

End User Computing (EUC) – Remediation approach



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Contents

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2. EUC Management System
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EUC: Definition, Scope and Remediation Objectives



EUCs are designed to automate business functionality including formatting, calculating, transforming, classifying, and/or transferring data and are typically created and/or modified, maintained, and operated by or within the end user's department.

They are defined as “spreadsheets & databases” accessible and modifiable by end users and meet 3 or 4 of the following criteria:

- ▶ *Contain mathematical calculation or logical process step (e.g., formula, pivot, macro, or query)*
- ▶ *Developed and managed outside an environment that uses formal IT controls*
- ▶ *Controlled or developed using desktop software (e.g., Access, Excel, VBA [not controlled by third parties])*
- ▶ *Continuous or repeatable business process*

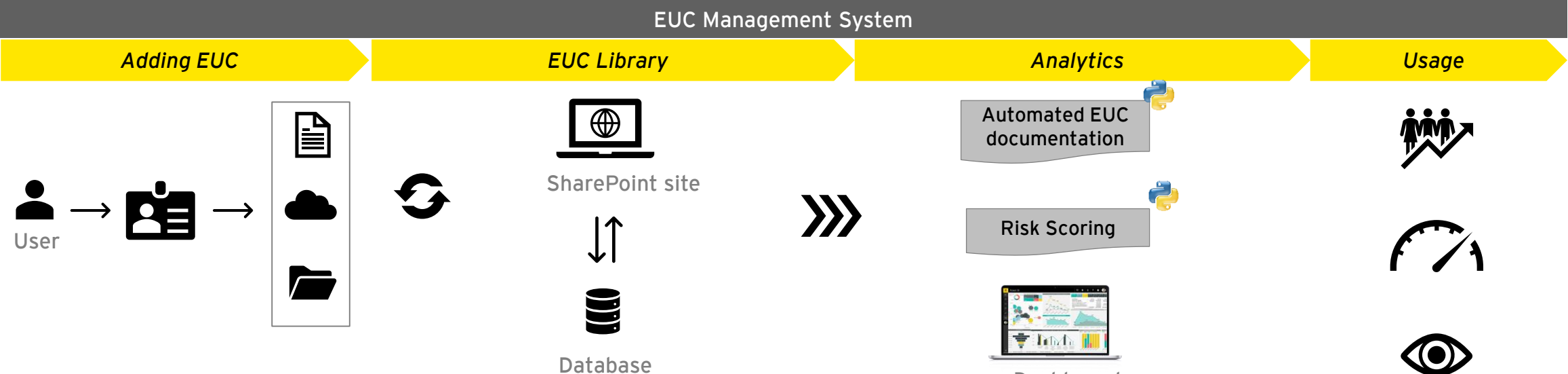
Scoping of EUCs is typically based on impact and usage, focused on high risk processes or key controls:

- ▶ *Financial Reporting (including valuation of on and off balance sheet items)*
- ▶ *Regulatory Reporting (including CCAR, Liquidity, RRP, NFR)*
- ▶ *Capital Planning and Liquidity Management*
- ▶ *Pricing for customers, products, and services*
- ▶ *Other high risk processes per Operational Risk program (e.g., may contain customer information)*

Many organizations are conducting large scale EUC remediation programs with the following objectives:

- ▶ *Strengthening the Control Environment*
- ▶ *Providing EUC Risk Transparency & Reporting*
- ▶ *Identifying EUC Efficiency Drivers*
- ▶ *Rationalizing, Automating and Eliminating EUC's*

EUC Management System



KEY ACTIVITIES:

- | 1 | 2 | 3 | 4 |
|---|--|---|--|
| <ul style="list-style-type: none">▶ Authentication▶ Single EUC upload▶ Bulk EUC Upload▶ Shared folder Scan▶ Network folder scan▶ Auto Sync▶ Scheduled Scans | <ul style="list-style-type: none">▶ Secure Storage▶ Keyword Search▶ EUC filter based on multiple criteria▶ Version control▶ Files synced with local system | <ul style="list-style-type: none">▶ Risk Scoring▶ Auto Documentation▶ Customizable Dashboard▶ Remediation analysis▶ Customized Workflow | <ul style="list-style-type: none">▶ Scheduled Alerts▶ Approval workflow▶ Access level setting▶ Site usage metrics |

Demo: Upload single/multiple files



Search

Home

EUC Library

EUC Tasks

Shared with us

Site contents

Recycle bin

Edit

+ New

Upload

Qu

EUC Library

Upload Files

COREP_CA2_r25.01 - E

COREP_CA2_r25.01.xlsr

Credit_Risk_COREP_Sig

FSA045_Gabriel_Submi

IP_Losses_extract_r25.0

Select Folder to Upload

< > > This PC > Documents > Work > Sharepoint > EUC

Search EUC

Organize

New folder

This PC

3D Objects

Desktop

Documents

Downloads

Music

Pictures

Videos

OSDisk (C:)

BAS_NonClient (

BAS_Engagemer

BAS_Client (\\inc

Name

Date modified

Type

Size

Advisory

Finance

HR

Investment Decisions

Operations

Strategic Management

04-10-2019 06:27 ...

04-10-2019 06:27 ...

04-10-2019 06:26 ...

04-10-2019 06:28 ...

04-10-2019 06:27 ...

04-10-2019 06:28 ...

File folder

File folder

File folder

File folder

File folder

File folder

Folder: Advisory

Upload

Cancel

While uploading files, the user is prompted to fill details about the EUC

Demo: Upload form for EUCs



The screenshot shows the EY EUC Library interface. On the left, a sidebar contains navigation links: Home, EUC Library (selected), EUC Tasks, Shared with us, Site contents, Recycle bin, and Edit. The main area displays a table of EUCs with columns for Name, Modified, and Modified By. The file 'out.csv' is highlighted. To the right of the table, a 'Form' is displayed, prompting the user to fill in details about the EUC. The form includes fields for Content Type, Name, Title, EUC-ID, Documentation, EUC - Business Function, EUC - Business Area, and EUC-Status. A red box highlights the form area.

Name	Modified	Modified By
CCyB_Adjustment_Analyser_vR23.01.xlsm	Monday at 11:20 PM	EY PI
COREP_CA2_r25.01 - Editable.xlsm	Monday at 11:22 PM	EY PI
COREP_CA2_r25.01.xlsm	Monday at 11:21 PM	EY PI
Credit_Risk_COREP_Signoff_26.03.xlsm	Monday at 11:22 PM	EY PI
FSA045_Gabriel_Submission_r25.02.xlsm	Monday at 11:22 PM	EY PI
IP_Losses_extract_r25.01.xlsm	Monday at 11:22 PM	EY PI
out.csv	A few seconds ago	EY PI

Form

out.csv

Content Type
Document

Name *
out .CSV

Title
Enter value here

EUC-ID *
Enter value here

Documentation *
Enter a URL
Enter display text
Documentation of the EUC

EUC - Business Function *
Enter value here

EUC - Business Area *
Enter value here

EUC-Status *
Active
The current status of EUC

While uploading files, the user is prompted to fill details about the EUC

Demo: Files synced with local system

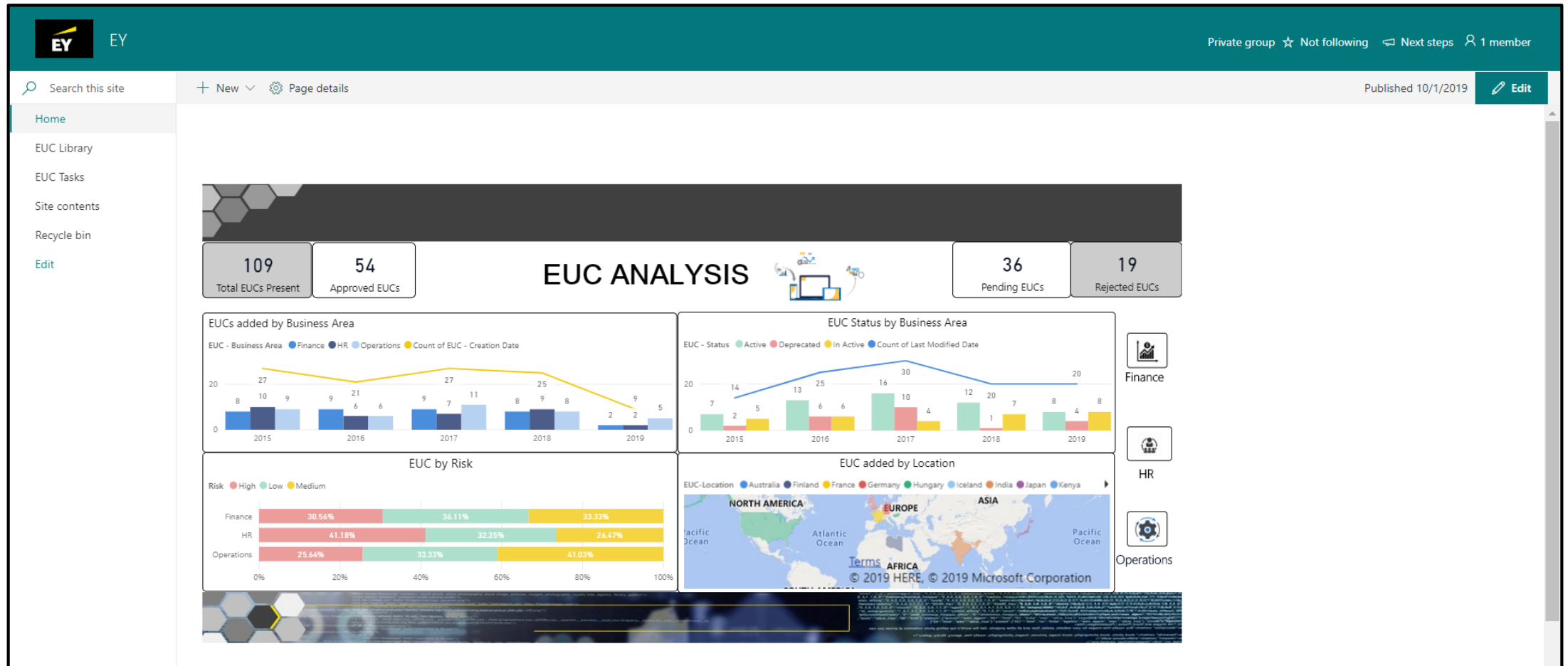


The screenshot displays a web application interface for a file library, overlaid with a Windows File Explorer window. The web application, titled 'EUC Library', shows a list of files including 'CCyB_Adjustment_Analyser_vR23.01', 'COREP_CA2_r25.01 - Editable.xlsm', 'COREP_CA2_r25.01.xlsm', 'Credit_Risk_COREP_Signoff_26.03.xlsm', 'FSA045_Gabriel_Submission_r25.02', and 'IP_Losses_extract_r25.01.xlsm'. The File Explorer window, titled 'EY - EUC Library', shows the same files in a local directory structure: 'This PC > OSDisk (C:) > Users > Ayushi.Goel > EY > EY - EUC Library'. The File Explorer window also displays a table of file details.

Name	Date modified	Type	Size
CCyB_Adjustment_Analyser_vR23.01.xlsm	01-10-2019 11:50 ...	Microsoft Excel M...	2,085 KB
COREP_CA2_r25.01 - Editable.xlsm	01-10-2019 11:52 ...	Microsoft Excel M...	277 KB
COREP_CA2_r25.01.xlsm	01-10-2019 11:51 ...	Microsoft Excel M...	235 KB
Credit_Risk_COREP_Signoff_26.03.xlsm	01-10-2019 11:52 ...	Microsoft Excel M...	1,333 KB
FSA045_Gabriel_Submission_r25.02.xlsm	01-10-2019 11:52 ...	Microsoft Excel M...	5,084 KB
IP_Losses_extract_r25.01.xlsm	01-10-2019 11:52 ...	Microsoft Excel M...	4,489 KB

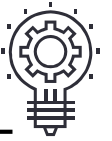
All the files within the EUC Library are well synced with a local folder on the system, and any changes made in either the file on site or on system are immediately updated at both places


Demo: Dashboard summarizing EUCs



The home page displays a PowerBI dashboard, summarizing information over the EUCs within the site

Demo: EUC Library



 EY

Private group ☆ Not following ↩ Next steps 👤 1 member

Search

+ New ↑ Upload ✎ Quick edit ↻ Sync 📄 Export to Excel ⚙ Flow ...

All Documents

Home

EUC Library

EUC Tasks







Shared with us

Site contents

Recycle bin

Edit

EUC Library

	Name	Modified	Modified By	EUC-ID	Documentation	EUC - Business Fun...	EUC - Business Area	EUC-Status	EUC - Location	EUC - Techno
	CCyB_Adjustment_Analyser_vR23.01.xlsm	Monday at 11:20 PM	EY PI	EY3456	Link to Documentation	Regulatory Reporting	Finance	In Active	Gurgaon	Excel
	COREP_CA2_r25.01 - Editable.xlsm	Monday at 11:22 PM	EY PI	EY7996	Link to Documentation	Fixed Income	Operations	Active	Bangalore	Excel
	COREP_CA2_r25.01.xlsm	Monday at 11:21 PM	EY PI	EY7996	Link to Documentation	Fixed Income	Operations	Active	Bangalore	Excel
	Credit_Risk_COREP_Signoff_26.03.xlsm	Monday at 11:22 PM	EY PI	EY4907	Link to Documentation	Payroll	HR	Deprecated	Delhi	Excel
	FSA045_Gabriel_Submission_r25.02.xlsm	Monday at 11:22 PM	EY PI	EY1099	Link to Documentation	Regulatory Reporting	Finance	In Progress	Delhi	Excel
	IP_Losses_extract_r25.01.xlsm	Monday at 11:22 PM	EY PI	EY3907	Link to Documentation	Fixed Income	Operations	Active	Chennai	Excel

EUC Library provides a comprehensive view of all the EUCs stored within the site, which can be edited and automatically versioned. New EUCs are uploaded on the same portal, while allowing the user to add related information about the EUC.

Demo: Filter options



The screenshot displays the EY EUC Library interface. On the left is a navigation pane with links to Home, EUC Library (selected), EUC Tasks, Shared with us, Site contents, Recycle bin, and Edit. The main area shows a table of documents with columns: Name, Modified, Modified By, EUC-ID, Documentation, and EUC - Business Fun... The table lists several documents, including CCyB_Adjustment_Analyser_vR23.01.xlsm, COREP_CA2_r25.01 - Editable.xlsm, COREP_CA2_r25.01.xlsm, Credit_Risk_COREP_Signoff_26.03.xlsm, FSA045_Gabriel_Submission_r25.02.xlsm, and IP_Losses_extract_r25.01.xlsm. A red box highlights the 'Filters' sidebar on the right, which includes sections for 'Modified since 2019' (with a date range from 2019 to Today), 'EUC-Status' (with checkboxes for Active, Deprecated, In Progress, and In Active), 'EUC - Creation Date anytime' (with a date range from Oldest to 2020+), and 'EUC-ID' (with checkboxes for EY7996, EY3907, EY4907, EY1099, and EY3456). A callout box labeled 'Filters over EUCs' with an arrow points to the filters sidebar.

Name	Modified	Modified By	EUC-ID	Documentation	EUC - Business Fun...
CCyB_Adjustment_Analyser_vR23.01.xlsm	Monday at 11:20 PM	EY PI	EY3456	Link to Documentation	Regulatory Reporting
COREP_CA2_r25.01 - Editable.xlsm	Monday at 11:22 PM	EY PI	EY7996	Link to Documentation	Fixed Income
COREP_CA2_r25.01.xlsm	Monday at 11:21 PM	EY PI	EY7996	Link to Documentation	Fixed Income
Credit_Risk_COREP_Signoff_26.03.xlsm	Monday at 11:22 PM	EY PI	EY4907	Link to Documentation	Payroll
FSA045_Gabriel_Submission_r25.02.xlsm	Monday at 11:22 PM	EY PI	EY1099	Link to Documentation	Regulatory Reporting
IP_Losses_extract_r25.01.xlsm	Monday at 11:22 PM	EY PI	EY3907	Link to Documentation	Fixed Income

The EUC Library can be filtered based on various parameters for an easy search

Demo: Keyword based EUC search



EY

EY

Private group ☆ Not following Next steps 1 member

currency

+ New Upload Quick edit Sync Export to Excel Flow

All Documents

IP_Losses_extract_r25.01.xlsm
EY PI - EUC_Library - 3/7/2018
"Companies.REPORTING_CURRENCY, CASE WHEN a...
a.collateral_assigned_amount/Currency.exch_rate,3..."

FSA045_Gabriel_Submission_r25.02.xlsm
EY PI - EUC_Library - 3/7/2018
"Site Site Name Currency Phase NCCR / CCR / Both..."

Credit_Risk_COREP_Signoff_26.03.xlsm
EY PI - EUC_Library - 3/7/2018
"I confirm that the Validations and Controls and... key for
constant currency calcs Phase 1 6001 Phase..."

COREP_CA2_r25.01.xlsm
EY PI - EUC_Library - 3/7/2018
"Site Site Name Currency Phase 43008 HBEU 2025 USD... Site Site
Name Currency Phase C 02.00 - OWN FUNDS..."

CCyB_Adjustment_Analyser_vr23.01.xlsm
EY PI - EUC_Library - 3/7/2018
"Exposure Currency : - Threshold : - 5000 (in... AI ANGUILLA AL
ALBANIA AM ARMENIA AO ANGOLA AQ..."

See more results

Modified	Modified By	EUC-ID	Documentation	EUC - Business Fun...	EUC - Business Area	EUC-Status	EUC - Location	EUC - Techn
Monday at 11:20 PM	EY PI	EY3456	Link to Documentation	Regulatory Reporting	Finance	In Active	Gurgaon	Excel
Monday at 11:22 PM	EY PI	EY7996	Link to Documentation	Fixed Income	Operations	Active	Bangalore	Excel
Monday at 11:21 PM	EY PI	EY7996	Link to Documentation	Fixed Income	Operations	Active	Bangalore	Excel
Monday at 11:22 PM	EY PI	EY4907	Link to Documentation	Payroll	HR	Deprecated	Delhi	Excel
Monday at 11:22 PM	EY PI	EY1099	Link to Documentation	Regulatory Reporting	Finance	In Progress	Delhi	Excel
Monday at 11:22 PM	EY PI	EY3907	Link to Documentation	Fixed Income	Operations	Active	Chennai	Excel



Keyword search

Any file within the EUC library can also be searched by some keyword present within the EUC



Demo: Risk Categorization



EY

EY

Private group ☆ Not following ↩ Next steps 👤 1 member

Search

Home

EUC Library

EUC Tasks

Shared with us

Site contents

Recycle bin

Edit

+ New

↑ Upload

✎ Quick edit

↻ Sync

📄 Export to Excel

📄 Flow

⋮

All Documents

🔍

ⓘ

ation	EUC - Business Fun...	EUC - Business Area	EUC-Status	EUC - Location	EUC - Technology U...	EUC - Creation Date	Review Status	EUC Owner	Risk	+ Add column
umentation	Regulatory Reporting	Finance	In Active	Gurgaon	Excel	September 24	Approved		Low	
umentation	Fixed Income	Operations	Active	Bangalore	Excel	August 6	Approved		Low	
umentation	Fixed Income	Operations	Active	Bangalore	Excel	August 6	Approved		Medium	
umentation	Payroll	HR	Deprecated	Delhi	Excel	September 3	Approved		Low	
umentation	Regulatory Reporting	Finance	In Progress	Delhi	Excel	July 24	Approved		Medium	
umentation	Fixed Income	Operations	Active	Chennai	Excel	June 14	Approved		High	

Risk calculated for each EUC

For each EUC uploaded, a risk score is calculated, which is then bucketed into three main classes, low, medium and high

Demo: Auto generation of documentation for each file uploaded



Search

+ New Upload Quick edit Sync Export to Excel

Home

EUC Library

EUC Tasks

Shared with us

Site contents

Recycle bin

Edit

Link to documentation automatically generated

EUC-ID	Documentation	EUC - Business Fun...
EY3456	Link to Documentation	Regulatory Reporting
EY3906	Link to Documentation	Fixed Income
EY3906	Link to Documentation	Fixed Income
EY4907	Link to Documentation	Payroll
EY1099	Link to Documentation	Regulatory Reporting
EY3907	Link to Documentation	Fixed Income

EY

Search

+ New Upload Quick edit Sync Export to Excel Flow ...

Home

EUC Library

EUC Tasks

Shared with us

Site contents

Recycle bin

Edit

Documentation

Name	Modified	Modified By	+ Add column
Sheet Level Map - FSA045_Gabriel_Submiss...	September 24	Ayushi Goel	
VBA code flow.xlsx	September 24	Ayushi Goel	
Workbook analysis.xlsx	September 24	Ayushi Goel	

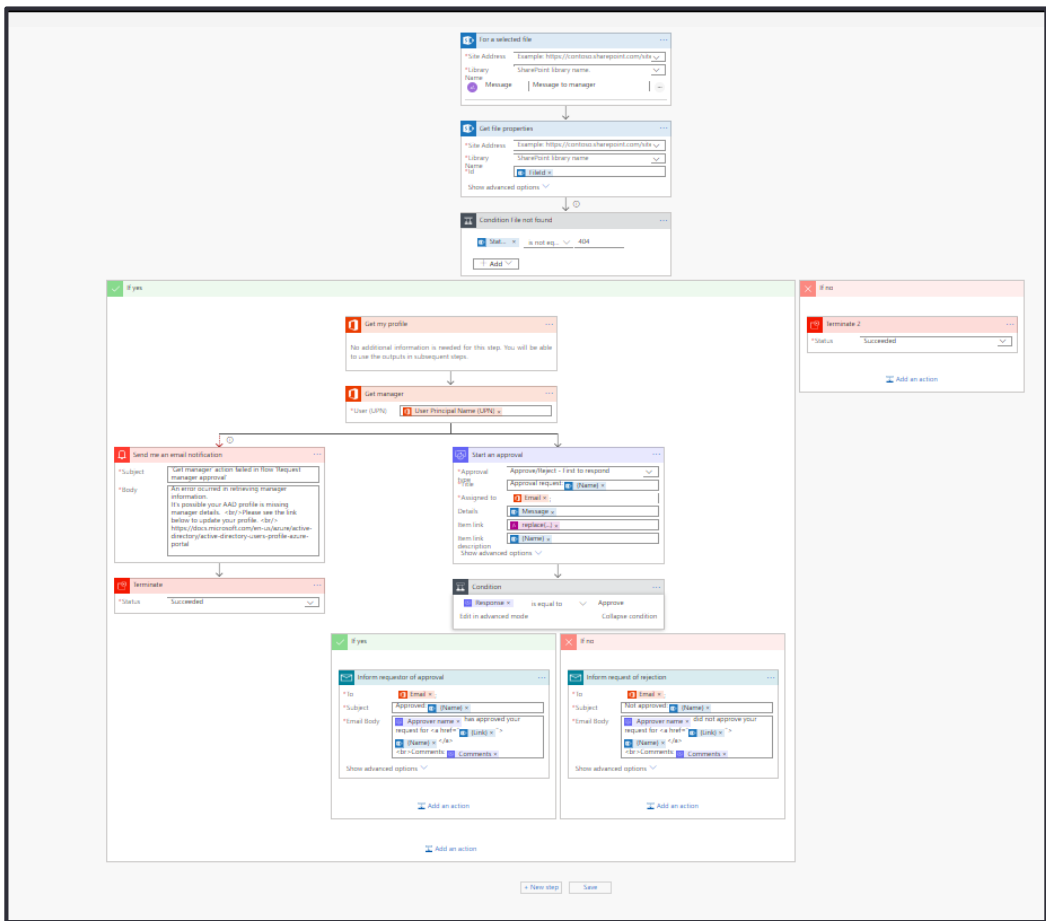
Documentation

For each uploaded file a workbook analysis sheet, a data lineage map and a VBA flowchart is generated automatically

Demo: Create Custom Workflows

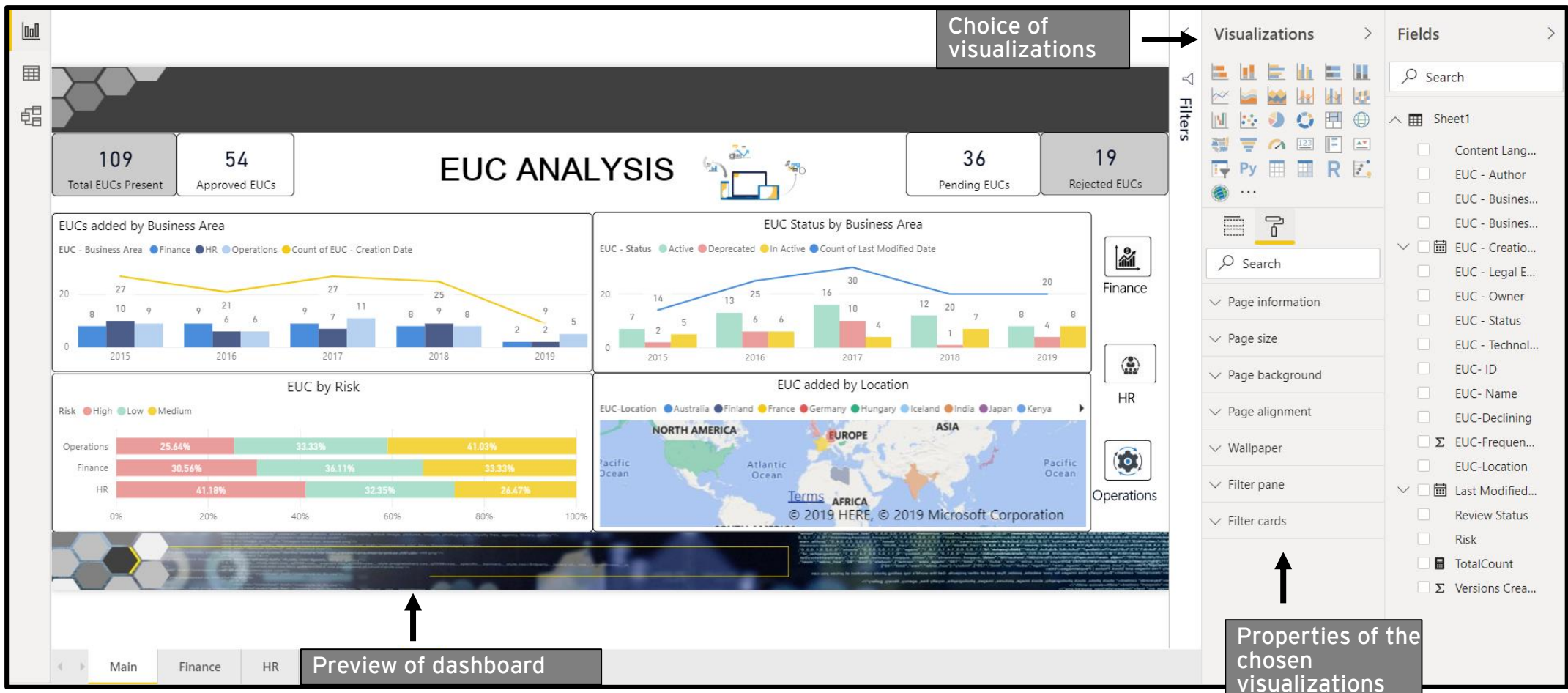


The screenshot shows the Microsoft Flow (Power Automate) interface. On the left is a sidebar with navigation options: Home, Action Items, My flows, Create, Templates, Connectors, Data, Solutions, and Learn. The main area displays a list of pre-built flows under the 'My flows' tab. The flows are organized into two rows. The first row includes flows like 'Request manager approval for a selected file', 'Save Office 365 email attachments to OneDrive for Business', 'Get today's weather forecast for my current location', 'Get a push notification when you receive an email from your boss', 'Get a push notification with updates from the Flow blog', 'Send a customized email when a new file is added', and 'Click a button to email a note'. The second row includes flows like 'Get updates from the Flow blog', 'Get a daily digest of the top CNN news', 'Copy new events in Office 365 to Google Calendar and send a notification', and 'Post messages to Microsoft Teams when a new task is created in Planner'. Each flow card shows its name, creator, type (Automated, Instant, or Scheduled), and a popularity count.



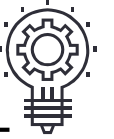
Along with many pre-built flows, the system allows to build any number of custom flows and connect with the site

Demo: Customizable dashboard



The dashboard along with the entire metadata is fully customizable according to the specific business requirement

Demo: Customized alerts



The screenshot shows the Microsoft Outlook interface. On the left, the 'Favorites' pane shows the 'Inbox' with 31 items. The main pane displays a list of emails. The selected email is from 'Microsoft Flow' with the subject 'Please review: EUC Library metadata | EY PI |'. The email body contains a 'Pending approval' card. The card is titled 'Pending approval' and is 'Powered by Microsoft Flow'. It lists the following details:

- Requested by: EY PI sachin@SACHINJHA.onmicrosoft.com
- Date Created: Wednesday, September 25, 2019 12:34 PM GMT
- Details: EY PI at Wednesday, September 25, 2019 12:34 PM GMT
- Link: EUC Library metadata

Below the details are two buttons: 'Approve ^' and 'Reject v'. Underneath these is a text box labeled 'Reason (optional)'. At the bottom of the card is a 'Submit' button. The email header shows it was received on 'Wed 9/25/2019 6:04 PM' from 'Microsoft Flow <maccount@microsoft.com>'.

As soon as a file is uploaded the admin is sent a mail seeking approval for the file uploaded

Demo: EUC Approved Confirmation



Outlook interface showing an email from Microsoft Flow. The email subject is "Please review: EUC Library metadata | EY PI |". The body of the email displays the "Approvals" logo and "Powered by Microsoft Flow". The status is "Approved" with a date of "Wednesday, September 25, 2019 12:45 PM GMT". The comments section is empty. The email is part of a series of notifications about EUC Library metadata changes.

The admin is notified of all approved EUCs

Demo: Access level for different users



Private group

36
Pending EUCs

19
Rejected EUCs

EUC Status by Business Area

Count of Last Modified Date

2016

2017

2018

2019

EUC added by Location

EUROPE

ASIA

AFRICA

Finance

HR

Operations

Site permissions

Manage site permissions or invite others to collaborate

Invite people

Site owners

tO EY Owners Full control

Site members

Mehak Naib Edit

tM EY Members Edit

Site visitors

Ayushi Goel Read

Sharing Settings

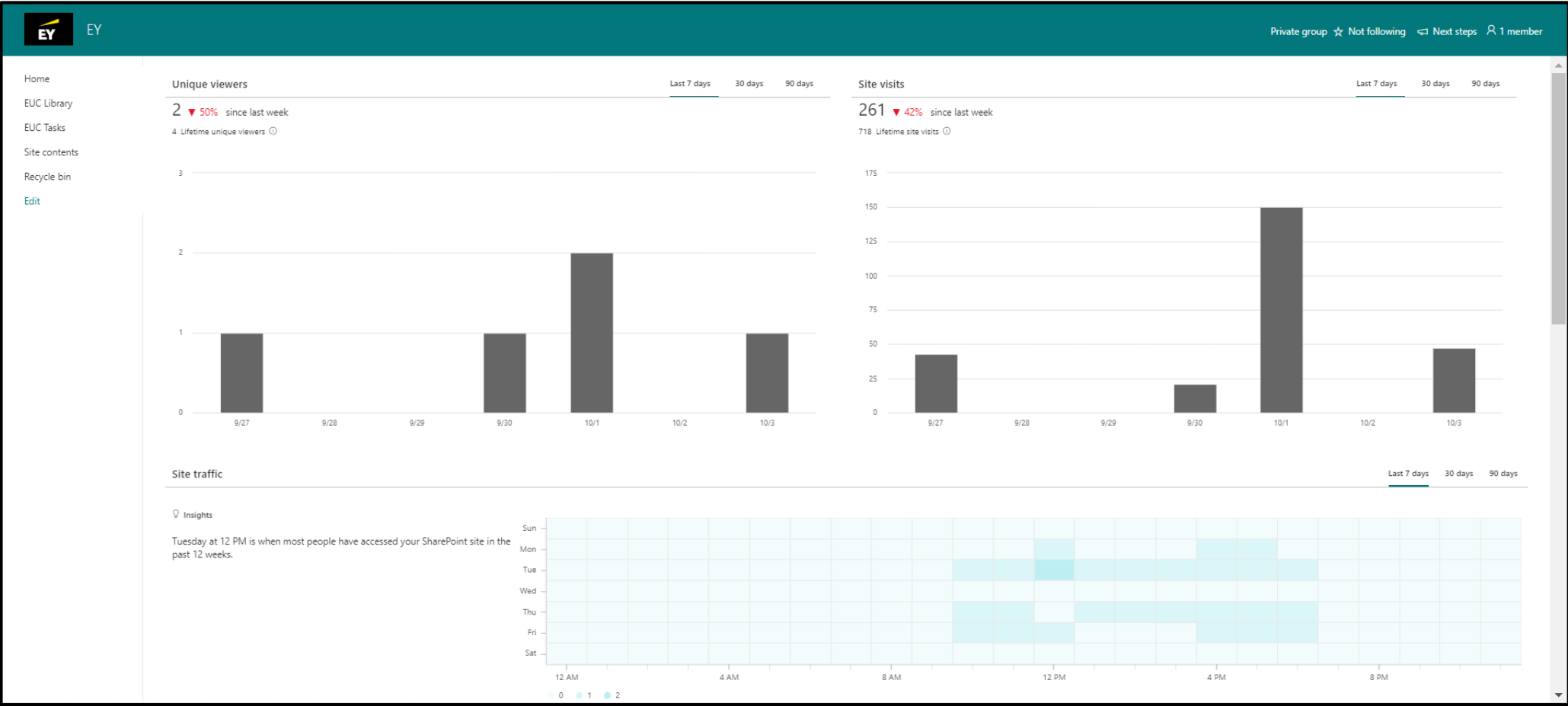
Change sharing settings

Advanced permissions settings



The site provides full control over which member can view and edit what file

Demo: Site usage metrics



There is a complete track of all activities within the site and a summary report is generated

Measuring EUC Risk



- ▶ Types of EUC applications used; how many there are of each type
- ▶ level of complexity: heavily coded, use macros, rely on connections to other spreadsheets, databases, etc
- ▶ 'Criticality' of the EUCs to the business.
 - ▶ Criticality must be assessed based on the quantitative (dollar loss) and qualitative (reputational risk, client exposure, regulatory sanction, loss of business functionality) impact on the business if these files were lost or otherwise unknowingly damaged or altered. For instance, assess what the cost to the business would be if the creator of a vital spreadsheet application left the organization? Would another member of the team have intimate knowledge of how the application works and needs to be maintained? Would they be able to test the integrity of the application in the event of inadvertent or malicious changes to any codes or macros in the application?
- ▶ EUC complexity
- ▶ Use of scripts
- ▶ External links
- ▶ Formulae design
- ▶ Size or scale of the application
- ▶ Processing frequency

Measuring EUC Risk



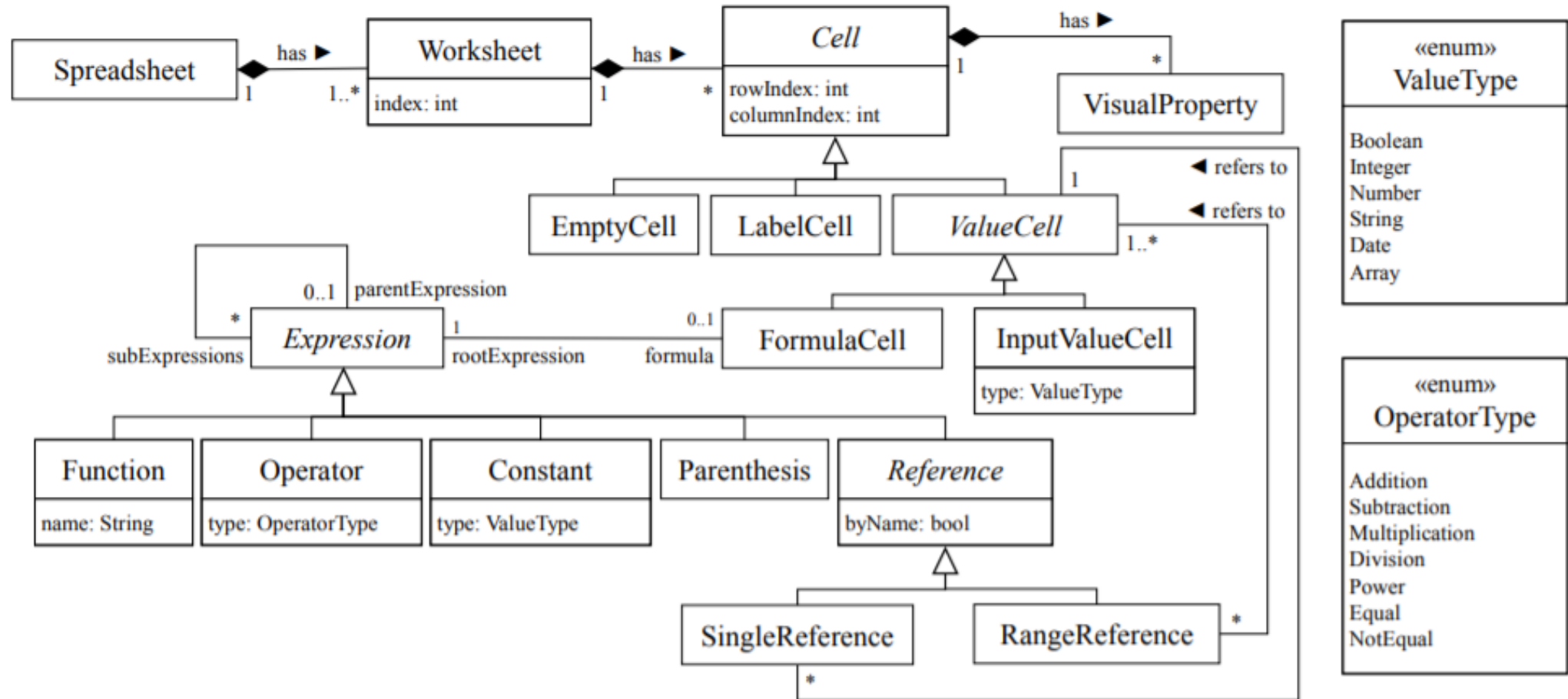
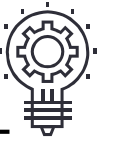
- ▶ Risk of an EUC is an aggregation of various factors combined together.
 - ▶ Complexity - factors within the spreadsheet itself:
 - ▶ Within worksheets
 - ▶ Across workbook
 - ▶ Functionality - purpose being served by the EUC
 - ▶ Usage - utilization of the EUC

Potential drivers of complexity: *within worksheet*

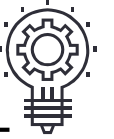


- ▶ Number of worksheets present
- ▶ Coupling between worksheets - high coupling between worksheets implies increased complexity
- ▶ Different types of cells present:
 - ▶ Empty cells - Do not contain any data or text
 - ▶ Value cells - actually contain the data:
 - ▶ InputValueCell - captures the type of data in cell
 - ▶ FormulaCell - represents cells which compute their value based on an expression
 - ▶ Label cells - not referenced by formulas and only serve as documentation and description of value cells
- ▶ Abstract Syntax Tree(AST) - level of nesting of the formulas
- ▶ Decision count - number of conditional within a formula:
 - ▶ Function
 - ▶ Operator
 - ▶ Constant
 - ▶ Parenthesis
- ▶ Dependencies between formulas:
 - ▶ Reference - references to single cell
 - ▶ Range - reference to a one or two dimensional cell block(range references have a higher impact than references to single cell)

Conceptual and integrated model measuring complexity in worksheets



Selection of complexity metrics based on potential drivers



Name	Description
Average AST depth per formula	The average depth of the abstract syntax tree which is formed by the Expressions of a FormulaCell.
Max AST depth per formula	
Number of formula cells	The size of the spreadsheet which is determined by the number/ratio of different kind of Cells, e.g., ValueCell and FormulaCell.
Ratio of formula cells to non-empty cells	
Number of input cells	
Ratio of input cells to non-empty cells	
Ratio of formula cells to input cells	
Number of distinct formulas	Number of distinct FormulaCells which have an equally structured AST which only differs with respect to its References.
Average fan-out per formula	Number of incoming and outgoing references of FormulaCells.
Max fan-out per formula	
Average fan-in per formula	
Max fan-in per formula	
Average number of conditionals per formula	Number of Boolean expressions within one FormulaCell, e.g., functions with the names IF, COUNTIF, SUMIF, etc.
Max number of conditionals per formula	
Average spreading factor per formula	Maximal Euclidian distance between References in a Formula. In this sense, rowIndex and columnIndex of the Cell and index of the Worksheet represent the x, y, z coordinates of a three-dimensional space.
Max spreading factor per formula	



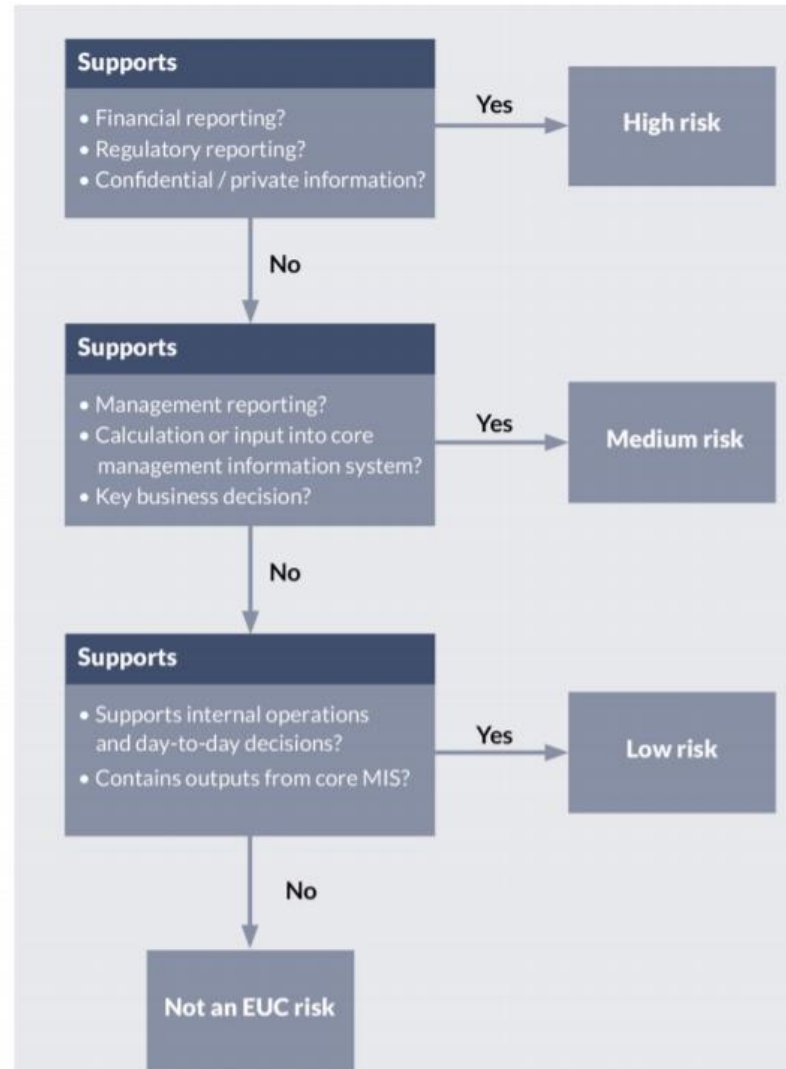
A comprehensive proposed set of complexity criteria for spreadsheets

- Sheets
- Formulas
- Formula with Errors
- Array Formulas
- Nested Ifs
- Max Nested If Level
- External Links
- Macros
- Pivot Tables
- Named Items
- Invisible Cells (text and background are the same color)
- Hidden Rows and Columns
- Hidden Sheets
- Very Hidden Sheets (sheet made invisible through use of VBA code)
- Password Protected
- Workbook Size

38



5.3. An example EUA risk assessment and categorization process



System fields being captured for EUCs



Provided by User

- ▶ EUC-Name
- ▶ EUC-Technology Used
- ▶ EUC-Owner
- ▶ EUC-Description
- ▶ EUC-Approver Comments
- ▶ EUC-Rejection Comments
- ▶ EUC-Status
- ▶ EUC-Business Area
- ▶ EUC-Location
- ▶ EUC-Legal Entity
- ▶ EUC-Business Function

Captured by the system

- ▶ EUC-Frequency of Use
- ▶ EUC-Created BY
- ▶ EUC-Creation Date
- ▶ EUC-Last Modified By
- ▶ EUC-Last Modified Date