Managing Measurement Risk in Building and Civil Engineering

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Preface

After a long, challenging and fascinating career – extremely varied, often high pressure and certainly never dull – I have decided to put down on paper my views on a subject that has been central to almost everything I have done in the construction industry.

Whilst working for various contractors and subcontractors, running a contracting business, lecturing both in higher education and at a professional level and undertaking various sorts of consultancy work, measurement has always played an important role in my life. It has permeated everything I have done in quantity surveying, estimating, financial management, contract administration and legal matters in my career in building and civil engineering.

Whilst I don't claim to be an expert in the subject, I have nonetheless always been an avid student of measurement, both theoretically and practically. I have owned and read many of the great standard textbooks on the subject, and I hold both the writers and the books themselves in the very highest regard. Some of them were instrumental in my own education, and some have been invaluable during my working career.

I have never been a professional quantity surveyor (PQS) as such – I wanted to be but, at the time that I qualified, contractors' quantity surveyors were excluded from membership of the RICS – the 'home' of the PQS in the City of Westminster, London (I sat the examinations of the Institute of Quantity Surveyors).

No, I have always been a 'contractor's man' at heart – happy to be ploughing through the mud, setting out with level and theodolite, doing physical measures on cold and windswept sites or 'arguing the toss' with main contractors who don't want to listen – and I was proud to be a fully qualified member of the sadly missed IQS, long since absorbed by the RICS.

Nevertheless, I have been involved in PQS-type work, both as a consultant to contracting firms, in loss adjusting for the insurance business and in undergraduate, postgraduate and practitioner training and education.

And so, it is from this background that this book has been written. Despite what some people may think, it is not just quantity surveyors who can measure – many engineers are involved in the measurement side of the industry and, increasingly, specialist subcontractors with no QS background find themselves preparing quantities as part of the bidding process. It is hoped, therefore, that this book will appeal to a broad 'church' of 'measurement practitioners', of whatever persuasion.

Whilst it is fervently hoped that this book will follow the traditions of the great measurement books, it is structured and written completely differently. The main theme of the book is 'risk', and so the chapters dealing with the various methods of measurement in particular

focus on 'risk issues' that emanate from the measurement process or impact on it in some way. Such risk issues may relate to questions of interpretation of standard methods of measurement or may refer to risks arising from the relationship between measurement rules and standard forms of contract or procurement methods.

Inevitably over the last 25 years, computer technology has impacted the subject of construction measurement, and this is an important theme in this book. However, do not fear! The book has not been written by a computer boffin or rocket scientist. It has been written by a practitioner for practitioners (and would-be practitioners) using everyday language. Where 'technical' words are unavoidable, these are explained in a simple and understandable fashion (with apologies in advance to the 'computer buffs'!).

The UK construction industry is privileged to have been served by several outstanding quantity surveyors over the years, some of whom have achieved iconic status. The likes of 'Jim' Nisbet, 'Ted' Skoyles and Douglas Ferry et al. are part of quantity surveying history, but no more so than equally iconic personalities such as A.J. Willis and Ivor Seeley, who have contributed significantly in the area of construction measurement, both through their professional work and through their publications – particularly textbooks.

Measurement remains the core skill of the profession, and there will be few quantity surveyors anywhere who have not owned or studied a copy of 'Willis' or 'Seeley'. These books have played an immensely important role in helping aspiring quantity surveyors to master both the 'tools and techniques' and the 'art' of measurement.

The means by which an architectural or engineering design may be modelled financially is provided by measurement; this provides the framework within which such designs may be controlled and realised within defined cost parameters, to the satisfaction of the client. Measurement has a particular skill base, but it is elevated to an 'art' because the quantity surveyor is frequently called upon to interpret incomplete designs, in order to determine the precise quantitative and qualitative intentions of the designer, so that contractors may be fully informed when compiling their tenders.

The true art of measurement is undoubtedly the province of the 'professional' quantity surveyor, and a great deal of experience is required to fully master the subject. By definition, therefore, most construction professionals, and many quantity surveyors indeed, cannot be considered competent in measurement. They may be able to measure up to a point but, faced with a drawing chest full of AO drawings and a multiplicity of standard details and schedules, most would be daunted by the prospect of 'taking off' the quantities for a project of any size. Many wouldn't have the first idea where to begin.

This is still the case despite the huge advancements that have been made in IT-based measurement, but it does not mean that measurement is a 'closed book' or an inaccessible skill that might never be acquired. Nor does it mean that everyone involved in the construction process needs to be able to measure to the standard of a PQS. Not everyone who uses measurement needs to prepare quantities for the production of formal bills of quantities in the normally accepted PQS sense.

It is hoped, therefore, that this book will help those construction professionals, subcontractors and the like, who use measurement in their work, or deal with the output from the measurement process, to understand not only the 'ins and outs' of measuring construction work but also the relationship that measurement has with contracts, procurement, claims and post-contract control in construction. Measurement is part of a 'big picture' that extends well beyond the process of taking off quantities.

The views expressed in this book are mine, and mine only, but I apologise only for any errors there may be. Some may disagree with my line of thinking, which is fair enough, but the intention has been to write a practical, constructively critical and thought-provoking book about construction measurement, approached from a risk perspective. The observations made, and the risk issues raised, are also personal but are in no way meant to be authoritative.

Measurement has moved into a new and exciting era of on-screen quantification and BIM models, but this has changed nothing in terms of the basic principles underlying measurement – thoroughness, attention to detail, good organisation, making your work auditable and, above all, understanding the way building and engineering projects are designed and built. You must know the technology to be able to measure.

It is hoped that this book will help to give you the confidence to both 'measure' and understand measurement risk issues and to do so in the best traditions of the likes of Willis and Seeley to whom the industry owes a great debt of gratitude for their vision and expertise in the field of construction measurement.

Peter Williams
Chester
November 2014

Author Biography

Peter Williams began his studies in construction in the mid-1960s at the Liverpool College of Building, gaining a Higher National Diploma in Building for which he was awarded the top honour of the Chartered Institute of Building – the Silver Medal. His studies continued with a Master of Science Degree in Construction Management and Economics at the University of Aston in Birmingham. During this period, Peter also became a fully qualified Member of both the CIOB and the Institute of Quantity Surveyors, by examination, and thence became a Member of the RICS.

Peter's working career began as an assistant quantity surveyor and he then worked as a site engineer on a number of large building and civil engineering contracts. Several years as a building estimator and then civil engineering estimator followed and he then became a Senior Lecturer at Liverpool Polytechnic. During the 1980s and 90s, Peter was responsible for running a civil engineering and building contracting company and this period was followed by his appointment as a Principal Lecturer, and then Director of Quantity Surveying, at Liverpool John Moores University. Later, Peter became Head of Construction Management Development which involved the authorship of a distance learning MSc in Construction Health and Safety Management and tutoring on the Post-graduate Certificate in Construction Law. As well as lecturing on a wide range of construction management and quantity surveying subjects, Peter was responsible for the development and validation of the LJMU MSc in Construction Project Management.

Following retirement from the University, Peter has been engaged as a Consultant and Lecturer and has worked with a variety of contractors, subcontractors and client organisations in the fields of quantity surveying, construction law, health and safety management, delay analysis and claims.

Peter's writing career has included co-authorship of the best-selling *Construction Planning, Programming and Control* (with B. Cooke) and *Financial Management in Construction Contracting* (with A. Ross), both published by Wiley-Blackwell. His present interests are as a writer, researcher, lecturer and consultant with particular interests in contracts and finance, delay analysis and health and safety management.

Cooking, food and wine are among Peter's leisure interests. He is a keen DIY-er and enjoys sport, especially football. He follows his local football team, Chester FC, and his boyhood club, Wolverhampton Wanderers.

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I have been privileged to have had the help and support of a number of people whilst writing this book, some of whom I have never met. Some have been very generous in supplying me with various resources, and everyone mentioned below has freely given the most valuable commodity of all – their time.

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And last but not least, my gratitude goes to Paul Hodgkinson, who worked on many of the line drawings, and to Jaqueline, for being a good listener and for providing the moral support, good food and wine just when needed!

Glossary

3D BIM: The use of parametric design models and space programming tools to enable 3D visualisation, walk-throughs, clash detection and coordination, item scheduling, etc.

4D BIM: Sometimes referred to as *3D BIM plus time*,[1] 4D BIM is where 3D objects and assemblies are linked with the project programme and phasing strategy and where resources can be quantified and scheduled.

5D BIM: 5D BIM may be considered as 4D BIM plus cost[1] where the BIM design is linked to the cost planning, bill production and estimating functions of the construction process.

Activity schedule: A list of unquantified construction activities, usually prepared by the contractor, often, but not necessarily, linked to the contractor's programme.

Admeasurement: The act of ascertaining and apportioning in order to establish the difference between a final quantity and an original quantity of work, whether more or less.

Anding-on: Where a set of dimensions for one item is copied to another item description that has the same quantity.

Bill compiler: The person responsible for assembling a completed bill of quantities ready to issue with other tender documents.

Bill of quantities: A list of item descriptions, and firm or approximate quantities, based on a standard method of measurement.

BIM model: A 3D assembly of components of the same family that carry technical, geometric, measurement and other data.

BIM: An acronym used to describe the tools, processes and technologies that facilitate the digital representation of the physical and functional characteristics of a building or structure, thereby creating a shared knowledge resource of information that can be used for reliable decision making throughout its life cycle.

Builder's quantities: A list of quantities lacking the precision of measurement and description normally associated with a professional quantity surveyor measuring to a standard method of measurement.

CESMM: Civil Engineering Standard Method of Measurement.

Commercial opportunity: A strategy often employed by contractors at tender stage where a risk allowance is calculated on the basis of potential future gains should the contract be awarded that enables a lower initial tender bid to be made. Capitalising on buying gains for materials and subcontractors, profiting from errors in the tender documentation and tactical pricing of rates are some of the techniques employed.

Contract sum analysis: A breakdown of a contract sum, usually in design and build, used for post-contract administration.

Cost-value reconciliation: The process of matching cost and revenue at a common date by measuring the true value of work carried out.

DBFO: Design-Build-Finance-Operate procurement used for major projects where a consortium delivers a capital project (e.g. a tunnel or bridge) and operates the facility for a concession period (e.g. 25 years) in order to recover the initial investment.

Daywork: A method of measuring and valuing work on the basis of the resources expended rather than in relation to the quantities of work done.

Design cost control: The process of establishing a budget, deciding how to spend the money in order to satisfy the client's functional and aesthetic requirements and reconciling the cost limit with tenders received.

Design intent: Intended ambiguity in a completed design, which leaves the final design decisions to those undertaking the construction work.

Dim sheet: A specially ruled sheet of paper used to ensure that measured dimensions are recorded in the correct order and fashion needed to ensure clarity, accuracy and a visible audit trail.

Direct billing: A method of quantification where the dimensions, waste calculations, item descriptions, quantities and pricing columns are provided on the same page.

Dotting-on: A way of adding an additional number to a 'times-ing' calculation where a measured item possesses the same dimensions as an item previously measured.

Earthworks balance: Calculation of the volumes of excavation, filling and disposal to ensure that the required quantity of material is available for construction and any surplus is disposed of Levels may be realigned to ensure the optimum use of materials arising from the site and the minimisation of imported materials from off-site.

Extra over: The additional burden required to complete an item of work over and above that of a base item, where the two items of work have some dissimilar characteristics but are essentially of much the same nature.

Final account: The process of calculating the amount due or final payment owing on a contract.

Final account statement: A statement of the amount owing at the conclusion of a contract, calculated according to express terms of that contract.

Lump sum: A type of contract based on a contract sum which can only be adjusted if there are express terms in the contract to do so.

Mass-haul diagram: A diagram or computer model that identifies the quantities of excavation and fill arising on a site together with the movement of those materials required to achieve the optimum earthworks balance and the minimum requirement for imported material or off-site disposal.

Measure and value: A type of contract where the quantities (if any) are estimated and the difference between the original quantities and the final quantities determines the contract sum and whether any change is needed in the rates and prices to reflect the consequences of a change in quantities. 'Remeasurement' is used as a synonym but is not strictly correct.

Measurement: The action or an act of measuring or calculating a length, quantity, value, etc.

Measurement claim: A contractual, common law, *quantum meruit* or *ex gratia* claim submitted by contractors or subcontractors where there has been an error in a quantity, an error in an item description, a discrepancy between a pricing document (e.g. BQ and schedule of rates) and any other contract document(s), such as drawings or specifications, a departure from the rules of a method of measurement or an omission or alleged omission, to measure something required by a method of measurement.

MMHW: The Method of Measurement for Highway Works which is part of Volume 4 (Bills of Quantities for Highway Works) of the Manual of Contract Documents for Highway Works.

NRM1: New rules of measurement *for order of cost estimating and cost planning for capital building works*.

NRM2: New rules of measurement *for detailed measurement for building works*.

Order of cost estimate: An estimate of the possible cost of construction in the early stages of design which forms the basis for deciding on the cost limit and marks the beginning of the cost planning process.

Overbreak: The additional excavation, filling and disposal generated when ground conditions, or construction methods, result in excavation beyond the minimum limits stipulated in the contract.

Pain and gain: A system of risk and reward designed to encourage value-engineered solutions that result in shared cost savings.

Pareto principle: A 'rule of thumb' in management and business which states that, *for many events, roughly 80% of the effects come from 20% of the causes*.

Plug-in: A software application, such as an on-screen measurement tool, that supplements an existing software application, such as bill production software package, thereby enabling greater interactivity and customisation.

POM(I): Principles of Measurement (International) for Works of Construction.

PQS: A professional quantity surveyor, engaged by the employer, whose duties may include giving cost advice, preparing cost plans, advising on contractor selection and procurement, the preparation of bills of quantities, tender reconciliation and dealing with pre- and post-contract issues on the employer's behalf.

Price list: A list of simple *ad hoc* items, with an accompanying unit of measurement, that may be used for small-scale construction projects and works orders.

Prime cost sum (PC sum): A monetary allowance in a bill of quantities for the provision of specialist goods or services to be nominated by the employer which cannot be precisely defined or quantified at tender stage.

Provisional quantities: Estimated quantities of items of work in a lump sum contract where accurate quantities cannot be measured.

Provisional sums: Described, but not measured, items in a bill of quantities representing a sum of money to be expended, as required, by the contract administrator.

QS: An abbreviation for 'quantity surveyor' to be distinguished from the abbreviation PQS.

Rates and prices: Rates are normally multiplied by quantities to arrive at a total for each BQ item; prices are lump sums, such method-related charges or preliminaries. In NEC3, a rate multiplied by a quantity is a price.

Remeasurement: The measurement of something that has already been measured but is to be measured again, resulting in a fresh set of quantities that replace the original.

RICS: The Royal Institution of Chartered Surveyors which is the primary UK professional body for quantity surveyors.

Schedule of cost components: A statement of 'defined cost', employed by NEC3 forms of contract, used for valuing compensation events and for target and cost reimbursement contracts.

Schedule of rates: An unquantified list of item descriptions, not necessarily based on a standard method of measurement, used where the nature of the work required is known but not the extent.

Schedule of works: An unquantified list of work items, usually composite, that is not based on any particular standard method of measurement.

SMM: Standard Method of Measurement of Building Works.

Written short: A method of writing item descriptions, or item coverages, where one item description or item coverage relies on another item description or item coverage in order to convey the complete meaning of the item description or item coverage 'written short'.

Note

1. http://www.fgould.com/uk-europe/articles/5d-bim-explained/#sthash.ExMxUsfc.dpuf (accessed 7 April 2015).

Addendum: Infrastructure Conditions of Contract – *With Quantities Version*

Since the manuscript for this book was completed at the end of November 2014, a new form of contract has been published which merits inclusion in the text in so far as it concerns the subject matter of the book.

The ICC – *With Quantities Version* (2014) is a new addition to the suite of contracts published by the Association for Consultancy and Engineering (ACE) on behalf of ACE and the Civil Engineering Contractors Association (CECA). The ICC suite is largely a rebranded version of the former ICE Conditions of Contract which were adopted by ACE and CECA in 2011 following the decision of the Institution of Civil Engineers in 2010 to sponsor the New Engineering Contract (NEC) suite as its contract of preference.

A.1 Type of Contract

The ICC – *With Quantities Version* is a lump sum contract intended for engineer/consultant-designed projects, with the option for an element of contractor design if desired. Being a lump sum contract, the *With Quantities Version* presumes that the design is sufficiently developed at tender stage in order that a bill of quantities (BQ) with fixed (not approximate) quantities may be produced as a basis for inviting tenders.

This new contract contrasts sharply with the ICC – *Measurement Version*, a measure and value (admeasurement) contract, which has been widely used for civil engineering contracts for many years. The ICC – *With Quantities Version* provides an alternative to this arrangement in circumstances where quantities can be measured with more certainty at tender stage and the parties can thus enter into a lump sum contract.

A.1.1 Lump Sum versus Measure and Value

The essential difference between a lump sum and a measure and value contract is that the parties agree to a contract sum, that is, an accepted offer to carry out the works for a defined sum of money. This sum can only be adjusted if there are express terms written into the contract to do so. Grounds for adjusting the contract sum may include:

- Remeasurement of approximate/provisional quantities
- Variations ordered by the contract administrator

- Adjustment of provisional sums
- Adjustment of prime cost sums, etc.

In a measure and value contract, the total of the BQ provides a tender total (i.e. not a contract sum) which is purely a total by which the various tenders received may be compared.

A.1.2 Form of Tender

Surprisingly, in a lump sum contract, the Appendix to the ICC – *With Quantities Version* is identical to that in the *Measurement Version*. In both cases, the contractor offers to construct and complete the works *for such sum as may be ascertained*. This indicates a measure and value, as opposed to a lump sum, contract, because the priced BQ is brought to a total – the 'tender total' – and the contract sum is 'ascertained' when the works are complete.

The term 'tender total' is defined in Clause 1.1(w), but this differs from the *Measurement Version* definition in that the tender total *means the total of the Contractor's tender for the design, construction and completion of the Works*. This is less than clear especially when read in conjunction with Clause 1(d): *Contract Price* which is defined as *the sum to be ascertained and paid in accordance with the provisions of the Contract for the construction and completion of the Works*. Both definitions resonate more with a measure and value arrangement than a lump sum contract.

A.1.3 Contract Documents

Clause 1.2(b) of the ICC – *With Quantities Version* provides that the *Contract Documents* are those defined in Clause 1.1(b). This would appear to be a drafting error as it is Clause 1.1(c) that refers to the *Contract*.

Inexplicably, there is no reference to 'drawings' or 'specification' amongst the various documents referred to in Clause 1.1(c), and whilst the term *Works Data* is defined in Clause 1.1(y), this simply *includes, without limitation, the Employer's Requirements and the Contractor's Proposals*. Such wording is normally used when referring to contractor design, but the words *without limitation* may be intended to have wider implications.

Notwithstanding the definition of *Works Data* in Clause 1.1(y), Clause 4.6 states that the *Employer's design shall be contained in the Works Data*. This sits more comfortably with a lump sum contract based largely on an engineer/consultant design and with a BQ prepared on the basis that the design is complete. Consequently, albeit somewhat tortuously, it is clear that the drawings and specification, upon which the BQ has been prepared, are intended to be contract documents.

A.1.4 Risk

One of the features of the ICC – *With Quantities Version* is that *Risk* is accorded its own clause where *Contractors Risk*, *Employer's Risks*, and *Excepted Risks* are collected in one place. Gone, for instance, is the famous Clause 12 from the *Measurement Version* and in its place is Clause 8.5(a) which places the risk of *physical conditions … or artificial obstructions which … could not reasonably have been foreseen by an experienced contractor* squarely with the employer, as before.

However, the means whereby such risks are valued is to be found in several places. Clause 8.9 states that *the Engineer* ***may*** *… order a variation* in such circumstances and, if so, this will be

valued in accordance with (the new) Clause 12.6. Where, however, the Contractor *intends to claim any additional payment or any allowance of additional time*, notice must be given in accordance with Clause 13.1, and *full and detailed particulars of the claim* must be submitted in due course as directed by the engineer.

A.1.5 Contractor-Designed Works

In the ICC – *With Quantities Version*, 'contractor-designed works' is defined as *the part or parts of the Permanent Works to be designed, constructed and completed by or on behalf of the Contractor* (Clause 1(f) refers). Such work could feasibly be measured in the BQ, or a single item could be included for the contractor to price as a lump sum.

Inclusion of suitable measured items for contractor-designed works in the BQ is not straightforward as there are no protocols in the ICC – *With Quantities Version* nor does CESMM4 contain provisions for billing contractor-designed works. Presumably, therefore, a suitable method measurement should be chosen which provides for contractor design, or, alternatively, the bill compiler should give appropriate consideration to ensuring that such works are properly described in the BQ by careful application of the additional description rules contained in Paragraphs 5.9–5.11 and 5.14 of CESMM4.

Where a contractor-designed item of work is to be included in the BQ as a single, non-measured item, the ICC – *With Quantities Version* provides for the inclusion of a milestone sum provided that Supplementary Clause 21 is incorporated in the Contract Agreement (see Section A.1.6).

A.1.6 Supplementary Clauses

Amongst the four supplementary clauses in the ICC – *With Quantities Version* is Clause 21, which deals with milestones.

Whilst not expressly stated in the form of contract, milestone sums would be included in the BQ for items of work to be designed by the contractor that are not to be measured in detail by the employer's quantity surveyor/measurement engineer. Milestones are sums of money, *identified as such in the Bill of Quantities*, which are not subject to remeasurement, and, therefore, risk for the accuracy of the quantities underpinning such lump sums lies entirely with the contractor.

Payments to the contractor in respect of milestone sums take place *only upon achievement of the criteria set out in the Works Data*. Therefore, interim payments for a bridge over a 9-month construction period would only be made when each stage of construction (e.g. substructure, superstructure, deck and finishings), identified in the Works Data, has been substantially completed, subject to deduction of retention as per Clause 21.3(a).

It is unfortunate that the ICC – *With Quantities Version* is tied to the use of formal BQ as milestone sums, linked to activity schedules, could have lent added flexibility to the form of contract.

A.2 Method of Measurement

The default method of measurement for the ICC – *With Quantities Version* is the CESMM 4th edition unless another edition, or another method of measurement, is stated in the Appendix (Clause 11.1 refers).

The *With Quantities Version* differs from the *Measurement Version* in that the employer warrants that the BQ has been prepared in accordance with the Method of Measurement

(Clause 11.1 refers). This is to be contrasted with Clause 57 of the ICC – *Measurement Version*, which states that the BQ is *deemed to have been* prepared in accordance with the method of measurement.

A.2.1 Employer's Warranty

ICC – *With Quantities Version* Clause 11.1 (Bill of Quantities) provides a non-contractual remedy to the contractor should the provisions of the method of measurement not be correctly observed when preparing the BQ. This remedy is available by virtue of the employer's warranty. The legal remedies provided by this warranty may well impose additional risk on the employer should the BQ not comply with the rules of measurement.

Breach of the employer's warranty may entitle the contractor to sue for damages outside the contract for the financial consequences emanating from the breach. Whilst such a breach does not go to the root of the contract or signify that the contract may be repudiated or rescinded, a warranty is a promise that one party may rely upon what has been promised by the other party, and breach of the warranty is established purely as a matter of fact. Whether such a 'sledgehammer' solution to a simple matter of contract administration was intended by the drafting committee remains to be seen.

A.2.2 Items Not in Accordance with the Method of Measurement

Clause 11.2 simply states that where *any item in the Bill of Quantities is not in accordance with the Method of Measurement*, the offending item *shall be corrected and the Contractor shall be paid the corrected amount*. One implication to be drawn from this is that the *corrected amount* is purely a corrected quantity, but this seems overly simplistic in view of the Employer's Clause 11.1 warranty and because the deviation from the Method of Measurement could be a failure to:

- Measure an item that should have been measured.
- Correctly describe an item in accordance with the descriptive rules.
- Provide additional description as prescribed by the method of measurement.
- Distinguish an item that displays different characteristics to a similar item.
- Clarify where a similar item is to be carried out in dissimilar conditions or in a different location, etc.

A.3 Bill of quantities

The quantities in a measure and value contract are all estimated and are therefore subject to change according to whether more or less work has been carried out. The process of determining the difference between the original and final quantities is called admeasurement (i.e. not remeasurement) because the change in quantity is added to or deducted from the original billed quantity. Confusingly, measure and value contracts are often referred to as 'remeasurement contracts', and the words 'admeasurement' and 'remeasurement' are often taken to be synonymous.

The ICC – *With Quantities Version*, on the other hand, is written on the basis that a BQ forms part of the contract and that the quantities stated therein are *Fixed Quantities* (Clause 11.2). This means that the quantities are not subject to admeasurement and can only be remeasured if the engineer has issued a variation. However, if there are quantities in the BQ that are not 'fixed'

for some reason – uncertain ground conditions, for instance – these must be *expressly identified therein as subject to remeasurement*.

Presumably, this means that the phrase *subject to remeasurement* must be used in the BQ and not the commonly accepted terms 'approximate' or 'provisional'.

A.3.1 Work Subject to Remeasurement

Where work is to be remeasured, Clause 11.3 provides that *the Engineer shall ascertain the quantities executed* and submit them to the contractor for agreement. Whilst there is no right for the contractor to attend or assist in the remeasurement process, in contrast with Clause 56(3) of the *Measurement Version*, the contractor does have a right to dispute the engineer's quantities and *shall provide fully substantiated details* of the quantities disputed.

In common with the ICC – *Measurement Version* Clause 7(1), there is provision in the *With Quantities Version* for the engineer to issue *further instructions, including drawings and specifications* (Clause 4.6). Consequently, it must be assumed that remeasurement is to be based upon revised drawings, failing which site measurement is the only alternative. In such circumstances, it may have been prudent to include provision for the contractor to be present on-site to 'hold the other end of the tape' and agree measurements at the time.

For remeasured quantities, Clause 11.2 states that the contractor shall be paid for the *actual quantities of work at the rates contained in the Bill of Quantities for those items*. For any particular item, this infers that the final account shall be computed by deducting the product of the *original quantity x BQ rate* from the contract sum and by adding the *remeasured quantity x the BQ rate*. This is normal practice for a lump sum contract.

However, where the original and final quantities differ significantly or where changes in the quantities impact the contractor's methods and/or sequence of working, there should be a means of valuing the work in order to adequately compensate the contractor. In some contracts, the ICC – *Measurement Version* Clause 55(2) for instance, the contract administrator has authority under the contract to adjust the BQ rates and prices according to the prevailing circumstances. In other contracts, a variation to the contract would be issued and the work would be valued in accordance with the variation procedure.

There are no provisions in the ICC – *With Quantities Version* for the engineer to adjust rates and prices nor are changes in quantities recognised as constituting a variation to the contract.

A.4 Protocols

Provision is made in the ICC – *Measurement Version* for the inclusion of a BIM Protocol in the contract, should BIM be employed for the design, and the protocol to be adopted shall be named in the Appendix – Part 1. The contractual obligation to comply with the protocol is provided in Clause 20 which also states that an Information Protocol may be included in the contract in order to underpin the BIM Protocol, if desired.

A.4.1 BIM Protocol

BIM protocols are intended to encourage collaborative working between members of the project team and to ensure that models are created at defined stages of a project, that common standards of working are adopted and that those using the model(s) have a legal right to do so.

The inclusion of such a protocol in the contract creates additional rights and obligations between the employer and the contractor, but not with other members of the project team, who

may nevertheless have similar contractual arrangements with the employer. An example is the CIC BIM Protocol[1] which has been designed to be incorporated into all direct contracts between the employer and the project team members.

Whilst not specifically identified in the CIC BIM Protocol, there are obvious implications for the accuracy and exchange of quantities extracted from model(s), especially in terms of the employer's warranty in Clause 11.1 of the ICC – *With Quantities Version*, and for the correction of quantities where there are design clashes or changes as the models develop.

A.4.2 Information Protocol

The CIC BIM Protocol requires the employer to appoint an information manager which could be a project manager, lead designer, a contractor or a stand-alone appointment. Amongst the duties of the appointee will be management of the agreed processes and procedures for exchanging project information, involvement in the preparation of project outputs (data drops) and implementation of the BIM Protocol.

Whilst model clash detection and coordination duties belong to the BIM coordinator, the information manager would clearly be involved in ensuring that the correct procedures are followed for quantities extraction from models and for the exchange of appropriate information required for the preparation of BQ.

The information manager appointment requires its own scope of services. There is a detailed *Scope of Services for the Role of Information Management*[2] available from the CIC as well as a simpler version, which may be incorporated with any other form of appointment, such as the NEC3 Professional Services Contract.

Notes

1. Construction Industry Council (2013), Building Information Model (BIM) Protocol, http://www.bimtaskgroup.org/bim-protocol/ (accessed 5 July 2015)
2. http://www.bimtaskgroup.org/scope-of-services-for-information-management/ (accessed 5 July 2015)