High Level Cost Modelling of Elevated Deck & Linkway
- the importance of Key Performance Indicators for Cost Planning

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Abstract

- The full potential of QS BIM for cost modelling should be realized
- QS practices will need to organize the historical information of tendered or completed projects into key indicators for economic evaluation of design alternatives
- Information from the public domain such as websites can sometimes be used, with caution

Abstract (cont'd)

- Make optimum use of available information to create a cost model where the Level of Detailing provided, of say 100, is insufficient
- There is a need to consider data-mining tools to develop the firm's knowledge management (KM) base
- How this KM base is to be developed will depend on the proper identification of key indicators for economic design evaluation

Key Performance Indicators for Building Structure

Table 1: Preliminary Design Cost Analysis

KPI Based on FT2 of GFA (figures provided are for illustration only)   3/29/2014

No	Description	Cost Plan area from QS	Based on Current/Latest Drawings (RM)						Concrete (m3)	Formwork (m2)	Reinforcement (kg)
			Preliminaries	Architectural	Structural	M&E	Total				
1	Transfer floor (Tower 1)	1900	351,000.00		4,390,000.00		4,741,000.00		2650	5900	740,000
2	Transfer floor (Tower 2)	1000	195,000.00		2,420,000.00		2,615,000.00		1500	2300	423,000
3	Transfer floor (Tower 3)	2000	373,000.00		4,660,000.00		5,033,000.00		2800	6000	798,000
4	Tower 1	37,000	5,880,000.00	32,000,000.00	21,500,000.00	19,500,000.00	78,880,000.00		17,600	85,000	2,250,000
5	Tower 2	24,000	3,750,000.00	22,500,000.00	12,400,000.00	12,000,000.00	50,650,000.00		10,500	57,500	1,450,000
6	Tower 3	34,000	5,700,000.00	31,500,000.00	20,000,000.00	19,500,000.00	76,700,000.00		17,000	82,000	2,100,000
	Total CPA (m2)	99,900	Total 16,249,000.00	86,000,000.00	65,370,000.00	31,000,000.00	218,619,000.00	TOTAL	52,050	238,700	7,761,000
	Total CPA (ft2)	1,075,324	Cost/ft2 CPA: 15.18	80.34	61.07	47.64	204.24	Concrete/m2 CPA	0.05		
	Total CPA (ft2) w/o transfer floor	1,070,424	% 7.43	39.34	29.90	23.33	100.00	Formwork/m2 CPA		0.22	
								Reinforcement/m2 CPA			7.25

Demand for KPIs for Economic Evaluation

- As property development becomes increasingly competitive and riskier, bankers and accountants are increasingly aware that project costs have to be managed even at the early design stage to meet investment objectives
- Marketers have to do their market research and analysis of what will sell and at what price **before** the schematic or sketch designs can be firmed up
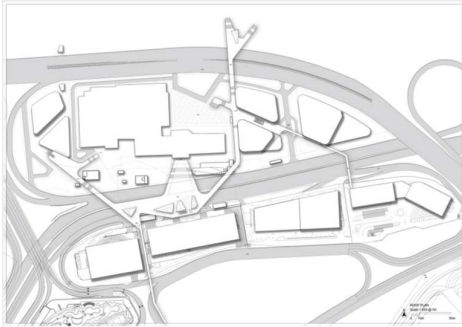
Evaluation of Structural Systems Design & Facade

- Comparison of Internal and External Shear Wall systems
- Comparison of Post-tensioned Flat Slab system and Conventional Beam & Slab system
- Comparison of unitized glass window system, curtain walling system and aluminum cladding system

Demand for KPIs for Economic Evaluation (cont'd)

- There has been a shift in emphasis on measurement (to produce bills of quantities) to that of a building or design economist to provide cost modeling or cost planning advice at the early stages not only to meet requirements of the design brief but also to address financing and marketing concerns.

Civil Engineering Structures in the Building Domain

- Inter-connecting elevated decks with pedestrian linkways supported by box girder structures between towers have made their appearance
- These are more like civil engineering bridge structures with a broad deck on top spanning between buildings
- This has made the task of using a suitable set of KPIs and benchmarks for cost modeling even more challenging for the QS

Conceptual Sketch Plan of Elevated Deck & Linkway Above Road

Brief Cost Plan for Elevated Deck & Linkway (for illustration only, cost/m2 not shown)

No.	Elements	Amount (RM)
1	Main Grid Space Truss & Non-long Span Structure	200,000,000
2	Linkway	42,000,000
3	Support columns, pile caps & bored piling - allow	10,000,000
4	Retail areas at deck (light structure) - allow	4,000,000
5	Escalator, elevator & staircase	3,000,000
6	Interfacing with existing building - allow	3,000,000
7	Diversion, underpinning, trial pits - allow	10,000,000
8	M&E installation - allow	10,000,000
9	Landscaping - allow	4,000,000
10	General Preliminaries – 15%, say	43,000,000
11	Contingencies – 10%, say	33,000,000
12	Total	362,000,000

Bridge Design

Bridge design can be classified as:
- single closed box girder composite bridge,
- twin girder cross-beam directly supporting bridges with cantilever,
- twin girder cross-beam directly supporting bridges without cantilever,
- multi-girder composite bridge,
- cross-beam composite bridges with deck local widening near abutments,
- variable width cross-beam composite bridge,
- special girder composite bridges

Relationship between Span and Cost

- It can be generalized that the larger the spans, the heavier the steel tonnage required
- Therefore, the weight of structural steel members (in terms of kg. per m2 of deck area) increases if the span increases
- The average kg. per m2 of deck area ranges from 0.25 – 0.33 kg. per m2, depending on the box girder type, whether there are supporting cross-beams or propped cantilevers or not

Price Grouping of Bridge Structures

(refer to main paper)

Project Information Management Systems and Knowledge Management

- Newforma
- Aconex
- Apex
- Cost XL

The above are for Buildings, what about civil engineering applications?

Extracting Information from a Model

Conclusion

- With the advent of BIM, the QS role has shifted upfront whereby the implications of early stage design choices has to be costed out and made known
- It is clear that key indicators for cost planning need to be further developed for better knowledge management in both building and civil engineering construction projects
- The development of key cost planning indicators for civil engineering projects may still be at its infancy but over time it is hoped that a "standardized" format for cost analysis of civil engineering structures such as bridges, etc. would be available