Chapter 3

New Approaches and Rules of Measurement for Cost Estimating and Planning

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1. Introduction

In the UK, cost estimating and cost planning, have for the past 50 years been used by Quantity Surveyors and Cost Consultants to convey to the building client, the predicted cost of a project. The basis of the preparation of these estimates and cost plans originates from a system of "elemental cost planning" (Seeley 1972) and owes its origins from the construction economist pioneers who created the Building Cost Information Service of the RICS, which provided the first rules for the measurement of the elements of a building. The rules were largely created, to enable historic cost data from Bills of Quantities to be archived in a standard format, to allow the UK surveyors, architects and engineers, to not only access the information, but use it to "model" the costs of future projects. Remarkably the cost data was freely provided by members of the Royal Institution of Chartered Surveyors, to allow fellow member's to access what had hitherto been only available to an individual practice. The development of cost analyses and cost planning has been extensively documented in text books (such as Ferry and Brandon et al 1999) together with many published conference papers and guidance rules, on cost planning methods.

However, in reality, whilst the cost consultant might have adopted "elemental format", and accessed cost information from the BCIS (Building Cost Information Service: RICS), as well as those from their own sources, the reporting methods to building clients, by the building team, have varied widely. Partly this was in response, in earlier years (and even today on small projects), to Clients, whom by and large, did not believe that extra fees for carrying out extensive cost planning exercises, was a necessary requirement. Later, as Clients realised the potential of the Cost Plan, cost consultants responded by developing and producing individual cost reports to the Client. However whilst loosely based on "elemental cost planning" the quality of the reporting process depended much on the capability, expertise and innovation of the cost consultant.

Cost plans from cost consultants, might be produced on a totally different basis from one another. Submitted cost plans could easily report costs as either current, predicted to tender date or completion date, contain or not contain allowances for named risks and could even be based on different assumptions regarding measurement rules. From a Client perspective, the lack of standardisation in cost reporting has produced unacceptable risk and confusion among the building team.

Following this introduction, the next section of this chapter examines the impetus of change that might be brought about by the standardisation of cost estimating and the purpose and use of New Rules of Measurement (NRM) for cost planning (NRM1) in conjunction with other similar documentation (BCIS) and the new Government guidelines on benchmarking (cost limits). The chapter also discusses how the production of NRM 1 provides the opportunity to map the RIBA Plan of work stages together with the OGC Gateways applicable to projects,

against defined stages of estimating and cost planning. With the production of NRM 1, the chapter also explains how the Building Cost Information Service (BCIS) elemental standard form of cost analysis has been revised to ensure that cost data will be stored appropriately. Finally it considers the impact of BIM on the process.

2. The standardisation of cost estimating

The RICS Quantity Surveying and Construction Professional Group, in recognition of the difficulties faced by the building client, established a Steering Group with the remit *"to research the problems associated with the measurement of building works at all stages of the design and construction process" (NRM1.RICS, 2012).*

The Steering Group discovered that one of the root causes of inconsistency between cost consultants lay effectively, in the lack of clear measurement rules and guidance for estimates and cost plans to the Construction Industry. Whilst various Standard Method of Measurements (e.g.: Standard Method of Measurement,7th Edition, RICS 1989), had been produced by the RICS since 1922, these rules were largely created to provide consistency on the measurement of building work to enable relative accuracy of providing cost estimates for unit rates and builder's overheads and profit. These were embodied in Bills of Quantities that became the traditional method of cost management/control for the most part of the twentieth century.

The Steering group discovered that *" the lack of consistency in the measurement and description.....for estimates and cost plans.....makes it extremely difficult for the employer and project team to understand what is included in the cost estimate, cost limit or cost target advised by the quantity surveyor; often resulting in doubts about cost advice provided. Moreover, the lack of uniformity afforded a just ground of complaint on the part of the employer who was often left in doubt as to what was really included in a cost estimate or a cost plan"* (based upon the Forward to the First Edition of NRM 1; RICS 2011).

Thus, the concept of, "*the RICS new rules of measurement. Order of cost estimating and cost planning, for capital building works,* NRM. *"(NRM1.RICS, 2012).* was born, and has culminated in its first publication in 2009, and later revised in 2012. All RICS surveyors were requested to implement these rules in January 2013. However it is too early yet to establish if this has proved effective.

Interestingly, the reader should note, that in the UK, standard methods of cost measurement are not, like their counterparts elsewhere in Europe enforceable in law. For example, in Germany, DIN 276 (2006) Kosten von Hochbauton and DIN 277 (2005) Grundflächen und Rauminhalte von Bauwerken im Hochbau, are standards that *must* be adopted as are all DIN standards (Symonds 1996). Only recently these standards were complimented by DIN 18960 which translates as "the determination of costs in the Construction Industry". These documents are not dissimilar to NRM1, and the Code of Measuring Practice (RICS 2007). However as DIN standards they must be used by everyone operating in the Public Sector. Arguably, the UK professional body RICS, is only able to recommend the use of NRM1, to ensure best practice to enable high standards of professional competence to be achieved. Should the UK be more like Germany, where the various stages of cost management are described and attached to the equivalent stages of the RIBA Plan of Work (HOAI) with each attracting a different percentage fee, then cost consultants might be more eager to follow

measurement standards. However as fee scales were abandoned in the UK in the 1980's this is an unlikely scenario either now or in the future.

The effective *"standardisation"* of the cost estimating and cost planning process and production of documents, in principle, embodies the long established systems of "initial cost estimating" and "elemental cost planning" but now provides clear guidance in terms of definitions and measurement rules.

Clearly the new *"standard"*, if widely adopted by the construction industry, should undoubtedly improve the quality and standard of cost information provided to the Client. However the nature of the UK Construction Industry with its many actors (i.e. Engineers, Architects, Contractors, sub-contractors and the like), may initially result in slow "take-up". Nevertheless the introduction of such a "standard" is to be applauded and will hopefully create an opportunity for the construction economist to report and capture cost data that will bring added value to construction projects.

Almost simultaneously to the introduction of the "standardisation" of the cost planning process, a relatively new phenomenon, Building Information Modelling (BIM), has entered the construction market place. BIM's impetus is in part enhanced by UK Government Strategy (Cabinet Office Efficiency Reform Group 2011) which has linked the various professional bodies, contracting organisations and a host of other bodies, to drive the construction industry to take up BIM techniques, in an effort to improve UK construction efficiency. The effect of BIM on cost information provides huge scope for change in cost estimating at an early phase and enabling this information to be updated automatically as the building model evolves. However, as the working group for the Government Construction Client Group's strategy paper discovered, BIM is being used, mostly by contractors to produce schedules of quantities (normally into some form of excel spread sheet) to allow pricing of the model. These quantities however are different from those derived for traditional cost estimating (e.g.: based on a standard method of measurement and bills of quantities).This then provides a major challenge for the UK construction sector.

3. The RICS New Rules of Measurement (NRM) 1

Purpose and Use of NRM

The authors of NRM 1, clearly state that NRM 1 is not a text that explains estimating methods or cost planning techniques. Such techniques that have evolved over the last century by cost consultants and constructors, are as earlier noted, the skill and expertise gained by construction economists and taught by academics and industry to graduates of the industry. As noted by one of the lead author's of NRM 1,

" NRM 1 does not intend to re-define estimating and cost planning-it captures best/common practice and documents it as a single reference source for everyone" (Earl 2012).

To this end, knowledge of formulating unit rates, the use of wall/floor ratios and other various cost modelling techniques (Seeley 1972; Cartlidge 2006) and the development and use of cost indices (Myers 2004) together with evaluation of shape, plan and height (Morton & Jaggar 1995) are techniques and innovations not specified by NRM 1.

The major aim and purpose of NRM 1 is in the words of the document

".....to provide a standard set of measurement rules that are understandable by all those involved in a construction project.....and assist the QS/Cost Manager in providing effective and accurate cost advice....." (NRM1.RICS, 2012).

These rules are specifically created to enable the preparation of:-

- Order of Cost Estimates (Preliminary Estimates)
- Cost Plans
- Elemental Cost Plans

And within the areas of cost analyses and benchmarking (RICS Practice Standards, UK) preparation of:-

- Cost Analyses
- Benchmarking Analyses.

This is based upon the structured and consistent basis for measuring building work. To underpin this approach the rules are backed up by a series of definitions e.g. cost limits, cost targets, gross internal floor area (GIFA) etc. This is extremely important and provides the industry with a standard set of definitions that should create less confusion. However, it should be noted that whilst the RICS Standard form of Cost Analysis (SFCA) shares elemental definitions and data structures, they have effectively different objectives vis:-the SFCA provides rules for allocating cost to their functional elements, whereas the detailed tabulated rules (NRM1:Part 4) are rules for measuring "designed" elements of future buildings (Martin 2012a). As many of these standards are hugely different from those used hitherto then academics, students and consultants will need to take extreme care when using traditional texts relating to measurement, estimating and cost planning. In addition historic cost data bases will need to be aligned to NRM1 and NRM 2.

4. RIBA Plan of Work and RICS estimating & Cost Planning and NRM 1.

The production of NRM 1 has provided the opportunity for the authors to map the RIBA Plan of Work Stages (RIBA 2008), together with the OGC Gateways (OGC 2007) applicable to projects, against defined stages of estimating and cost planning. This should provide a clear understanding for the construction team when estimates, cost plans, pre and post-tender estimates and Bills of Quantities to be produced within a sequential time line. The RIBA Plan of work (2013) has only recently been updated to include BIM and guidance is provided by Sinclair (2013), on the use of the new documentation. As BIM is still in its infancy it is perhaps too early to predict the stages for production of cost estimates & cost plans that will fit building models. This effectively demands a different approach. However some BIM software companies are indicating that NRM 1 is reasonably compatible, and that model objects can be quantified to match elements. However the fact remains that design models are not created (or should be created) to fit rules of measurement. To that end, the conflict between measurements derived from a model e.g. floor areas, and areas defined by The Code of Measuring Practice, will inevitably be different from model quantities and compatibility can only be achieved by the software companies adapting their software to fit rules of measurement.

However, it is evident that some cost consultants in the UK, are already overcoming the problems of compatible information, (Patchell 2012) where full working elemental cost plans may be created in a BIM file incorporating NRM 1 and National Building Specifications. Thus, it is expected that quantitative data will increasingly be derived from BIM.

5. Cost Estimating and Cost Planning

NRM 1 effectively divides provision of cost information relative to the Outline RIBA Stages of Work and OGC Gateways.

Stage A: (Appraisal) and Stage B (Design Brief):
Order of Cost estimate. (NRM 1 Part 2)

Many cost consultants would identify this stage with the terminology "Preliminary Estimates". However these are identified by NRM1 as Cost Estimates. A standard template of the "Constituents of an order of Cost Estimate" (see fig 1) is recommended, and detailed rules and formulae for deriving quantities for floor areas (cost/m2 gross internal floor area known commonly by the abbreviation GIFA) and functional units (e.g. Cost /m2 of NIA, or net internal area, for offices/factories, cost per bedroom for hotels, cost per student for schools/universities, cost per bed space for Hospitals & nursing homes) which might be used at this early stage to create basic estimates, are provided.

Perhaps the most significant standard referred to by NRM 1 is that of "Gross Internal Floor Area" (GIFA) which has been used by cost consultants for many years (since the 1960's) and based, most likely, upon definitions provided by the Building Cost Information Service (BCIS) of the RICS. However, it should be noted that GIFA is defined as the Gross Internal Area (GIA) as defined by the RICS Code of Measuring Practice, 7th Edition, 2007. Care should be taken by cost consultants with the GIFA definition when working on projects as unfortunately GIFA and GIA together with Net internal Floor (NIA) are hugely confused by construction clients. This is due to the following reasons:

- Definition by building cost estimator
- Definition by estate agent, valuer and property developer
- Definition for property management (Agency)
- Definition for rating purposes

This is further complicated both in the UK where definitions for different building types may differ, and at the international level where many countries have differing definitions, making cross comparisons of costs and values somewhat hazardous. Thus extreme care should be taken by cost consultants, to make clear to clients the meaning of GIFA/GIA for the purposes of reporting estimates, especially to global clients operating in the UK.

Research by Kippes et al (2005) on residential property in Germany and Australia indicated that reporting floor areas to residential buyers could differ hugely from defined standards. The impact of incorrect interpretation of floor areas on a property investor's portfolio could prove crucial to both investment decisions and residuals valuations.

Simultaneously it is recognized that if sufficient information is available, then the cost estimate could be derived using an elemental method. Most surveyors will be familiar with both the rules and the formulae for the calculations which are now standardised.

Fig: 1 Constituents of a Cost Estimate.
(Source: based on NRM1 and Rapid5D cost reports)

	COST ESTIMATE 001							
PROJECT:	**Offices Chelmsford**			**Project ref**	**R5D.5.15**			
Dated.	**01.11.2012.**							
			£	**£**	**£**	**£**	**£**	
GIFA	**38000**	**m2**	**Sub-totals**	**Total Cost**	**cost/m2 GIFA**	**% of total**	**% of total**	**NRM1 Ref**
Ref Code	**Constituent Part of Estimate**							
1	**Faciltating Works Estimate**	sum		400,000	10.53	**0.33**		3.1
2	**Building Work Estimate**	sum		90,000,000	2,368.42	**75.27**		3.11
3	**Main Contractor's preliminaries estimate**	sum		10,000,000	263.16	**8.36**		3.14
4	**Sub-Total**	sum	**100,400,000**		-	-	**83.96**	
5	**Main Contractor's overheads and profit estimate**	sum		5,000,000	131.58	**4.18**		3.15
6	**WORKS COST ESTIMATE**	**sum**	**105,400,000**		-	-	**88.14**	
7	**Project/Design team fees estimate**	sum or %		3,000,000	78.95	**2.51**		3.16
8	**Sub-Total**		**108,400,000**		-	-	**90.65**	
9	**Other development/project costs estimate**	sum		500,000	13.16	**0.42**		3.17
10	**BASE COST ESTIMATE**		**108,900,000**		-	-	**91.07**	
11	**RISK ALLOWANCE ESTIMATE**	sum		2,750,000	72.37	**2.30**		3.18
11.1	Design development risk estimate	sum	250,000			-		
11.2	Construction risk estimate	sum	500,000			-		
11.3	Employer change risk estimate	sum	1,500,000			-		
11.4	Employer other risk estimate	sum	500,000			-		
12	**COST LIMIT (excluding inflation)**	**sum**	**111,650,000**		-	-	**93.37**	**(CL1) 3.18.9**
13	**TENDER inflation estimate**	2%		2,233,000	58.76	**1.87**		3.19
14	**COST LIMIT (excluding construction inflation)**	**sum**	**113,883,000**		-	-	**95.24**	
15	**CONSTRUCTION inflation estimate**	5%		5,694,150	149.85	**4.76**		3.19
						-	**1.87**	
16	**COST LIMIT (including inflation)**	**sum**	**119,577,150**	**119,577,150**	**3,146.77**	**100.00**	**100.00**	**(CL2).3.19.7**
17	**VAT Assessment**							

Consultants however, may be less familiar with the rules governing the production of items such as risk. To this end, in the example given (Fig1) the risks were derived as a percentage whereas in practice only exact computations of risk should be included and most likely reported to the building client separately. However rules detail all constituent parts of the Cost Estimate and these should provide a uniform approach that will enable all members of the team to more easily understand what is included in the various forms of Estimate.

Perhaps the most significant outcomes of such a standardised approach are that all the building team will be able to easily identify the following:

- Works Cost Estimate
  (Facilitating Works+ Building Works estimate + Preliminaries+ Overheads and Profit)

- Base Cost Estimate
  (Works Cost estimate + Project/design team fees)

- Cost Limit (Base Cost Estimate + Risk Allowances).

Rules for the measurement of all these items are rigorously explained in NRM 1. Guidelines for the reporting of "order of cost estimates" (OCE) is provided with a reminder that the cost consultant should take considerable care with "inclusions and exclusions" from the OCE.

It is recommended that Value Added Tax and other forms of taxation are excluded from all estimates. This can effectively only be assessed by the client organisation. The cost limit may be expressed either with or without construction inflation and there are separate calculations for the provision of construction inflation. In addition provision is made for tender inflation to be calculated. Allowances for risk, in a formalised way, is perhaps the most significant addition to the process of cost reporting. However as Mann (1992) succinctly established this is an area of *"what we must know but cannot control"* and therefore cost consultants should ensure that the construction team is fully aware of risk allowances and what they do and do not cover. Forecasting and forecasting techniques are now disciplines in their own right and cost consultants need to become more conversant with the science of risk management. As NRM1 states, risk allowances are not standard percentages. Risks in the cost management process are given as:

- Design development risks
- Construction risks
- Employer change risks
- Employer other risks.

Whilst definitions for each type of risk are provided, NRM1 clearly advises that the definitions are not meant to be definitive or exhaustive, but simply a guide. In reality risk assessment is a specialist skill and needs quantitative analysis.

Cost Planning Phase:
RIBA Outline stages of work Stages C-F.
NRM 1 Part 3.

In accordance with past good practice, NRM 1 recommends that after the completion of Cost Estimates ("preliminary estimates"), and when more design information is available then, "formal" cost plans should be prepared. NRM perceives that separate Cost Plans should be submitted at each of the stages of the RIBA outline plan of Work i.e.:

• RIBA: Stage C: Concept.	Cost Plan 1	(OGC Gateway 3A)
• RIBA: Stage D: Design Development	Cost Plan 2	
• RIBA: Stage E: Technical Design	Cost Plan 3	(OGC Gateway 3B)

However, for experienced cost consultants, this is likely to prove a difficult hurdle in practice, as seldom are the RIBA Stages of Work, as clearly sequential as that envisaged by NRM 1.

Nevertheless, the cost planning phase of the "pre tender" cost advice stage is formalised within NRM 1 Part 3, the purpose of which is to provide advice to employers & designers of:-

- Value for money
- Cost consequences (i.e. alternative design/specification/layout etc.)
- Practical & balanced design
- Expenditure within budget (cost limits)
- Cost information to allow informed decisions

Whilst not explicitly stated, these objectives are underpinned by another RICS publication, Cost Analysis and Benchmarking (RICS 2011), which perceives cost consultants using the cost analyses of other projects to benchmark costs and elements, for new projects. This publication indicates that considerable care should be taken in the use of existing data to benchmark future projects. The prospect of Government Departments linking future costs of building projects for Schools, Social Housing, Hospitals, or infrastructure such as Roads, looms large in a cash deficient public sector. Similarly, the commercial sector may well adopt a similar stance with offices, factories and speculative housing. Whether this predicates a return to the "yardstick" era (Seeley 1972) of the 1960-1980 periods remains to be seen. However as the Thatcher government of the late 1970's was soon to discover, Government *cost yardsticks* were also wasteful (especially for housing) of resources. These were also backed up by high standard specifications (e.g. Parker Morris Standards (1961) in housing design) that the commercial sector found vied with profits. To that end, according to the Greater London Authority (2006) today's housing provides less space per M2 per-person, than during the *cost yardstick* period. Developers profit and value in use make for poor bed-partners and the UK lays claim to the dubious honour of providing the smallest dwelling space per person than any other country in comparable European states. Although this is in part due to UK real estate surveyors and buyers, focusing value on the number of bedrooms per dwelling, rather than evaluating the M2 cost/value.

NRM 1 Part 3 perceives the widespread adoption of "elemental cost planning" (defined as *"an iterative process, which is performed in steps of increasing detail as more design information becomes available"*) *(NRM1.RICS, 2012).* and provides detailed rules for measurement of the *"Constituents of a Cost Plan"* which is effectively an update of the *"Constituents of an order of cost estimate".*

Fig: 2 Cost Plan.
(Source: based on standard template from NRM1 and Rapid5D cost reports)

	COST PLAN 001							
PROJECT:	**Offices Chelmsford**			**Project ref**	**R5D.5.15**			
Dated.	**01.11.2012.**							
			£	**£**	**£**	**£**	**£**	
GIFA	**38000**	**m2**	**Sub-totals**	**Total Cost**	**cost/m2 GIFA**	**% of total**	**% of total**	**NRM1 Ref**
Ref Code	**Constituent Element of Cost Plan**							
1	**Faciltating Works Estimate**	sum		400,000	10.53	**0.34**		3.1
2	**Building Work Estimate**	sum		85,000,000	2,236.84	**73.18**		3.11
3	**Main Contractor's preliminaries estimate**	sum		8,000,000	210.53	**6.89**		3.14
4	**Sub-Total**	sum	**93,400,000**		-	-	**80.41**	
5	**Main Contractor's overheads and profit estimate**	sum		5,000,000	131.58	**4.30**		3.15
6	**WORKS COST ESTIMATE**	**sum**	**98,400,000**		-	-	**84.72**	
7	**Project/Design team fees estimate**	sum or %		5,750,000	151.32	**4.95**		3.16
7.1	Consultants Fees		4,000,000			-		
7.2	Main Contractor's pre-construction fee estimate		250,000			-		
7.3	Main Contractor's Design Fee Estimate		1,500,000			-		
8	**Sub-Total**		**104,150,000**		-	-	**89.67**	
9	**Other development/project costs estimate**	sum		500,000	13.16	**0.43**		3.17
10	**BASE COST ESTIMATE**		**104,650,000**		-	-	**90.10**	
11	**RISK ALLOWANCE ESTIMATE**	sum		2,750,000	72.37	**2.37**		3.18
11.1	Design development risk estimate	sum	250,000			-		
11.2	Construction risk estimate	sum	500,000			-		
11.3	Employer change risk estimate	sum	1,500,000			-		
11.4	Employer other risk estimate	sum	500,000			-		
12	**COST LIMIT (excluding inflation)**	**sum**	**107,400,000**		-	-	**92.46**	**(CL1) 3.18.9**
13	**TENDER inflation estimate**	2%		3,222,000	84.79	**2.77**		3.19
14	**COST LIMIT (excluding construction inflation)**	**sum**	**110,622,000**		-	-	**95.24**	
15	**CONSTRUCTION inflation estimate**	5%		5,531,100	145.56	**4.76**		3.19
16	**COST LIMIT (including inflation)**	**sum**	**116,153,100**	**116,153,100**	**3,056.66**	**100.00**	**100.00**	**(CL2).3.19.7**
17	**VAT Assessment**							

These rules are stated as “measurement rules for cost planning”. They not only refer to measurement, but also define *“unit rates” (EUR) i.e. the total cost of an element divided by the element unit quantity (EUQ),* their use and methods of updating. The rules of measurement for elemental cost planning are tabulated in circa 300 pages of detailed documentation.

Any cost consultant conversant with many years of providing cost advice via “elemental cost plans” will understand with relative ease the requirements of the RICS self-regulatory standard. However, the rules governing the process i.e. the submission of Formal Cost Plans 1, 2 and 3, might best have been written as recommendations rather than the self imposition of a “strait-jacket” which prevents innovation. Nevertheless, no doubt the writers of NRM 1, have only best practice in mind, and should cost consultants adopt the principles outlined, few could doubt that the standardisation of cost planning, should result in a better understanding of costs than hitherto.

Fig: 3 Elemental Cost Plan.
(Source: based on standard template from NRM1, Appendix G: based upon level 1 codes and Rapid5D cost reports)

	ELEMENTAL COST PLAN 001							
PROJECT:	Offices Chelmsford			Project ref	R5D.5.15			
Dated.	DATE: 28.12.2012.		£	£	£	£	£	
Cost Cenrtre	GROUP ELEMENT/ELEMENT	GIFA 38000 m2	Sub-totals	Total Cost of ELEMENT (TARGET COST)	cost/m2 GIFA	% of total element	% of total sub-total	NRM1 Ref
	Facilitating Works and Building Works							
0	Faciltating Works Estimate			400,000	**10.53**	**0.34**		
1	Substructure			12,600,000	**331.58**	**10.77**		
2	Superstructure			38,000,000	**1,000.00**	**32.49**		3.1
3	Internal Finishes			8,350,000	**219.74**	**7.14**		
4	Fittings,furnishings and equipment			3,000,000	**78.95**	**2.56**		3.11
5	Services			19,000,000	**500.00**	**16.24**		
6	Prefabricated buildings and building units			1,450,000	**38.16**	**1.24**		3.14
7	Work to Existing Buildings			150,000	**3.95**	**0.13**		
8	External Works			4,500,000	**118.42**	**3.85**		
	SUB-TOTAL: FACILITATING WORKS AND BUILDING WORKS (A)		**87,450,000**		-	-	**74.76**	
9	Main Contractor's preliminaries (B)			8,745,000	**230.13**	**7.48**		3.15
	SUB-TOTAL: FACILITATING WORKS AND BUILDING WORKS (A) (including Main Contractors Preliminaries)(C) when (C=A+B)		**96,195,000**		- -	- -	**82.24**	
10	Main Contractor's overheads and profit (D)			5,771,700	**151.89**	**4.93**		
	TOTAL: BUILDING WORKS ESTIMATE (E) when(E=C+D)		**101,966,700**		**2,683.33** -	**87.17** -	**87.17** -	
	PROJECT/DESIGN FEES and		-		-	-	-	3.16
	and other DEVELOPMENT/PROJECT COSTS		-		-	-	-	
11	Project /Design team Fees (F)		**5,750,000**		-	-	-	
12	Other Development / Projectcosts (G)		**1,500,000**		-	-	-	
	TOTAL: PROJECT/DESIGN FEES AND OTHER DEVELOPMENT/PROJECT COSTS ESTIMATE(H) when (H=F+G)			7,250,000	- **190.79**	- **6.20**	-	
			-		-	-	-	
	BASE COST ESTIMATE (I) when (I=E+H)		**109,216,700**		- -	- -	**93.37** -	
13	**TOTAL: RISK ALLOWANCE ESTIMATE(J)**			2,184,334	**57.48**	**1.87**		3.17
	COST LIMIT (excluding inflation) (K) when (K= I+J)		**111,401,034**		**2,931.61**	**95.24**	**95.24**	
14	**TOTAL INFLATION ALLOWANCE (L)**			5,570,052	**146.58**	**4.76**		
			-		-	-	-	
	COST LIMIT (excluding VAT assessment) (M) (M=K+L)		**116,971,086**		**3,078.19**	**100.00**	**100.00**	3.18
16	**VAT Assessment**					- -	- -	

Recommended templates are produced both for *"constituents of a cost plan"* and both condensed and expanded *"Formal Elemental Cost Plans".* In addition the author's of NRM1 have mercifully recommended methods of codifying elemental cost plans but also for work packages which it is recognized may be the process by which the project is managed.

6. Elemental Standard form of Cost Analysis (SFCA)

With the production of NRM 1 the Building Cost Information Service (BCIS) of the RICS has completely revised the elemental standard form of cost analysis (4th NRM Edition 2012) to ensure that cost data will be stored appropriately. As stated in the preface to this document, the new edition of the SFCA has been produced to meet the Government's construction strategy for *"implementation of cost-led procurement, benchmarking, life cycle costing, BIM, which requires cost information to be presented consistently in a standard format".*

Whilst the SFCA is a radical change in terms of the standardization related to NRM, the basic rules of cost analysis remains the same. However it is recognised that the Government's

preoccupation with cost reduction (benchmarking) and BIM, will need to be accommodated. *"The development of BIM calls for information to be supplied from the BIM model at various stages along the project timeline so that costs can be produced or validated*". SFCA envisages that the employer and the projects team will need to clearly adopt rules for measuring the building and its elements. However, it should be recognised perhaps, that BIM does not automatically produce elemental quantities or costs. These need to be imposed upon the model. Also cost data derived from contracting organisations involved in Design Build projects is not elemental in format. Nevertheless, the new SFCA is another step in the direction of standardising cost information.

7. Benchmarking (Cost Limits)

The UK Government have a long post war history of "benchmarking" costs of construction, dating back to the post war period of stringent budgets. The then Ministry of Education created the first "cost limits" for the construction of schools to enable the greatest expansion of school building since 1870. The Ministry of Education formed the Architects and Building branch in 1949 and together with pioneers such as Herefordshire County Council, innovated new construction techniques such as prefabricated units and flexible spaces (i.e. open plan) within schools. Recent commentators such as the Institute of Education, University College London (2007) have referred to this innovation as "rat trad" or "rationalized traditional style". It could be said that this innovation, was the foundation stone of "cost planning" within the UK, and led by the 1960-70 period to "cost yardsticks" and "costs per functional unit" for all types of public sector construction, most notably perhaps the "housing cost yardstick" by which vast numbers of the UK housing stock were built in 20 years.

By the 1980's the Thatcher Government, had by and large divested itself of "yardsticks" and embraced the methods of the private sector, in the belief that "cost yardsticks" and the huge bureaucracy that implemented them was an encumbrance to speculative development, which it was believed could drive down costs by market forces of supply & demand. However towards the end of the twentieth century there was some move to return to cost control but by and large the Governments of the day were more engaged in attempting to gain value for money via the Private Finance Initiative (PFI) which effectively took many construction costs off the Government balance sheet. More recently, and mostly as a result of the 2008-9 subprime debt revelations and the subsequent banking crisis, Government budgets are being hugely reduced to cut the UK deficit, and Government Departments are returning to "benchmarking" (*i.e.*: *yardsticks*) of construction costs.

The Cabinet Office (Government Construction) in 2011 and later in 2012 have published guidelines for benchmarking and cost reduction. In brief, the intention of the government is to "*to produce, a sustainable reduction of construction costs of between 15-20% by May 2015",* which is effectively the end of the current parliament. It is clear that it is not the intention to reduce costs by cutting on quality and it is stated that reductions are*" to be achieved without impacting either on the whole life value or the long term health of the construction industry".* As in 1949, the Government appears to be stating that it is not intending to cut construction budgets but obtain more building for the same budget. So no doubt the government are looking to the construction sector to innovate with for example prefabrication, and procurement techniques, such as employed by European constructors in Belgium, Holland, Germany and Scandinavia, where many global clients believe buildings are 20-30 % cheaper than the UK. To this end, the UK Governments drive with Building Information Modelling

(BIM) could be considered as one of the innovations they believe can bring about change and cost savings.

Not surprisingly perhaps, but the Building Cost Information Service (BCIS) of the RICS, has worked closely with the Government to assist with the implementation of the policy. Martin (2012 b) has from the BCIS defined benchmarking as "the continuous process of measuring products, services and practices against the toughest competitors or those recognised as industry leaders. The intention being to *"learn from the best in class".* It is not the objective of this chapter, to inform the reader of the detail involved in benchmarking exercises. However in many ways the new government guidelines call upon construction economists and cost managers to use the "order of Cost Estimate" as defined in NRM1 in the knowledge that this will normally be created from cost data related to a specific building rather than the cost of a building of a specific design. Thus we should be aware that by and large we know what buildings should cost rather than what they will cost.

The Cabinet Offices latest publication (2013) claims that already since 2012, Government Departments have made reductions in cost of £447m and that the sustainable reduction in construction cost of 15-20% is achievable circa 2015.

According to the Governments publication "Cost benchmarking principles and expectations" (2012) cost benchmarks are described as follows:-

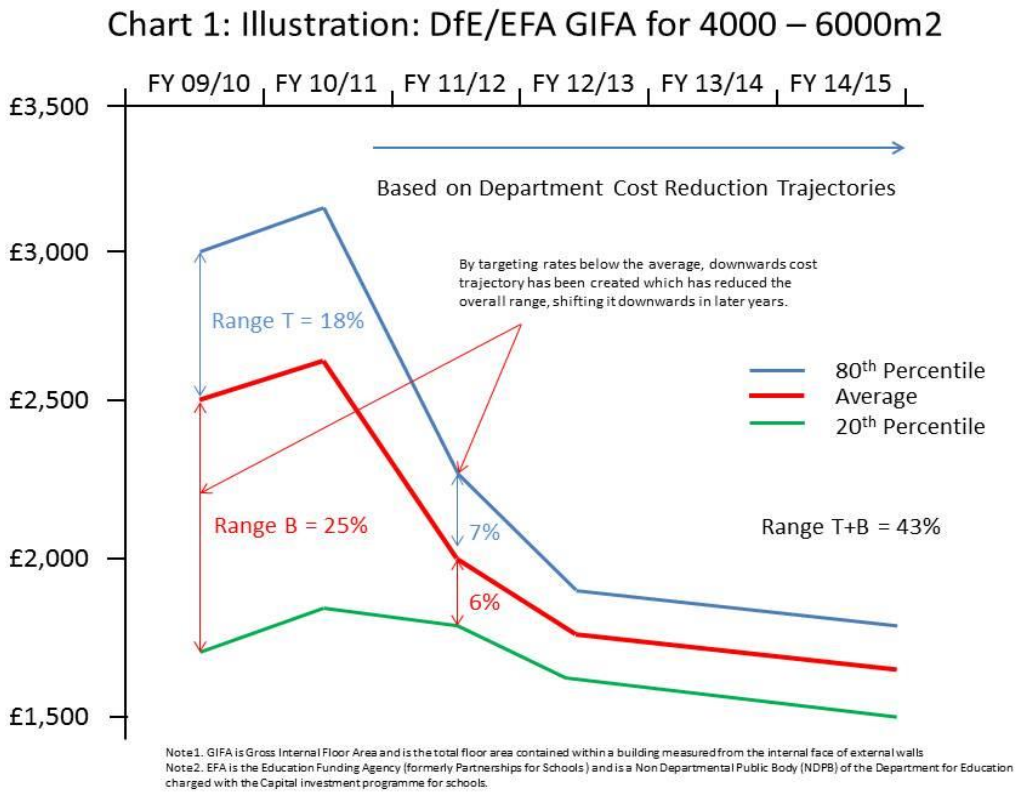
- **Type 1 Benchmarks (Spatial Measures)** encompass the most common formats used by clients and industry to benchmark total construction costs, for example: £/m, £/m^2, £/m^3. They are related to *throughput* (quantity) in the sense, for example, of square metres of accommodation delivered by a project.

- **Type 2 Benchmarks (Functional Measures)** encompass a range of more department-specific benchmarks, which address *business outcomes* per £ for example: £/Place; Flood Damage Avoided £/Investment £.

- **Type 3 Benchmarks** address a range of more department-specific benchmarks but where *business outcomes* are related only indirectly to the benchmark, for example: ratio of product cost (or alternatively development cost) to total construction cost.

- **Type 4 Benchmarks** are similar to Type 1 benchmarks but applied at an *elemental throughput* (quantity) level, for example: foundation costs £/m, £/m^2 or £/m^3. They are only applied within this document, when elements taken together represent majority of spend.

Figure 4: Benchmarking Illustration
Source: Joe Martin (BCIS). Presentation: QS Seminar Nr 9 Council of Heads of Built Environment (CHOBE). Birmingham City University: November 2012. Taken from Cabinet Office. The Government Construction Cost benchmarks, cost reduction trajectories & indicative cost reduction. April 2011 Addendum July 2012.

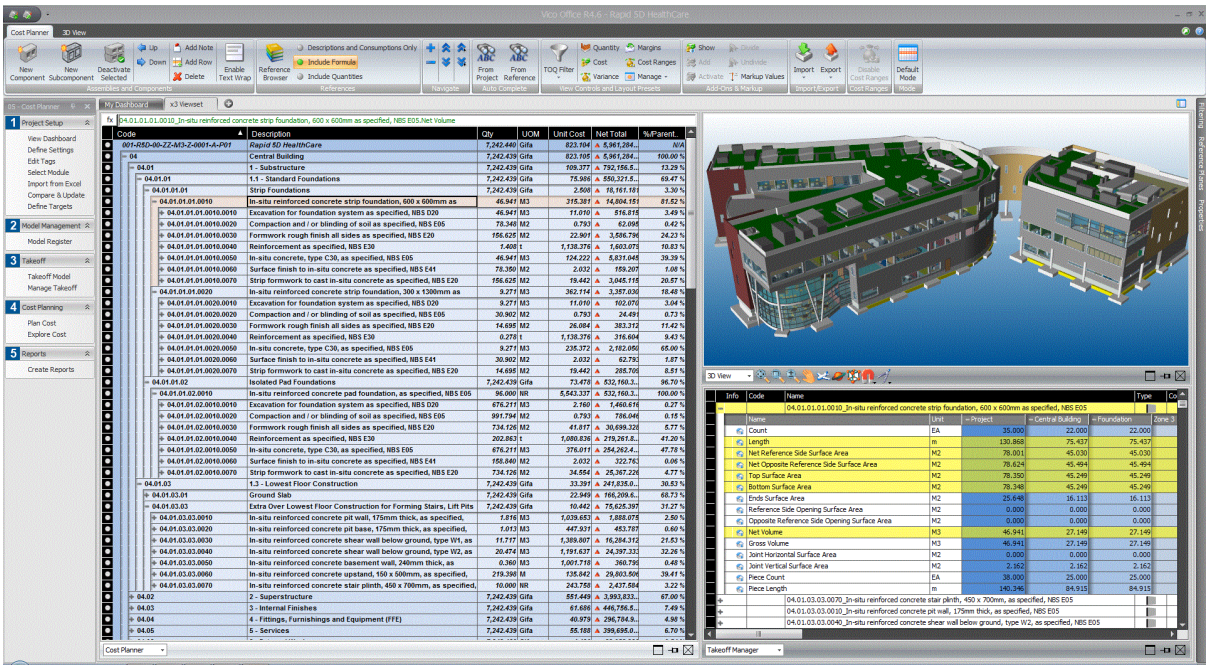


8. Building Information modelling

Building Information Modelling (BIM) is already in use and will become a common feature on construction projects over the coming years. BIM will revolutionise the way the building industry thinks and works. The basis of BIM is a single multi-dimensional collaborative project model which will see a project through from its initial conception to its eventual demolition. In other words, the model will deal with the entire life cycle of a project. There are many perceived benefits of BIM relating to design, including full co-ordination of the various consultants' design elements; remodelling of alternative layouts, elements and construction techniques; and the modelling of 'as built' design on completion for maintenance, facilities management and life-cycle replacements. However, one of the key elements of the full BIM model when in use is the ability to integrate scheduling of quantities and/or materials (referred to as 4D of the model) and estimating and pricing of the works (referred to as 5D of the model).

The designed model can be measured and priced by a cost manager using an automated system with ad-hoc adjustments being incorporated for site specifics, abnormal issues and specification requirements. By using a BIM model, the take-offs and measurements can be generated direct from the underlying model, therefore the information is always consistent with the design; and where a change is made to the design, the take-offs and measurements are also automatically altered. (See Fig 5 for VICO example). The adoption of this process reduces the time that is spent on taking off quantities and eliminates the potential for human error. Time can then be more usefully spent on ensuring that the pricing levels for elements of the work are consistent with the nature of the works.

Fig 5: Screen Shot: BIM showing 3D model and 4D & 5D attributes of time, measurement and cost. Source VICO and RAPID5D



In addition, the model can be continually updated as work is completed so that the valuation of works executed can be compared to the budget allowance. Further, savings, extras and value engineering possibilities can easily be tested and/or incorporated into the budget through an entire or a partial remodelling exercise. For the 4D and 5D models to be successful, the annotation of the various design elements will be critical (with regards to the level of specification and coding) in order to enable each individual element to be accurately priced. Therefore, although standard components and allowances can be incorporated, there will be a need for the component descriptions / specifications to be an accurate description of the ad-hoc nature of each construction project, and the schedule of rates will need to be both comprehensive and capable of adjustment for ad-hoc specifications and particular site circumstances.

The automated pricing system would usually need to be refined and aligned with the designer's specification level and range of products, and may also need to be designed to take account of or otherwise allow for the impact of inflationary influences (e.g. economic climate, supply & demand, technological changes etc.). Given that virtually all construction projects are unique, the requirement for ad-hoc adjustments for project specific and/or abnormal elements is a challenge that the 4D and 5D element of the BIM model still needs to address.

9. Concluding Remarks

New approaches in cost estimating and cost planning in the UK are largely related to the drive for efficiency not only from the public but also the private sector. Whilst in part this is

due to the austerity of Government budgets it is also due to Global Clients identifying that construction costs in the UK, are often higher than those in comparable economies.

It is difficult perhaps in the above to identify the enormity of the changes that will come into being as a result of BIM and standardisation of construction cost documentation. The introduction of NRM1 (in addition to NRM 2 and 3), plus new standard forms of cost analysis and benchmarking, provide not only the greatest challenge to the construction economist and cost manager, but the best opportunity in a generation, of improving the prediction and control of construction costs. This in turn will drive innovation in construction management and techniques of construction to new models of production.

As outlined in the Chapter above, the rapid standardisation of cost documentation, are not in themselves radical innovations. However the implications of standardisation together with BIM will hugely change not only the methods by which we build but the way we procure construction and work together. Integrated working is undoubtedly the keyword. However as Ray Crotty (2012) has noted standardisation will only assist if it fits the need and that standards can if not carefully thought out, impose difficulties,

"*the idea of a shared language, of uniformity and consistency of meaning across the disciplines of project management, is stymied from the beginning. Home-made applications, spreadsheets, and baseless but impressive looking planning graphics proliferate-all presenting mutually contradictory views of the project"*

It has to be accepted that in many respects the massive standardisation of the RICS of New Rules of Measurement, was commenced long before the full implications of BIM was understood. In addition BIM is only at the inception of its development and it will take some time to reach its full potential. However, already software companies are writing standard libraries and creating cost data bases to fit, and construction companies are beginning to see the advantages that standardisation can bring.

There can be little argument that the standardisation of the cost estimating process, will lead to better efficiency and greater understanding. However we are only at the beginning of the process. Standardization is a positive, but cost prediction will only remain as good as the sum of intelligent standardised systems, integrated information, cost data and the ability of the cost consultant. Thus the skills of tomorrow's construction economists and managers will need to encompass much more than now and this will require a massive level of investment in re-education and training. This then is the challenge for the construction sector.

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