

Regaining control of EUCs

Step 1 - Documentation and compliance for End-User Computing

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ABSTRACT

End-User Computing tools (EUCs), such as spreadsheets, desktop databases, and scripts, remain widely used across actuarial, finance and risk functions. They provide speed and autonomy, but they also introduce operational risk, control gaps and compliance challenges when they become part of critical production processes. In many organizations, critical EUCs still operate as undocumented “shadow tools”, creating key-person risk and limiting auditability and reproducibility. For instance, if a key person leaves tomorrow, can you still reproduce last quarter’s results?

Regulatory frameworks such as DORA, Solvency II, BCBS 239 and RDARR increasingly require financial institutions to demonstrate, end to end, how results are produced, controlled and reproduced. For EUCs, the first and non-negotiable step toward meeting these expectations is documentation. Without a clear description of purpose, data lineage, logic, controls and ownership, effective governance is not achievable.

This paper proposes a pragmatic, risk-based approach to move from “shadow tools” to documented and auditable assets. It focuses on inventory, prioritization, documentation to a consistent standard, and simple lifecycle practices that keep documentation accurate over time. It also shows how Generative AI can accelerate documentation efforts by producing structured first drafts under a human-in-the-loop model, reducing time-to-compliance while improving consistency and traceability. A follow-up paper will discuss the “buy-vs-build” question.

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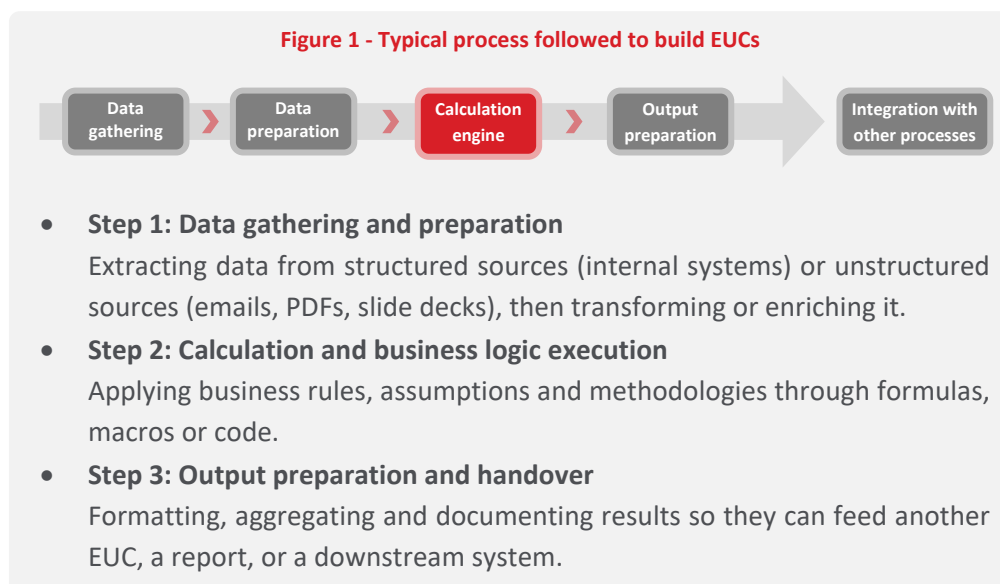
1. EUC CHALLENGES AND RISKS

End-User Computing tools, in short EUCs (for instance, your Excel spreadsheets, SAS, R or Python scripts that you use in your reporting or business planning processes) exist because they solve real problems. They are often the fastest way to test an idea, close a process gap, or respond to a data request.

The issue is not that EUCs exist. It is that many EUCs quietly evolve from “workbench tools” into production engines without the controls expected from production systems.

3-stage pattern

Most EUCs emerge from a three-stage pattern as described in Figure 1.



Challenges and risks

When this process is repeated frequently, by multiple users, with manual steps and weak traceability, the probability of errors and control failures becomes uncomfortably high.

For instance, from an operational point of view, have you ever encountered issues such as broken links, hard-coded assumptions, or incorrect tool versions at a critical point in a reporting process? We propose a common EUC risks list in Table 1 (non-exhaustive).

Considered together, these risks mean EUCs should be treated as managed assets rather than personal files. **Documentation is the foundation**: it reduces key-person risk, enables testing and review, and provides evidence to auditors and regulators.

Table 1 - EUCs' common risks

Risk	Description
Operational risk	<ul style="list-style-type: none">• Spreadsheets are often strongly error-prone¹.• Undetected errors can have serious business impacts.• Merging or reconciling data from multiple sources is labor-intensive and error-prone.
Control gaps	<ul style="list-style-type: none">• EUCs may function as “shadow IT” with limited oversight.• They often lack testing, documentation, access management or change controls.
Key-person dependency	<ul style="list-style-type: none">• Knowledge of assumptions and logic may sit with a small number of individuals.• Lack of resources and attractiveness to maintain legacy EUCs tools developed using old technologies.
Compliance exposure	<ul style="list-style-type: none">• EUCs used in critical processes are increasingly expected to meet standards comparable to traditional ICT systems, including traceability, resilience and auditability.

Quick self-assessment

Here is a small questionnaire you can use to quickly estimate if you have a control gap.

	Score 0/1 for each
We have a complete EUC inventory for actuarial/finance/risk	
Every critical EUC has an owner and backup	
We can reproduce results from last quarter in few hours/days	
We have documented data lineage and key assumptions	
Changes are reviewed and logged	
Access rights are controlled and reviewed	
Total	

If you have a score lower than 4, you might have a control gap.

¹ P.-L. Poon, M. F. Lau, Y. T. Yu, and S.-F. Tang, “Spreadsheet quality assurance: a literature review,” *Front. Comput. Sci.*, vol. 18, no. 2, p. 182203, Jan. 2024, doi: 10.1007/s11704-023-2384-6.

2. WHAT “COMPLIANCE” LOOKS LIKE FOR EUCS

Regulations and supervisory expectations rarely use the word “EUC” as a standalone category^{2,3,4}. Instead, they focus on outcomes: **controlled processes, reliable data, traceable change, strong operational resilience, and clear accountability.**

If EUCs are used for a material decision or regulatory output, the practical question becomes:

“Can we demonstrate, end to end, how inputs become outputs, and prove that this transformation is controlled?”

In most financial institutions, this translates into a small set of mandatory requirements as described in Table 2.

Table 2 - Compliance requirements

Requirement	Description
Ownership	<ul style="list-style-type: none">A named business owner and technical owner, with defined responsibilities.
Traceability	<ul style="list-style-type: none">Documented inputs, logic and outputs.Ability to reproduce results for a given date and dataset.
Change control	<ul style="list-style-type: none">Versioning, peer review and approvals for changes to logic and critical parameters.
Testing and validation	<ul style="list-style-type: none">Evidence that calculations perform as intended, including regression testing after changes.
Access and security	<ul style="list-style-type: none">Appropriate permissions, segregation of duties where required, and secure handling of sensitive data.
Operational resilience	<ul style="list-style-type: none">Backup, recovery and continuity arrangements proportional to the EUC's criticality.

You do not need to “turn every spreadsheet into an enterprise system”. You do **need a risk-based control framework** that scales with criticality. Table 3 gives a more detailed (non-

² “[...] ICT systems developed or managed by the business function’s end users outside of the ICT organisation (e.g. business managed applications or end user computing applications) using a risk based approach.” as stated in EIOPA’s Guidelines on information and communication technology security and governance, EIOPA-BoS-20/600, as implemented in NBB’s Circular NBB_2021_15.

³ “[...] ICT systems developed or managed by users outside the ICT function” as stated in Art. 16(9), Commission Delegated Regulation (EU) 2024/1774 of 13 March 2024 supplementing Regulation (EU) 2022/2554 (DORA).

⁴ “[...] The full integration of end-user computing or end-user developed applications, including an overview of such applications, into data quality management policies and processes.”, as stated in Guide on effective risk data aggregation and risk reporting, ECB, May 2024 (RDARR).

exhaustive) description of compliance requirements according to financial institutions' relevant regulatory frameworks.

Table 3 - Synthetic compliance mapping to key regulatory frameworks (indicative, non-exhaustive)

Regulatory driver (EU)	Supervisory expectation	EUC artifact / evidence	Owner (accountable)
DORA (EU) 2022/2554	<ul style="list-style-type: none"> • ICT risk governance & accountability • Change, resilience & incident readiness • Visibility of ICT dependencies 	<ul style="list-style-type: none"> • Tiered EUC register & ownership • Runbook + lineage/dependency map • Change log + test evidence + approvals • Access review + backup/restore evidence 	Business EUC Owner ICT Risk & Security
EBA/GL/2019/04 (ICT & security)	<ul style="list-style-type: none"> • Controlled change management • Access management & business continuity management (BCM) alignment 	<ul style="list-style-type: none"> • Versioning + release notes + approvals • Regression tests + evidence • Access control model (incl. segregation of duties (SoD) where needed) • BCM for Tier-1 EUCs (fallback, restore drill) 	ICT governance / IT operations
ECB RDARR (Guide)	<ul style="list-style-type: none"> • End-to-end data traceability • Data quality controls for reporting 	<ul style="list-style-type: none"> • Lineage map (source -> transform -> report) • Data dictionary & key parameters • Reconciliations + exception handling • Periodic review & sign-off 	Risk reporting / Data owner
EIOPA-BoS-20/600 (ICT)	<ul style="list-style-type: none"> • ICT security governance & measures • Risk-based controls over ICT assets 	<ul style="list-style-type: none"> • Secure storage & least-privilege permissions • Logging/audit trail (where feasible) • Periodic control self-assessment • Approved tooling & sensitive-data handling 	Information Security EUC Owner
Solvency II	<ul style="list-style-type: none"> • Internal control & written policies • Governance over valuation/reporting processes 	<ul style="list-style-type: none"> • Intended use, limitations, control points • Assumption governance & approvals • Validation/testing evidence (incl. after changes) • Audit-ready evidence pack 	Actuarial / Finance owner

3. A PRACTICAL FRAMEWORK FOR DOCUMENTING EUCS

A workable approach usually combines four building blocks: **inventory**, **risk-based prioritization**, a **consistent documentation standard**, and **lightweight lifecycle controls** to keep documentation current.

Build an EUC inventory

Start by creating a central register of EUCs used in actuarial, finance and risk processes. The goal is coverage, not perfection.

Many organizations begin with a targeted scope (for example: EUCs involved in reserving, solvency reporting, ALM projections, pricing or financial reporting). We propose in Figure 2 a minimal checklist for an EUC inventory.

Figure 2 - Inventory checklist

Here is a checklist of the items an inventory should at least capture.

Item	Covered	Why it matters
EUC identifier	<input type="checkbox"/>	Unique ID and name used consistently across documentation and audits.
Business purpose	<input type="checkbox"/>	What decision/output the EUC supports and why it exists.
Process and frequency	<input type="checkbox"/>	Where it sits in the process (upstream/downstream) and how often it runs.
Owner and users	<input type="checkbox"/>	Named accountable owner, key users, and a backup contact.
Technology	<input type="checkbox"/>	Excel/Access/SAS/Python/R... and whether it uses macros, add-ins, external libraries, etc.
Inputs and data sources	<input type="checkbox"/>	Systems, files, manual inputs and data transformations.
Outputs	<input type="checkbox"/>	Reports, files, numbers and downstream consumers.
Criticality rating	<input type="checkbox"/>	Materiality of impact and risk category (see next section).
Known issues	<input type="checkbox"/>	Historic incidents, control weaknesses, or manual workarounds.
Current controls	<input type="checkbox"/>	Existing checks, reconciliations, approvals or monitoring.

Classify and prioritize EUCs

Not all EUCs deserve the same level of control. A **risk-based classification** prevents over-engineering and focuses effort where it matters.

A practical classification can consider two dimensions:

- **Business impact (materiality):** Financial statement impact, solvency/regulatory reporting relevance, customer outcomes, model risk, and reputational risk.
- **Complexity and change:** Amount of logic, number of data sources, manual steps, frequency of changes, and number of users.

A simple scoring model (for example, 1 to 5 on each dimension) is often sufficient to define tiers such as Critical, Important, and Standard. Critical EUCs should be documented first.

Document EUCs to a consistent standard

Documentation should be good enough so that a competent colleague can understand the EUC, reproduce results, and operate it safely. It should also generate evidence that auditors can rely on. Figure 3 proposes a short checklist for your documentation.

Figure 3 - Documentation checklist

Here is a checklist of the items a proper documentation should at least include.

Item	Covered	Why it matters
Overview	<input type="checkbox"/>	Purpose, scope, owner, users, frequency, criticality tier, and known limitations.
Process context	<input type="checkbox"/>	Upstream inputs, downstream consumers, handovers, and controls at each step.
Data lineage	<input type="checkbox"/>	Data sources, extraction method, transformations, reference data and manual inputs.
Business logic and methodology	<input type="checkbox"/>	Key calculations, assumptions, model choices, parameter definitions and rationale.
Control framework	<input type="checkbox"/>	Input checks, reconciliations, reasonableness checks, exception handling, and sign-offs.
Testing evidence	<input type="checkbox"/>	Unit tests / check cases, user acceptance testing, regression testing approach and results.
Change and release management	<input type="checkbox"/>	Versioning approach, peer review, approvals, release notes and rollback plan.
Access and security	<input type="checkbox"/>	Permissions, storage location, sensitive data handling, segregation of duties where applicable.
Runbook	<input type="checkbox"/>	Step-by-step operating instructions, schedules, dependencies and troubleshooting guide.
Continuity and resilience	<input type="checkbox"/>	Backups, recovery procedure, fallback process and key-person mitigation.

Keep documentation current over the lifecycle

Documentation quickly becomes outdated if it is not connected to how the EUC changes in practice.

A **central repository is a practical enabler**. Depending on the organization, this could be SharePoint with strict permissions, a controlled network location, or a Git-based repository for code-driven EUCs.

4. USING AI TO ACCELERATE EUC DOCUMENTATION

Documenting existing EUCs is often the hardest part of getting them under control. AI, and in particular **Generative AI (GenAI) combined with agentic patterns**, represents an **opportunity for business teams** to help them regain ownership of their critical EUCs, by making them easier to understand and easier to document. It turns existing files and supporting material into a structured first draft that the EUC owner can review and complete.

From GenAI assistance to an AI-assisted Documentation Factory

In practice, **GenAI can speed up the creation of documentation** by producing clear summaries from the EUC itself and from related artefacts (like notes, emails, specifications, sample runs...), e.g.,

- Map the EUC structure,
- Explain the logic in plain language,
- Clarify inputs, outputs, and run steps, and
- Sketch data lineage and dependencies.

Agentic AI patterns allow these steps to be chained and orchestrated. For instance, one agent focuses on technical structure, another on business logic, and a third on control and compliance aspects. Outputs are then consolidated and cross-checked automatically before being presented to the human owner.

Human-in-the-loop as a core design principle

These automated checks do not replace expert judgment. They reduce noise and surface issues early, allowing human reviewers to focus on material risks, methodological soundness and business relevance. The result is not “AI-written documentation”, but **AI-prepared documentation**, where the **human owner remains fully accountable**.

Human-in-the-loop is not a safeguard added at the end. It is a **design principle**. In practice, this means that

- The EUC owner validates purpose, assumptions and methodology.
- Reviewers confirm controls, testing evidence and operational aspects.

- AI outputs are treated as drafts, not authoritative sources.
- Final approval and sign-off remain explicitly human.

This model **accelerates documentation while reinforcing ownership** rather than diluting it.

Guardrails

To be acceptable in regulated environments, AI usage must be framed by clear guardrails⁵, as briefly described in the following table (Table 4).

Table 4 - Guardrails

Item	Description
Privacy and confidentiality	<ul style="list-style-type: none">• Controlled access to EUC files and artefacts.• Clear rules on which data can be processed by AI tools.• Preference for secure, enterprise-grade AI environments where required.
Traceability	<ul style="list-style-type: none">• Logging of AI interactions, prompts and outputs.• Versioning of AI-generated drafts alongside human edits.
Accountability	<ul style="list-style-type: none">• Explicit human ownership and acceptance criteria.
Hallucination management	<ul style="list-style-type: none">• Constrained prompts, source-based generation and mandatory review.
Governance	<ul style="list-style-type: none">• Defined scope of AI usage and periodic review of models and workflows.

⁵ Alignment with internal model risk management or AI governance frameworks where applicable.

5. TAKEAWAY AND NEXT STEPS

Documentation is the first step toward regaining control of EUCs. It enables effective controls, reduces key-person dependency, and provides the evidence trail expected by auditors and supervisors. Once EUCs are documented and classified, organizations can make informed decisions about which tools to remediate, refactor or replace.

This work does more than satisfy documentation expectations. It rebuilds shared understanding of what the EUC does, how it behaves, and where it is fragile. That understanding is the **foundation for the next steps**, such as **integration** into a controlled environment or **refactoring and rebuilding** based on software development best practices (this part will be covered in an upcoming white paper).

6. HOW CAN REACFIN HELP?

Reacfin helps you **bridge business expertise and technology**.

Combined expertise

We **combine deep actuarial and quantitative expertise** with **advanced technical know-how** to help clients **make better use of technology in their day-to-day work**.



Review

Review and enhance current methodologies



Streamlining and optimization

Streamline and optimize actuarial and financial processes for greater efficiency and control



Upskilling

Train or coach your team to master new solutions and best practices



Overview and risk assessment

Identify and assess your critical EUCs and map their interdependencies



Documentation

Document existing EUCs to prepare for future transformation



Refactoring

Migrate and integrate legacy EUCs to robust, maintainable solutions

Team-as-a-Service

Team-as-a-Service provides operational continuity and accelerated automation by embedding tech-savvy consultants directly into day-to-day activities such as financial or actuarial closing. These consultants back-fill operational workloads while actively contributing to process improvement and automation, by combining

- Embedded Reacfin consultants who **support the closing process** when needed and work between cycles to **automate, stabilize, and document processes**.
- **Centralized support** from Reacfin technical experts or our partner B12 Consulting (part of Yuma), bringing **software engineering best practices, architecture guidance, testing, project management, and advanced technical support**.
- Continuous **on-the-job coaching** to upskill internal teams in automation, tooling, and modern development practices.

This approach **ensures operational resilience during critical periods** while **progressively reducing manual effort, dependency on individuals, and long-term operational risk**.

7. ABOUT REACFIN

We develop **sustainable actuarial, quantitative financial and AI for Finance solutions** in partnership with our clients (from **design and modeling to operationalization** in their systems), building on **strong data analytics** while securing **full transparency** and **integral knowledge transfer**.



Reacfin is the reliable bridge between academic excellence and market best practices.

The company started its activities in 2004 as a spin-off of department of [UCLouvain School of Statistics, Biostatistics and Actuarial Science](#).

In its early days, we focused on actuarial consultancy services for Belgian Pension Funds, Insurance Companies and Mutual organizations. Rapidly, in the following years, we expanded our business internationally and broadened our scope of services to Risk Management, Quantitative Finance, Portfolio Management and Data Analytics for Financial Institutions in the broader sense (i.e. Insurers, Banks, Asset Managers, Pension Funds, Financial Market Infrastructures and Regulators). Today, Reacfin is extending its range of services to include process automation, the introduction of AI and, more generally, the optimal use of corporate and external data.

Based in Louvain-la-Neuve (Belgium), Reacfin employs today more than 35+ consultants most of which hold PhD's or highly specialized university degrees.

Over the years, we have now served in excess of 150 different financial institutions, the vast majority of which are recurrent clients, which we see as the most convincing indicator of our clients' satisfaction.


Missions we regularly perform consist of models design, developments & deployment, model validations, definition of risk- & portfolio management policies, organization & governance advisory, strategic asset allocations or specialized management consulting with regard to Risk & Portfolio management problems.


<p>RISK MANAGEMENT & FINANCE</p> <ul style="list-style-type: none">ESG / climate risk managementImplementation/calibration of stochastic modelsValuation/pricing of financial instrumentsDevelopment of AM & ALM modelsCredit Portfolio Management Models (incl. IRB, IFRS9, etc.)Asset allocation, (Automated) trading & hedging strategiesQuantitative Risk Management modelsStrategic opportunities assessment and business valuationsIndustrialization of processes & organizational optimizationBusiness intelligence, benchmarking & surveysInternal & regulatory reporting (KRI's & KPI's dashboards)Validations, model review frameworks and model documentation	<p>LIFE, HEALTH AND PENSION</p> <ul style="list-style-type: none">Valuation frameworks: Solvency 2, IFRS17, Local GAAPPricing, product development & reservingDynamic Financial Analysis (DFA)Capital Requirement optimizationBusiness valuation support & Actuarial function outsourcingPension liabilities valuation
	<p>NON-LIFE</p> <ul style="list-style-type: none">Implementation or review of reserving methodologiesDevelopment of innovative pricing methodologies and toolsValuation & profitability analysis modelsRisk mitigation optimizationBusiness valuation, capital management and actuarial function
<p>ACTUARIAL ENGINEERING</p> <ul style="list-style-type: none">Processes streamlining and automation leveraging best-in-class software development techniques and deep learning (DL) algorithmsRefactoring of legacy tools, supporting from design and development to deployment within client's infrastructureInnovative application of state-of-the-art machine learning (ML) and generative artificial intelligence (GenAI), like large language models (LLM)Data management & data quality pipe-line automationData visualization (dynamic dashboards, automated reports, etc.)Training and coaching to help clients' teams to upskill their technological knowledge	


We deploy material efforts at ensuring that Reacfin deliverables systematically have the following characteristics:

State of the art technical skills	<ul style="list-style-type: none"> ▪ Expertise in most advanced quantitative modelling & academic excellence of a spin-off ▪ All our consultants hold multiple masters or Phd ▪ Best-in-class quantitative and qualitative risk management leveraging on highly experienced senior consultants
Balanced and pragmatic approach	<ul style="list-style-type: none"> ▪ Client-centric solutions focused on deliverables ▪ Respecting the principle of proportionality ▪ Cost efficient within tight pre-agreed budgets
No black box solutions	<ul style="list-style-type: none"> ▪ Hands-on implementation tested for real-life conditions ▪ Open source solutions on request ▪ Close cooperation with our clients
Clearly structured processes	<ul style="list-style-type: none"> ▪ Lean & efficient tailored project management ▪ Regular progress reviews ▪ Agile approach to adapt to the evolving needs of our clients
Documentation, coaching & training	<ul style="list-style-type: none"> ▪ Clear & comprehensive documentation compliant with existing or upcoming regulation ▪ Adapted trainings at all levels of the organisation ▪ Coaching support for implementation and operationalisation of processes






We articulate our offer along 3 brands:

 We offer consulting services in actuarial science & quantitative finance, including a.o. capital, portfolio, product, risk and liquidity management. We build our expertise on broad data analytics capacities.

 By blending strong actuarial and financial business expertise with an in-depth understanding of cutting-edge IT and AI technologies, we enable our clients to become more competitive and focus on their core business such as complex analysis, strategic decision-making and innovation.

 We share our knowledge with our clients. We offer a comprehensive learning platform, including on-site trainings, e-learning modules, e-classrooms and webinars.

Reacfin's management puts great emphasis at sharing and embedding our driving values within the company:

 <p>Excellence: Our main feature</p> <p>We attract the best people</p> <p>We develop their skills and career through diversified missions and rigorous knowledge management</p> <p>We go the extra-mile to deliver the best quality in our work & services</p>	 <p>Innovation: Our founding ambition</p> <p>By acting as a bridge linking academic excellence with best market practices, we select the latest research that best serves our client</p> <p>Through out of the box thinking, we apply state-of-the-art techniques that offer our clients pragmatic added-value solutions</p>	 <p>Integrity: Our commitment</p> <p>We put work ethics, client's best interest and confidentiality as the foundation of our work</p> <p>We commit to promoting the greatest transparency and knowledge sharing in all our client's solutions</p>	 <p>Solution-Driven: Our focus</p> <p>We are dedicated to clearly understanding the needs of our clients</p> <p>We deliver solutions that produce measurable value</p> <p>Our deliverables are tailored and actionable solutions to our client's challenges</p>	 <p>Reliability: Our characteristic</p> <p>We develop sustainable partnerships with our clients</p> <p>We never compromise on our commitments including level of quality, budgets & deadlines</p> <p>All our deliverables are designed, developed and tested to last over time with constant efficiency</p>
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*We develop **sustainable actuarial, quantitative financial and AI for Finance solutions** in partnership with our clients (from **design and modeling** to **operationalization** in their systems), building on **strong data analytics** while securing **full transparency and integral knowledge transfer**.*