Unit 9: Measuring, Estimating and Tendering Processes in Construction and the Built Environment

Unit code: F/600/0223

QCF Level 3: BTEC Nationals

Credit value: 10

Guided learning hours: 60

Aim and purpose

This unit gives learners an understanding of the processes and techniques involved in measuring, estimating and tendering. It also gives learners an opportunity to develop skills in producing final quantities, calculating all-in rates and determining the approximate value of building projects.

Unit introduction

Estimating is concerned with the processes used by contractors to establish the cost to themselves of carrying out construction work. Tendering is concerned with the commercial aspects of bidding for and obtaining work from contracting companies by selecting contractors and asking them to tender and submit a price for the project work.

Measurement, and the accurate estimation of the cost of construction work, is crucial to providing meaningful cost information for the construction firm and the client. The process of bidding for a construction contract normally involves the contractor measuring the works required accurately and using the outcomes to estimate the costs and compile the tender.

Measurement and the estimation of costs are closely linked to the practical activity of construction work. The estimator needs a detailed knowledge of the relevant operations and processes involved in the construction of building elements, and will need to be able to use this knowledge to perform accurate calculations relating to the projected and final costs of materials, plant and labour.

Tendering is the process of obtaining a price for the client's work. This is done by issuing the documents needed to prepare the estimate, selecting contractors to bid, and evaluating the prices received in order to award the contract. Tenders are then evaluated for accuracy and checked numerically to ensure that no mistakes have been made before formal acceptance and the issue of contract documents to the successful contractor.

Learners will have the opportunity to obtain detailed quantities from drawings and other documents, estimate the cost of a variety of construction works, convert the estimate into a tender and provide outline cost estimates for proposed construction projects.

Learning outcomes

On completion of this unit a learner should:

1 Be able to produce final quantities from dimensions and descriptions of construction work

2 Understand the purpose of estimating and the common techniques used to price construction work

3 Be able to calculate all-in rates of materials, labour and plant

4 Be able to derive approximate quantities and costs to determine the approximate value of building projects

5 Understand the process of tendering.

Unit content

1 Be able to produce final quantities from dimensions and descriptions of construction work

Applications: detailed measurement and production of quantities eg descriptions for bills of quantities, variations, interim payments, final account work, claims, disputes

Processes: traditional; cut and shuffle

Production of accurate descriptions and quantities: compilation of descriptions for works; mensuration techniques; calculation of quantities (volume, area, lengths)

Application of standard methods of measurement: Standard Method of Measurement for Building Work; Civil Engineering Standard Method of Measurement

2 Understand the purpose of estimating and the common techniques used to price construction work

Purposes of estimating: estimating net cost; pricing of preliminaries; profit and general overheads; the effects of quantity and value on the chosen method of estimating

Estimating techniques: labour, plant and materials; rates per unit of measurement; standard price book rates; output tables; historical rates; work study

Documentation: Code of Estimating Practice

3 Be able to calculate all-in rates of materials, labour and plant

Material costs: calculation of material quantities; cost of construction works based on unit costs of materials

Labour rates: calculation of all-in rates for craft workers (skilled, unskilled, gang rates); application of labour costs in unit rates; definition of prime cost of daywork; comparison with 'all-in' rates

Plant rates: calculation of fixed and operating costs; calculation of hourly rates; application of plant costs in unit rates

Calculation of unit rates for various classes of construction work: eg excavation, masonry, concrete work, underground drainage, structural steelwork, suspended timber floors, roof construction, roof coverings, plastering, dry linings, painting and decorating, plumbing work, electrical installation, glazing

4 Be able to derive approximate quantities and costs to determine the approximate value of building projects

Traditional cost modeling: approximate estimating techniques; cost per unit, eg bed, seat, pupil, space; cost per unit area eg m2 of gross floor area, m2 of functional space; cost of functional element; approximate quantities

Application: eg feasibility studies, pre-contract cost planning, control, links to stages of RIBA Architect's Plan of Work

Processes: eg use of historical data, tender price indices, location factors, wall-to-floor ratios, window-to-floor ratios, plan shape, number of storeys

5 Understand the process of tendering

Common methods of tendering: methods of tendering relevant to the scale, size and value of the construction works; type of work (building, civil engineering or building services work) for a range of construction works (eg single stage selective, two stage selective, open, serial); target cost; measured term; fee bidding

Documentation: eg drawings, schedules, specifications, schedules of work, bills of quantities, activity schedules; codes of procedure for tendering relevant to main and principal contractors, sub-contract packages and supply packages

Factors affecting the level of tenders: impact on value, price or level of a tender for main and principal contractors, sub-contract and supply packages; profit element; potential variations; quality of tender document; standard form of contract; amended standard form or bespoke contract forms; local authority conditions

Assessment and grading criteria

In order to pass this unit, the evidence that the learner presents for assessment needs to demonstrate that they can meet all the learning outcomes for the unit. The criteria for a pass grade describe the level of achievement required to pass this unit.

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P1 carry out the measurement of quantities for different applications [IE4, SM2]	**M1** apply the Standard Method of Measurement to the production of accurate quantities and descriptions	
P2 abstract final quantities from measurements [IE4, IE6, SM3]	**M2** justify the selection of a new estimating method	
P3 explain the purposes of estimating [IE1, IE3, IE4, IE6, RL5, RL6]	**M3** justify the selection of an appropriate tendering method.	**D1** evaluate the limitations of pre-production costing methods
P4 explain the uses of different estimating techniques		
P5 review the content of a given estimate [IE1, IE3, IE4, IE6, RL5, RL6, TW1]		
P6 determine labour and plant rates, and material costs [IE4, RL1, RL2, RL3, SM2]		
P7 produce all-in rates for two classes of construction work		
P8 select techniques and processes for use in determining costs		
P9 produce approximate quantities and associated cost budgets for two stages of a construction project [IE4, IE6, SM3]		
P10 explain the common methods of tendering for construction work		

Assessment and grading criteria		
To achieve a pass grade the evidence must show that the learner is able to:	**To achieve a merit grade the evidence must show that, in addition to the pass criteria, the learner is able to:**	**To achieve a distinction grade the evidence must show that, in addition to the pass and merit criteria, the learner is able to:**
P11 discuss the documentation required to support the tendering process		
P12 explain the factors that can affect the level of tenders.		**D2** evaluate the impact of potential variations on the level of tender.

PLTS: This summary references where applicable, in the square brackets, the elements of the personal, learning and thinking skills which are embedded in the assessment of this unit. By achieving the criteria, learners will have demonstrated effective application of the referenced elements of the skills.

Key	IE – independent enquirers	RL – reflective learners	SM – self-managers
	CT – creative thinkers	TW – team workers	EP – effective participators

Essential guidance for tutors

Delivery

Tutors delivering this unit have opportunities to use a wide range of techniques. Lectures, discussions, seminar presentations, guest speakers, research using the internet and/or library resources and use of personal and/or industrial experience are all suitable. Delivery should stimulate, motivate, educate and enthuse learners. Visiting quantity surveyors could add to the relevance of the subject.

The recording of measurements should follow the use of industry-standard methods, using taking-off sheets for either the traditional or cut and shuffle methods of processing into finished quantities. Whichever approach is adopted, the alternative method should also be demonstrated and the advantages and disadvantages of each method explained. Similarly, the production of bills of quantities should follow industry-standard formats and layouts. Learners should be encouraged to follow a logical and methodical approach to the processes of measurement, tendering and estimating, and to develop appropriate descriptions of the work they are measuring. Reference to the appropriate standard method of measurement will provide a useful guide. The unit should develop learner awareness and understanding of, rather than the ability to use, relevant computer software and its applications.

The application of different estimating methods to different types of construction work should be demonstrated and learners should have the opportunity to calculate rates and prices for a variety of different types of construction work. The emphasis should be on applying principles as well as calculating realistic prices. As part of the estimating process, calculation of all-in rates for labour and plant resources will be a feature, as will the pricing of preliminary items and the factors to be considered when calculating general overheads and profit. Learners should be made aware of the procedures and processes involved in managing the initial enquiry through to the tender, and of the differences between the estimating and tendering stages of the process.

Wherever possible, links should be formed with industry in order to obtain real examples of measurement, estimating and tendering documentation and specialist input from current practitioners.

Overall delivery of the unit should be supported by the use of case studies and visual media, where appropriate, including documentation and project drawings to illustrate and contextualise the methods used for measurement, estimating and tendering.

Group activities are permissible, but tutors will need to ensure that individual learners have equal experiential and assessment opportunities, and produce individual evidence for assessment.

Health, safety and welfare issues are paramount and should be reinforced through close supervision of all workshops and activity areas, and risk assessments must be undertaken before practical activities are taken. Centres are advised to read the *Delivery approach* section in the specification, and *Annexe H: Provision and Use of Work Equipment Regulations 1998 (PUWER)*.

Outline learning plan

The outline learning plan has been included in this unit as guidance and can be used in conjunction with the programme of suggested assignments.

The outline learning plan demonstrates one way in planning the delivery and assessment of this unit.

Topic and suggested assignments/activities and/assessment
Unit introduction and SMM7 rules – presentation by tutor
The SMM7 and the CESMM – individual research
Taking off quantities: areas, volumes, items, number and length – practical exercises
Understanding drawn information and centre line calculation – demonstration by tutor
Taking-off: individual practice exercises
Take offs for various different sections of the Standard Method of Measurement
Taking-off quantities – foundation and substructure of small building
Technology of substructure – tutor input
Take off lists compiled
Practical exercises
Completion of take off in learner's time
Assignment 1: Measurement Processes
Estimating methods types, differences, accuracy – theory session
The bill of quantities – preliminaries, items, provisional sums, prime costs
Bill of quantities versus specifications – individual research
Collective summary – by tutor
Breakdown of all-in rates – calculation of labour rates practical exercises
Calculation of plant rates – theory and practical exercises
Calculation of material rates – theory and practical exercises
All in-rate for a Bill of quantities item – calculation practice
Tutor demonstration followed by individual practise
Corrections and catch up – individual completion of formative assessments
Assignment 2: Estimating Processes
Tender procedures and processes – theory and assessment
Individual research on tendering processes
The factors affecting tendering levels for different contributors
Assignment 3: Tendering Processes
Review of unit and assignment feedback

Assessment

Evidence for this unit may be gathered from a variety of sources, including well-planned investigative assignments, case studies or reports of practical assignments. There are many suitable forms of assessment that could be used, and tutors are encouraged to consider and adopt these where appropriate. Some example assessment approaches are suggested below. However, these are not intended to be prescriptive or restrictive, and are provided as an illustration of the alternative forms of assessment evidence that would be acceptable.

The structure of the unit suggests that the grading criteria could be addressed fully by using three assignments and one class exercise. The first assignment would cover P1, P2, M1 and M2, the second would cover P3, P4, P5, P6, P7, M3 and D1 and the third P8, P9, P10, M4 and D2.

For P1, learners must use basic mensuration techniques to calculate and record accurate dimensions, volumes, areas and lengths from drawings. They must demonstrate an ability to extract accurate dimensions from information provided and use basic mensuration techniques, as appropriate for a variety of work sections. These should be recorded using standard formats to enable their processing into bills of quantities and other estimating and tendering documentation.

For P2, learners must develop the evidence produced for P1 to abstract several dimensioned quantities into totals.

For P3 and P4, learners must be able to explain the purposes and uses of different estimating techniques, the meaning of net pricing, the content of the preliminaries section of a project and general overheads and profit. Application of the different estimating methods should be evident and a clear distinction should be made between the estimate of the likely costs of a project and those used when actually tendering for work. Learners must also be able to distinguish between the net cost to the firm prepared to carry out the construction work and the value to the client of having the work done. The inclusion of preliminaries, general overheads and profit in the pricing should also be evident. Learners must also be able to show understanding of the content and purpose of the preliminaries section of a project and how it contributes to the execution of the work.

For P5, learners must review the content of an estimate. The review must include preliminaries, temporary works, profit and overheads, contingencies and other cost considerations. Evidence could be in the form of a written report.

For P6, learners must demonstrate an ability to calculate all-in labour rates, plant rates and material costs. They will need to use basic cost and output data to calculate all-in labour rates for skilled and unskilled operatives which must include direct and indirect employment costs. Learners must be able to calculate the hourly cost of various types of mechanical plant, including operating costs, finance charges and other direct and indirect costs. Using the above information, learners must then be able to compute unit rates, which include the labour and plant elements, for a variety of work sections, together with allowances for materials.

For P7, learners must produce all-in rates for two classes of construction work.

For P8, learners must select techniques and processes for use in determining costs. At this stage it is sufficient for learners to understand that there are limitations and how they affect costs. There is no requirement for an in-depth treatment.

For P9, learners must produce approximate quantities and associated cost budgets for two stages of a construction project.

For P10, learners must explain the common methods of tendering for contractors, sub-contractors and supply package contractors, and the circumstances under which each might be used.

For P11, learners must discuss the documentation required to support the tendering process. Evidence could be in the form of a written report.

For P12, learners must explain the factors that can affect the level of tenders.

For M1, learners must be able to apply the rules of the Standard Method of Measurement to the production of accurate quantities and descriptions. Their evidence must show a correct interpretation and application of the appropriate Standard Method of Measurement throughout the execution of the measurement and description processes.

For M2, learners must justify the selection of a new estimating method. Their evidence must demonstrate a clear link between the selected method of tendering and the nature of the project.

For M3, learners must be able to justify the selection of an appropriate method of tendering for the project. Their evidence must demonstrate a clear link between the selected method of tendering and the nature of the project.

For D1, learners must evaluate the limitations of pre-production costing methods. The selected estimating method must be described and evaluated in terms of its suitability for the given scenario when compared to other commonly used methods.

For D2, learners must evaluate the impact of potential variations on the level of tender for a given scenario. The selected tendering method must be evaluated in terms of its suitability for the scenario when compared to other commonly used methods.

Programme of suggested assignments

The following table shows a programme of suggested assignments that cover the pass, merit and distinction criteria in the grading grid. This is for guidance and it is recommended that centres either write their own assignments or adapt any Edexcel assignments to meet local needs and resources.

Criteria covered	Assignment title	Scenario	Assessment method
P1, P2, M1	Measurement Processes	You have been given a small extension to measure quantities from to test your role as assistant QS. Take off and produce the quantities from supplied drawings of this low-rise building project.	Produce measured quantities Abstracts in a formal report for the senior QS.
P3, P4, P5, P6, P7, P8, P9, M2, D1	Estimating Processes	The estimator has asked you to assist with compiling an ISO quality procedure. Identify what the following contain: estimate, adjudication process, and on-costs. The estimator has asked you to produce standards rates for a low-rise building in order to form standard output tables and hourly labour rates.	Assignment on estimating methods.
P10, P11, P12, M3, D2	Tendering Processes	The estimator has asked you to help with identifying weaknesses in the success rates for jobs won. Explain the common tendering methods that could be used, the factors that affect sub-contractor prices and the main estimate tender.	Assignment on tendering methods.

Links to National Occupational Standards, other BTEC units, other BTEC qualifications and other relevant units and qualifications

This unit forms part of the BTEC Construction and the Built Environment sector suite. This unit has particular links with the following unit titles in the Construction and the Built Environment suite:

Level 1	Level 2	Level 3
	Construction Processes and Operations for Low-Rise Domestic Buildings	Construction Technology and Design in Construction and Civil Engineering,
	Construction Methods and Techniques for Low-rise Domestic Buildings	Economics and Finance in Construction and Civil Engineering

This unit links to the Edexcel Level 3 NVQ in Technical Design (Construction Environment), the Edexcel Level 3 NVQ in Construction Plant and Equipment Supervision, the Edexcel Level 4 NVQ in Site Inspection and the Level 4 NVQ in Construction, Plant and Equipment Management.

The unit also links to the following level 3 NOS:

- BE Design
- Transportation
- Construction Contracting Operations
- Construction Plant and Equipment
- Supervision and Surveying
- Surveying Property and Maintenance.

Essential resources

Copies of the Standard Method of Measurement 7 (SMM7) will be needed so that learners can establish the application of the rules of measurement in a realistic context. The method of measurement can be related to civil engineering or construction as learner pathways require. Dimension paper will be required for learners to set out and take accurate dimensions. Good quality drawings, for taking-off quantities, and standard measurement, estimating and tendering documentation are essential to the delivery of the unit, as is up-to-date data on costs and outputs. Access to relevant software systems, for demonstration purposes only, would also be beneficial.

Employer engagement and vocational contexts

It would be useful to engage an estimator from a construction company to assist with providing information on tendering processes and to provide some old, unused tender documentation for learners to look at.

Organisations that are able to offer support, establish links with, and arrange visits to, industry and experienced practitioners include:

- Learning and Skills Network – www.vocationallearning.org.uk
- National Education and Business Partnership Network – www.nebpn.org
- The Royal Institution of Chartered Surveyors – www.rics.org
- Work Experience/Workplace learning frameworks – Centre for Education and Industry (CEI University of Warwick) – www.warwick.ac.uk/wie/cei/.

Indicative reading for learners

Textbooks

Ashworth A – *Cost Studies of Buildings, 4th Edition* (Pearson, 2004) ISBN 013145322X

Brook M – *Estimating and Tendering for Construction Work, 3rd Edition* (Butterworth-Heinemann, 2004) ISBN 0750658649

Buchan R D, Fleming F W E and Grant F E K – *Estimating for Builders and Surveyors, 2nd Edition* (Butterworth-Heinemann, 2004) ISBN 0750642718

CIOB – *Code of Estimating Practice, 6th Edition* (Longman, 1997) ISBN 058230279X

Ferry D J, Brandon P and Ferry J – *Cost Planning of Buildings, 7th Edition* (Blackwell, 1999) ISBN 0632042516

ICE – *Civil Engineering Standard Method of Measurement, 3rd Edition* (Thomas Telford, 1991) ISBN 0727715615

Lee S, Trench W and Willis J – *Elements of Quantity Surveying, 10th Edition* (Blackwell, 2005) ISBN 1405125632

Packer A D – *Building Measurement* (Longman, 1996) ISBN 0582098165

RIBA – *Code of Procedure for Selective Tendering, revised 1999* (RIBA, 1995)

RICS – *Standard Method of Measurement of Building Works, 7th Edition* (Revised 1998) ISBN 0854063609

Seeley I H and Winfield R – *Building Quantities Explained, 5th Edition* (Palgrave Macmillan, 1998) ISBN 0333719727

Smith A J – *Estimating, Tendering and Bidding for Construction* (Macmillan, 1995) ISBN 0333627946

Delivery of personal, learning and thinking skills (PLTS)

The following table identifies the PLTS opportunities that have been included within the assessment criteria of this unit:

Skill	When learners are ...
Independent enquirers	exploring estimating issues from the contractor and client side
Creative thinkers	generating ideas as to the factors that affect labour and plant outputs, exploring other possible factors
Reflective learners	assessing the calculations undertaken for all-in rates against a peer identifying opportunities for improvement
Self-managers	working towards producing accurate dimensions and quantities, using own initiative and researching into SMM7
Team workers	breaking down large rates into smaller items for individuals to collaborate in a team task.

Although PLTS are identified within this unit as an inherent part of the assessment criteria, there are further opportunities to develop a range of PLTS through various approaches to teaching and learning.

Skill	When learners are ...
Effective participators	proposing a practical solution to an estimating problem for a complex all in-rate problem

Functional Skills – Level 2

Skill	When learners are ...
ICT – Use ICT systems	
Select, interact with and use ICT systems independently for a complex task to meet a variety of needs	
Use ICT to effectively plan work and evaluate the effectiveness of the ICT system they have used	
Manage information storage to enable efficient retrieval	
Follow and understand the need for safety and security practices	
Troubleshoot	
ICT – Find and select information	
Select and use a variety of sources of information independently for a complex task	
Access, search for, select and use ICT-based information and evaluate its fitness for purpose	
ICT – Develop, present and communicate information	
Enter, develop and format information independently to suit its meaning and purpose including: • text and tables • images • numbers • records	
Bring together information to suit content and purpose	
Present information in ways that are fit for purpose and audience	
Select and use ICT to communicate and exchange information safely, responsibly and effectively including storage of messages and contact lists	
Mathematics	
Understand routine and non-routine problems in a wide range of familiar and unfamiliar contexts and situations	calculating routine rates and the development of complex all in rates
Identify the situation or problem and the mathematical methods needed to tackle it	calculating excavation volumes for quantities
Select and apply a range of skills to find solutions	
Use appropriate checking procedures and evaluate their effectiveness at each stage	checking quantities and abstraction
Interpret and communicate solutions to practical problems in familiar and unfamiliar routine contexts and situations	
Draw conclusions and provide mathematical justifications	

Skill	When learners are ...
English	
Speaking and listening – make a range of contributions to discussions and make effective presentations in a wide range of contexts	
Reading – compare, select, read and understand texts and use them to gather information, ideas, arguments and opinions	reading and understanding the SMM7 and applying the stated rules
Writing – write documents, including extended writing pieces, communicating information, ideas and opinions, effectively and persuasively	producing quantities on dimension paper