓ Codify BIM standard and protocol; without compromising the soft value model of the organization and potential requirement of the new process.
- ✓ Bentley, Autodesk, Graphi soft and Tekla are most popular in the region, among many other Software manufactures in the industry as listed in the table below.
- ✓ Autodesk Revit has been used in the Middle East and elsewhere and most competitive software to the counter parts in terms of history of usage, cost and reliability. It also provides free training license for students learning the modelling through Revit software.
- ✓ Purchasing high spec Server and computers suitable to the software and data storage requirement and number of BIM staffs to be utilized.
- ✓ Amendment of standard terms of FIDIC Conditions of Contract 1999, a great attention to good faith and duty of care of team and Client, insurance and copy rights must be

given attention among other provisions at great extent.

- ✓ Getting drafting the BIM provisions rights so that they enhance the project control which is intended tie together future design, construction, operation and maintenance or eventual demolition. In this context accepted programme, early warning compensation event are essential if the contract based on NEC4.

When implementing BIM in to Quantity Surveying or Consultancy Organisation level, the outcome of it has tremendous in terms of speed and the accuracy this require additional server or computer or laptops and the relevant version of software and their features necessary to the business model. A few such software and its special features are illustrated for better understanding.



QS and BIM in Project Control

BIM & QS Software

Software tools have revolutionized the way Quantity Surveyors work by enabling them to complete their tasks more efficiently and effectively. They provide accurate and reliable estimates, which are crucial in the decision-making process. With the help of these tools, Quantity Surveyors can manage their time better and meet tight deadlines. They can also work with limited resources and make immediate changes to the design if necessary.

The potential return on investment for Quantity Surveyors who adopt these software tools is significant. They can save time and money by using these tools, which translates into higher profits and better business outcomes. Additionally, these tools can help Quantity Surveyors to provide better services to their clients, which can lead to increased customer satisfaction and loyalty.

QS software like Cost X, on-screen take-off, CubiCost, BIM vision-Take-off / Advance Schedule/ BIMQTO, Primus, plan swift are essential tools for Quantity Surveyors in today's fast-paced and competitive environment. They provide accurate and reliable estimates, save time and money, and help Quantity Surveyors to provide better services to their clients. Therefore, it is crucial for Quantity Surveyors to adopt these software tools at any level to remain competitive and successful in the industry.

Revit (Autodesk) v Cost X (RIB)

Cost X is a powerful software tool that provides a comprehensive solution for estimating costs in the construction industry. It is designed to streamline the process of quantifying and pricing, from simple sketches to complex 3D models, with various SMM integrated within.

One of the key advantages of Cost X is its ability to produce a BoQ for detailed measurements based on SMM. This means that the software can accurately estimate the quantities of materials required for a project, based on industry-standard measurement methods.

Another advantage of Cost X is its integration with cost databases. This allows users to access up-to-date or able to update pricing information for materials, plant and labor, equipment, which can be used to generate accurate cost estimates quickly and efficiently.

Cost X software can produce measurements and BoQ automatically based on NRM from a BIM model. This is one of the key advantages of using Cost X with BIM, as it allows for faster and more accurate cost estimating and quantity take-off.

When using Cost X with BIM, the software can extract data from the 3D BIM model and automatically generate measurements and BOQ based

on NRM. This eliminates the need for manual measurement and calculation, saving time and reducing the risk of errors.

In addition to automatic measurement and BoQ generation, Cost X also allows users to customize their measurements and pricing to suit their specific needs. Users can adjust the rate of materials and labor, apply discounts or markups, and add contingencies or overheads to their cost estimate.

In contrast, other software tools such as REVIT may not have the same level of functionality when it comes to estimating costs. While REVIT is a powerful tool for creating 3D models and generating construction drawings, it may not be able to produce a BoQ based on SMM or estimate costs from a cost database.

Revit can provide detailed information about the components and systems of a building, including their quantities and properties, it does not have the built-in functionality to produce measurements and BoQ based on SMM. However, there are third-party software applications that can be used in conjunction with Revit to produce measurements and BoQ based on SMM.

Cost X is a risk mitigating tool that offers amazing and super-fast features for the estimate function and evaluation for contract management. It integrates 2D and BIM functions closely linked with the workbooks, allowing for efficient and accurate cost estimating and management throughout the construction project.

Cost Management Services & BIM

Best practices in cost management involve a combination of clear communication, accurate cost estimating, standardization, regular cost monitoring, risk management, continuous improvement, and collaboration.

Providing services related to cost management requires a clear identification of the party's intention and specifying the standard method of measurement with any proper amendment where applicable. This information should be included in the preamble note of the BOQ to ensure that all parties involved in the project are aware of the measurement method and any relevant amendments.

However, it is also important to note that sometimes the standard method of measurement may not be sufficient to measure the quantity accurately or may

not be applicable to the specific situation. In such cases, it is necessary to interpret the BoQ correctly and adapt to the new situation by adopting common sense and considering the facts and circumstances reasonably and fairly.

During the post-award stage, it is essential to have a clear understanding of the BoQ and ensure that any discrepancies or inconsistencies are addressed promptly. This can help to avoid disputes and delays in the project timeline.

For example, some of the suggestions to mitigate such situations when dealing with measurement under the Sri Lankan Standard method of measurement (SLS-573) deviation focused in the quarterly e-journal of Institute of Quantity Surveyors Sri Lanka (IQSSL).ⁱⁱⁱ

Let's take an example of the execution of a mixed-use or real-estate development project in the Port-City. This type of project typically involves the construction of a complex that includes residential, commercial, and retail spaces and of .

During the execution of such a project, there are several potential situations where pricing levels might vary. For example, there may be delays in the delivery of materials or a shortage of labor, which can lead to additional costs and extended project timelines.

In addition, there may be changes in the design or scope of the project, which can lead to ambiguity in the contract document and changes in pricing levels.

Another potential situation where pricing levels might vary is due to unforeseen circumstances such as a pandemic. The pandemic can result in a shortage of materials or labor, delays in construction timelines, and additional costs for PPE and other safety measures.

To manage these situations effectively, it is important to have mechanisms in place for risk management and cost control. This can include contingency planning, regular monitoring of costs, and clear communication between all stakeholders involved in the project.

In addition to that BIM and QS software assist to estimate accurate quantity and cost a learnt cost database would help to demystify the basic cost, allocatable overheads, realistic risk contingencies and other allowances.

Demystifying the payment model of construction and real-estate projects in the Port city

The involvement of third-party funding or a foreign contractor through JV partnering can bring significant benefits to the local economy and of the investors. The project will create employment opportunities for the local workforce, increase the demand for local goods and services, and generate revenue for the government through taxes and fees in long-term.

It's most common and increasingly using sub-contracting strategy in the construction and real-estate industry due to the volatility of the market and elevated prices of goods and services and needs of specialised skills and capacity to cope with the trending situation. Further, local and foreign supply chain plays crucial role where shortage and delays in deliveries and disrupted services are of most common and of quite concerns.

Furthermore, the involvement of sub-contractors, suppliers, and manufacturers from both local and international markets can pose several challenges. It's not uncommon that the liner model in procuring materials and prefabricated elements from far away to the construction site involve waste and energy emission, a nearby construction or manufacturing yard would be ideal to establish to reduce the waste and carbon footprint. It will also promote SME & locals.

Therefore, procurement process should be transparent, competitive, and comply with the local laws and special economic zone regulations. The project team needs to ensure that all stakeholders are aligned with the project's objectives, timelines, and quality standards. The project team should also consider the local content requirements, such as the use of local materials, equipment, and labor, to promote the growth of the local economy.

In addition, the project team should establish clear communication channels with all stakeholders, including sub-contractors, suppliers, and manufacturers, to avoid delays, misunderstandings, and conflicts. The team should also ensure that all stakeholders comply with the project's safety, health, and environmental requirements. Implementing BIM in asset management and cost estimate could provide greater savings of time and cost of the end-to-end process.

It's also worth to consider the construction methods and contractual clauses and terms that are address disruptions and new events to include relevant contingency plan or risk management strategies in a best way to apportion the risk fairly between the parties. This due to global recession and pandemic, global warming, zero carbon target, BRI initiatives and continuous ramification of world power and war in Ukraine, to better dealt with the situation.

In addition to that, it is also uncommon that the scope of work could have grey areas at the outset due to cut and shuffle practice or utilize a previous model and document. Therefore, it may lead to value engineering during the early involvement with Main Contractor's and/or Client's for design development and the estimation and cost planning process. As a result, this can lead to the issuance of a number of addendums to reconcile the original design intent and scope, as well as to provide the new terms and conditions introduced during the project.

Therefore, it is important to understand that a proactive Client's Cost Manager or Contract Administrator should include in the Contract document a provision for possible/potential alternative materials or a supplier/manufacturer list to obtain provisional rates to adapt to changed or new conditions where potential shortages or delays may occur due to a pandemic or other unforeseeable circumstances. This can help to mitigate risks and minimize delays in the project timeline by allowing for more flexibility in the procurement process.

It is important to anticipate potential situations where pricing levels might vary during the execution of a project and to have mechanisms in place to manage these situations effectively. This can help to minimize the impact of these situations on the project timeline and budget.

The following are some of the most striking situations where the pricing level envisaged might vary during the execution of a project and may be adjusted to:

- **Grave loss:** In some cases, unforeseen circumstances such as a pandemic may result in grave loss that would be unjustifiable to give effect to a future order for the delivery to the pre-pandemic awarded projects. This can result in a need to renegotiate pricing levels to account for the additional costs incurred.

- Ambiguity in the contract document: Ambiguity in the contract document with regards to certainty of quantity involves or unfinalized detailed design which can lead to changes in pricing levels during the execution of the project. This can result in the need to renegotiate the contract terms to account for the additional costs incurred due to the lack of clarity in the contract document.
- Prolonged / Time at large situation: A time at large situation may arise due to a shortage of labor or a delay or inefficiency in material

delivery and handling, or its shortage. This can lead to additional costs due to extended project timelines and the need for additional resources. Where there is a situation with no EOT granted for delay.

These situations must be proactively handled and may be alternatives like change the manual process to mechanized or digitized way for example implementing BIM and BIM Estimate, so it may give solutions to negate the situation more affordable and efficient way in cost management in controlling project cost.

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