ICAEW

INFORMATION TECHNOLOGY FACULTY

Minimising spreadsheet errors

Second edition

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Excel is one of the most popular end-user tools in the accountant's portfolio. Spreadsheets enable us to quickly and flexibly perform analysis that otherwise would be difficult or time-consuming; however, there is a tendency to place undue trust in them. ICAEW's Excel Community provides a 'one-stop shop' for accountants who want to use Excel better and understand and minimise spreadsheet risk.

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Executive summary

Spreadsheets have quickly become a business tool of choice within organisations. They allow us to effectively and rapidly perform analysis that would otherwise be difficult or time-consuming to perform. They were never designed to be enterprise-level applications, but the growing use of complex and user-defined functions, lengthy macros and links to other spreadsheets and systems has led to the development of highly complicated applications. In contrast to most other applications of this nature, spreadsheets are rarely designed and developed by expert users or with controls in mind.

Many organisations acknowledge that their reliance on spreadsheets poses a major challenge for them to understand and manage associated risks. Consequently, there is an increasing focus on trying to minimise the numerous errors that impact organisations through better designed and controlled spreadsheets.

The key aim of this publication is to provide guidance on practical approaches to managing spreadsheet risk as well as providing background information on the topic.

The publication also provides further detail on the following topics.

- The prevalence of spreadsheets within today's businesses.

- The increased risk presented by spreadsheets due to advances in technology and the 'super users'.

- Increasing regulation and scrutiny as a result of costly and embarrassing spreadsheet errors.

- Key challenges facing organisations in developing an effective spreadsheet risk programme.

- A practical approach to managing a business's portfolio of spreadsheets, including:

  – understanding key components of solving the spreadsheet problem across the organisation;

  – identification of spreadsheets which are used to support business critical processes;

  – implementation of a control framework, including policy, processes and training; and

  – considering whether to phase-out or rebuild certain spreadsheets.

- Key review activities for gaining assurance over spreadsheets.

- Key principles for good spreadsheet practice.

- Leveraging technology to support organisations' ability to discover, analyse and control spreadsheets.

1. Introduction

In a world of big data, the risk of costly and embarrassing mistakes caused by spreadsheet errors has never been higher. Understanding and controlling the functionality, usage and evolution of spreadsheets, however, enables an organisation to transform their spreadsheets from a potential risk to a competitive advantage.

1.1 Why are spreadsheets so prevalent?

The simple answer is they work. Technology is developing rapidly, as are users' expectations about what it should deliver – and when. This impatience poses a challenge to IT departments who are unable to respond to the speed of the users' expectations. Spreadsheets, in many cases, are cost effective, easy to use and can provide users with immediate results during analysis. As a result, spreadsheets are everywhere.

Spreadsheets are also flexible, providing users with 'real-time' answers and enabling them to quickly develop and customise reports. There is no need to involve other departments, justify budgets or obtain management approval for their use. Further, many companies rely on spreadsheets as a key application that supports their operational and financial reporting processes. The use of spreadsheets in business is widespread, limited only by the imagination and proficiency of users, ranging from performing complex modeling for trading decisions to accounting reconciliations and calculating employee bonuses.

1.2 What's the risk – why worry?

Spreadsheets can often undermine the millions spent on technology controls if the weakest link in the information security chain happens to be a spreadsheet containing customer data/employee data and key financial reports.

> 'Half (51%) of C-level executives in financial services say there are either no usage controls at all or poorly monitored policies over use of business critical spreadsheets at their firms, with only one in ten (11%) saying there is an automated control policy that allows them to fully understand changes between different versions of spreadsheets and see a clear audit trail for data.' (Source: ClusterSeven)

Should you be worried about spreadsheet risk?
If you or your company use spreadsheets to perform or support business functions then the answer is almost certainly yes. And, if you don't think your company uses spreadsheets, a simple search of your company's network may surprise you, as it will typically reveal anywhere from hundreds of spreadsheets per employee (for smaller to medium-sized organisations), to thousands per employee (for larger organisations). Some key questions about your company's spreadsheets are as follows.

- Do you know which ones are critical?

- Do you know what they are used for?

- How well are they designed?

- Who uses and maintains them?

- How reliable are their calculations?

- Who ensures the results they produce are valid?

Not knowing the answers to some of these questions can cause a company to place undue reliance on uncontrolled spreadsheets and the results they produce. When little consideration is given to how spreadsheets are managed, can the results truly be relied upon? Despite the benefits, when spreadsheets are poorly controlled, they are notoriously risky and lead to numerous costly and embarrassing errors, as well as instances of fraud. However, a far more common impact on many organisations are the costs associated with inefficiencies introduced into a process through poorly designed and controlled spreadsheets. These inefficiencies include the requirement to perform manual reconciliations, manual interfaces between systems and spreadsheets or the re-work required when errors are eventually identified.

1.3 The rise of the super user

As individuals we also have a responsibility to ensure that the spreadsheets we develop are free from errors, produce the intended results and are designed and documented so that they can be easily maintained. We often place too much trust in our team's ability to develop spreadsheets even though very few spreadsheet users have undertaken formal training at a basic, let alone intermediate or advanced level, and very few users would be considered 'experts' in their knowledge of spreadsheet design and development practices. However, research has shown that the vast majority of spreadsheets (that have some level of complexity) contain errors; these errors are rarely identified by the person who owns the spreadsheet.[1]

More recent versions of Microsoft Excel bring not only a redesigned user experience but also additional data capacity, processing efficiency and, in some cases, version compatibility issues. This, combined with increased use in schools, enables more previously basic users to consider themselves 'super users' in the development of spreadsheets. The common view is that this increased employee capability will increase the level of spreadsheet risk.

[1] Raymond R. Panko, 'What we know about spreadsheet errors', http://panko.shidler.hawaii.edu/SSR/Mypapers/whatknow.htm.

2. Effective spreadsheet risk management: key risks and challenges

Intuitively easy to use, share, and modify, spreadsheets are powerful tools that are prevalent across organisations, and in many cases are the right solution. So why do they expose organisations to potentially high-risk errors time and time again?

Understanding and controlling the functionality, usage and evolution of spreadsheets makes all the difference. Organisations should embrace spreadsheet usage when coupled with good control principles. The following table provides some insights into common areas of spreadsheet risk and possible control options.

Risk areas	Example control areas
Dependency on a spreadsheet developed by an individual no longer within the organisation	• Ensure documentation for key spreadsheets exists • Have a secondary individual with knowledge of the spreadsheet
Changes to spreadsheets over time with ongoing use	• Implement automated technology to monitor changes • Include a change log to manually capture changes
Accidental changes to the business logic	• Introduce security to protect from unintentional changes • Leverage technology or manual reviews to validate data integrity
Unauthorised or fraudulent changes to spreadsheets	• Leverage technology to identify anomalies in data sets • Protect key calculations and non-input cells from being edited
Complicated or complex spreadsheets that are difficult to use and/or review	• Keep an end user computing (EUC) review log with automated checks for quick review • Build in input/output validation checks • Provide clear instructions for EUC understanding and use
Implementing EUC controls is too expensive and/or difficult	• Focus on critical EUCs as opposed to the entire inventory • Build off existing best practices

3. Responding to changing legislation

Regulatory pressure and increasing focus from internal or external auditors is forcing organisations to address the issue of spreadsheet risk management. We see companies filing material weaknesses and deficiencies as a result of the lack of control around their financial reporting spreadsheets. Material errors are widely reported due to simple errors and fraud, causing substantial problems and significant financial losses.

As a result, the increased regulation and compliance requirements that now impact spreadsheet control is not surprising. This has been further compounded by the numerous multi-million pound errors and frauds associated with the use of spreadsheets.

Some commonly quoted examples include:

- **JP Morgan**: The most recent high-profile spreadsheet error was cited by JP Morgan in its investigation of $7bn of 'London Whale' losses, with substantial evidence for massive error rates in their spreadsheets. JP Morgan launched an internal investigation into how it happened, and released the findings indicating 'Spreadsheet-based calculations were conducted with insufficient controls and frequent formula and code changes were made'. (Source: Forbes)

- **ProQuest**: Former CFO, Scott Hirth, with the help of spreadsheets, made fraudulent accounting entries for more than five years, and created false documentation to manipulate account balances. This ultimately cost the company more than $437m in market capital, caused its stock price to drop by 58% and NYSE to subsequently suspend trading in ProQuest shares. (Source: CFO Magazine)

- **Credit Suisse:** The UK Financial Conduct Authority fined Credit Suisse £5.6m, stating 'The booking structure relied upon by the UK operations of Credit Suisse for the CDO trading business was complex and overly reliant on large spreadsheets with multiple entries.' (Source: FCA)

- **Fidelity**: A missing minus sign caused Magellan Fund to overstate earnings by $2.6bn and miss a promised dividend. (Source: CIO World)

While these examples are from large companies (where there are legal requirements on public reporting and transparency), spreadsheet errors do occur across the spectrum of industries and in companies of all sizes. In fact it is often the smaller companies where there has been less investment in 'enterprise class' applications that the reliance on spreadsheets to perform critical business activities is proportionally the most prolific.

This continued pressure is forcing organisations to address the issue of spreadsheet risk management, though few really understand what the issue is and what they need to do about it. While guidance exists, much of it is dated and has been academic, providing little practical value to companies.

Major legislation does not currently focus specifically on spreadsheet risk. However, effective management of spreadsheet risk may be required to satisfy the requirements of a number of regulations in the near future.

Legislation tends to provide more generic statements such as, 'An effective system of internal control …'. This ensures a broad sweep of requirements that will cover as many scenarios as possible within a diverse commercial environment. Therefore, companies and their monitoring bodies (eg, external audit firms, regulatory authorities) are required to interpret the legislation and determine how its requirements should be applied to each organisation.

What has become clear is that the regulatory bodies and audit firms are becoming increasingly aware of the potential exposure to spreadsheet risk that can exist in an organisation. The Public Company Accounting Oversight Board (PCAOB), a private-sector, non-profit corporate created by the Sarbanes-Oxley Act of 2002, performs audits of 'Big 4' accounting firms in the second and third quarters of each calendar year, and other accounting firms in the fourth.

According to a report released in June 2013, the PCAOB inspection identified 25 issuers with audit deficiencies that appeared on the report, 22 of which had comments relating to internal controls over financial reporting, including the following.

- Not testing appropriate controls over end-user computing solutions used in the performance of key controls.

- The need to better consider issuer controls over end-user computing solutions not typically subject to SOX related controls:

  - input control – the company reconciles the data back to source documents;

  - access control – access is restricted to authorised personnel and is password protected; and

  - version control – a standard naming convention is in place so only current and approved versions are used.

- Additional consideration to testing of controls over source data or final reports (eg, complexity of the calculations in a spreadsheet or manipulation of the data in the preparation of the report).

The below exhibit shows how Open Air Sales application controls can easily be circumvented through the use of a spreadsheet to perform supplemental analysis. The final report, developed manually by the sales manager, has no formal controls over its development.

Figure 1: Final report generated via a spreadsheet from a system output
(Where YES = controls in place, NO = controls not in place)
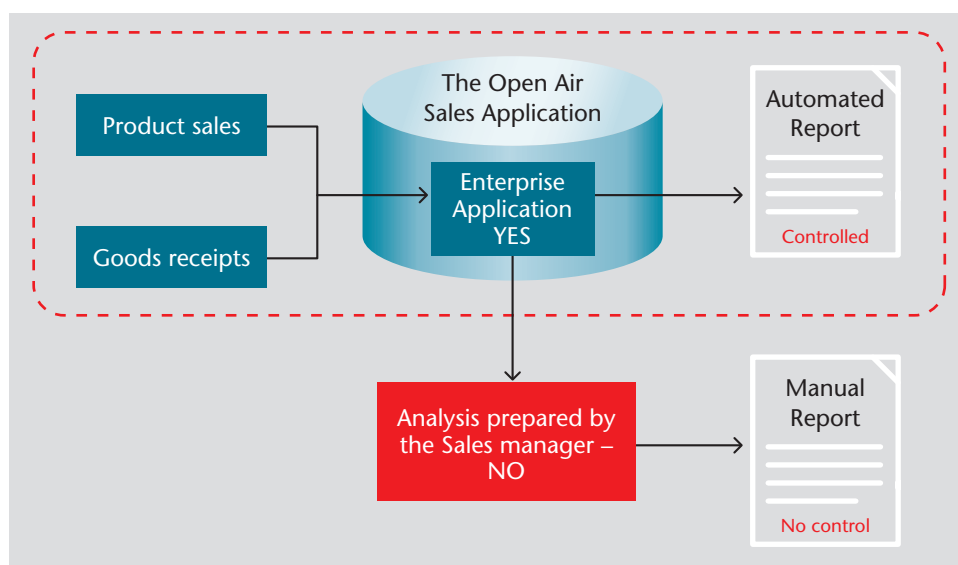
Source: Protiviti

Many additional regulators and oversight agencies have published notices indicating that this is an area requiring specific attention. In many organisations, they found that managing spreadsheet risk was an issue for which no one in the organisation was taking accountability.

4. Governance and accountability

To begin, a fundamental question: Would you sign off on the integrity of critical spreadsheets you depend on?

While ultimate accountability is placed on business management, spreadsheets are designed, developed, tested (rarely!), updated, implemented and made operational by the owners and users of those spreadsheets. This accountability is usually to the shareholders (where applicable) and the regulatory bodies governing the industry and environment in which the organisation operates. It is important that spreadsheet owners and users are held accountable for maintaining the integrity of the spreadsheet, and all associated inputs/outputs. As such, spreadsheet owners should be responsible for operating and maintaining effective spreadsheet risk management processes. Formalising these roles, such as 'owner' and 'deputy owner', can help drive this responsibility. Other optional roles, such as an independent 'reviewer' of changes, are also helpful to maintain segregation of duties, but will not be appropriate for every organisation.

Therefore, it is important for management to not only define a practical and effective spreadsheet management programme, but to also raise awareness and provide end-user training. Information related to spreadsheet controls and the risks associated with uncontrolled spreadsheets should be clearly communicated. Management should take into account processes in place to ensure compliance with existing policies. If there is no effective process in place to monitor compliance with policies, it is likely the spreadsheet policy will become another ineffective piece of paper.

Management should define what constitutes effective spreadsheet management processes. They should also ensure appropriate monitoring is in place to ensure compliance with these processes. At the end of the day, business management is ultimately accountable, on behalf of the organisation, for the effective management of all risk, including spreadsheet risk.
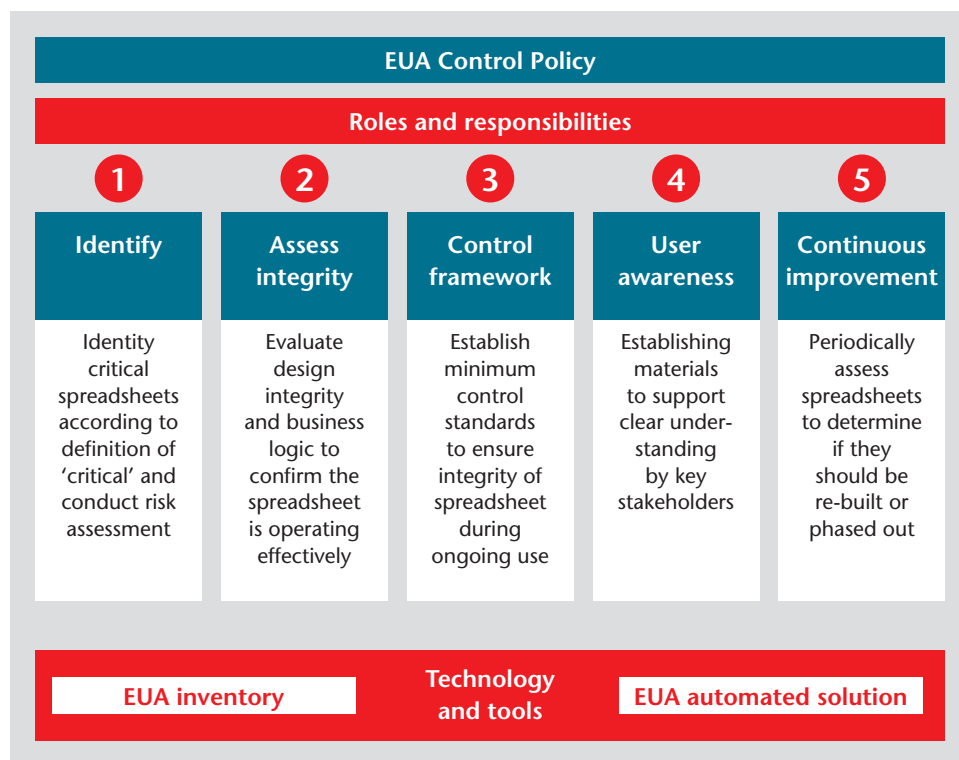
5. A five-stage approach to managing spreadsheet risk

The appetite for addressing spreadsheet risk holistically across a company will depend on the extent of reliance on spreadsheets (which requires a company to be aware of the extent of reliance), the individual company's risk appetite (the amount of risk a company is willing to accept in pursuit of value), business objectives and other drivers.

The approach to managing spreadsheet risk that is illustrated in Figure 2 provides a proven and scalable approach that any company, regardless of size and risk management objectives, can apply. Although the stages are shown sequentially, in practice there are activities in stages 2 and 3 that can be progressed in parallel.

Practical steps that individuals can take to better control their own spreadsheets are described in Section 6 – Principles for good spreadsheet practice.

Figure 2: A scalable approach to managing End user application (EUA)/ spreadsheet risk

EUA Control Policy				
Roles and responsibilities				
1	**2**	**3**	**4**	**5**
Identify	**Assess integrity**	**Control framework**	**User awareness**	**Continuous improvement**
Identity critical spreadsheets according to definition of 'critical' and conduct risk assessment	Evaluate design integrity and business logic to confirm the spreadsheet is operating effectively	Establish minimum control standards to ensure integrity of spreadsheet during ongoing use	Establishing materials to support clear under-standing by key stakeholders	Periodically assess spreadsheets to determine if they should be re-built or phased out

EUA inventory	Technology and tools	EUA automated solution

5.1 Stage 1: identify spreadsheets and conduct risk assessment

Defining the objectives of the initiative and what is 'in-scope' is critical at this stage, as this will have a significant impact on scoping decisions and priorities. For example, focusing on spreadsheets used to support financial reporting activities will result in different scoping to focusing on spreadsheets used to support operational or decision-making activities.

There are two basic questions you should answer when defining the scope and objectives of the spreadsheet risk management initiative:

1. What is the scope of the initiative?

   a. What business functions or activities are in scope? Is the focus on financial reporting, operations, compliance etc?

   b. What types of applications will be covered? This document is focused on spreadsheets but there are other desktop tools used by business (although in significantly lower volumes) eg, desktop databases. Are these also in scope?

2. What is the primary objective of the initiative? Is the focus solely on risk mitigation (ie, prevention of errors) or is increasing efficiency of use also an objective?

Identifying potentially critical spreadsheets
While individual spreadsheets identified and the approach taken will vary depending on how companies answer each of these two questions, the fundamental steps related to the identification, assessment and management of spreadsheets will be the same.

The first step in identifying critical spreadsheets in use is to define what is considered a 'critical' spreadsheet. There are a number of ways to start the process of identifying the critical spreadsheets, including:

• automated scanning tools;

• questionnaires;

• existing process documentation (where available); and

• interviews or workshops.

A commonly recommended way to generate a listing of key spreadsheets is to perform an automated scan of the network. The problem with automated scans is they usually return numerous results – in larger organisations several thousand files per employee is not uncommon – due to multiple versions of the same file combined with the identification of lots of spreadsheets that are not business critical. Once companies have gathered this information, they often feel obliged to manually review the list which can be very time consuming. Targeted scans can be helpful in quickly identifying any potentially complex spreadsheets in use, quickly identifying the parts of the business that appear to be most reliant on spreadsheets, as well as helping to establish the scale of the problem.

An effective, but more time consuming way of identifying critical spreadsheets is to hold discussions with key individuals, process owners and department heads. Any initiative to implement an effective spreadsheet risk management model should start with the areas perceived to be the most dependent on spreadsheets, areas that have significant operational importance, or areas that are known to have had previous spreadsheet incidents; management generally has a good sense for this.

When discussing the spreadsheets that individuals are dependent on, it is often useful to start from the premise that key spreadsheets are those that, if deleted, would either take too long to recreate (in some cases, just one hour redeveloping a spreadsheet can be too long), could not be recreated at all or would not allow the supported process/activity to be performed in the required timeframe. The output of an automated scan can also be helpful when holding these discussions as a cross-check to ensure that all complex spreadsheets that are currently in use are discussed.

Questionnaires can provide a lower effort way of contacting individuals, with the results returned being more targeted than those from scans. A well designed questionnaire that is easily understood by its recipients can go a long way towards identifying critical spreadsheets as well as capturing responses that can be used for a risk assessment. That said, the effectiveness of questionnaires is often dependent on whether there is a culture in the company of individuals completing questionnaires (and completing them well!).

Risk assess

The next step is to conduct a risk assessment over the identified spreadsheets. A spreadsheet's risk is most commonly determined by a combination of its (i) criticality (impact) to the organisation and (ii) the inherent likelihood of error in the spreadsheet. These two factors are explained in the following paragraphs.

(i) Spreadsheet **criticality** is the potential impact to the organisation of an error occurring in the spreadsheet. Ideally, any spreadsheet risk should be evaluated in terms of its potential financial impact. However, unless a spreadsheet is directly related to financial processes, financial quantification can be difficult to assess. Therefore, companies often employ a more general scale for estimating likely impact based on business specific definitions of impact categories. An example is provided below:

Low: no key business decisions are made based on the information contained within the spreadsheet. Errors that occur would be of embarrassment or hindrance to those directly associated with the spreadsheet, but would have no real long-term impact on the business or external impact.

Medium: an error in the spreadsheet or a delay in preparing the spreadsheet may result in significant loss or reputational impact to the business. Information contained in the spreadsheet may be sensitive and employees could exploit the information if they had access to it.

High: an error in the spreadsheet or a delay in preparing the spreadsheet may result in a material loss or reputational impact to the business. Information contained in the spreadsheet is highly sensitive and inappropriate disclosure could be exploited by markets or competitors, or could be in breach of legislation (eg, the European Union's Data Protection Act or the Payment Card Industry (PCI) legislation).

(ii) The **likelihood of error** in a spreadsheet is typically derived from a combination of the complexity, design characteristics and nature of use of the spreadsheet.

To determine the complexity of a spreadsheet, the following key characteristics should be reviewed:

- spreadsheet size;
- complexity of formulae;
- volume of linkages to other cells, tabs, spreadsheets or external data sources;
- volume of data;
- existence of Visual Basic code;
- use of user-defined functions and add-ins;
- existence of hidden data (hidden or very hidden tabs); and
- existence of unusual formatting eg, white font on white background.

Assessing spreadsheet design involves reviewing each spreadsheet in turn and identifying characteristics of bad design that could increase a spreadsheet's likelihood of error. Examples of bad design include hard-coding of numbers or assumptions into formulae and inconsistent or overwritten formulae within a column or row, which result in a higher likelihood of error.

This can be a time-consuming process for large spreadsheets, but software tools (see Section 7 – Software to help manage spreadsheet risk) can automatically scan spreadsheet files and produce a score based on a predefined scale of likelihood of error.

Assessing the nature of use of a spreadsheet largely covers manual interactions with the spreadsheets. Increased manual interaction increases the likelihood of error.

The impact and likelihood of error assessments can be combined to give an overall risk score. Most commonly when each of these – impact and likelihood of error – are assessed as high, medium, low, they can be combined in a 'heat map' to assign overall risk ratings (see Figure 3 below). Risk ratings are not only important to identify those spreadsheets that are the highest risk and therefore should be the focus of any remediation efforts, but also enables controls to be implemented in a risk-based manner.

Figure 3: Simple example of a spreadsheet risk heat map
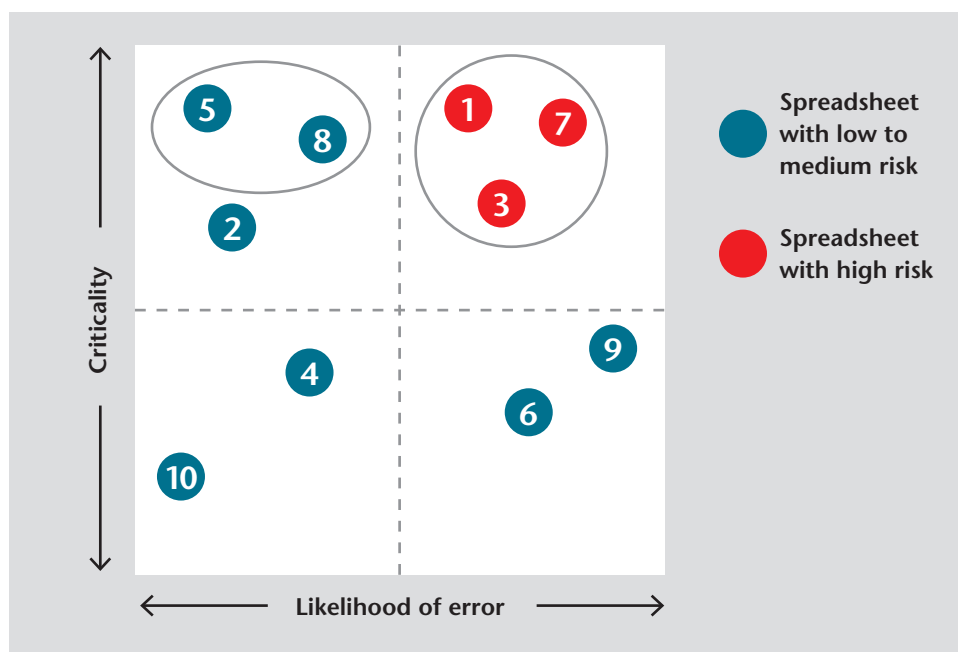
5.2 Stage 2: assess spreadsheet integrity and controls

This is an important area that many companies overlook. It is very important that the design integrity and business logic are evaluated to confirm that the spreadsheet is producing the intended results and can be maintained.

The objective of the controls implemented in Stage 3 is to ensure that the integrity of the spreadsheet is maintained during ongoing use. If the spreadsheet is inaccurate when the controls are first implemented, it will remain inaccurate. It is therefore critical that the integrity of the spreadsheet is assessed and necessary corrective action taken early in the spreadsheet's 'life'.

The testing of a spreadsheet can appear daunting or even impossible. However, there are techniques that can be employed to provide a reasonable level of assurance at minimum cost.

Spreadsheet testing/auditing tools (see Section 7 – Software to help manage spreadsheet risk) are available to help perform analysis of formulae, spreadsheet links, design characteristics and data. These types of tools typically provide a number of tests that can be run, along with functionality to graphically represent the structure and flow of calculations in the spreadsheet. These tools cannot completely automate the testing of spreadsheets, as their output still needs to be reviewed and interpreted. However, they do make the process considerably more efficient and facilitate tests that would be impractical to perform manually. The output from these tools should be analysed and any anomalies investigated with the spreadsheet owner or someone who understands the operation of the spreadsheet.

For the most critical spreadsheets, this process may not be sufficient. Other options include performing sensitivity testing, changing key parameters and comparing expected output to observed output of these changes on the spreadsheet. This can be an effective final step to check that the spreadsheet appears to be functioning correctly. Sensitivity analysis alone, however, will not be sufficient to identify all potential errors. Other activities can include tracing transactions through the calculation cycles, analytical reviews and parallel testing with independently developed models. Some of these examples may seem excessive, but where the integrity of highly critical spreadsheets is concerned, a high level of assurance of processing integrity should be attained.

There may also be significant benefits to building check totals into the spreadsheet to identify potential issues early. Ultimately, the spreadsheet owner must confirm that someone has checked the integrity of the spreadsheet and that it is operating as expected.

Some common observations identified during this stage include:

- Spreadsheets have no supporting documentation (instructions for use, purpose, key assumptions/calculations, description of Visual Basic (VBA)/macros etc) – increasing risk and single person dependencies;

- Presentation standards are not implemented;

- Cell/worksheet protection has not been applied to prevent unintentional, careless or unauthorised changes to calculations and key standing data/assumptions;

- Redundant data has not been removed from the spreadsheet;

- External links are outdated;

- Inconsistent or overwritten formulae exist or formulae have incorrect reference ranges;

- Overly complex formulae are used (eg, nested IF statements);

- Hard-coded numbers are used extensively in formulae rather than split into separate input cells;

- VBA/macros are poorly constructed/coded and commented;

- Where data connections are used (eg, ODBC connection to a database), data truncation occurs at Excel row limit; and

- Unusual/suspicious formatting is hiding/changing cell presentation eg, white font on white background.

5.3 Stage 3: implement control framework

Once the design integrity and logic inspection of the spreadsheet has been established, a control framework should be implemented to sustain this. A spreadsheet control framework defines spreadsheet risks, describes control objectives, outlines processes to mitigate the risks and provides guidance on the controls that should be considered.

The control framework also:

- establishes minimum standards, including control standards; and

- includes references to supporting documentation providing further guidance of control practices.

The control framework often supports a spreadsheet policy and typically includes the following components:

- minimum standards;

- control process and procedures; and

- roles and responsibilities.

The reason for having control objectives is that spreadsheet owners can assess each of the high-level risks for their spreadsheets and then assess how the current controls achieve the associated control objectives.

Some of the control objectives may be deemed mandatory or key, and should be clearly defined in the spreadsheet policy (eg, spreadsheet security). For other control objectives that are not classified as mandatory, the decision about which objectives apply may be left to the spreadsheet owner. The control objectives that apply will depend on the level of risk and the criticality of the spreadsheet. The controls outlined in the control framework should be applied in a risk-based manner, with increasing control requirements for spreadsheets of higher risk.

A typical set of controls that could be incorporated into the framework are suggested below. The extent to which these controls must be applied will vary on a case-by-case basis.

- **Access control**: defining and maintaining appropriate user access rights and restrictions, including segregation of duties where applicable.

- **Backups**: backup of spreadsheets and data to ensure continuity and availability.

- **Change control**: controlling changes that are made to the spreadsheet, including adequate testing and documentation of changes.

- **Data input validation**: ensuring completeness and accuracy of data inputs.

- **Data integrity and security**: preventing unauthorised modification of the spreadsheet and protecting sensitive cells from accidental change or deliberate manipulation.

- **Documentation**: appropriate documentation maintained to describe the purpose of the spreadsheet, instructions for use, key assumptions or constraints in the use of the spreadsheet, key inputs, calculations and outputs, explanations of complex formulae and areas of particular complexity in the spreadsheets (eg, Visual Basic code).

- **Independent review**: documented independent review of spreadsheet logic and changes.

- **Version control**: ensuring that only the current version of the spreadsheet is used, and specific previous versions can be retrieved or recreated if required.

A prescriptive approach to achieving these controls rarely works because every spreadsheet is different. The spreadsheet owner will need to assess the potential risk and the control objectives, and then put in place appropriate control activities to achieve the objectives.

For example, any spreadsheet risk management policy is likely to state that access to the spreadsheet should be restricted to appropriate users. One approach may be to add a password to the file, utilising the basic security features of Excel. This provides only a basic level of control as passwords are shared and rarely changed, and repeat attempts are allowed.

Another approach (potentially additional to the Excel password) is to set up a directory on the network and to grant access to a defined list of users. This should provide a higher level of control, as user accounts are centrally managed and better password standards can be applied. However, under this model all users with access to the spreadsheet do have the same level of access.

For many of the above listed controls, spreadsheet control software can be utilised to facilitate individual control activities (see Section 7 – Software to help manage spreadsheet risk). Such tools can provide greater flexibility, allowing user- or role-based access and segregation of duties in the spreadsheet to be enforced. These tools also provide an audit trail of actions that users have performed as well as centralised reporting and workflow features.

The spreadsheet owner will need to decide the specific control activities to be implemented, taking into account any requirements of the spreadsheet risk management policy. A basic password may be adequate for some spreadsheets that do not contain sensitive data and that only have a few users. This will not, however, be sufficient in many other cases.

One key process that is often forgotten is a mechanism to ensure that newly developed or identified spreadsheets that were not included in the initial inventory, are captured. While there is no infallible solution to this, making users aware of their responsibilities, as well as performing periodic reviews or audits of the spreadsheet environment, will help.

Policies and procedures will only reduce risk if the policies are consistently adopted and enforced. Awareness activities, training and monitoring processes will be required to achieve and sustain the required level of control. Key steps to increasing user awareness are outlined in the next section.

5.4 Stage 4: increasing user awareness

Tried and tested approaches to risk awareness
Increasing spreadsheet risk awareness can be challenging because spreadsheets are typically used by many people within the company with varying degrees of skill and knowledge.

Basic awareness training should be provided, covering the minimum control standards and illustrating some best-practice techniques. It also should provide individuals with guidance on where to go for further information (such as an online resource). Critically, they should be educated on key indicators that imply significant inherent risk within the spreadsheets they operate, and know whom to contact when these indicators are present. Example indicators include: complex formulae, user defined functions, Visual Basic for Applications (VBA) code, multiple concurrent users and links to other sources.

Users should be provided with regular reminders of the key issues and of their responsibilities. Simply providing some initial training and posting a standard on the intranet is unlikely to achieve the desired level of accountability.

An effective process is to integrate the awareness training into the HR joiners' process. In doing so, all new joiners to the company are provided with the training. Training current employees, however, remains a challenge.

There are many different approaches to training and this can be dependent on the size of a company, their training budget and requirements. Outlined below are some forms of training that have been found successful.

- **One-to-one training:** this is particular suitable for smaller companies or where training is targeted to a specific audience (eg, senior management).

- **Computer-based training (CBT):** particularly suitable for role-specific training and reaching out to larger audiences. Often included as part of a company's existing online training curriculum.

- **Classroom training:** particularly suitable for role-specific training and targeted training for smaller sized audiences.

- **Guidebooks:** suitable for all audiences and can be used to reinforce the other forms of training mentioned above.

An alternative to training that has worked well for many companies is providing a central support team to walk the spreadsheet owner through the process. This can be more effective than classroom training, but also helps the business achieve consistency with implementing the spreadsheet risk management framework.

Training requirements for spreadsheet owners
Training requirements can vary and will be depend on the individual spreadsheet owners. Spreadsheet owners should have the option to request additional training on spreadsheet development techniques. These typically would be standard spreadsheet training courses that cover more effective use of spreadsheets.

However, specific training on spreadsheet risk management processes will need to be provided to users who own and operate spreadsheets with an increased level of inherent risk. It is also a good idea to review those individuals requesting spreadsheet development training, as this often implies they have a higher dependency on spreadsheets and wish to develop more effective (and probably more complex) solutions. This training should provide guidance on evaluating spreadsheet risk and the effectiveness of spreadsheet controls.

5.5 Stage 5: phase out/rebuild selected spreadsheets

This stage is often one that companies revisit at a later stage, once the control framework implemented in stage 3 is embedded and has been operating effectively for a period of time. That said, there is opportunity during the business logic and design integrity assessment to determine whether individual spreadsheets are overly complex, poorly designed or can be replaced by existing or readily available 'mainstream' applications. It is also worth spending some time understanding why individual spreadsheets are used. In some cases, the functionality exists in other IT-managed applications within a company but spreadsheet use persists. This can be due to lack of awareness, poor training, user frustration with the interface or usability of the application or even because the user prefers their spreadsheet.

The objective of this phase is not to replace or rebuild all spreadsheets. However, for the most critical/complex spreadsheets, it is worth considering redevelopment to implement design best practices or migration of the spreadsheet functionality into a structured application controlled by the IT department (eg, an existing accounting system or new bespoke application). Well-designed spreadsheets not only enhance risk mitigation but can significantly improve efficiency of use, potentially saving business users hours each period of use.

Example scenarios in which this option should be considered include:

- the spreadsheet contains master or reference data that is used to feed calculations and reports;

- the spreadsheet makes use of a large amount of VBA code;

- there are multiple users of the same spreadsheet;

- the spreadsheet is used as an interface between two systems or has a large number of connections to other systems; and

- the spreadsheet is slow and often requires regular restarting.

Transitioning the spreadsheet into a more formal application development environment will significantly reduce the risk of errors in logic and unintentional or unauthorised changes. The cost/benefit of this action, including the ongoing effort (and associated cost) to maintain and use the spreadsheets, will need to be assessed. While the overall risk profile is reduced, there may be a significant cost associated with the development and ongoing maintenance of such an application.

6. Principles for good spreadsheet practice

In the absence of a company-wide initiative on spreadsheet risk management, there are a number of practical steps that end-users can take to protect their own spreadsheets. This section, which provides reference to ICAEW's *Twenty principles for good spreadsheet practice* (see page 20), outlines measures end-users can put in place on their own to help reduce the risk of spreadsheet errors. Users should always consider the risk when applying these.

Control area	Steps to consider	ICAEW spreadsheet principle
Access to spreadsheets	• Place important/sensitive spreadsheets into a restricted folder on a network (ie, a folder with access appropriately restricted) to prevent unauthorised users from accessing it. • Although passwords in Excel are relatively weak, they still provide a way of preventing accidental manipulation (Excel versions 2007 and later provide much stronger encryption and digital rights management). Excel provides the functionality for separate passwords to open and modify the spreadsheet ie, the open password prevents an unauthorised person viewing the contents and the modify password prevents changes being saved.	3, 20
Backups	• Regularly archive spreadsheets (eg, weekly, monthly or quarterly – based on how frequently the spreadsheet is used) to ensure continuity and availability of data. • Ensure current and archive versions are stored on backed-up servers or take your own backups onto secure media.	17
Change control	• Control changes that are made to the spreadsheet, including review, testing (if needed) and documentation of changes. For example, use a manual change log to record any significant changes (eg, changing formulae, VBA coding, deleting/adding worksheets) being applied. Such change logs can be included as a tab within the spreadsheet.	3, 20
Data validation (inputs and outputs)	• Use data validation within a clearly designated input range to help prevent incorrect values from being entered. For example, having pre-determined values in a cell or setting a minimum and maximum range on the values users can enter. The validation option can be accessed via the option, Data → Validation → Settings. • To ensure completeness and accuracy of data, consider the inclusion of check cells to recalculate and reconcile input, calculation and output data. For example, using row counts and sum totals to ensure source data matches imported data in a spreadsheet.	9, 11, 12, 13, 14, 18, 19
Documentation and key person dependency	• Include documentation to describe the purpose of the spreadsheet, instructions for use, key assumptions or constraints in the use of the spreadsheet, key inputs, calculations and outputs, areas of particular complexity in the spreadsheets (eg, VBA code). • Work collaboratively and prevent extreme reliance on 'super users' within your organisation by ensuring spreadsheets are clearly explained.	3, 4, 6, 7

Control area	Steps to consider	ICAEW spreadsheet principle
Version control	• Include a version number in the name or documentation section of a spreadsheet to help ensure that only the current version of the spreadsheet is used.	17
Data integrity and security	• Within a spreadsheet, sensitive data and formulae can be locked to prevent them being accidentally overwritten. By default in Excel all cells are locked; however, this protection only applies when the worksheet is protected. Therefore, to allow inputs to still be editable you need to unprotect those cells (Excel 2007 and later option: Home → Format → Protection → deselect Lock Cell option) then protect the worksheet (Excel 2007 and later option: Home → Format → Protection → Protect Sheet OR Review → Protect Sheet). • Password protect VBA if the integrity of the code is important, by adding a VBA module password.	20

Data transparency	• For clarity purposes, use the 'Grouping' functionality within Excel instead of hiding rows/columns. This function highlights to users that there is additional information which has been hidden. This can be achieved in the following way:
	
	  – select rows or columns to be grouped;
	
	  – Excel option: Data → Group and Outline → Group.
	
	• Avoid using hard-coded numbers in formulae and calculations. Where appropriate, the hard-coded number should be removed from the formula and placed in its own cell which the formula references eg, SUM(C1:C77)***F5** (instead of =SUM(C1:C77)***0.2**) where cell F5 contains the rate. Alternatively, a named range can be applied to the cell (see below).
	
	• Where appropriate, named ranges should be used. In the example above, cell F5 could be named eg, '**VATRate**'. This would allow the formula to read: = SUM(C1:C77)***VATRate**, thereby adding clarity to the value being referenced.
	
	• Names can be given to a single cell or a range of cells:
	
	  – select a cell or range of cells;
	
	  – Excel option: Insert → Name → Define; and
	
	  – enter a name for the range and select OK (it is good practice to precede the range name with the worksheet name to help prevent multiple, conflicting range names in a single workbook, which can be a source of error).
		10, 11, 14

Visual separation of data	• Visually separate out formulae, inputs, outputs, standing data and check cells by applying colour coding to cells (or something similar such as coloured text) to make updating and reviewing of the file easier and quicker. Having defined coloured cells can also help to maintain the lock status of individual cells (ie, coloured input cells can be checked to verify if they are unlocked). Figure A Figure B • Colour-coding may be used within one worksheet to colour different cells (Figure A) or if all cells in a given worksheet have the same 'role' then colour-coding could be applied at tab-level (Figure B).	9, 10, 14, 15, 16

Control area	Steps to consider	ICAEW spreadsheet principle
Pivot tables	• Pivot tables should be on separate worksheets to calculations and inputs. If pivot tables are in the same worksheet as calculations and inputs, there should be sufficient space (eg, place data above or to the left of the pivot table) between the pivot table and other 'non-pivot' information. This will prevent 'non-pivot' information from being overwritten when a pivot table expands down or to the right of the worksheet.	11
Policies and procedures	• Understand the risk appetite of your business; your EUC policy should be developed to align to your organisations risk appetite. • Understand what your business defines as an EUC; for extremely complex requirements, perform an assessment to define the appropriate solution (eg, spreadsheet vs IT application). • Ensure appropriate stakeholder support is obtained prior to defining a spreadsheet risk target operating model.	1, 2, 5, 6

6.1 ICAEW's *Twenty principles for good spreadsheet practice* – in summary[1]

The spreadsheet's business environment

1. Determine what role spreadsheets play in your business, and plan your spreadsheet standards and processes accordingly.

2. Adopt a standard for your organisation and stick to it.

3. Ensure that everyone involved in the creation or use of spreadsheets has an appropriate level of knowledge and competence.

4. Work collaboratively, share ownership, peer review.

Designing and building your spreadsheet

5. Before starting, satisfy yourself that a spreadsheet is the appropriate tool for the job.

6. Identify the audience. If a spreadsheet is intended to be understood and used by others, the design should facilitate this.

7. Include an 'About' or 'Welcome' sheet to document the spreadsheet.

8. Design for longevity.

9. Focus on the required outputs.

10. Separate and clearly identify inputs, workings and outputs.

11. Be consistent in structure.

12. Be consistent in the use of formulae.

13. Keep formulae as short and simple as practicable.

14. Never embed in a formula anything that might change or need to be changed.

15. Perform a calculation once and then refer back to that calculation.

16. Avoid using advanced features where simpler features could achieve the same result.

Spreadsheet risks and controls

17. Have a system of backup and version control, which should be applied consistently within an organisation.

18. Rigorously test the workbook.

19. Build in checks, controls and alerts from the outset and during the course of spreadsheet design.

20. Protect parts of the workbook that are not supposed to be changed by users.

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[1] Full publication at icaew.com/excel20principles

7. Software to help manage spreadsheet risk

Technical solutions for spreadsheet risk management vary from commercially available enterprise-wide monitoring applications to off the shelf add-ins that perform basic comparisons and analysis. What solution to implement will depend on various factors including a company's budget, the number of spreadsheets in use and the spreadsheet management requirements.

7.1 Types of technical solution

The types of technical solutions available can generally be categorised into three groups, although a number of solutions provide functionality in all three categories.

1. Spreadsheet search/discovery
Perform automated scans of networks or specific servers to generate an inventory of all spreadsheets discovered. Some solutions perform analysis to allow the user to deal with the large number of results typically generated, such as consolidating potential duplicates and determining when the spreadsheet was last updated and other characteristics to aid in the assessment of spreadsheet likelihood of error or overall risk ratings.

2. Spreadsheet auditing/baselining
Automated tools to assist a reviewer when auditing a spreadsheet. Although some element of manual review is still required, these tools, when used correctly, greatly improve the efficiency of performing such reviews. The objective of the audit is to analyse formulae/calculation construction, design, complexity, referencing and consistency in order to identify design issues, errors and risky configuration settings. For example, a formula that is copied down hundreds of rows may be found to have had a number accidentally typed over it part of the way down the column.

3. Spreadsheet search/discovery
Typically provide change control, version management, change history (audit trail) and security over those spreadsheet managed by the solution. Some solutions can be used to restrict access to functionality or specific cell ranges.

7.2 Frequently asked questions on technical solutions

Are these solutions only for large companies?
No. The solutions come in a range of formats, from add-ins that can be used to control a single spreadsheet to enterprise-wide solutions that are used by companies to control hundreds or thousands of spreadsheets.

If technology solutions are implemented, will they impact all spreadsheets operating within the company?
It is worth noting that what solution a company implements depends on its size, requirements and budget. The majority of solutions on offer are flexible enough to allow users to select which spreadsheets to monitor and analyse.

It is theoretically possible to monitor and manage all of a company's spreadsheets with larger spreadsheet management and control solutions. However, it would normally be impractical given the number of spreadsheets that exist in most companies. These solutions are typically used only to manage spreadsheets that have been identified as business-critical or 'in-scope.'

It is recommended, as part of the solution implementation that careful consideration be given to determine which spreadsheets should be included. The rules for determining which spreadsheets are in scope should be defined and documented before commencing.

Are there performance or usability issues that need to be considered when implementing spreadsheet control solutions?
This depends on the individual solution and how it operates. Some solutions place limitations on user functionality. Others may increase the time it takes to save large spreadsheets or may generate significant volumes of data traffic on the network. Smaller add-in solutions limit the volume of files that can be monitored and functionality can be restrictive. Companies should ensure that they evaluate any usability and technical constraints and requirements during the product selection process and do so thoroughly during a proof-of-concept or appropriate testing rather than just vendor demos.

The implementation of a spreadsheet solution can vary from simply installing an add-in and running the tool on the desired spreadsheet, to implementing a global solution and running it as a project, with a dedicated project team reporting to both business and IT stakeholders. It is worth noting that in either case, the business will want to ensure that the solution and its associated processes meet defined objectives.

For larger solutions, IT will often require the solution to fit with their technical architecture and not adversely affect network performance. IT is also likely to have responsibility for maintaining the platform going forward, and therefore, will need to be involved in the selection and implementation processes.

Often, the solution will also require a system administrator role for technical assistance with matters such as setting up new users. Additionally, there is likely to be a requirement for a business manager or reviewer to ensure that changes made are appropriate. The actual roles will depend on the objectives and the solution(s) chosen.

Installed and ready to go?
Unfortunately, spreadsheet risk management is not as straightforward as simply implementing a tool. It is too simple to assume that once a spreadsheet solution has been installed, a company's exposure to spreadsheet risk has been mitigated. In fact, the selection and implementation of a spreadsheet solution is potentially one of the easiest parts of the overall process.

From small to large companies, the business will need to determine its risk appetite and policies governing the use of spreadsheets. Further, the business will need to educate all users of spreadsheet risks, good practice spreadsheet design and embed a culture of risk and awareness throughout the business. This is typically the most complex part of any spreadsheet risk management process.

Once the business has identified the spreadsheet(s) to monitor using the implemented tool, the spreadsheet owner will need to perform testing to ensure the spreadsheet is operating effectively. (There is limited value in tracking changes to a spreadsheet that lacks integrity from the start.)

The spreadsheet owner will then need to decide what actions/changes should be logged and review responsibilities. There is no point in building up an audit trail of all the changes made to a spreadsheet if nobody reviews and follows up on the changes. The spreadsheet owner must also consider access control requirements. The use of manual controls might be required to enforce such measures when using smaller off-the-shelf add-ins.

For larger spreadsheet risk management tools, users will need to appropriately configure access monitoring settings and exception reports that can be produced for review.

Appendix: useful links and references

ICAEW Excel Community

www.icaew.com/excel

The Institute of Internal Auditors (IIA)

Global Technology Audit Guide 14 – User Developed Applications

www.theiia.org/guidance/technology/gtag-14

European Spreadsheet Risks Interest Group

www.eusprig.org

Software vendors

CIMCON Software: www.sarbox-solutions.com/main/index.asp

ClusterSeven: www.clusterseven.com

Finsbury Solutions: www.finsburysolutions.com

Lyquidity Solutions: www.lyquidity.com

Incisive: http://new.incisive.com

Apparity: www.apparity.com

Academic research

http://mba.tuck.dartmouth.edu/spreadsheet

http://panko.shidler.hawaii.edu/SSR/Mypapers/whatknow.htm

About the authors

Protiviti (protiviti.com) is a global business consulting and internal audit firm composed of experts specialising in risk and advisory services. The firm helps clients solve problems in finance, operations, technology, litigation and GRC. Protiviti's highly trained, results-oriented professionals serve clients in the Americas, Asia-Pacific, Europe and the Middle East and provide a unique perspective on a wide range of critical business issues.

Protiviti has extensive experience in helping organisations understand the risks associated with spreadsheets and subsequently implementing an effective risk management framework that provides an appropriate level of control without adversely impacting usability or productivity. The approach represents a pragmatic response to spreadsheet risk based on real business need and built on practical experience.

Ewen Ferguson is a Director with Protiviti. He oversees much of Protiviti's spreadsheet risk management services in the Asia-Pacific region and supports the creation of much of the firm's thought leadership on the subject. Ewen has worked on various projects helping companies of all sizes with their spreadsheet risk management initiatives. He has written a number of articles on the subject, including for ICAEW's *Chartech*, as well as for the ICAEW IT Counts website.

Scott Bolderson is a Director with Protiviti. He is responsible for leading Protiviti's spreadsheet risk management services in Europe and provides support in the creation of much of the firm's thought leadership on the subject. He has over 15 years' experience in technology risk consulting and his main focus is leading efforts to define and implement effective IT operational risk management frameworks and operating models. This includes incorporation of common ISO standards and assessment of non-IT specific risks (eg, financial crime).

Belton Flournoy is a Senior Manager with Protiviti. He is one of the key team members supporting the delivery of spreadsheet risk programmes across Europe. He has managed global teams across large organisations, as well as supporting small and medium-sized organisations strengthening their spreadsheet controls, which they often rely on rather than formal business applications. Belton also has significant experience in IT governance, IT risk management, programme and project management and IT Controls testing across SOX and COBIT domains.

Excel Community

EXCEL SUPPORT AT YOUR FINGERTIPS

The Excel Community provides a 'one-stop shop' for accountants who want to use Excel better and understand and minimise spreadsheet risk. Excel Community materials are provided by accounting experts who use, train and consult on Excel.

WHAT YOU RECEIVE

- Hints and tips on how to use Excel better and reduce risk.
- In-depth analysis of particular aspects of Excel, providing a deeper understanding of the areas covered.
- Bi-weekly e-bulletin that summarises all the latest Excel Community content.
- Excel online training – featuring a mixture of learning methods, model spreadsheets and video tutorials.
- An online forum to raise questions and discuss issues with other community members.
- Technical publications written by experts.
- Webinars which are free to attend and discounted rates for Excel Community events.

in linkedin.com – find ICAEW IT Faculty

🐦 twitter.com/icaew_Excel

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