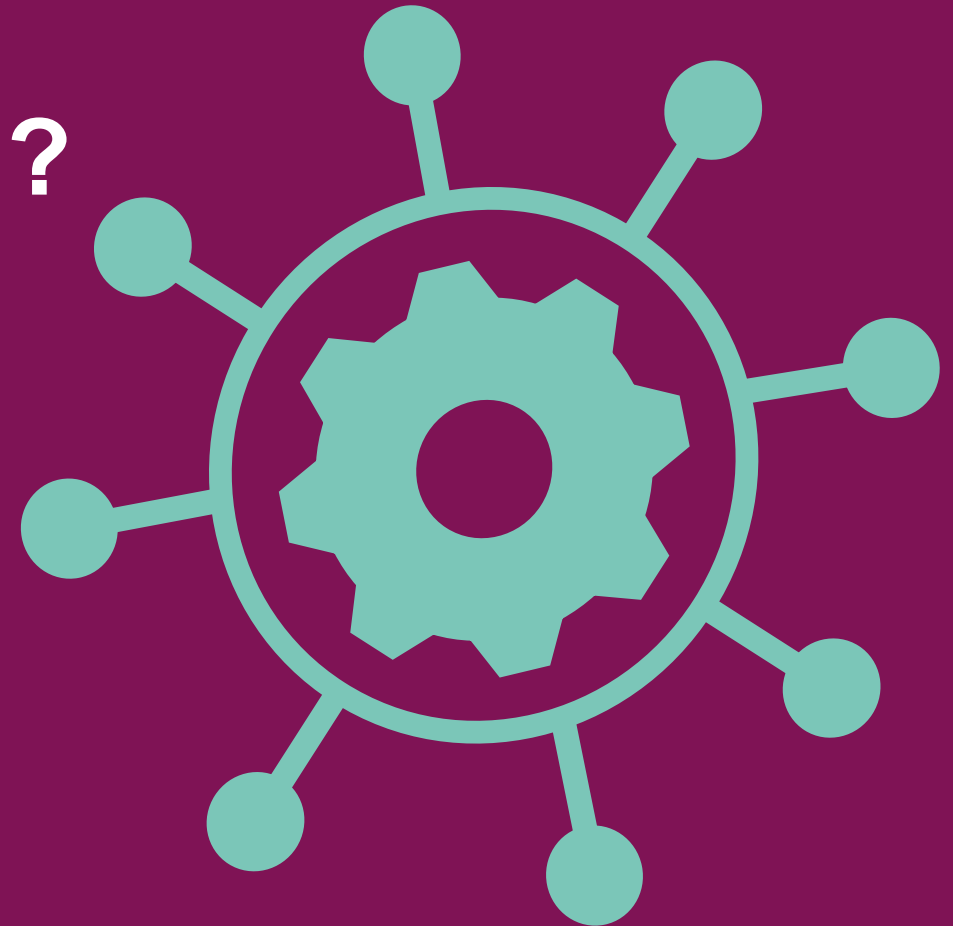


What makes a Quality Model?

Welcome and introduction
Ruth Kelly, Chief Analyst



Financial modelling in government

Philip Bradburn, Audit Manager



Scope

- How well are the principles set out in the *Macpherson Review, Managing Public Money* and other modelling guidance embedded across government and applied to business-critical financial models?
- The report examines:
 - How responsibility for modelling is organised across government
 - The quality processes and how organisations provide assurance
 - How uncertainty is assessed, communicated and taken into account.



Financial modelling in government

Cross-government

REPORT
by the Comptroller
and Auditor General

SESSION 2021-22
27 JANUARY 2022
HC 1015

Poll

How many business-critical models were on departments' central registers in 2021?

- a. 20 or fewer
- b. 21 to 200
- c. 201 to 600
- d. 601 to 1,000
- e. 1,001 or more

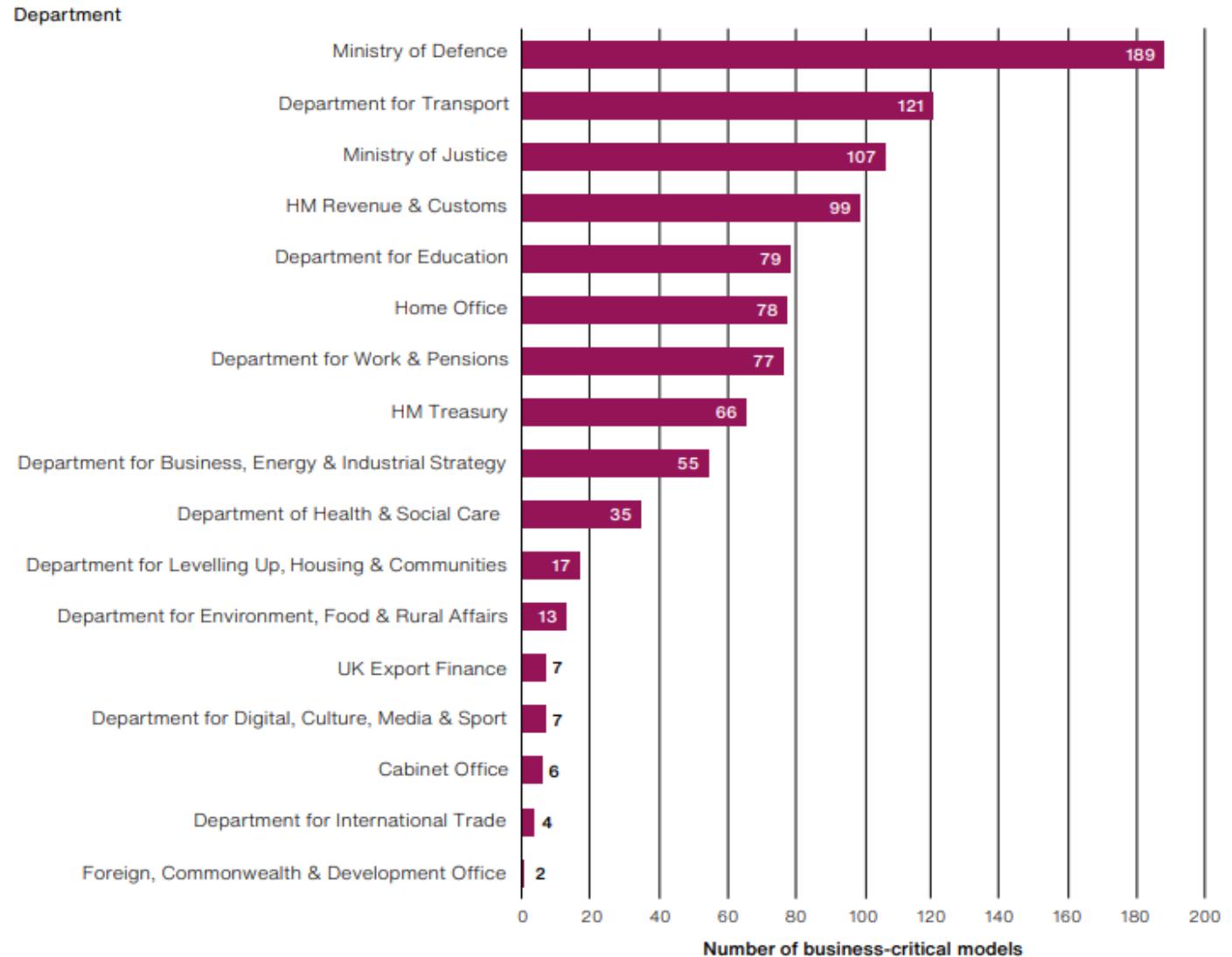
962

business-critical models on departments' central registers

Figure 2

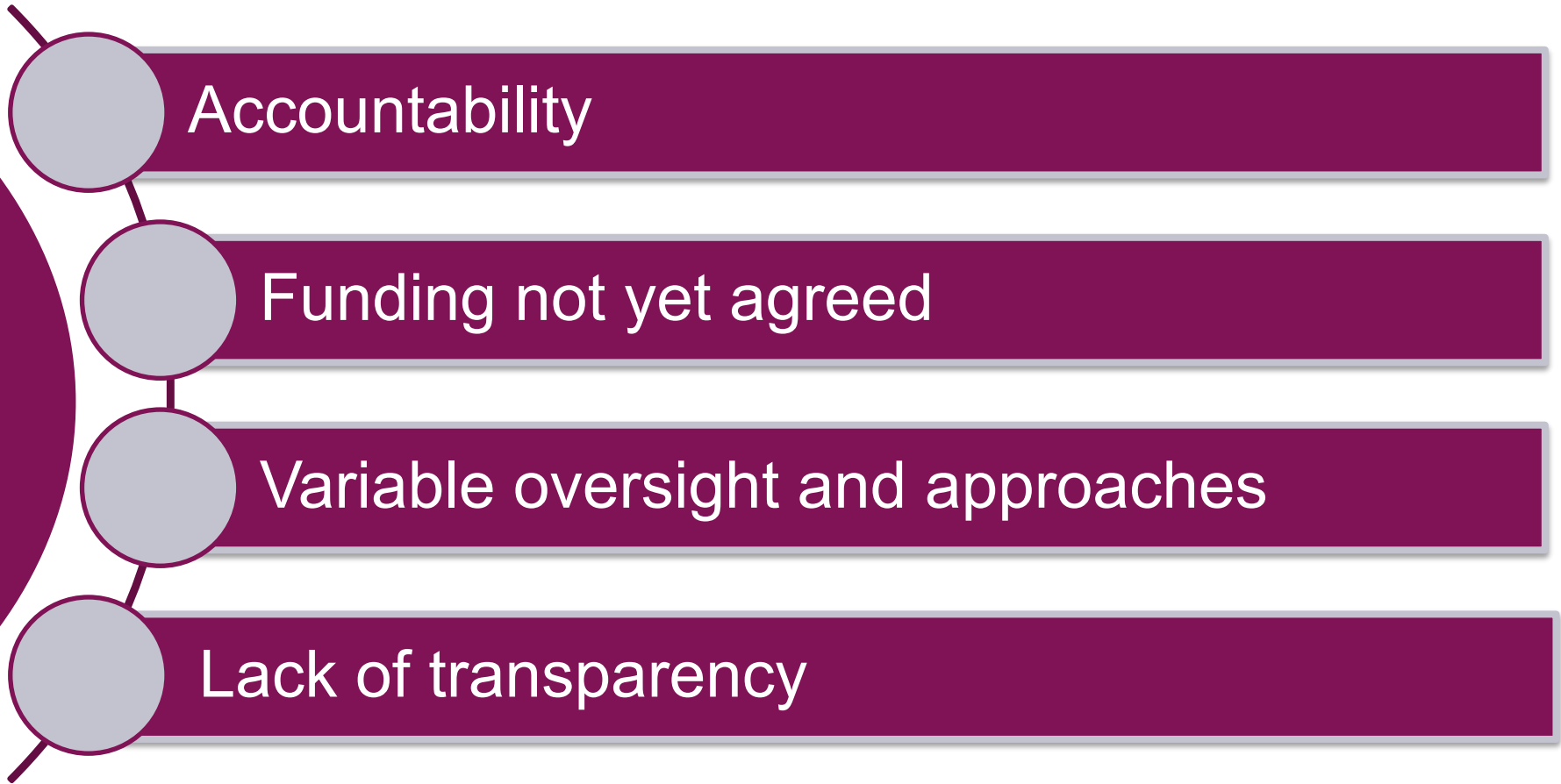
Number of business-critical models in 17 central government departments, as surveyed in 2021

There are 962 business-critical models in use across the 17 departments we surveyed, with the Ministry of Defence owning the largest number: 189 models



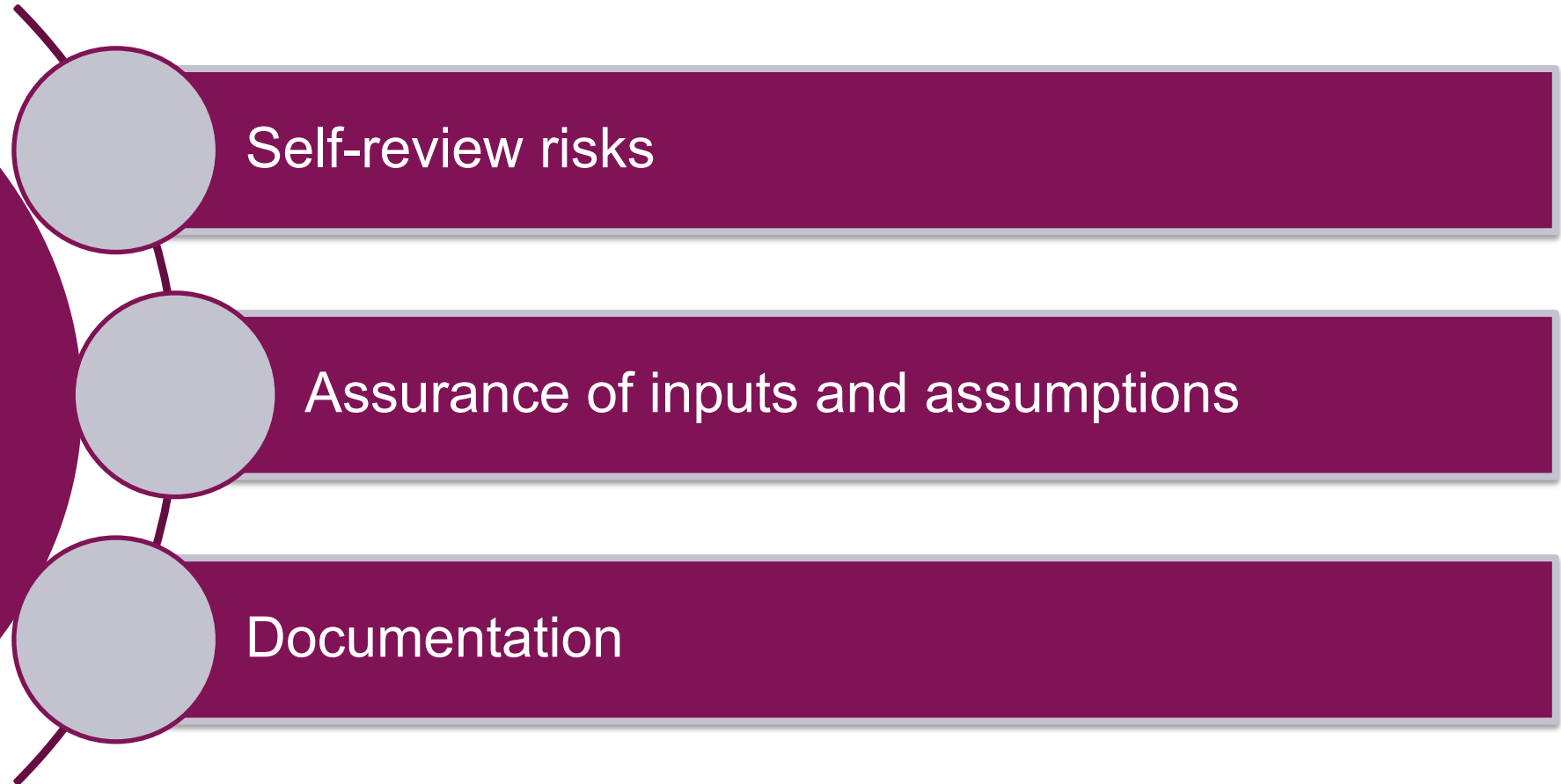
Governance of business-critical models

Scope for better governance



.. Data issues, assumptions, methods and calculations

**Variability in
quality
assurance**



Risks due to how uncertainty analysis is used

**Weakness with
uncertainty
analysis**

Poor Communication

Limited use

Missing insights

Actions needed to tackle significant weaknesses

Areas to improve



Conclusion

Financial modelling is at the heart of how the government understands its spending, performance and risks and makes business-critical decisions. Outputs from models underpin decisions made by departments and ALBs that often have very real impacts on people's lives. Errors in government models have directly caused significant losses of public money and delays to critical public programmes. Since the completion of the Macpherson Review of the quality assurance of models, the government has made progress through publishing cross-government guidance. Separately, the government introduced the Analysis Function and the Finance Function. Departments and ALBs have implemented new governance and assurance procedures.

Although progress has been made, there remain significant weaknesses in how government produces and uses models. There is scope for better leadership from the centre of government to drive further progress, uphold standards and support greater transparency around models that departments use to make decisions. Although we saw examples of good practice, the level of quality assurance that departments apply to business-critical models remains variable. The analysis of uncertainty is often a peripheral activity despite it being extensively recommended in government guidance and despite the risks to long-term value for money of not doing so. Taken as a whole, the government is overly reliant on best estimates from models which do not fully reflect the inherent uncertainty and risks. Without further progress, government plans will continue to be developed with weaknesses that place value for money at risk.

Framework to review models

NAO Modelling Team -
presented by Linh Nguyen



Overview of the Framework and common weaknesses found in government financial models

This Framework (2022) is a refresh of our 2016 published framework under the same name. This refresh builds on our [Financial modelling in government VfM study](#) (2022) and existing guidance such as the [Aqua Book](#). Overall:

- it provides a structured approach to review models;
- it is aimed at people who commission analysis, provide analytical assurance and deliver the analysis itself;
- it is **not** intended to be a checklist; instead it is a flexible framework which can be tailored to account for available resource, complexity of the model and level of assurance needed to reach an overall judgment.

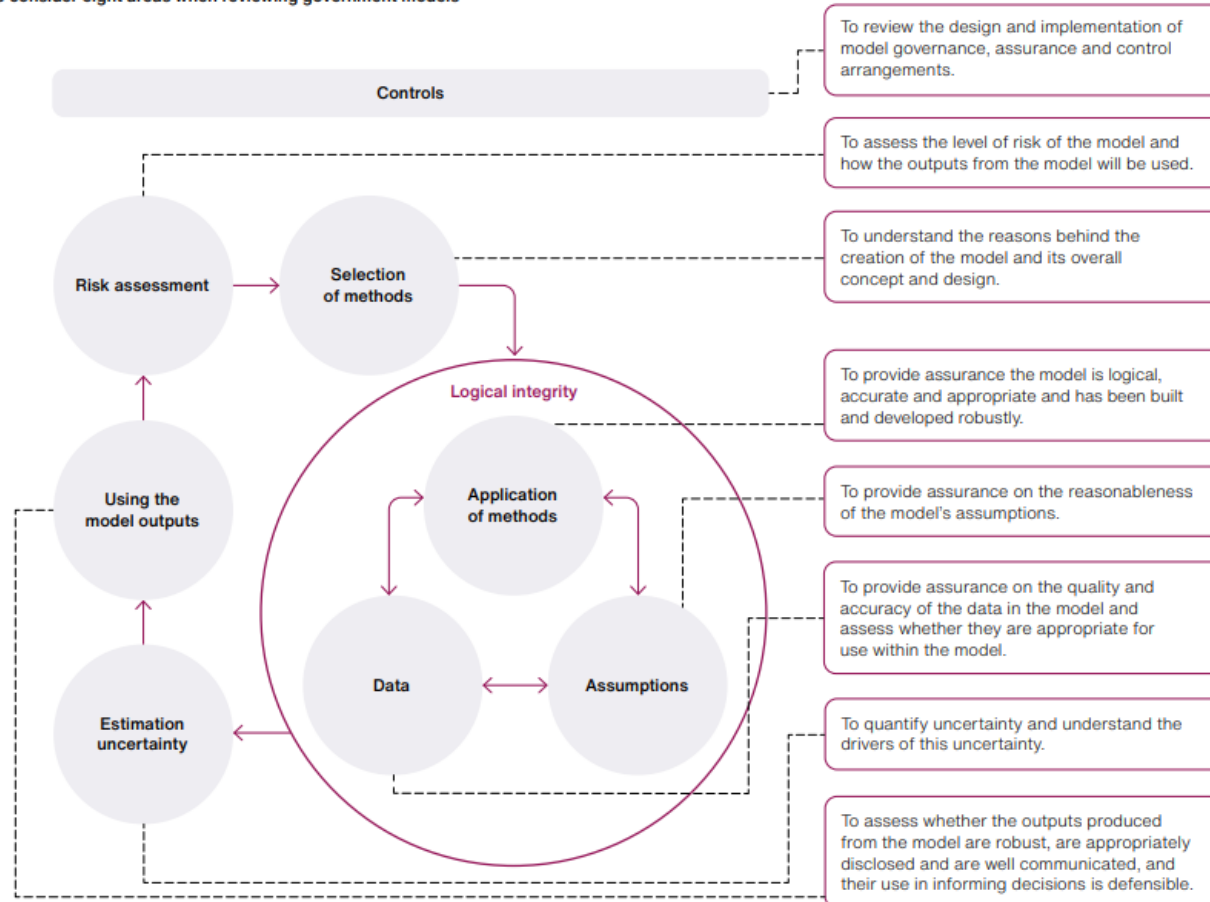
The Framework's main aim to help reduce common weaknesses found from our audit work (seen in both financial audit work and fieldwork of our VfM study):

- limited or poor-quality data;
- unrealistic assumptions and optimism bias; and
- inadequate sensitivity and scenario analysis.

What is the framework to review models?

The National Audit Office's framework to review models

We consider eight areas when reviewing government models



Source: National Audit Office

Main 8 areas we look at when reviewing models, these 8 areas are the ones we focused on for the Framework.

The starting point is an initial risk assessment which drives the rest of the model review.

The Framework aims to be practical and for each of these 8 areas, there is a list of questions the model commissioner/analyst/reviewer should ask themselves.

Examples of questions for 2 (of 8) main areas

Risk assessment:

Questions to consider	Examples of checks to make or evidence to look for
Is there risk in the selection and application of the model's methods?	<p>Identify the maturity of the model.</p> <p>Identify any standards or guidance the model must align to.</p> <p>Identify the methods applied in the model.</p> <p>Identify the software environment used to host and run the model (including its data).</p> <p>Identify whether any adjustments or overlays are made to the model outputs outside of the core modelling environment.</p>
Is there risk in the model's data?	<p>Identify the data used in the model.</p> <p>Identify how the data used in the model are verified and assured prior to use.</p> <p>Identify how the data used in the model are cleaned and/or joined together prior to use.</p>
Is there risk in the model's assumptions?	<p>Identify the assumptions applied in the model.</p> <p>Identify how the assumptions applied in the model are validated and assured prior to use.</p> <p>Identify the assumptions which require significant judgement and/or are highly uncertain.</p>

Assumptions:

Questions to consider	Examples of checks to make or evidence to look for
Are the assumptions used in the model documented?	<p>An assumptions data log should detail all assumptions used in the model (including both explicit and implicit assumptions). For each assumption the log should also include information on:</p> <ul style="list-style-type: none"> ● suitability of selection based on the aims of the model; ● underlying evidence – source and quality, and the extent to which assumptions have been tested with experts, including external stakeholders; and ● level of complexity of each assumption's derivation.
Do you know which assumptions are most significant to the model outputs? ⁴	<p>Sensitivity analysis can be used to support the identification of significant assumptions. Options include:</p> <ul style="list-style-type: none"> ● varying independent assumptions by a standard unit, that is, +/-1%; and ● varying independent assumptions by the minimum and maximum values of their plausible range.

Note: these lists of questions for the eight areas of model review are not exhaustive, meaning the framework does not represent a comprehensive methodology for audits of models carried out to test compliance with the International Standard on Auditing (UK), where further requirements will apply.

Example of NAO's model assurance outputs including how we measure uncertainty in the estimates

Laura Cole, Head of Modelling





National Audit Office

Q&A session

An external perspective from DfE's Student Finance Modelling Team

Jon Tecwyn, DfE



Government
Actuary's
Department

How GAD can help to improve financial models across government

Steve Lewis

2 March 2022



Who are GAD?

- **Mission**
- Our mission is to improve the stewardship of public sector finances by supporting effective decision-making and robust financial reporting through actuarial analysis, modelling and advice.

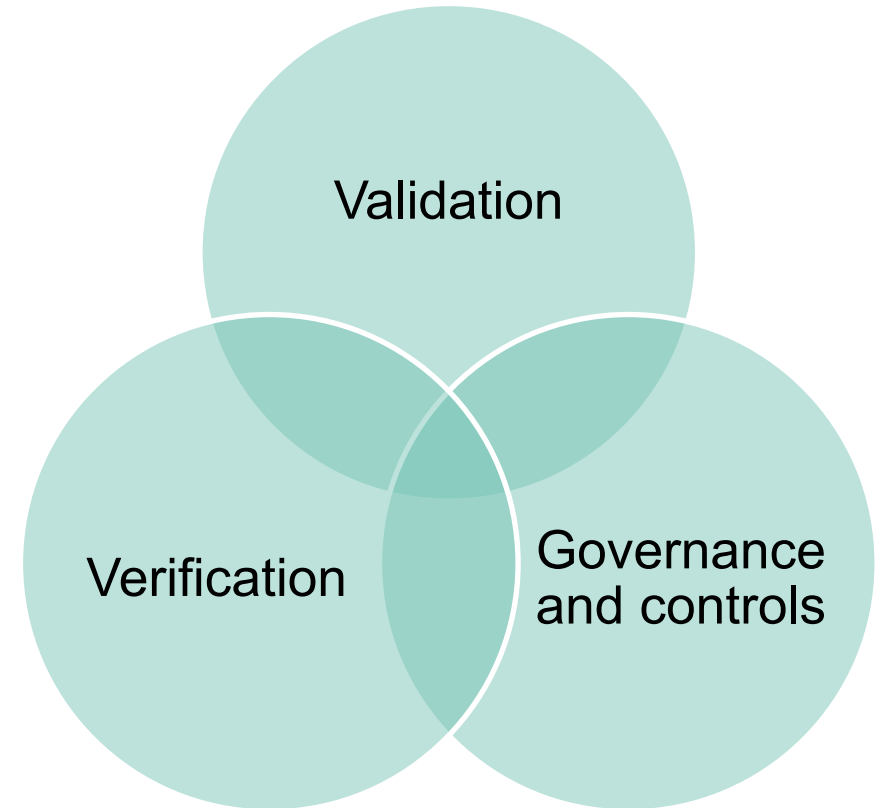


Insurance
and
investment

Modelling
and quality
assurance

Pensions
and social
security

How does GAD provide quality assurance?



What models can we quality assure?

ofgem

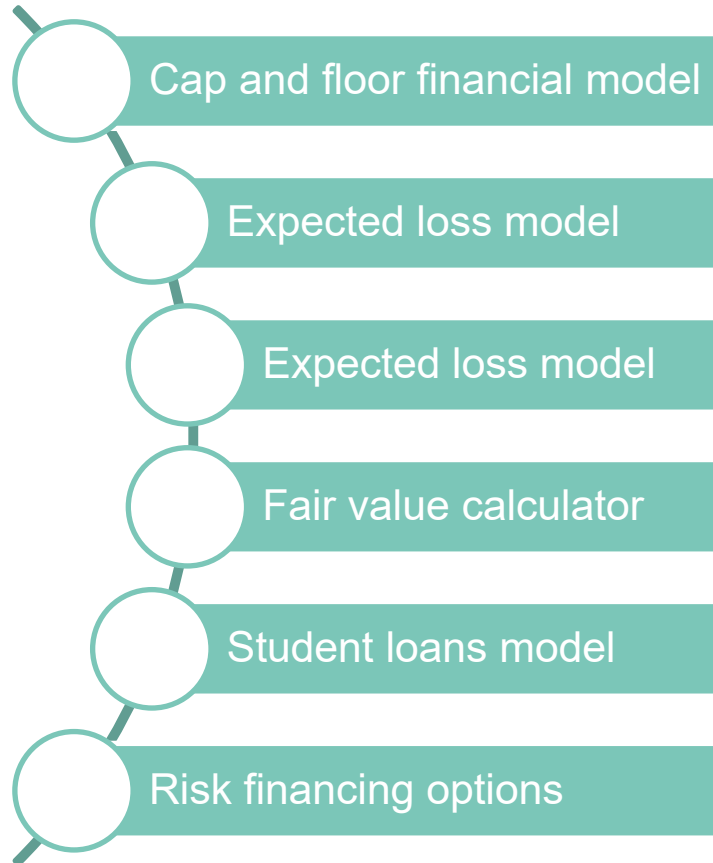

UK Export
Finance


British
Business
Bank


UKRI
Innovate
UK



Department
for Education


HS2




Lambeth

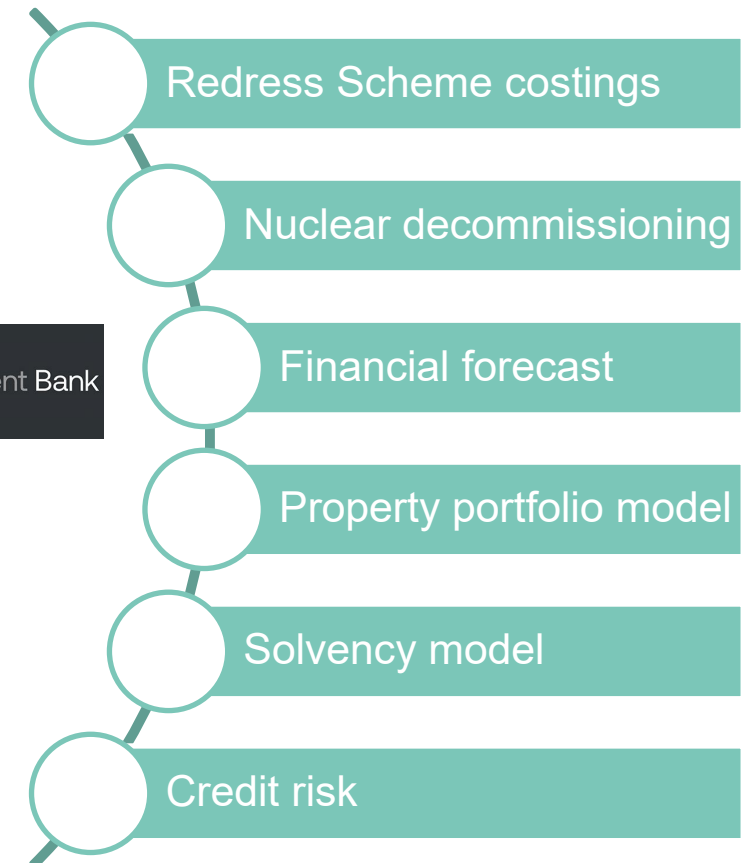

NDA

 The Scottish National Investment Bank

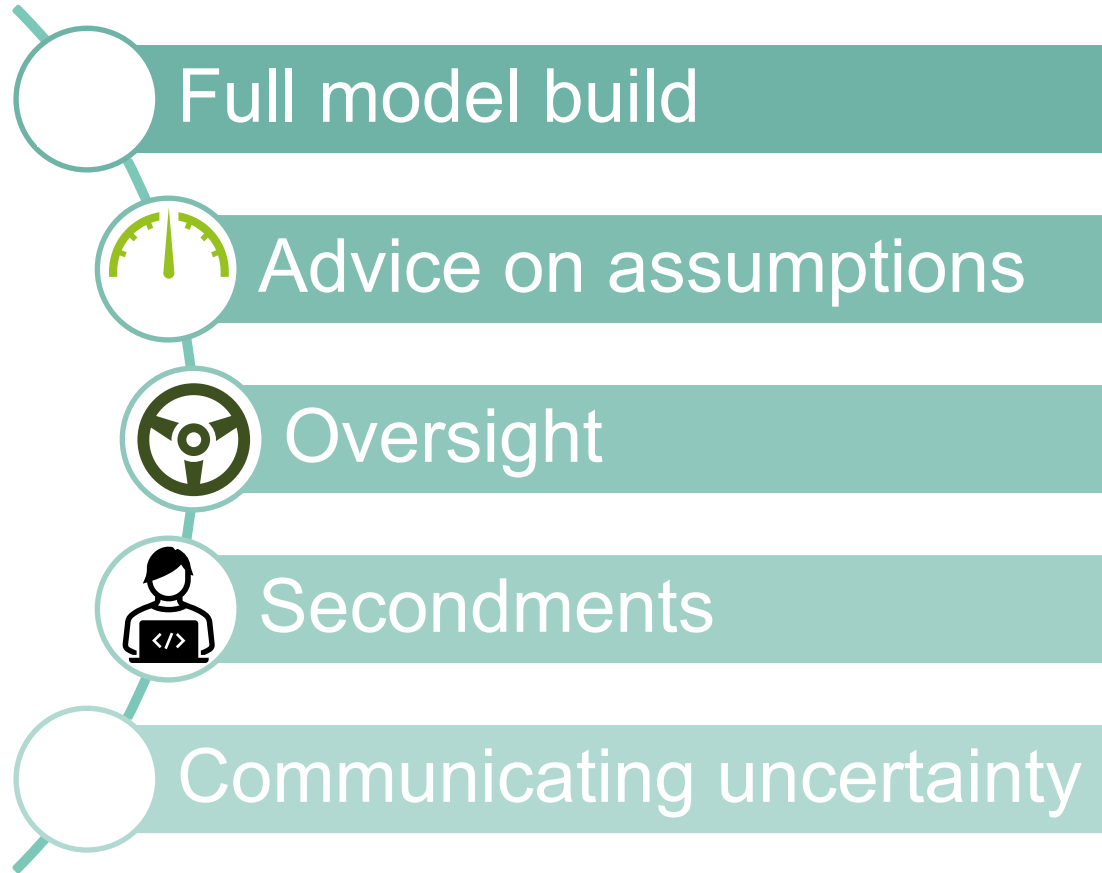

Government Property Agency


**Reclaim
Fund Ltd**


Department for Levelling Up,
Housing & Communities



GAD's modelling services



Student Loans sale model

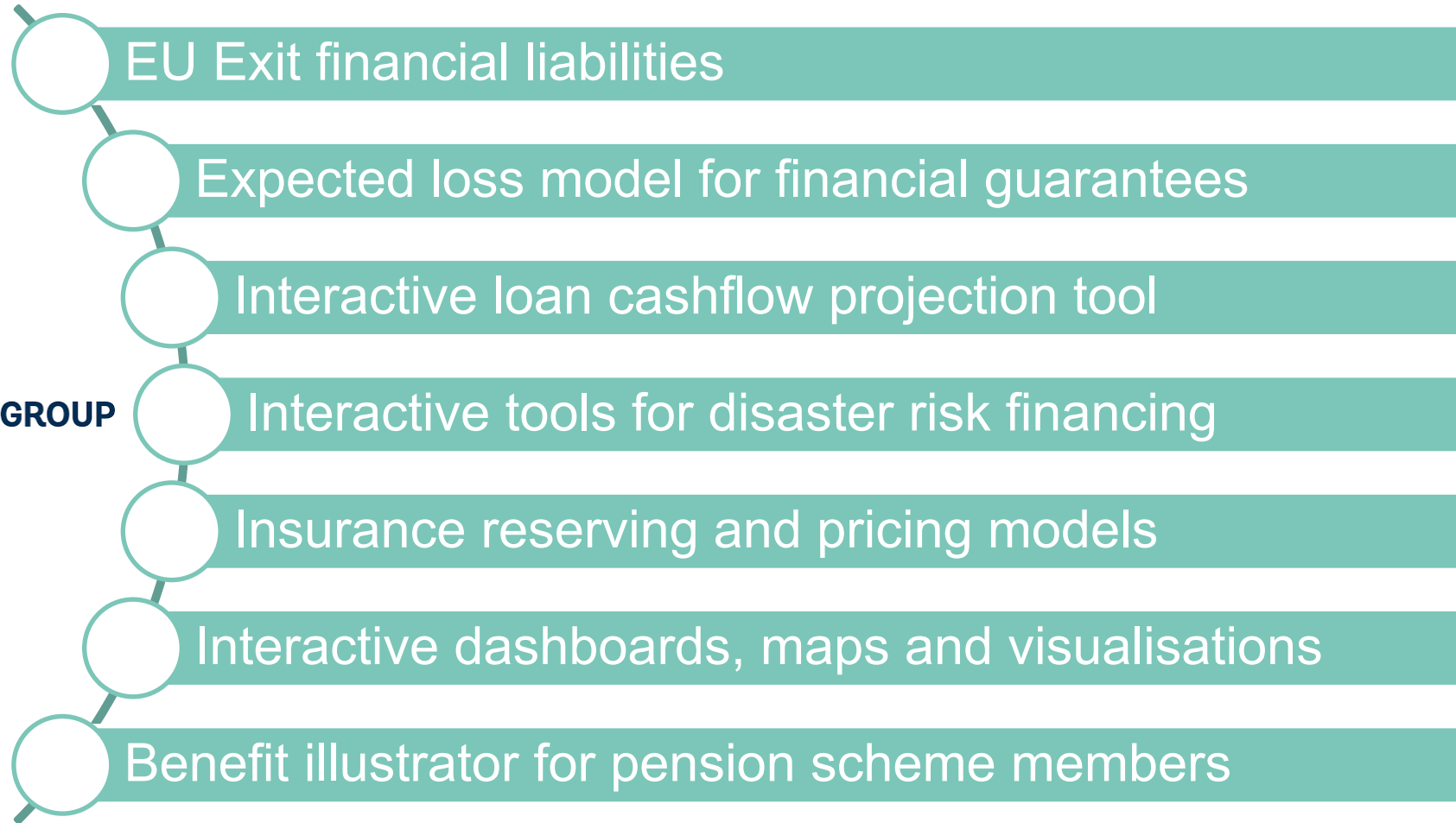


UK Government
Investments



- Developed a new model to facilitate loan sales
- Support UKGI in transaction
- Advice on discount rate and VfM
- Seconded staff

Other models developed by GAD



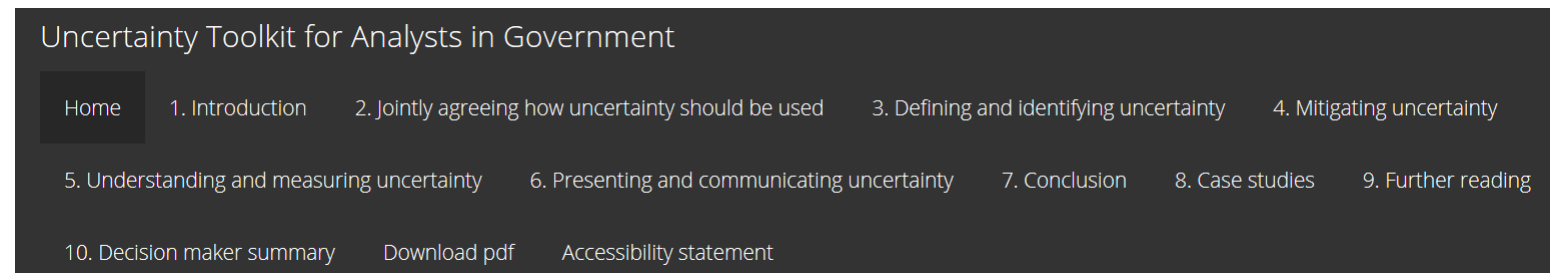
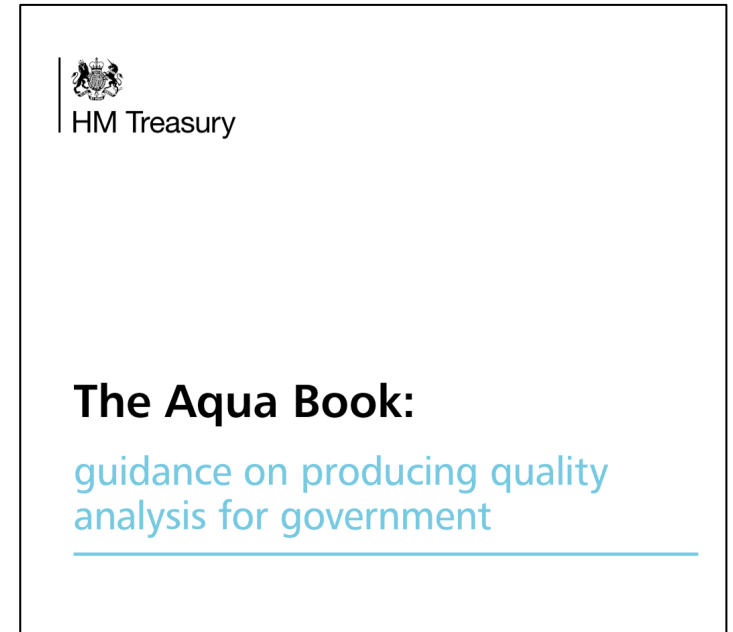
Where else can you get help?

Analysis Function and internal QA networks

Aqua Book and associated resources

<https://www.gov.uk/government/collections/aqua-book-resources>

- BEIS QA Tools and Guidance
- DfT QA Tools and Guidance
- Uncertainty Toolkit for Analysts in Government



Q&A



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www.gov.uk/gad