National Audit Office

Good practice guide

Digital and transformation

Guidance for audit committees on cloud services

Our vision is to help the nation spend wisely.

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Contents

1 Introduction

The 'cloud' is a term for using the internet to access systems and data stored outside an organisation's own premises. It can be thought of as an evolution of outsourcing IT provision although cloud solutions also introduce new contracting models.

Public and private sector organisations are increasingly adopting cloud services with the aims of reducing costs, increasing efficiency and transforming their operations. This use of the cloud brings greater challenges than simply storing data on the cloud.

Detailed cloud guidance is available, as outlined below. Our guide provides a short summary and complements other resources by setting out specific questions for audit committees to consider when engaging with their management. Other related support for audit committees includes *Cyber security and information risk guidance for audit committees* and *Transformation guidance for audit committees*.[1]

This guide aims to help audit committee members to ask informed questions at three stages:

- **Assessment of cloud services.** This section considers cloud services as part of organisational and digital strategies; the business case process; and due diligence.

- **Implementation of cloud services.** This section covers system configuration; data migration; and service risk and security.

- **Management of cloud services.** This section covers operational considerations; the need for assurance from third parties; and the capability needed to manage live running.

Why this requires attention

Government digital policy supports the move to the cloud and the use of cloud services is increasing rapidly in both the public and private sectors. Some more traditional organisations may, however, lack the capacity and expertise to select the right product for their needs, implement it securely and manage it effectively. In particular, the cost and effort of moving to cloud solutions and the skill sets required to manage them effectively should not be underestimated – particularly where multiple suppliers are involved.

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1 National Audit Office, *Cyber security and information risk guidance for audit committees*, September 2017. Available at: www.nao.org.uk/report/cyber-security-and-information-risk-guidance/; and National Audit Office, *Transformation guidance for audit committees*, May 2018. Available at: www.nao.org.uk/report/transformation-guidance-for-audit-committees/

An overview of cloud services

Cloud services are provided through the internet. This contrasts with traditional systems with hardware and software on an organisation's own premises. Cloud services are not a new concept. An early example was email accessed through a web browser. Today better and faster internet connections create new opportunities for cloud services, which are available in an increasing range of areas, including business and financial systems.
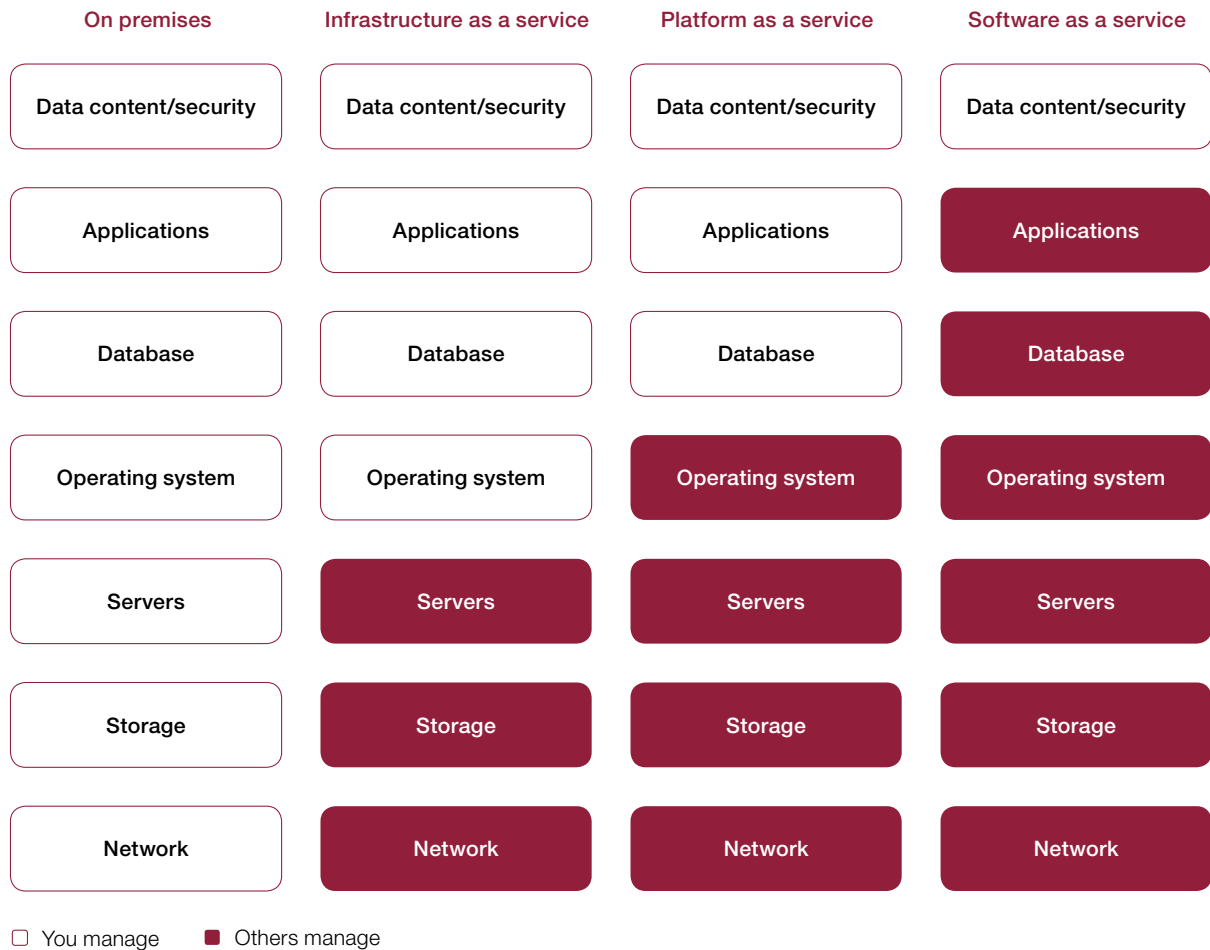
Cloud services are being heavily promoted as providing a wide range of benefits, including efficiency, flexibility and security. These benefits may be achieved through the cloud provider's economies of scale and expertise.

Figure 1 overleaf sets out the different levels of cloud service and gives examples of each. In some cases it is no longer necessary to have the data storage, servers, software or digital team on an organisation's own premises. The three basic levels of cloud service are:

1   **Infrastructure as a service (IAAS).** This provides the base layer of computing infrastructure. It is suited to users who need access to high levels of capacity for their own systems, for example computationally intensive research. Examples include Microsoft Azure, Google Cloud Platform and Amazon Web Services (AWS).

2   **Platform as a service (PAAS).** This provides the computing infrastructure plus the operating system and databases. This option works for organisations who want to run their own software on a cloud platform. Examples include Microsoft Azure and Heroku.

3   **Software as a service (SAAS).** This delivers fully featured applications over the internet. Customers do not need to install or maintain software or have their own hardware. However, it gives the least amount of control over updates and changes to features. Examples include Microsoft Office 365, Google Apps, Oracle Fusion Cloud, SAP S/4HANA Cloud, Salesforce.

Not all cloud services are necessarily described in the above manner. For example, the G-Cloud framework categorises services as **cloud hosting** (infrastructure and/ or platforms), **cloud software** and **cloud support** (that is, to help set up and maintain a service).

Figure 1

Comparison between on-premises and different levels of cloud service

On premises	Infrastructure as a service	Platform as a service	Software as a service
Data content/security	Data content/security	Data content/security	Data content/security
Applications	Applications	Applications	**Applications**
Database	Database	Database	**Database**
Operating system	Operating system	**Operating system**	**Operating system**
Servers	**Servers**	**Servers**	**Servers**
Storage	**Storage**	**Storage**	**Storage**
Network	**Network**	**Network**	**Network**

☐ You manage ■ Others manage

Source: National Audit Office

The three levels of cloud service outlined above may be provided on the following types of 'cloud':

- **Public cloud** – the cloud provider owns and runs the cloud systems, delivering services over the internet. Many customers (known as 'tenants') share the same hardware, storage and network devices.

- **Private cloud** – the cloud provider gives a single customer dedicated use of specific cloud systems. This provides enhanced control over the environment as the resources are not shared with others. This option is more expensive.

- **Community cloud** – an extension of the above whereby a dedicated service is shared between a limited community of organisations with common requirements around security, privacy, performance and compliance and who bear the costs of the service. It is generally the responsibility of the community itself to determine who it wishes to admit.

- **Hybrid cloud** – this is a combination of the above where some applications and services are run in a public cloud and others in a private cloud. These can be complex and challenging to create.

What is government policy on cloud services?

The government supports the move towards cloud services. It encourages public sector organisations to adopt cloud systems where they offer better services or value for money. It has developed its policy over time:

- **Cloud first**, May 2013: expresses an explicit preference for public cloud over private, community or hybrid deployment models. Departments are free to choose alternatives to cloud services if they can demonstrate that they are better value for money.[2]

- **Cloud native**, February 2017: expresses a preference for Software as a Service (SAAS) applications and encourages organisations to move towards using a range of cloud-based tools.[3]

- **Use of G-Cloud**: all cloud purchases must be made through the G-Cloud procurement framework. A new framework for cloud services is being developed by the Crown Commercial Service (CCS) looking at updating the existing procurement arrangements, for example lengthening the terms of the contract to five years.

- **Technology Code of Practice**: updated guidance in early 2019 will emphasise that one size does not fit all, and organisations should make sure they understand what 'cloud' is and means for them. 'Cloud first' may not be right for everyone and cloud solutions may not always save money.

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2 Available at: www.gov.uk/government/news/government-adopts-cloud-first-policy-for-public-sector-it, accessed 26 March 2019.
3 Available at: governmenttechnology.blog.gov.uk/2017/02/03/clarifying-our-cloud-first-commitment/, accessed 26 March 2019.

Guidance continues to evolve and organisations should ensure they are aware of the latest developments. There is an increasing recognition and acknowledgement that 'cloud first' will not be right for everyone and cloud solutions will not always save money.

Other guidance available

Our cloud guidance is highly summarised and there are other complementary, more detailed guides on offer.

- The National Cyber Security Centre (NCSC) provides guidance on security specific to cloud services. It covers how to configure, deploy and use cloud services securely.[4]

- The Chartered Institute of Public Finance and Accountancy (CIPFA) provides a guide to the accounting questions raised by buying software and technology 'as a service'. Compared to traditional technology procurement, this may move expenditure from capital to revenue.[5]

- The Financial Conduct Authority (FCA) provides a guide for firms outsourcing to the cloud and other third-party IT services. This guidance helps firms to oversee the life cycle of their outsourcing arrangements. This ranges from making the decision to outsource, selecting an outsource provider, and monitoring outsourced activities on an ongoing basis, through to exit.[6]

- Gartner has produced a framework for how moving to cloud services should be managed via the following steps: (a) Build skills and assess applications; (b) Select cloud providers and services; (c) Design cloud services and manage risks; (d) Estimate the bill and establish governance; (e) Provide and automate cloud services; (f) Operate cloud environments at scale.

4   Available at: www.ncsc.gov.uk/guidance/cloud-security-collection, accessed 26 March 2019.
5   The Chartered Institute of Public Finance and Accountancy, *Accounting for the cloud*, March 2017. Available at: www.cipfa.org/policy-and-guidance/reports/accounting-for-the-cloud
6   Financial Conduct Authority, *FG16/5 Guidance for firms outsourcing to the 'cloud' and other third-party IT services*, July 2018. Available at: www.fca.org.uk/publication/finalised-guidance/fg16-5.pdf

2 Assessment

Before selecting a cloud solution, organisations need to evaluate whether the cloud is suitable for their needs and objectives. Cloud providers are promoting their services very strongly in the market. It can be challenging for decision-makers to form a clear view of the relative merits and potential pitfalls of various cloud services. Management needs to set clear criteria for success so that it can properly evaluate the options available. This is particularly important when using G-Cloud because of the requirement to evaluate all suppliers which meet the organisation's stated requirements and choose that which fits best including whole-life cost.

2a Digital strategy

A successful digital strategy should be central to the wider organisational vision and strategy. Many organisations are now developing 'cloud strategies'. However, management should guard against their vision being led by specific technological solutions. Management should first develop robust organisational and digital strategies and establish a clear view of their technological requirements. Smaller bodies may find it beneficial to engage the expertise of service companies to help them understand and navigate the various options.

Questions audit committees could ask:

- **What are the priorities for the digital strategy?** Does the digital team have a clear understanding of the operational realities? Are operational experts committing time to supporting the digital team to develop their strategy?

- **What are the technical requirements?** Has the organisation considered what is the most appropriate type of cloud solution (infrastructure, platform or software as a service)? Will all places from which users will be accessing the service have sufficiently fast and reliable internet connectivity for software as a service to be viable?

- **Is the complexity of legacy system issues really understood?** Has the organisation thoroughly investigated the challenges involved in migration and configuration, such as moving a bespoke system onto a shared platform? Does the digital strategy include a risk assessment of the degree of change involved, including personnel considerations? Is there a strategy for retiring legacy systems to avoid the costs of supporting old and new systems together for extended periods?

- **Will best practice be followed in respect of security?** Has the organisation followed the NCSC cloud security principles before committing to using cloud services? Does it have an in-depth plan for how cloud services will interface securely with existing services, systems and processes?

- **Are private cloud, public cloud, and on-premises options all considered?** Does the organisation have a strategy for the use of cloud services, based on a clear understanding of the implications for personal data, privacy and consent? Is the organisation aware that most cloud providers do not accept liability for the clients' data?

2b Business case

Cloud service providers advertise a range of selling points. These include cost efficiencies, adaptability, scalability and security. However, the cost of cloud services can vary significantly depending on uncertain factors such as user numbers and data volumes in future usage scenarios. Different suppliers have different elements to their pricing. The benefits of adaptability and flexibility depend on the complexity of implementation and the extent to which services are tailored.

Questions audit committees could ask:

- **How sensitive are planned costs to scenario testing?** Does the organisation have a clear understanding of current service usage and how this might change in the future? Has it analysed the fixed, marginal and step costs in each of the different options and bundled packages? Is it necessary to buy the full service or would a streamlined or more basic version be sufficient? Does the expected usage include the development environment as well as live services?

- **What extra skills and capacity will be needed?** Can the in-house team manage business case development, commercial negotiation, implementation, operations and assurance? If consultants or contractors are required to implement systems, will in-house staff be able to build knowledge and capability alongside them? What is the wider impact on the workforce and the cost of training and roll-out? The skills to implement cloud services are different from those required to implement and maintain more traditional on-premises or outsourcing arrangements. And moving from a single prime supplier to an environment involving multiple suppliers will call for a service integration and management skillset, which must be developed.

- **What time horizon is being considered in the commercial model?** Has management ensured that break clauses are there to prevent lock-in if the provider does not keep pace with changes in open standards? If implementation costs are high with highly tailored services, will this weaken the negotiating position when the initial contract expires?

- **What is the cost of implementing and operating countermeasures to mitigate risk?** What would be the cost of bringing services back in-house, for example if there are changes to data privacy or other regulations? What costs and barriers would there be to retrieving the organisation's own data in a format suitable for migration to another service? The degree of effort and expense to move to a new provider should not be underestimated, and the risk is most acute with software as a service.

2c Due diligence

There is a wide variety of cloud service providers and many are global suppliers. The providers on G-Cloud have been pre-screened only to check they are suitable to work with government, and not to provide any assurance on their specific services. Selection criteria should, therefore, cover the specific needs of the organisation. The organisation should conduct due diligence on shortlisted suppliers to check they meet all security requirements, relevant standards, regulations and business-specific needs.

Organisations should be clear that they are responsible for the security of their data in the cloud. The supplier may provide a secure technical environment but identifying and addressing data breaches, hacking and so on remains the responsibility of the organisation and it will not be sufficient to be a passive consumer of the service.

Questions audit committees could ask:

- **Will there be clear accountability between the organisation and cloud provider?** What oversight regime will there be for the organisation over the cloud provider? Does the cloud provider sub-contract and how does it manage risks? Has the organisation undertaken sufficient due diligence to mitigate against the risk that in the event of a General Data Protection Regulation (GDPR) breach, it will be held liable as the data controller alongside the cloud provider as the data processor?

- **Have the service features being promoted been verified?** Has the organisation obtained feedback from other customers on how easy to configure the system is? How easily will the new service integrate with other systems? Are some of the features listed as 'beta', meaning they could potentially be modified or withdrawn with little or no notice?

- **What are the terms of service?** Is the capacity and availability guaranteed by the cloud provider sufficient for the organisation's needs? Is this backed up by the provider's track record to date? What are the business continuity arrangements? How quickly is service guaranteed to resume after an outage? Is the provider's liability cap likely to be sufficient (particularly for smaller contracts) to cover the cost of any damage the organisation suffers?

- **Where is the provider's infrastructure physically situated, and in what jurisdiction(s) is the organisation's data being held and accessed?** What assurances and guarantees are there on data residency and sovereignty? Are there security or sovereignty constraints imposed by a parent department or other important stakeholders? If the provider has a UK data centre, what assurances does the organisation have that it will be used for the organisation's own data, and/or covers all services that the organisation plans to make use of? Will this incur additional cost? Will UK resident data be accessed from offshore locations?

- **Will the cloud service contract be governed by the law and subject to the jurisdiction of the United Kingdom?** Will the cloud provider allow access to its premises and data by the organisation, its auditors (internal and external) and any relevant regulators without any restrictions? How does the provider support compliance with data protection legislation? Will they support GDPR requests, such as subject access requests?

- **What security accreditation and protocols does the provider have?** What information security standards do they meet? What measures are there to prevent unauthorised access, for example encryption or multi-factor user authentication? Are these part of the core offering, are they additional paid-for options, or are they left to the organisation to implement separately?

- **Has the technical architecture of the system been reviewed by appropriate experts?** What is the contractual liability for data losses or service unavailability? What is the provider's approach to proactive testing, and is there historical evidence of how they have responded to security issues?

- **Does the organisation understand what security information will be fed back from the provider as part of the service?** Will there be sufficient in-house resources to understand and interpret the information and alerts being fed back? Will there be the capacity and expertise to respond appropriately when the alerts indicate that action is required on the part of the organisation?

- **Has the organisation considered the costs of exiting from a cloud provider to take advantage of competition in the market?** Are contract exit arrangements fully documented with a legal commitment for the cloud provider to cooperate with transfer and removal of data? Are there contractual mechanisms to ensure the provider can supply the organisation's data in a reasonable electronic format for migration to another provider? Are the actual mechanics of how the data would be extracted under such a scenario sufficiently clear from the outset (particularly given the current contract lengths on G-Cloud)?

3 Implementation of cloud services

The majority of the challenges in introducing cloud services implementation are common to on-premises system implementation. Indeed, the broader challenges of change management and stakeholder engagement also apply to the introduction of cloud systems. However, many cloud services are relatively new and configuration can be complex. Management needs to be confident that it has addressed the risks associated with cloud service implementation. Failing to configure cloud services correctly can severely hamper the achievement of financial benefits.

3a System configuration

The potential variation and innovation in the cloud environment can make configuration more challenging than for an on-premises network. Correct configuration is essential for a mixed network of cloud and legacy systems to interoperate and communicate efficiently and securely. Smaller organisations are less likely to have sufficient expertise and capacity to manage configuration of new systems. Such organisations will need a robust plan in place to manage business as usual at the same time as managing the change.

Questions audit committees could ask:

- **Is there a strong governance and project management plan in place?** What commitment is there from the provider to work collaboratively on systems configuration? Is there a full range of senior representatives from across the relevant areas of the business in the programme governance?

- **Have infrastructure, applications and data been prepared for the move?** If legacy data is poor quality, should it be transferred in its existing state into the new system? Are other systems sufficiently up to date to integrate with the new cloud service?

- **Is the organisation overly reliant on third-party resource?** Is there sufficient resilience in the in-house team to maintain a robust corporate memory? Will the post-implementation in-house team understand how the system has been configured?

- **Is the organisation following configuration best practice?** Is the move to the cloud being clearly documented to ensure that any changes, for example in data categories or business processes, are understood? Has pre-implementation testing been completed and documented prior to go-live?

- **Will people be ready for the new systems?** Have users been engaged throughout? Have there been clear communications about the changeover dates? Are people confident about the systems they should use and their own responsibilities for maximising the chances of a smooth transition?

3b Risk and security

The cloud is not necessarily any more or less secure than on-premises technical architecture. The threats in an on-premises and public cloud ecosystem are broadly similar. There are entire application ecosystems running in public cloud that have strong cyber defences with multiple layers of security. Equally, there is a plethora of cloud solutions that are deployed with default configurations and patch management issues.

Questions audit committees could ask:

- **Are technical risks covered with clear responsibilities and mitigating actions?** Has the organisation put an agreement and action plan in place to cover risks such as resource exhaustion, isolation failure, malicious insider, interface compromise, data interception, data leakage, insecure data deletion, denial of service (DoS) attacks, and loss of encryption keys? Are key personnel aware of the steps they would need to take in the event of different kinds of security breach?

- **Are the required legal and policy agreements in place?** Do contracts cover data protection risks, licensing risks and changes of jurisdiction? What are the policies covering key issues such as vendor lock-in, governance, compliance, reputation and supply chain failures?

- **Have business continuity plans been updated?** Is the organisation prepared for a range of scenarios for service outage?

- **Are plans in place to cover the event of data loss?** Is key data covered by a system of point-in-time backups? Are there plans in place to support on-going business in the event of data being lost?

- **Are financial controls fully tested and compliant with best practice?** How robust is identity management to ensure that financial controls are not undermined (for example, segregation of duties)?

3c Implementation

The realisation of benefits from new software can be contingent on user acceptance, compliance and engagement. Cloud systems often involve a significant change in the user interface and, while they may appear intuitive to technical colleagues, they may not work for everyone. In addition to managing technical implementation, organisations must focus on the importance of change management for all key stakeholders and users.

Questions audit committees could ask:

- **Have key stakeholders been engaged through a comprehensive change management strategy?** Does the organisation have adequate plans to provide training, ongoing support and coaching for users before, during and after implementation, according to the service chosen? Does the implementation programme have an effective governance structure to prioritise the backlog of requirements?

- **Are contingency plans in place to manage implementation issues?** If the organisation is relying on third parties, will there be sufficient control over them? Do the organisation's existing systems represent a 'burning platform' and would they be able to continue indefinitely until implementation issues are resolved?

- **What plans are there for technical and user acceptance testing?** Has the organisation identified all relevant business scenarios for inclusion in testing, and defined thresholds for acceptable deviations or other issues with acceptance? Has testing been completed and does it demonstrate that users are able to complete all required tasks without encountering system errors?

- **Is there sufficient information for a Go / No Go decision?** Has the organisation assessed the impact of any issues outstanding?

4 Management of cloud services

A move to cloud services should reduce the previous type of capability required in-house to manage live services. Cloud service providers can take care of infrastructure management and maintenance and software patching and updates. They can also provide a helpdesk and support to users and technical staff depending on the service in the cloud. However, new capability is required to understand, manage and interpret the interface between the cloud service and the organisation. Organisations cannot outsource responsibility for governance of data and controls operated over financial and other transactions. Many organisations also opt to modify the services they use and this can increase the ongoing need for in-house service management.

4a Operation

Immediately after go-live there may be a period of teething issues and frustration as it takes time for the requirements backlog to be addressed. Ongoing change management will be important through these stages to reassure users and sign-post any further changes to system interfaces or configuration. It is important for there to be strong governance in place over the cloud provider and the in-house team. Thereafter the cloud environment is likely to be more dynamic with a greater frequency and volume of changes and updates compared to an on-premises environment. The organisation will have a lesser degree of control over the acceptance of these updates, particularly with SAAS.

Questions audit committees could ask:

- **Is there effective governance to prioritise the removal of any temporary workarounds?** Are there any integration issues still outstanding which expose security weaknesses? Is information being manually exported to other systems and are there plans to automate this?

- **Is there clear oversight over what the cloud providers are planning?** Is the cloud provider being transparent over its plans to release new features and upgrades to its systems? Is the organisation able to influence the cloud provider to prioritise the developments it would value? Is the organisation assessing the impact of planned changes on the business?

- **Are responsibilities clear for system changes, upgrades and patches?** Does the in-house team have the capacity and expertise to manage any changes they will be required to make? How long will the team have to test any changes in a sandpit before being required to release them into the live service?

- **Is there sufficient capability to take advantage of the reporting functionality?** Will the in-house team continue to be dependent on third-party support to manage key reporting and system processes? Has the auditing function been turned on to provide tracking information?

- **Is the organisation monitoring its usage of the cloud to confirm that it is getting the best value?** Does this monitoring include the development environment as well as live services?

4b Assurance

Cloud providers typically offer assurance to their customers in the form of Service Organisation Controls reports (SOC1, SOC2 and SOC3). Cloud providers commission independent auditors to write these reports to provide assurance on their processes and security arrangements. Management needs clarity on the assurance these reports provide and where there may be controls gaps or areas where further assurance is needed. External auditors will also wish to have sight of these reports as part of the annual audit.

Questions audit committees could ask:

- **Does management understand the general scope and limitations of different Service Organisation Controls reports?** Is assurance required to cover financial reporting (SOC1) or wider operational controls (SOC2)? Is a publishable public-facing report (SOC3) needed? Does the report provide a view on the cloud provider's latest penetration test or vulnerability assessment report?

- **Is management clear on the scope of controls tested and the extent of testing?** Is the service auditor a recognised firm? What additional controls or assurance is needed to cover internal processes and systems? If there are weaknesses or gaps in the cloud provider's controls, are there additional steps which management should take to strengthen internal controls? Should management obtain further assurance on the overall operating model?

- **Do Service Organisation Controls reports give assurance on the success of operational controls over time?** Are Type 2 reports available which test the controls over time rather than simply documenting them? Does management have a way of monitoring any changes in key controls between reports?

- **Are Service Organisation Controls reports frequent enough to keep pace with continuous improvement?** Is there a mechanism to allow management to continuously monitor compliance with key controls? Is there a trigger clause to oblige the cloud provider to obtain a new report if it makes significant changes to its systems or controls?

- **Does management carefully scrutinise Service Organisation Controls report findings?** Even if the report gives an 'unqualified opinion', are there any exceptions noted? What is the quality of the cloud provider's responses to any exceptions raised?

4c Capability

Moving functionality into cloud systems does not necessarily mean that there will be any significant efficiencies in terms of in-house capability. Simple cloud applications may make little difference to capability requirements. However, more complex integrations will need significant upfront resource to configure and implement with an extended period required to manage ongoing system improvements and updates. Integrating several different cloud services can be particularly challenging.

Questions audit committees could ask:

- **Will the organisation retain the necessary technical knowledge post-implementation?** What knowledge will there be of any ongoing legacy systems and how they interface with new cloud systems? What plans are there for knowledge transfer from the cloud provider pre- and post-migration? How is knowledge-sharing operating with the cloud provider?

- **Does the technical team have the capability to take full advantage of the cloud systems?** Is specific training arranged for different cloud provider systems which may have widely varied data structures and technical requirements? Do teams responsible for legacy systems (such as business intelligence (BI) reporting, third-party payroll, or fixed asset modules) have the capability to manage the interfaces with the cloud system?

- **Will there be sufficient capability to manage updates, downtime and system changes?** Will the organisation retain people who understand the cloud system configuration and can manage changes and continuous improvement? Will the technical team be able to effectively monitor planned cloud system updates and understand the organisational impacts?

- **Will there be sufficient commercial and legal capacity to challenge value for money and compliance?** Will the commercial team have sight of the usage of cloud systems through monitoring tools? Will they be able to understand and interrogate the cost drivers to ensure ongoing value for money? Will there be legal capacity to support the technical team if there are breaches of service level agreements (SLAs)?

- **Is there sufficient base-level stakeholder capability to optimise cloud system usage?** Are system users taking advantage of the opportunities and features available? Is there a training plan in place to keep users up to speed with changes and induct new users? Do decision-makers have sufficient understanding of cloud capabilities to engage effectively?

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