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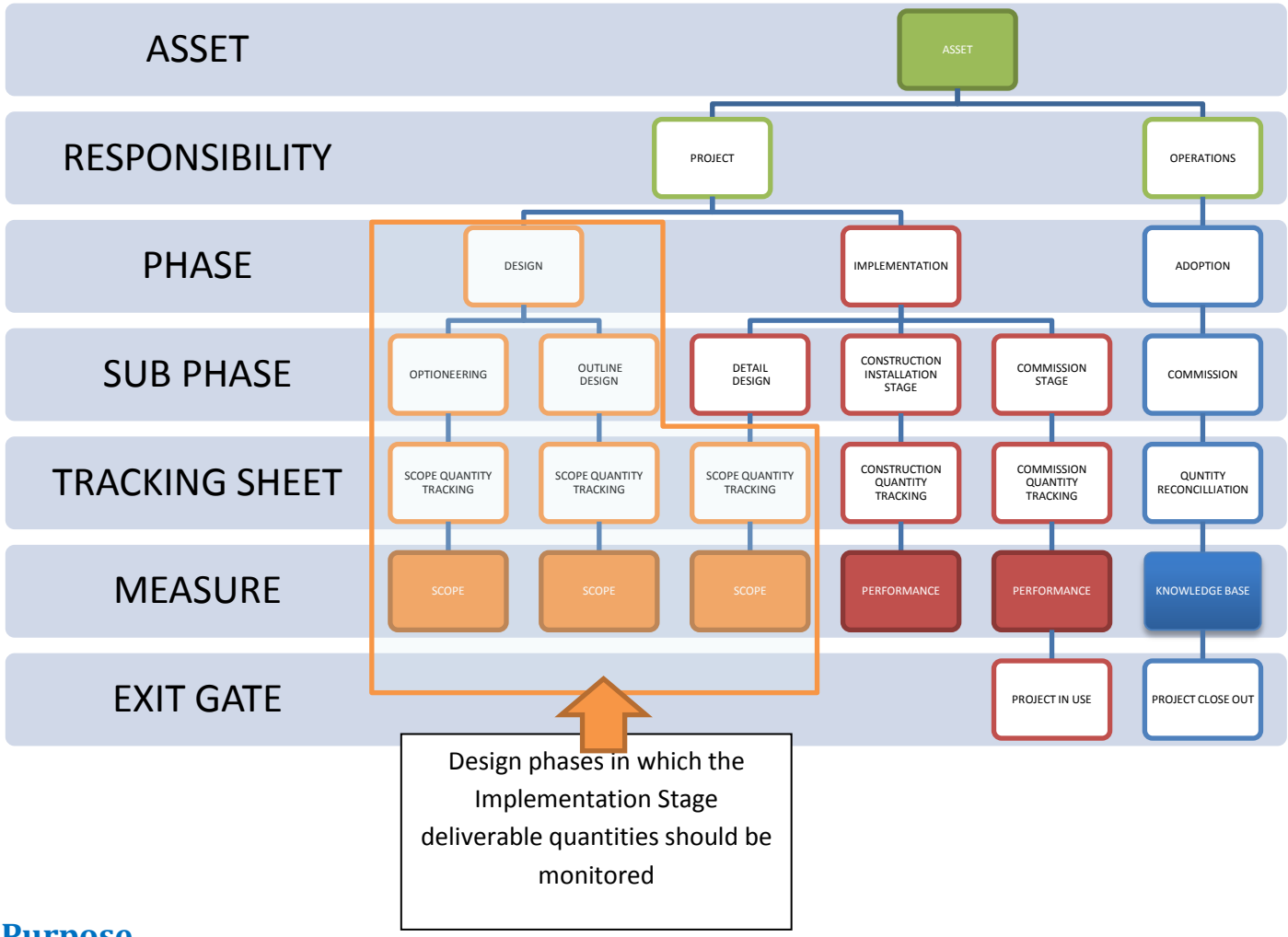
[SCOPE TRACKING USING QUANTITIES IN THE DESIGN PHASES]

Once a Project moves into implementation, using quantities to measure installation performance rates is common place and techniques have been developed that allows easy be tracking. In design phase, drawings and documents have been tracked to measure performance on a similar basis but the growth of scope has been harder to identify. The advent of BIM has opened new opportunities to track effectively the true scope the project over the full lifecycle.

TRACKING QUANTITIES IN DESIGN



Purpose

Most Construction companies have tracked quantities in the implementation stage of a project as a method of measuring progress, but with the advent of BIM there is an opportunity that tracking of these type of quantities in the upfront design stages and the approach becoming a major controlling element.

In these early stages measuring quantities of the implementation deliverables can be used to control the growth in both project and programme scope, and be an additional form of measure as well as tracking the number of drawings created or specifications written.

The Underlying Business Driver

The business driver for this is that scope creep can be considerable during the design of a project and it previously has been previously difficult in tracking when quantities have increased until a control gate has been reached.

The Change Enablers

It is only with recent changes in how design is carried out that the opportunities of more advanced tracking can occur.

1) BIM: Building Information Modelling and the use of integrated modelling tools in the design process has allowed for an opportunity to be able to track the individual models objects through the lifecycle and baseline them against original quantities.

2) NMM2: The New Method of Measurement 2 developed by RICS provides measurement rules which can be standardised and used over a project or programme bringing in an improved consistency of material and equipment quantification.

3) Use of advanced estimating systems with unit cost databases, and the estimating items relating back to NMM2 and to design objects in the BIM model.

4) Data Federation: The final piece of the jigsaw is the ability to federate information between the deign package and estimating package allowing tracking against baseline and stage gate quantities.

Quantity Tracking Levels

The level of information available is the same on both minor and major works, but it is important to define what should be collectable to prevent over reporting and over analysis on minor works.

As an example; it is probably not economically viable to deploy scope quantity tracking on small infrastructure projects up to the value of £500K.

It also has to be understood that whilst most estimating processes go down in some cases to around six levels of CBS, scope quantity tracking down should only really go down to the first three levels of an estimating CBS as even when using BIM data it is impractical to measure quantities month on month any lower.

Outline Structures

The changes to the processes will commence with the development of the quantity tracking designations and these will be the same on all projects throughout a capital programme The use of pre-defined methods of measurement such as NRM2 which covers construction (Note different pre-defined methods of measurement will be needed for process and mechanical equipment and when blended should form an overarching CBS.

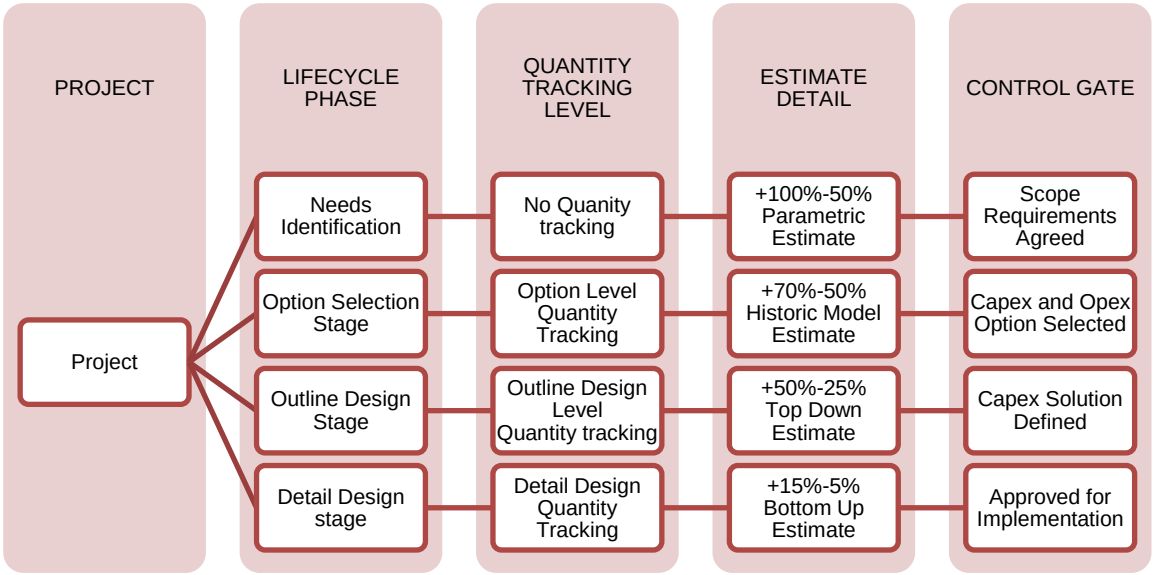
Outline Approach

The need for quantity tracking varies over the project lifecycle. In the design phases of the life cycle it is a facility which enables trending potential cost and time increases in the future stages. It is not an underpinning performance measure in the design phases

In the construction phase, it is used to underpin delivery performance by means of work off curves, and also can confirm potential variances in time and cost if the projected deliverable quantities vary from the estimates for the works. (Note this document does not cover the construction phase.)

TRACKING SCOPE IN THE DESIGN STAGE BY THE USE OF QUANTITIES

The quantity tracking of equipment and materials in the design stages is not a performance measure, but an underpinning for either project growth or reduction within the design life cycle.



This approach has to take into account the level of design maturity at each phase, ensuring that the measurement can be enabled based on the knowledge around the project at that point in time.
In general at each phase it means reviewing the potential out turn quantities, such as the lengths, volumes and weights of material and equipment currently in scope. These quantities will be tracked on a monthly basis, against the initial baseline value and against the last control gate.

QUANTITY TRACKING IN THE OPTION SELECTION STAGE

In the Option Selection phase the design options have not been selected and the estimates are usually based on parametric and volumetric norms. This means the measurement of quantities has also to be at a high level.

UCD Ref	BIM Ref	CBS LEVEL 1		CBS LEVEL 2	
		Cost Code Title	Unit of Measure	Cost Code Title	Unit of Measure
1		Groundwork	m2 area		
2		Building, Concrete and others	m3		
3		Architectural	m2		
4		Structural Steel	te		
5		Mechanical Process Equipment	SUM		
5.1				Tanks and vessels	m3 vol
6		Piping	m		
7		HVAC Ductwork	m		
8		Electrical	SUM		
9		Insulation	m		

In the Option Selection phase the tracking only uses the CBS level 1 and CBS level 2 information. The quantities will be against the estimate produced in the Needs phase.

QUANTITY TRACKING IN OUTLINE DESIGN

As we develop information relating to the project we also collate more quantifiable detail. In outline design we have selected our options including finalising the procurement approach and the process is underway to take the design to a level that it can be priced for implementation.

UCD Ref	BIM Ref	CBS LEVEL 1		CBS LEVEL 2		CBS LEVEL 3	
		Cost Code Title	Unit of Measure	Cost Code Title	Unit of Measure	Cost Unit Description	Unit of Measure
1		Groundwork	m2 area				
1.1				Groundwork preparation (inc excavation and backfill)	m2		
1.2				Groundwork and Logistics, Storm and Foul Drainage, Service ducting and Channels	m		
1.3				Groundwork site architecture (roads, parking, landscaping, etc.)	m2		
2		Building, Concrete and others	m3				
2.1				Construction base slab	m3		
2.2				Construction roof and floors	m3		
3		Structural Steel	te				
4		Architectural	m2				
5		Mechanical Process Equipment	SUM				
5.1				Tanks and vessels	m3 vol		
5.1.1						Shop built (stainless steel)	m3
5.1.2						Shop built (HDPE etc.)	m3

The quantity in the Outline design phase will be tracked at level 1 level 2 and level 3. The confidence level is increasing through increased definition and reliance on parametric / volumetric models are no longer needed

QUANTITY TRACKING IN DETAIL DESIGN

At each iteration of the design process, the knowledge of the project requirements increases. This enables the Project team to define the quantities in far more detail.

UCD REF	BIM REF	CBS LEVEL 1		CBS LEVEL 2		LEVEL 3	
		Cost Code Title	Unit of Measure	Cost Code Title	Unit of Measure	Cost Unit Description	Unit of Measure
1		Groundwork	m2 area				
1.1				Groundwork preparation (inc excavation and backfill)	m2		
2		Building, Concrete and others	m3				
2.1				Construction base slab	m3		
2.1.1						Mass Concrete	m3
2.1.2						Formwork - Plain Finish	m2
2.1.3						Reinforcement	te
2.2				Construction roof and floors	m3		
2.2.1						Mass Concrete	m3
2.2.2						Formwork - Plain Finish	m2
2.2.3						Reinforcement	te
3		Structural Steel	te				
3.1				Building fabric	te		
3.2				Ancillary and support steelwork	te		
4		Architectural	m2				
4.1				Cladding & Covering	m2		
4.2				Windows, Doors, Stairs	nr		
5		Mechanical Process Equipment	SUM				
5.1				Tanks and vessels	m3 vol		
5.1.1						Shop built (stainless steel)	m3
5.1.2						Shop built (HDPE etc.)	m3

As the design complexity increases, the added value of more depth in the tracking process provides more detailed quantification of the movement in equipment and materials.

It is also important to understand that we are tracking only key quantities in design; it's not the full estimate breakdown, but specific material and equipment items for the specific project type which will be able to help us identify trends and growth issues.

This means in Detail Design we have to quantity track at all three CBS levels so we can fully understand the trends between the project gateways and reviews from the project start. Modern estimating software linked to BIM can accommodate this.

Subject to the type of project, increases in equipment and material quantities will provide a rapid indication of cost escalation occurring which in turn will impact durations well before any re-estimates take place. When the project moves into detail design phase tracking quantities will be mainly at level 2 and 3

KEY STAKEHOLDERS

This information has several stakeholder groups who will benefit and each group requires output to suit their individual business needs.

Programme Management

When the scope quantity tracking information is collated over a capital programme, analysis can be carried out on what the original quantities were expected in the differing project categories, this enables trends on differing solutions to be evaluated and potentially implemented subject to the overall programmes duration.

Project Management

Quantity tracking has always been a key tool in the Project Managers portfolio; by growing upstream it provides increased underpinning and highlighting quickly potential project growth which in turn will impact delivery performance

Programme & Project Control

Scope Quantity tracking provides a project control team; the underlying information in the design phases which in turn provides the ability to be able develop trends for assessing overall growth and performance delivery in the implementation phases.

Cost Management and Estimating

The information collated during construction and close out will enable the development of long term knowledge bases and data mining in-turn allowing the quality of the regression curves and estimating norms to improve especially in the early stages of a project

Asset Management

The uses of the information by Asset management is very similar to that of estimating as it will provide long term knowledge information which will be useable when planning the delivery of new assets in future years. It will also allow Asset Managers to more accurately consider viable targeted operational solutions instead of capital investment. The fact every component of a plant has a cost element means accurate maintenance regimes can also be developed.

Procurement

Procurement will primarily use the estimates to understand the overall equipment framework requirements and demands especially over the overall programme.

SUMMARY

This approach to be effective relies on a level of investment in automated and integrated processes. Without that investment the approach will be not be as cost effective.

As the process starts in the needs stages it is expected the use of this type of approach will by Asset Owners, but implemented by their supply chain. Therefore it needs contractual rules with the design supply chain on attributes both around design and estimating.