SHOULD COST MODELLING

GUIDANCE NOTE

MAY 2021

Contents

1.   Context

1.1   Overview

1.1.1   This Guidance Note provides high-level guidance for contracting authorities on 'Should Cost Models' (SCMs), the term used in the Sourcing Playbook and the Construction Playbook to describe whole life cost modelling. Although the terminology may be new or unfamiliar, contracting authorities have a long history in developing cost models. These include straight-forward spreadsheets through complex, specialist models to plan and monitor activity, support decision making, and drive value for money in the delivery of public services and public works projects and programmes. The term 'Should Cost Model' (SCM) introduces a standard terminology for contracting authorities in order to formalise existing cost modelling activities and set clear expectations, and guidance for what good SCMs look like.

1.1.2   Although this Guidance Note has a focus on Should Cost Modelling in the context of sourcing services and public works projects or programmes, it is recognised that Should Cost Modelling applies to other types of sourcing and is relevant to wider decision-making processes for projects. Effective Should Cost Modelling will also involve multiple professional functions, including Finance, Commercial or Economic disciplines.

1.1.3   This Guidance Note is the first of a set of Cabinet Office guidance relating to SCMs:

- **SCM Guidance Note** (this document) **–** outlines what SCMs are, when and why contracting authorities should produce them, and key considerations around developing and/or procuring them. *It is not intended to be a detailed guide on how to develop an SCM internally.*

- **SCM Development Guidance –** provides contracting authorities with guidance on using internal resources to design, develop, manage, test and govern SCMs; and

- **SCM Technical Build Guidance –** guidance, based on good practice principles for building SCMs. It is technical in nature and aimed at people who will be building SCMs.

    Practitioners should also consult existing good practice, including HM Treasury's Macpherson report, Aqua Book and Green Book.

1.1.4   A number of practical Tools and Templates have also been produced by Cabinet Office to support the development of SCMs and to help reinforce good practice approaches (see Section 5.1.2 for further details). These are aligned to different phases/ stages of the model development lifecycle (See Figure 1):

Figure 1: SCM Guidance and Tools & Templates to support the model development lifecycle

Project Phase / Stage	Plan		Design	Develop	Test	Use
Activities	Quality Assurance					
	Initial Model Assessment	Scope	Specification & Design and Data	Build & Populate	Review & Formal QA	Implement & Use
SCM Guidance	SCM Guidance Note	SCM Guidance Note	Development Guidance Technical Build	Development Guidance Technical Build	Development Guidance Technical Build	Development Guidance
SCM Tools and Templates	Initial Model Assessment Tool	Scoping Template Planning Template QA Plan Template Development Checklist	Specification Template Example SCM Build Template Book of Assumptions / Data Log Template Development Checklist	SCM Build Template Book of Assumptions / Data Log Template Good Practice Build Toolkit Version Control Log User Guide Example Development Checklist	Testing Procedures Book of Assumptions / Data Log Template Good Practice Build Toolkit Development Checklist	Book of Assumptions / Data Log Template Development Checklist

1.2   Contact

1.2.1   You should consult the Cabinet Office Sourcing Programme for further information or before planning an SCM for complex services, projects or programmes via sourcing.programme@cabinetoffice.gov.uk.

2.   What is a Should Cost Model?

2.1   Introduction to Should Cost Models

2.1.1   An SCM provides a forecast of what a service, project or programme 'should' cost over its whole life. As summarised below, there are different types of SCMs that may also differ in design as requirements change over the procurement lifecycle. However, **the term Should Cost Model or SCM is used throughout this Guidance Note to mean all of them**.

2.1.2   For public works projects, SCMs forecast costs over a period that includes both the build phase and the expected design life. This includes costs of additional market factors such as risk and profit. It provides an understanding of whole life costs, including the impact of risk and uncertainty on both cost and schedule. Notably, the key factor is 'whole life cost' and not the initial purchase price. SCMs should be used early in the procurement process (see Chapters 4 & 5 in the Construction Playbook) to:

- Inform the delivery model assessment (DMA), which considers both cost and non-cost criteria, such as the whole life carbon assessment;

- Drive a better understanding of the whole life costs and the risks and opportunities associated with different options and scenarios;

- Drive more realistic budgets by providing greater understanding of the impact of risk and uncertainty on both cost and schedule;

- Inform the first business case (Strategic Outline Case for departments and ALBs); and

- Inform engagement with bidders and the appropriate commercial strategy, including methods to incentivise the supply chain to focus on whole life value.
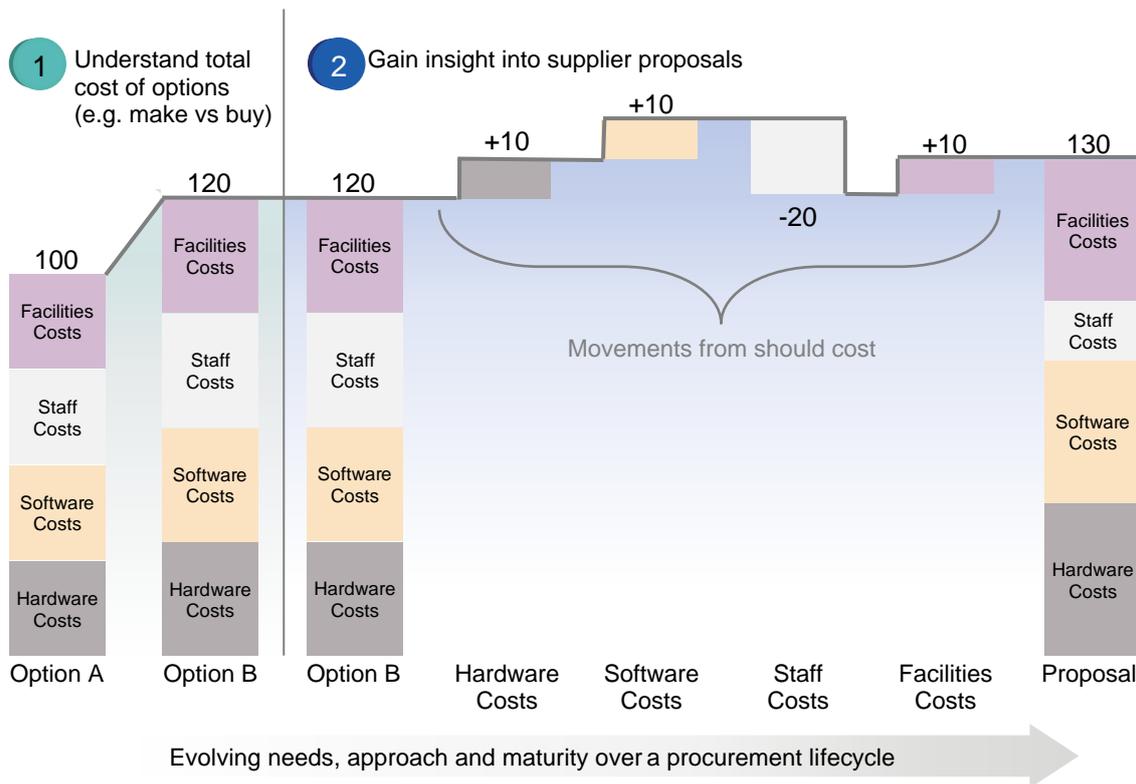
2.1.3   For public services an SCM should be used to help evaluate different delivery model options:

- **In-house** - This (also referred to as a 'Public Sector Comparator') is the whole life cost to deliver a service in-house using internal resources and expertise. It includes the cost of acquiring and maintaining assets and the necessary capability. This should be used early in the procurement to compare costs against the 'Expected Market Cost' and/or 'Mixed Economy' options at a high-level to inform a DMA (see Chapter 3 in the Sourcing Playbook).

- **Expected Market Cost** - This is the expected whole life cost of procuring a service from an outside supplier. It includes the cost of additional market factors such as risk and profit. If the decision is to procure the service from an outside supplier, the 'Expected Market Cost' option can be used to inform engagement with bidders. Use early market engagement to help ensure that the model structure can be evolved to enable comparison to the bids you expect to receive from the market.

- **Mixed Economy** - A delivery model will often be a combination of insourcing and outsourcing different components of the service. In these cases, a combination of the 'In-house' and 'Expected Market Cost' options, referred to as a 'Mixed Economy' option, can be used to calculate the cost of the service.

2.1.4   SCMs are calculations of what a service, project or programme 'should' cost over its whole life, irrespective of where it has been obtained from. See Figure 2.

Figure 2: Demonstrating the evolution of an SCM over a procurement lifecycle

2.1.5   It is important to define and ensure decision makers are aware of what costs are included in the SCM, how they are treated and the limitations of the SCM. An SCM is an estimate of a specific set of costs under particular circumstances over a defined time period, usually defined as the whole life of the service, project, or programme.

2.1.6   An SCM is a both a financial model (e.g. they may use financial techniques such as Net Present Value calculations) and an analytical model and should follow the principles set out in the Green Book and Aqua Book. An SCM will:

- Use analytical techniques, such as unit cost multiplied by unit volume;

- Take account of uncertainty and include relevant risks[1];

- Use relevant data, such as day rates and employee numbers; and

- Usually model a number of different options for comparison and sensitivity purposes.

---

[1] **See the Aqua Book for a more detailed commentary on uncertainty and risk**

2.2   Levels of complexity

2.2.1   SCMs vary in complexity and the time they take to create. The complexity of an SCM should be proportional to and reflective of the complexity and criticality of what you are trying to source. The complexity will also depend on the purpose the SCM is serving (e.g. high-level analysis compared with detailed forecasting). A very simple SCM could be key cost drivers and assumptions captured in a spreadsheet, which may be appropriate for sourcing something that is low value, simple, and stable. In contrast, a complex SCM could be a detailed financial model, which may be appropriate for sourcing something that is high value or complex and could take several months to prepare.

2.2.2   If going to tender, factor in the time that suppliers will need to create their equivalent cost models when setting the procurement timetable.

2.2.3   Simple SCMs with fewer data sets and less complex calculations are less resource intensive to produce than complex SCMs with advanced features. Sufficient time to plan, design, develop and test the SCM should be planned into any programme or procurement activity.

2.2.4   The level of detail in an SCM can vary significantly and it may need to be iteratively developed over time as more information becomes available and as greater certainty is required. Simple models based on an initial service, project, or programme definition and key cost drivers may be appropriate during the early stages of the decision-making and procurement process.

2.2.5   As the procurement process progresses, the service, project or programme specification and other determining factors develop, and greater confidence is required, SCMs may need to become more detailed and the data within them more robust. There may be a need to revisit and recalibrate the assumptions. For example, the SCM may require further development to allow for greater insight into cost components and potentially even their evaluation as part of supplier selection, provided the SCM is disclosed to the bidders. See Figure 2.

"SCMs vary in complexity and the time they take to create. The complexity of an SCM should be proportional to and reflective of the complexity and criticality of what you are trying to source."

2.3   Evolution of a Should Cost Model

2.3.1   Delivery model assessments (DMAs) are expected to be iterated over time in-line with the Business Case development process set out in the Green Book. Similarly, SCMs are also expected to evolve over time as more information becomes available and requirements change. These requirements may, for example, include using the SCM to help demonstrate value for money, to inform the development of payment mechanisms or to help protect government from 'low-cost bid bias'.

2.3.2   SCMs have utility across the procurement lifecycle and the level of detail, which can vary significantly, may require iteration over time. Their evolution is similar to how the Green Book describes the Business Case development process:

- **Initial Should Cost Modelling** – Informs the initial strategic delivery model assessment (Strategic Outline Business Case).

- **Developed Should Cost Modelling** – A more detailed model that provides an evaluation framework for options to help demonstrate value for money. (Outline Business Case).

- **Evaluative Should Cost Modelling** – This is a full cost model that includes all cost drivers and data to support evaluation of the costs of supplier returns that have been received. This is possible only where the SCM has been made available to bidders during the procurement. Contracting authorities should carefully consider the potential risks and benefits of sharing SCMs (Full Business Case).

- **Performance Should Cost Modelling** – This is a full cost model using actual cost data and volumes, allowing comparison to expectations and robust open book contract management (Full Business Case).

3. Why produce an SCM?

3.1 Benefits of Should Cost Models

3.1.1 The three fundamental benefits of SCMs are to provide a better understanding of the costs associated with different delivery model options; to provide insight into the potential delivery models; and help protect the Government from 'low-cost bid bias' (the tendency to favour the lowest cost bid as the preferred option).

3.1.2 Where services, projects or programmes are complex, there is a risk of low-cost bid bias and departments are required to refer abnormally low bids prior to accepting them (see Chapter 10 in the Sourcing Playbook and Chapter 9 in the Construction Playbook):

- If the bid is more than 10% lower than either the average of the other bids or the Should Cost Model estimate it should be referred to the Continuous Commercial Improvement Team (i.e. if it fails either of these criteria it should be referred). The SCM comparison should be made between the bid and the Should Cost Model estimate at the 50% confidence interval for probabilistic estimates or the median scenario for deterministic estimates.

3.1.3 SCMs are powerful tools that can be used to support a much wider range of analysis. These may be best understood by reference to the Five Case model outlined in the Green Book:

- **Strategic Case** – Supporting the case for change by clearly defining the scope of the offering and associated delivery costs, including confidence ranges around the costs. Depending on the required scope of the SCM, this may also include providing a quantitative understanding of aspects of the current situation, referred to as Business as Usual (BAU).

- **Economic Case** – Having a should cost model will allow for the costing elements of the business case to be better articulated and understood, and support discussions around options and value for money. In assessing value for money, whole life cost considerations will extend beyond those of just the contracting authority and benefits will also form part of the evaluation. The required scope of the SCM and the extent to which it will be used to support the Economic Case will drive its overarching design.

- **Commercial Case** – Designing an SCM for first generation outsourcing or where services, projects or programmes are novel will help to drive an understanding of their commercial viability through a better understanding of cost components, including risk and timing, and whether or not there is a market from which they can be procured.

- **Financial Case** – Having a granular cost profile of a target service, project, or programme will help to determine issues of affordability and financial viability through highlighting whole life costs and confidence ranges around them. Akin to the Economic Case, the extent to which the SCM will be used to support the Financial Case will impact the broader costs and benefits included within the SCM and drive its overarching design.

- **Management Case** – Having a view of what the delivery costs should be will assist in overall project management. It can provide structure to reporting by providing a baseline set of costs against which deviations can be measured.

In addition to the initial delivery model assessment and helping to protect government from low-cost bid bias, SCMs can support different elements of the procurement lifecycle, provided they are supported with accurate management information and market data.

This can include:

Options Analysis – Gives objective views on cost estimates and drivers for different option combinations, broadening insight into delivery options;

Switching Values – Enables, through sensitivity analysis, the threshold at which changes in input values would make an option no longer viable;

Key Cost Driver Analysis – Provides additional insight through enabling a more detailed understanding of key factors that influence cost and raise awareness of their underlying drivers;

Maximising Value for Money – Establishes cost by cost category, providing transparency over the cost of something and the output delivered in return;

Negotiation Support – Allows for element level comparison between different bidders' proposals and the SCM to identify and understand differences between a bidder's proposed price and the expected baseline during competitive procedure with negotiation or competitive dialogue procurement processes;

Budget Setting – Can be used to give a framework to inform budgets;

Project Performance Review – Once a contract has been signed, the supporting SCM can be updated with the contracted costs to provide a cost baseline against which analysis can be performed, highlighting variances between outturn and plan at a granular level and enabling further investigation; and

Contract Management – Provides a cost baseline which, along with actual costs, can be used to manage the performance of the contract and supplier, challenge VFM and inform contract change.

4.   When to produce an SCM

4.1   Requirement for a Should Cost Model

4.1.1   The requirement to produce an SCM when making sourcing decisions and contracting outside suppliers for the delivery of **public services** is set out within the Sourcing Playbook (see Chapter 3) and for **public works projects or programmes** within the Construction Playbook (see Chapter 5).

4.1.2   It is good practice to produce an SCM for all procurements and its development should be agreed as part of the planning stage of the business case and procurement, prior to advertising the contract and the publication of any procurement documents.

4.1.3   Initially, an SCM should be used, in conjunction with an analysis of non-cost criteria (e.g. whole life carbon), as part of a delivery model assessment to inform the recommended delivery model.

4.1.4   Prior to developing the SCM it is important to create a definition of the service, project or programme, including what good looks, the desired outcomes and key performance indicators to ensure modelling is completed to the right level. Further guidance on creating a service definition and delivery model assessments is available here.

4.2   Using Should Cost Models to assess the deliverability of bids

4.2.1   Through providing insight into potential delivery models and cost drivers, SCMs can be used to help devise the evaluation model. The SCM can inform the understanding of what costs should be included and inform discussion with the bidders.

4.2.2   SCMs can be used during a competitive dialogue or competitive procedure with negotiation to help ensure that suppliers provide transparency throughout the dialogue/negotiation of all key cost drivers over the whole life of the service, project or programme. An SCM can provide contracting authorities with a better understanding of costs. Where they are higher or lower than expected this should prompt a discussion with the bidder around how they arrived at their costing. The SCM will not normally be shared with bidders during dialogue/negotiation but used to inform the contracting authority's negotiation position and the robustness and deliverability of bids.

> "The SCM will not normally be shared with bidders during dialogue/negotiation but used to inform the contracting authority's negotiation position and the robustness and deliverability of bids."
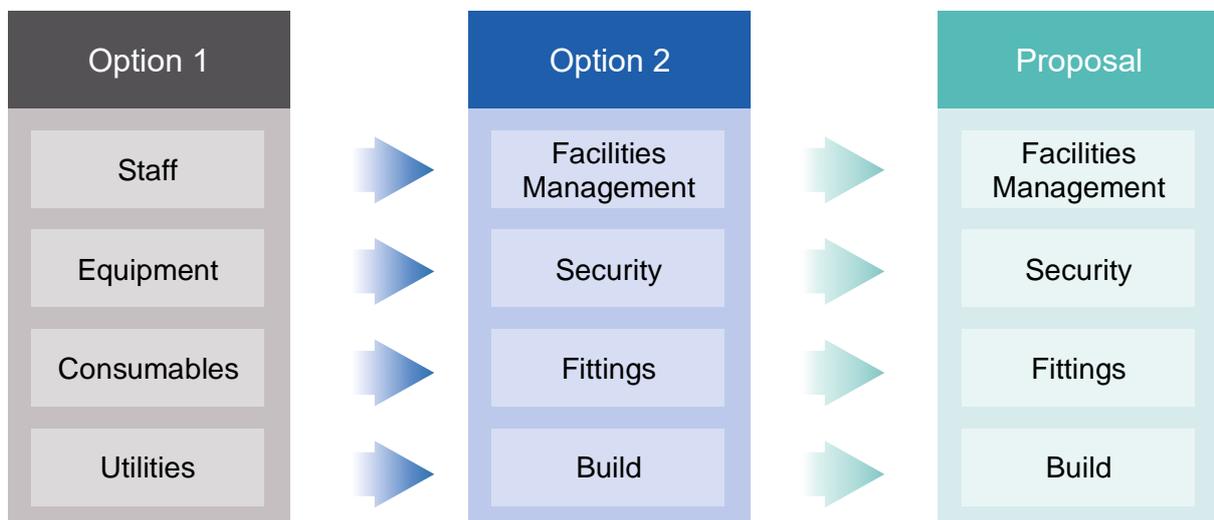
4.3 Using Should Cost Models as formal evaluation criteria

4.3.1 SCMs can only be used as formal evaluation criteria for final bids if they have been disclosed to bidders during the procurement. How the SCM will be used for the evaluation and how bids will be scored against the SCM shall be clearly set out in the procurement documents. If a department doesn't disclose an SCM it cannot be used for evaluation purposes. If disclosed, an SCM can be used to provide:

- **Better understanding of the make-up of costs and cost components**. SCMs can be used to provide deeper insight into the costing of components of a bid. An SCM can provide granular insight into the components that make up the cost of a service, project or programme. Notably, the components may differ between delivery options and this can impact the level at which comparisons can be me made. However, using early market engagement can help to ensure that the SCM is designed in a way that is comparable to the bids you expect to receive from the market. Figure 3 is an example of this.

- **Insight into potential risks relating to costing**. Whilst SCMs cannot inform assessment of delivery risks directly, they can show the impact of risks materialising and highlight areas where costs may appear to be too low or high, and therefore represent a risk. Having a well-reasoned and internally agreed SCM provides an opportunity to investigate where delivery costs are higher or lower and allow for targeted clarification if appropriate. This will provide greater insight into the supply side assumptions and costs.

Figure 3: Using an SCM to compare cost components

Cost components may differ between different delivery options

5.   Producing an SCM

5.1   Five stages

5.1.1   Whether sophisticated or simple, producing an SCM will follow a process with five distinct phases or stages (See Figure 1). Interaction may be required across a number of different functions ranging across financial, economic, statistical or commercial disciplines. The approach to model development can be summarised as follows:

- **Plan**: **create a model Scope and prepare provisional Delivery, Data and QA Plans**. Set out why an SCM is required and what it needs to do. Establish the high-level design, complexity, data, delivery and resource requirements and whether to develop the SCM internally or procure from the market. Confirm the stakeholders, timelines, governance and Quality Assurance (QA) requirements. The model Scope will evolve into a more detailed model Specification (Inc. Design) and provide the blueprint for the model's technical development.

- **Design: create a model Specification (inc. Design) for the SCM.** Codify the inputs to and outputs from the model, set out in writing the key calculations and formulae that will be designed into the model and articulate the model's overall design. Update the Data, Delivery and QA Plans and, together with the model Specification, have them approved prior to commencing model build. The SCM Development Guidance provides guidance on preparing Delivery, Data and QA Plans and producing a model Specification and Design.

- **Develop: Build and Populate the model**. It is important to follow good practice modelling principles to help reduce risk and increase usability of the SCM. These principles should be used to guide development of the model in line with the agreed model Specification. The SCM Technical Build Guidance provides guidance on good practice model development principles. As the model is developed, the model developer should perform self-testing prior to submitting it for formal QA and testing.

- **Test: undertake formal QA and testing and sign-off the model**. The model Scope will highlight QA and testing requirements and these will be set out within the QA Plan. This phase of model development is when formal QA and testing is performed. QA is discussed in detail in HMT's 'Review of Quality Assurance of Government Analytical Models' and the Aqua Book.

- **Use: put in place governance and control processes to help ensure the model remains fit-for-purpose**. Once developed, tested and appropriately signed off as fit for purpose, the model is ready to be used. At this point appropriate governance and control is required to help ensure that the SCM remains fit for purpose over its lifecycle.

5.1.2   The following practical Tools and Templates have been produced by Cabinet Office to support the development of SCMs and to help reinforce good practice approaches:

- **Initial Model Assessment Tool** – informs the SCM development approach and informs setting an appropriate level of Quality Assurance (QA) and testing;

- **Scoping Template** – proforma document containing key questions to help structure and formalise the SCM Scope;

- **Planning Template** – project management aid to support scheduling of SCM tasks and tracking roles & responsibilities, delivery risks and project status;

- **QA Plan Template** – for agreeing and formalising the SCM QA and testing activities over the model development lifecycle;

- **Development Checklist** – checklist containing QA and governance checks to be performed at each stage of the model development lifecycle;

- **Specification Template Example** – key headings, with content examples, to inform production of a model Specification (inc. Design);

- **SCM Build Template** – model build template with embedded good practice elements (e.g. error check network, timelines, style guide etc.);

- **Book of Assumptions / Data Log Template** – customisable template for documenting SCM data and assumptions and guiding data collection;

- **Good Practice Build Toolkit** – toolkit to structure and help automate the review of an SCM's adherence to good practice approaches;

- **Version Control Log** – template tool to help manage and provide a record of changes to an SCM over its life;

- **User Guide Example** – key headings, with content examples, to inform production of a model User Guide; and

- **Testing Procedures** – procedural level guidance for testing an SCM (also includes QA Report and Test Memos).

6. Planning an SCM

6.1 Structured approach

6.1.1 Once the decision to produce an SCM has been taken, it is important to plan it properly and provide a structured approach to onward development by:

- Undertaking an Initial Model Assessment (IMA) to determine the SCM's criticality and sophistication and, in-turn, the associated requirements for its governance, QA and testing;

- Outlining the SCM's purpose, functionality, data requirements, high-level design, stakeholders and delivery timelines; and

- Establishing the resourcing requirement and whether this is available in-house or needs to be procured from the market.

6.1.2 The approach to model development should be captured in a model Scope, with accompanying Delivery, Data and QA Plans. These documents form the bridge that helps to translate requirements into practical SCM development activities. The model Scope, Delivery, Data and QA Plans, should be created on a model-by-model basis. Tools and Templates to support their development are set out in Figure 1.

6.1.3 SCMs that inform critical decisions may be more sophisticated, require more granular data and contain more advanced features than models used to support less critical decisions. Greater sophistication adds to development time and invariably brings a greater risk of error. There is a balance to be struck and the development of SCMs should be driven by the principle of proportionality.

6.1.4 To assist in determining how to approach the development of an SCM, including QA and testing, an Initial Model Assessment (IMA) should be undertaken. It is important to consider both the criticality of the decision that the SCM is designed to support as well as its level of sophistication. For example, consider how detailed the analysis needs to be, how well defined the service being sourced is, the accessibility and robustness of data and the availability of appropriately skilled resources may impact the risk profile of the SCM. An IMA Tool has been developed by Cabinet Office to support this assessment. It is informed by the Cabinet Office Tiering Tool, which should be used to provide an initial indicator of the criticality to the business of the decision that the SCM is designed to support

6.1.5 These considerations should inform thinking around:

- **Procedures and Controls** – how the SCM should be managed and controlled over its lifecycle, including what QA and testing should be applied to help assure its fitness for purpose; and

- **Roles and Responsibilities** – what are the various roles and responsibilities across the SCM's lifecycle. This will include determining whether people are suitably qualified and have sufficient experience to perform the task[2].

2 See **Review of Quality Assurance of Government Models** **for additional information on assessing experience.**

6.1.6   When preparing the model Scope, the factors outlined in Figure 4 should be considered proportionally in the context of the criticality of the SCM. The model Scope should be owned by the Model Senior Responsible Owner (Model SRO), who has overall responsibility for the SCM, including its development and use. Once prepared, the model Scope, Delivery and QA Plans should be agreed and signed off via appropriate governance.

Figure 4: Key factors in developing the model Scope

1: Overview

- Frame the challenge by setting out why the SCM is required, what its primary function is (e.g. what does it need to show or compare?) and what the required accuracy is.

- Outline user requirements, key outputs, and what supporting documentation will be required (e.g. a model Specification, Book of Assumptions / Data Log, User Guide, etc.).

- Identify if similar modelling has been undertaken previously, any lessons learnt and whether there are any materials (in addition to the Cabinet Office Tools and Templates) that could support development of the SCM.

- Set out the overall model development timelines and key milestones, considering interdependencies with other activities (e.g. the delivery model assessment, whole-life carbon assessment, etc.).

- Identify key stakeholders and their roles and responsibilities, including who will sign-off the various aspects of model development.

- Keep modelling cost and complexity proportionate to the cost of the service, project or programme/issues being modelled and as simple as possible to achieve the goal.

- You should consult the Cabinet Office Sourcing Programme for further information or before planning an SCM for complex services, projects or programmes via sourcing.programme@cabinetoffice.gov.uk.

Key Questions

- What decision or issue is the model intended to solve?

- What is the approximate value of the decision?

- What outputs are required from the model?

- How accurate does the model need to be?

- What are the key deliverables (e.g. SCM, model Specification, User Guide, Book of Assumptions / Data Log, QA Report)?

- Who are the key stakeholders? What are the roles and responsibilities?

- What are user requirements and how will you support them?

- What are the procurement and model development timescales?

- Who needs to sign off the model Scope, model Specification (inc. Design) and Delivery, Data and QA Plans, QA Reports and the SCM for use?

- Who will run and operate the model? How will it be handed over?

2: Costs

- Capture the range of cost components for the service, project or programme that will be included in the model. For services this should include costs required to deliver and/or transform a service (e.g. people, including TUPE if applicable, licences, utilities and any Capital Expenditure costs such as space/property, equipment) as well as the costs of a service itself (e.g. cloud storage costs). For public works projects or programmes this should include design and build costs as well as the costs of operation and maintenance over the design life. Costs associated with broader business factors (e.g. management fees, overheads, indexation and profit), socioeconomic factors (e.g. social value) and benefits (e.g. cost savings) should also be considered. If the SCM is required to support aspects of the Business Case (e.g. the Economic Case), consider the wider breadth of costs and benefits that may need to be included. For each component, set out the level of detail or granularity required.

- These considerations allow for early discussion about the nature of the service, project or programme under consideration. They can also help set the agenda for the DMA. For example, what costs (or benefits) could differentiate between potential delivery options and at what level of detail does analysis have to be undertaken in order to be meaningful. Detailed scoping of costs (and benefits) helps to set the limits around where the model will be able to operate and what decisions it can support.

Key Questions

- What are the range of costs (and benefits) to be included in the model? What are the main assumptions behind them and what are their key drivers?

- Do costs (and benefits) need to be split between fixed and variable, direct or indirect? What assumptions should be used to drive this?

- What depth of analysis will the model go to? Is the level of granularity appropriate?

- What is the time period being modelled and what is the required periodicity?

- Are there any KPIs? Have these been captured through the cost (and benefit) components?

- Are there any out-of-scope areas? What are the key limitations?

3: Modelling Techniques

- Specify what modelling techniques will be used to provide analytical insight. For example, whether top-down (e.g. analogous or parametric) or bottom-up approaches will be used. Consider this in light of the required accuracy, the impact on associated data requirements and the time and resource required to develop the model.

- Set out within the model Scope how risk and uncertainty will be addressed. Consider if the model should be designed to incorporate different scenarios and sensitivities and whether more advanced techniques, such as Monte Carlo simulation[3] are required. Consider how risk and uncertainty will be treated in different delivery model options (e.g. in 'In-house' and 'Expected Market Cost' models) to allow a fair and robust comparison between them.

[3] **Monte Carlo simulation is a technique that can be used to understand the impact of risk and uncertainty in cost forecasts. It gives the decision maker a range of possible outcomes and the probabilities that they will occur.**

- Consider the need for input from Subject Matter Experts (SMEs) in relation to the application of advanced modelling techniques or other specialist areas, such as tax, pensions, econometric or statistical analysis. Consider the need to balance the potential for additional insight with the impacts from a resourcing perspective.

Key Questions

- What modelling techniques will be used?

- What specialist input is required? When and how will this be secured?

- How will risk be managed? What risks will be included in the model and have these been tested with the market?

- How will uncertainty be managed? Which inputs are subject to uncertainty and how will their impact on model outputs be assessed?

- Will the model include different scenarios? What are the scenarios?

- Is sensitivity analysis required? Which inputs will be sensitised?

- Are switching values required? Which inputs should be changed to assess the point at which an option is no longer viable?

- How will Optimism Bias be accounted for?

4: Data and assumptions

- Costs (and benefits) to be included in the model and the applicable modelling techniques inform the model's design but also provide direction on what data is necessary to operate it. The model Scope will highlight the data requirements and these, together with details such as where data will be sourced from, when it will be available, who will provide it and its quality or maturity will be set out within the Data Plan. This will help to reduce the risk of misalignment between the data that the model needs to operate and its availability.

- Focusing on data availability and data quality at the planning stage will shape model development. Where data is not available or not sufficiently mature, it provides early awareness to develop alternative plans to source, develop or mature data to the required level for the model.

- Where data is not readily available or there are gaps in a data set, it is important to consider whether assumptions will need to be made in the model and where they are going to be used.

Key Questions

- What are the key data inputs? What is the process for collecting the data?

- How much data is going to go into the model? Financial? Volumetric? Transformational? Operational (e.g. headcount, service levels)?

- What format will the data be in? Are validation checks required?

- Is the data likely to change during development and after the final version?

- Where will assumptions have to be used in place of data sets?

5: Tool Selection

- Documenting the model requirements, the cost components of the model, the techniques it will use and the volume of data it will consume will help to inform selection of an appropriate tool.

- SCMs will most likely be built using Microsoft Excel. However, where data volumes are significant and cannot be reduced, database programmes, may be more appropriate to manage the additional requirement.

Key Questions

- What tool will be used to undertake the modelling? Is there a pre-existing model or will a new one need to be developed? Are model templates available? What is the software version and operating environment (e.g. IOS, Windows)?

- Are add-ins or specialist software required (e.g. for Monte Carlo simulation, schedule risk analysis, model Verification)?

- Does the model need to interact with other systems? Are there feeder files?

- Does the model need to conform to specific guidelines? Are guidelines available?

- How long will the model be required for? Will the model be reused or adapted to support other activities?

6: Quality Assurance Plan

- Performing an Initial Model Assessment (IMA) will help to identify appropriate and proportional QA and testing to be performed. It is important to understand the QA and testing that will be performed to help ensure that it is appropriately planned and sufficient time and resources are set aside to undertake it.

Key Questions

- What is the result of the IMA?

- What formal QA and testing will be required? (e.g. Verification and Validation, including Analytical Review and Commercial Review).

- Are independent, suitably qualified and experienced resources available to undertake QA and testing?

- Are software or other tools that may be required to undertake testing available?

- Has sufficient time been allocated to undertake formal QA and testing? Is time included for multiple review 'cycles' (where any issues address by the developer are re-tested)?

- Has sufficient time been allowed for the model developer to undertake their own self-testing prior to formal QA and testing?

- Is User Acceptance Testing (UAT) required and has it been scheduled?

- What level of assurance will be required over the model's outputs?

- Is model review by an external or third party entity required?

- How will development of the model be governed and controlled?

7.   Establishing the resource requirement

7.1   Suitably qualified and experienced people

7.1.1   The model Scope will inform resource requirements. For all models it is necessary to have suitably qualified and experienced people with sufficient time and resource to perform their responsibilities. These two factors, time and resource, are key to developing robust models in a manner that is informed by good practice and manages risks. Typical roles that should be considered when establishing resource requirements are set out in Figure 5. These are roles, not job titles, and several roles may be performed by the same person. For example, the model architect and developer roles may be performed by the same individual for less complex models.

7.1.2   A distinction should be maintained between individuals responsible for developing models and those who will undertake formal QA and testing.

7.1.3   It is important to assess whether internal resources possess sufficient skills and experience, and are available to support SCM development and testing, or whether external resources are required. There are no universal professional qualifications to cover the development and testing of a model, however analytical, commercial, finance and economic expertise is required to produce a robust SCM. Individuals responsible for financial input should have relevant financial qualifications and appropriate costing experience; individuals performing any kind of statistical function should have appropriate qualifications to support. See Section 8 on procuring an SCM.

"There are no universal professional qualifications to cover the development and testing of a model, however analytical, commercial, finance and economic expertise is required to produce a robust Should Cost Model."

Figure 5: Typical roles in the development of an SCM

Role	Typical Responsibilities
Model Developer	• Driving production of the model Specification (inc. Design), Data, QA and Delivery Plans, and seeking their approval and sign-off ahead of model development. • Updating the model Scope, Specification (inc. Design) and other documentation to reflect any agreed changes. • Building the SCM in line with requirements and good practice guidance. • Populating the SCM with data for self-testing and to support formal QA and testing, handover and release of the SCM for use. • Producing and updating the Book of Assumptions / Data Log with key information pertaining to the collected data. • Undertaking self-testing of the SCM throughout development and prior to release for formal QA and testing. • Working with Quality Assurers to implement changes required to address issues identified as part of QA and testing processes. • Producing the model User Guide and, if required, handover training materials and the model Technical or Developer Guide. • Undertaking demonstrations and familiarisation sessions as required and producing interim results to support in-flight QA and testing. • Implementing any file management procedures that may be applicable during the development of the SCM.
Model SRO	• Model Senior Responsible Owner who takes overall responsibility for the SCM and its use, including its QA and testing and governance throughout its lifecycle.
Model Customers	• Inputting to the model Scope and Specification and confirming the suitability of the model's design to support decision-making requirements. • Inputting to the Delivery Plan and confirming that the overall timescales are in-line with requirements.
Model Operator	• Undertake familiarisation and/or training as required to operate the model. • Implementing the required file management processes and procedures. • Running the model to produce the required outputs and to interpret the result. • Refreshing the input data as required to run the model and produce the outputs.
Model Architect	• Leading the model design and taking responsibility for the associated model documentation, including agreeing any required changes during development. • Overseeing the model development process and providing technical and design support and challenge during build.
Data Providers	• Inputting to all relevant aspects of the Data Plan including the provisional timescales and risks. • Sourcing the data required by the model and undertaking any data pre-processing that may be required. • Updating key stakeholders on progress and any required changes to the Data and Delivery Plans.
Quality Assurers	• Undertaking QA and testing and producing associated documentation, such as QA Reports and Test Memos. • Liaising with the Model Developer to explain identified issues where further clarity is needed and undertaking re-testing, as required.

8. Procuring an SCM

8.1 Commercial considerations

8.1.1 Where internal resources are insufficient or unavailable, external service providers may be best placed to deliver all, or part, of an SCM. There are a number of specific considerations before procuring all, or part, of an SCM to support its development:

8.1.2 Plan

- What modelling credentials do service providers have to develop and/or test SCMs to public sector guidelines and requirements?

- What market credentials do service providers have to support the development (how familiar are they with the target market and do they possess appropriate technical skills)?

- What are the estimated delivery timelines, what is being delivered (e.g. model Specification and Design, draft model, tested model, User Guide) and when?

- Are service providers also potential providers of what you are trying to procure? Is there a conflict of interest concern?

8.1.3 Design

- What will the level of interaction with service providers be during the model design phase to ensure requirements are fully reflected and will this be agreed via a detailed model Specification (inc. Design)?

- If changes are required to the model design once development is underway how will these be agreed and accommodated?

8.1.4 Develop

- Are service providers proficient in building SCMs to good practice guidelines?

- Will interim versions of the SCM be shared for comment and what are the plans for this, including accommodating any feedback?

- Will service providers be responsible for populating the SCM with data and what, if any, data will they be responsible for providing?

- It is normal for data to be provided by the customer to any service provider; are plans to source and make the data available in place?

- In addition to the SCM, if required, will delivery include a User Guide, Technical or Developer Guide, Book of Assumptions / Data Log and training materials?

- Will any software add-ins (e.g., for Monte Carlo simulation) be required in the development of the SCM and are there licensing implications?

8.1.5 Testing

- What tests will be performed, what will they entail and how complete will they be?

- For Verification, will any additional software be used to support this (e.g. for logic testing) and what reports will be provided?

- What documentation will be provided on the test procedures applied and the resulting findings (e.g. Test Memos)?

- How many testing 'cycles' (where identified issues are fixed by the developer and then re-tested) have been assumed and will be supported?

- What, if any, level of assurance will be provided over the model's fitness for purpose?

8.1.6 Using

- Will the service provider operate the model and/or what level of training and support will be provided for internal model operators?

- Is there sufficient internal expertise to handle service provider queries or anomalies during development?

- Who owns the Intellectual Property and are there any restrictions on distribution, use or redevelopment of the SCM?

- What is the level of post-delivery support for bug-fixing or refinements?

- Will the SCM be password protected and, if so, will all passwords be provided?

The CCS Management Consultancy Framework Two (MCF2) can be used to procure expertise to develop an SCM although departments may wish to consider other procurement options.

Contracting authorities can consult the supplier shortlisting tool to identify the specific services that they require. The following capability categories align most closely with the development of SCMs, however SCM services could be procured as part of a wider engagement:

- Business consultancy (Lot 1)

- Options appraisal (Lot 1)

- Value for money reviews (Lot 1)

- Commercials (Lot 2)

- Commercial Expertise (Lot 2)

- Tender analysis (Lot 2)

- Data and analytics (Lot 4)

Capability in these areas is not a guarantee of a supplier being suitable for the provision of a specific SCM, and contracting authorities should conduct a thorough procurement process to ensure that a supplier is suitably qualified to develop and/or Quality Assure and test an SCM.