ΕΣΔΕΛ
NATIONAL COORDINATING BODY FOR AUDIT AND ACCOUNTABILITY

HELLENIC REPUBLIC

METHODS OF DATA ANALYSIS

IN THE CONTEXT OF AUDIT MISSIONS

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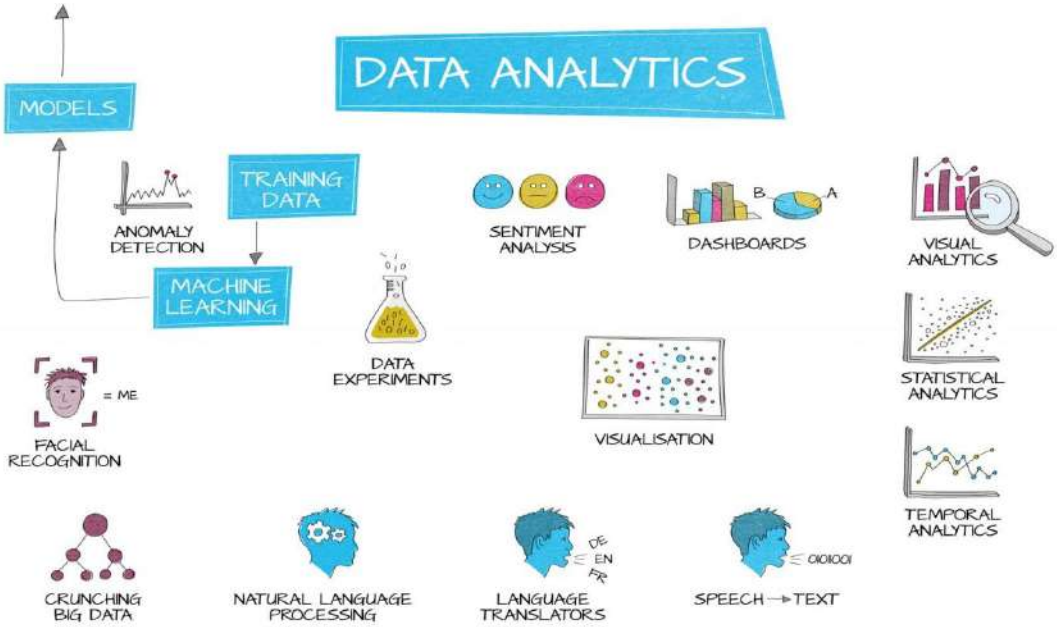

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NATIONAL COORDINATING BODY FOR AUDIT AND ACCOUNTABILITY (ESOEL)

November 2021

Foreword by the President of ESOEL

One of the main objectives of the National Co-ordinating Body for Audit and Accountability (hereinafter "ESOEL" or "the Body") is the development of common standards and tools, with the aim of standardising audit procedures and methodologies to better support the work of the staff of the authorities, bodies and services participating in ESOEL.

The manual on "Data Analysis in the context of Audit Missions" was prepared by a Working Group composed of staff from the Member Services of the Institution and constitutes a useful manual on the methodology of data analysis in the context of audit work in the planning and execution of audits. This manual, considering the types, categories and types of audits, provides guidelines for managing the volume of data and information related to the audit environment and subject matter, in order to identify and analyse these data in a professional, structured and reliable manner.

It is worth noting that the present manual has been prepared thanks to the intensive efforts of a group of public sector staff serving in ESOEL member audit bodies, without additional compensation and in parallel with their official duties.

Finally, we would like to express our sincere thanks to the ACFE Greece Chapter Team for their valuable contribution to the evaluation and review of the manual.

The President of ESOEL

Angelos Binis

Governor of the National Transparency Authority

Preamble

This Manual is the fruit of a collective work of Inspectors - Auditors of the Audit Services participating in the National Coordination Body for Audit and Accountability (NCCA). Following the Decision 164/02.11.2020 of the President of the ESOEL, the ad hoc Working Group was appointed for the sole purpose of preparing a Manual on "Data Analysis in the context of Audit Missions" which will substantially assist auditors in the context of their audit work when carrying out audits.

The Handbook is an embryonic attempt to explore the issue. It goes without saying that the Handbook does not exhaust all the topics covered in this Handbook, but a sufficient effort has been made to cover - in the judgement of the authors - the most important ones, and the whole approach is therefore dynamic. In this context, the aim is to regularly update and enrich the Handbook through continuous feedback, or whenever deemed necessary, if sufficient information is obtained, in order to keep it as consistently adapted as possible to best practices and current audit needs for data collection and processing/analysis.

The fact that it was produced by a collective audit body such as ESOEL shows the high degree of importance attributed to it by all the participating Audit Authorities / Agencies / Services.

Members of the Working Group

- **Georgios Skiathitis**, Major General Financial Inspector (OE), Chief of Staff of the Strategy and Information Management Department of the Internal Affairs Service of the Ministry of National Defense, as Chairman
- **Vassilios Dikopoulos**, Ministry of Finance (Deputy Head of Department), General Secretariat for Fiscal Policy / General Accounting Office of the State / General Directorate of Audits of Co-financed Programmes / Audit Planning and Evaluation Directorate / Department A' - Strategy and Error Calculation, as a member
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Introduction

This manual has been prepared in order to contribute to the description of common methodology and good audit practices and to serve the cooperation network of audit institutions/authorities developed within the framework of the National Coordination Body for Audit and Accountability (NCCA). The manual is part of the actions of the NCCA described in the National Strategic Plan for the Fight against Corruption 2022-2025.

The main pillars of a National Audit Strategy are the fight against corruption and fraud and the optimisation of performance (effectiveness, efficiency and economy) in public sector activities. In this direction, the National Audit Strategy should include:

- ✓ The description of the Audit Authorities/Authorities, their mission and responsibilities, their scope of activity and the synergies developed between them.
- ✓ Common audit ethics, methodology and procedures, good practices, standards and tools.
- ✓ Human resource development and utilization policy / auditors.
- ✓ Long-term and short-term objectives.

This manual is in the direction of continuous quality improvement in the field of audit carried out by public bodies/audit authorities, in the different areas of public administration and in the synergies developed between the public and private sectors.

A "PESTEL" analysis (Figure 1) captures the current external environment and the wider factors influencing the scope and activities of public bodies/auditing authorities. All institutions and partners in social and economic activity have an interest in improving the quality of audit mechanisms in order to produce added value that will benefit everyone.

Figure 1: *PESTEL analysis*

(Political, Economic, Social, Technological, Environmental, Legal Factors)

Political

- Transparency in state-citizen relations is a political will of modern governments. The establishment of the National Transparency Authority (NTA) is a political act in this direction.
- The NTA takes initiatives, through the ESOEL, to coordinate the audit activity of public bodies/auditing authorities.

Economic

- The objective of reducing deficits and public debt presupposes, on the one hand, the proper and efficient collection of revenues for the state and, on the other hand, the sound and efficient management of expenditure.
- Sound financial management and implementation of the resources generated by EU co-funded programmes (NSRF, Recovery Fund etc.) is a prerequisite for sustainable development.

Social

- A culture of transparency is being instilled in citizens. Citizens demand a fair distribution of resources and burdens and are willing to inform/report corruption and fraud.
- Businesses demand a fair distribution of state aid-financing that respects the principles of competition.

Technological

- The internet is a source of a wealth of information, the reliability of which must be ensured. The Internet also guarantees risks (phishing and hacking).
- Information Systems and Business Intelligence (BI) software are embedded in economic activities and are often funded by government spending.
- The culture of e-cohesion is being embedded in the economic actors.

Environmental

- Development must respect the environment. To ensure this, a set of indicators are monitored and audited by monitoring mechanisms.

Legal

- Regulations at European and national level fortify management and audit systems, while at the same time ensuring the protection of personal data.
- The international organisations that establish International Standards on Auditing are in constant consultation with a view to modernising the audit profession by exploiting the opportunities offered by technology.

1

PURPOSE AND OUTLINE OF THE MANUAL

REFERENCE TO INTERNATIONAL AUDITING STANDARDS

CHAPTER 1 - Purpose and Outline of the Manual/Reference to International Standards on Auditing

This manual has been prepared in order to provide guidance to the Audit Bodies of the Greek public administration on the methodology of data analysis in their audit work.

The audit work of an Audit Body and in particular the work performed by each audit team (Auditor) is based on data related to the audited environment. The Auditor is required to manage a large volume of data and, through appropriate analysis, to transform it into information, some of which is useful for planning the audit work and some of which can be used as evidence to formulate the audit opinion.

In accordance with International Standards on Auditing[1] (ISA 500 - Audit Evidence), the Auditor has a responsibility to plan and perform audit procedures to obtain sufficient and appropriate audit evidence and to be able to draw reasonable conclusions on which to base his or her opinion.

Audit work involves a set of tests, based on the analysis of data from different populations, which provide reasonable assurance for the formulation of the Audit Opinion. Audit testing can be divided into two main categories with different objectives:

A. Tests of audits, as evidence to support the claim that the procedures in a management system are implemented and that any observed deficiencies fall within tolerable deficiencies/deviations.

B. Substantive testing/detail testing, as evidence to support the assertion that an entity's financial statements/accounts are complete, valid and accurate and that its property, sources of finance and transactions (expenditure/revenue) are legal and regular and free from material misstatements/errors.

In the two categories of tests mentioned above, wherever possible, entire data populations are used and conclusions are drawn with the greatest possible certainty by applying analytical procedures (ISA 520 - Analytical Procedures). However, in most cases there is no

[1] https://www.iaasb.org/publications/2018-handbook-international-quality-audit-auditing-review-other-assurance-and-related-services-26

ability to examine entire populations of data. Sampling methods (ISA 530 - Audit Sampling) are therefore applied to select samples, on the basis of which conclusions are drawn about the respective populations with relative accuracy. The application of sampling methods aims at reducing the audit burden and balancing the cost- benefit trade-off of audits, taking into account various parameters, risks and constraints.

The data available to the Auditor are quantitative and qualitative and should be assessed as to their suitability, reliability and adequacy for the purpose of the audit.

The data may come from:

1. The internal environment of the audited entity. This is data relating to the operation of the audited entity, which is recorded in the accounting information systems and reflected in the audited entity's financial statements. Data on the audited entity of interest to the audit may include: the staff employed by the audited entity, the entities with which it cooperates and transacts, the contracts it has entered into, its assets, its sources of funding, its transactions (expenditure/revenue), minutes of meetings of decision-making bodies, management documents, etc.
2. The external environment of the audited entity. These are data recorded in databases maintained by third parties, benchmark data, etc.
3. Data available to the auditor from previous audits related to the audited entity that are relevant to the purpose of the current audit.

Accordingly, data collection and analysis techniques and sampling methods have a significant impact on the reliability of the Audit Opinion. It is good practice to delegate responsibility for these matters to a specific organisational unit within the Audit Body.

Special software (Computer Assisted Audit Techniques - CAATs) may be used to support the audit work, data analysis and testing. Some of the most commonly used software in auditing are: Microsoft Excel, ACL, IDEA, SAS and various Business Intelligence (BI) software.

The following chapters present:

- A gap analysis between the current and the desired situation of the ESOL Audit Entities in the field of audit data analysis (Chapter 2).
- A guide to analytical investigation procedures according to the data analysis approach to testing (Chapter 3).
- Guide to sampling procedures and methods in the audit (Chapter 4).
- A guide to codification and exploitation of audit results (Chapter 5).
- The concept of electronic consistency and ethics in the protection of personal data (Chapter 6).

CURRENT SITUATION AS OPPOSED TO DESIRED SITUATION OF THE INSTITUTIONS IN ANALYSING AUDIT DATA

2

CHAPTER 2 - Current situation versus desired situation of the ESF bodies in the analysis of audit data

This chapter presents a gap analysis between the current and the desired situation in the field of development and implementation of audit data analysis procedures and methods by the Audit Entities participating in the ESOEL (at the time of writing, June 2021). The analysis is based on the Audit Entities' responses to a relevant questionnaire submitted and completed through the Google Forms platform.

The respondents to the survey indicated the scope of their audit activity. As Figure 2 below reveals, the vast majority (66.7%) of the bodies participating in the ESOEL ensure, as part of their audit activity, the prevention, detection and response to corruption and fraud. The majority of the bodies carry out checks on the legality/regularity of contracts and expenditure (58.3%). Half of the bodies stated that they carry out checks on procedures and the functioning of systems. 25% of the Entities carry out performance audits, while a smaller percentage (16.7%) appear to be carrying out audits on revenue and loans.

Graph 2: *Scope of audits of ESOEL bodies*

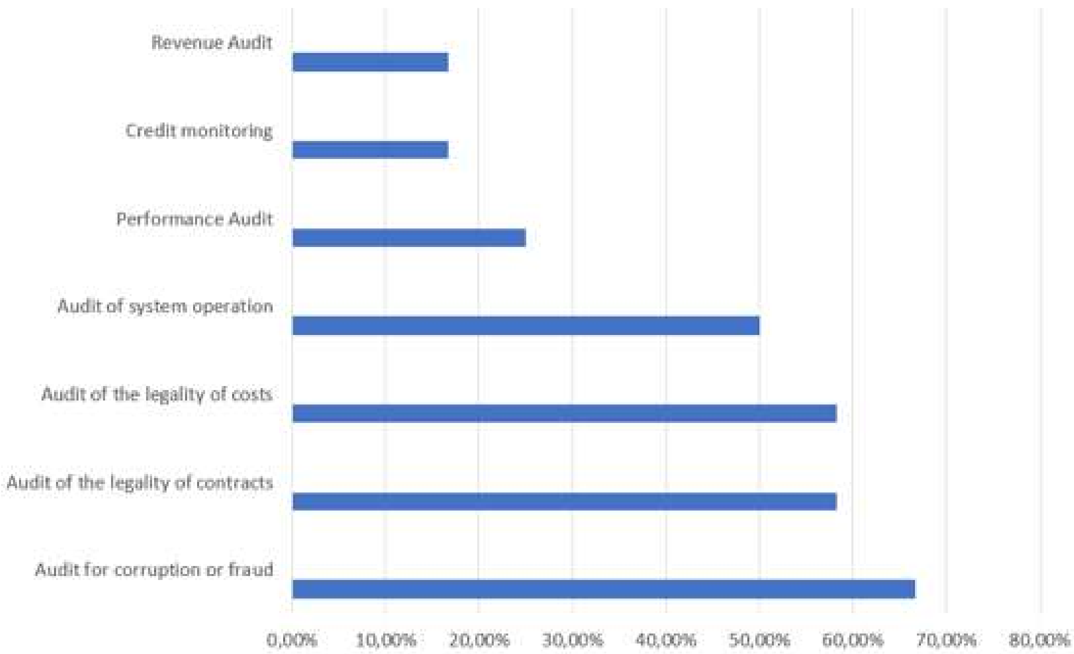
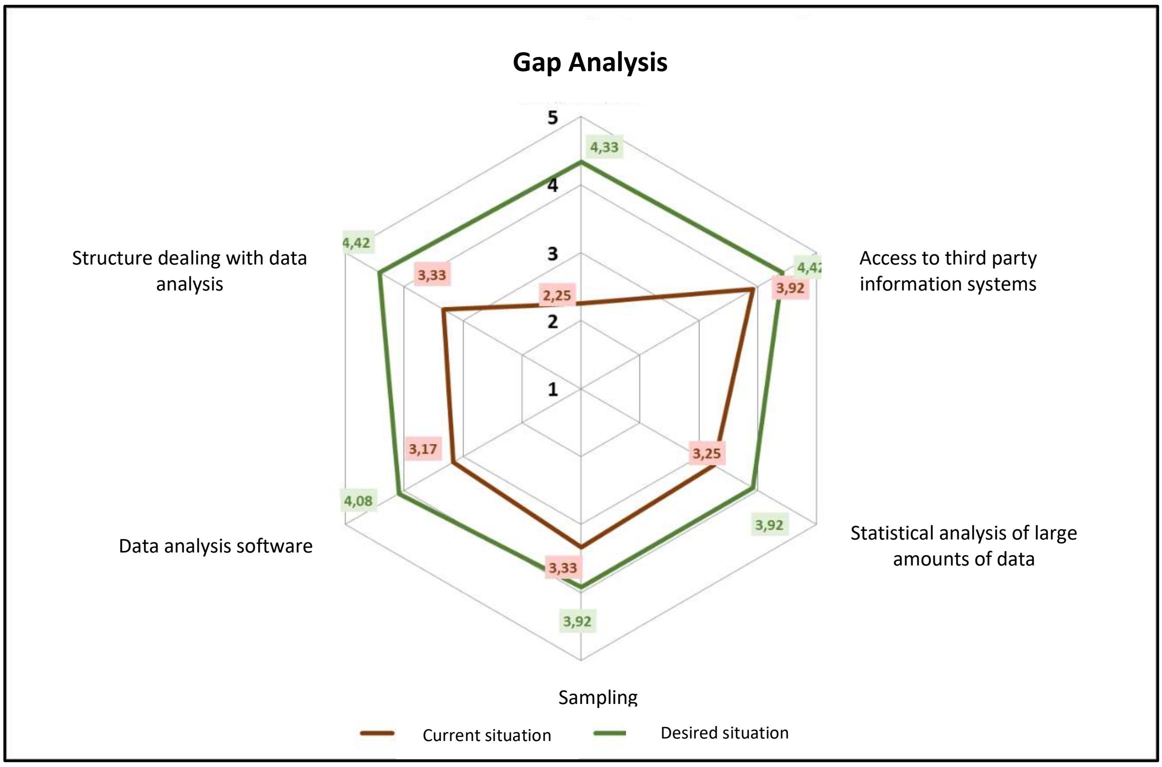


Figure 3 below illustrates the present versus desired condition on the key axes of the audit data analysis. The finding of underperformance is evident, which demonstrates the feasibility of designing and implementing an Audit Data Analysis Strategy with priority axes:

1. e-cohesion by achieving interoperability of information systems.
2. The provision of units or teams of staff responsible for the analysis of audit data.
3. Training of staff in data analysis and sampling audit methods and related software.

Graph 3: *Existing versus desired situation in the field of audit data analysis*



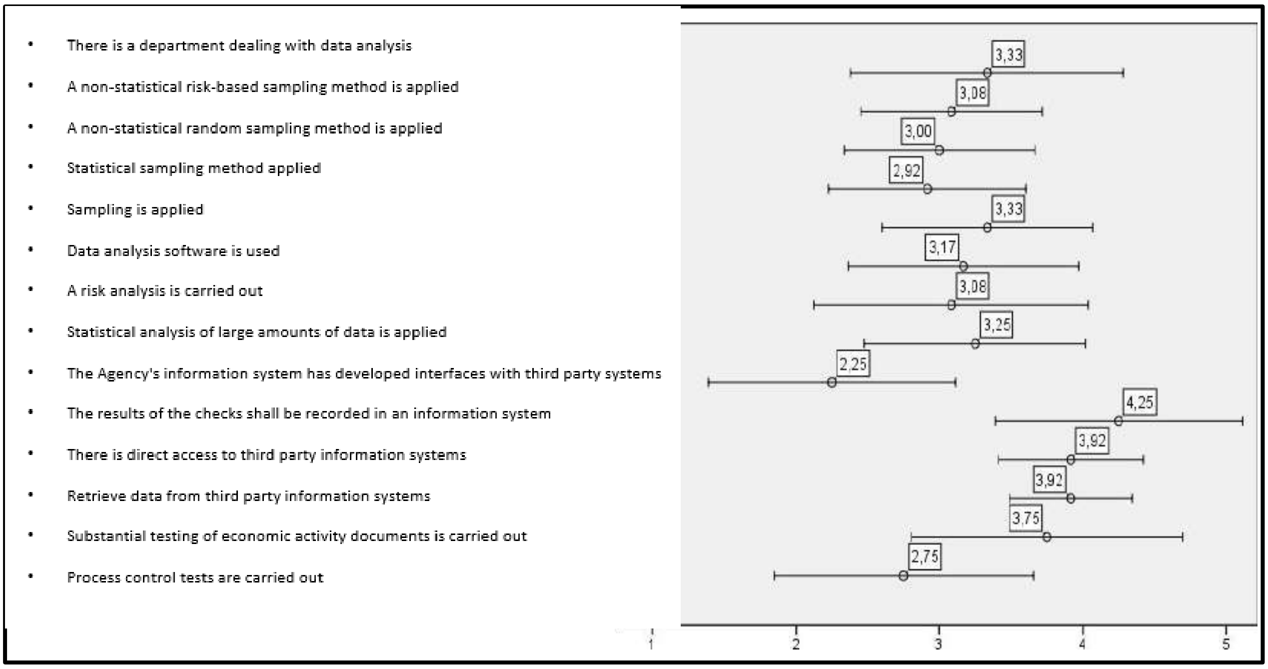
Averages (Scale 1: Not at all, ..., 5: Absolutely)

This manual provides guidance and direction for bridging the gap between the current and desired situation in the field of development and implementation of audit data analysis procedures and methods by the Audit Entities participating in the ESOEL.

Graphs 4 and 5 present the results of the survey in more detail. In particular:

On the basis of the questionnaire, the Audit Entities assessed (on a 5-point scale) the current situation in relation to the extent to which their audit work/procedures include the items listed in Figure 4.

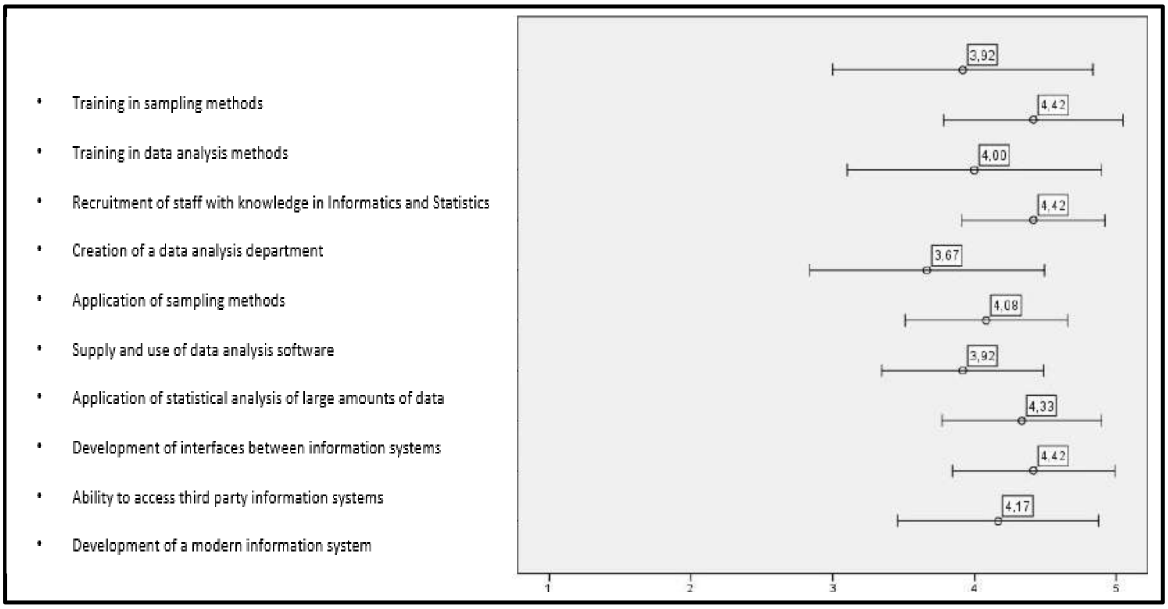
Graph 4: *Current situation in the field of audit data analysis*



Averages (Scale 1: Not at all, ..., 5: Always)

Also, based on the questionnaire, the Audit Bodies assessed (on a 5-point scale) to what extent they believe that the items listed in Figure 5 are useful to improve the quality of their audits:

Figure 5: *Desired state in the field of audit data analysis*



Averages (Scale 1: Not at all, ..., 5: Absolutely)

ANALYTICAL PROCEDURES FOR DATA ANALYSIS

3

CHAPTER 3 - Analytical Procedures for Investigation/Data Analysis

According to international auditing standards, the term "Analytical Procedures" (ISA 520 - Analytical Procedures) refers to the processes of analysing financial and non-financial information and performing tests to investigate the validity of assumptions and specifications and to identify any significant deviations from them. In modern auditing, analytical processes involve the use of big data populations and data analytics to assess risks and perform analytical tests to ensure that sufficient evidence is available to formulate an audit opinion with the greatest possible assurance.

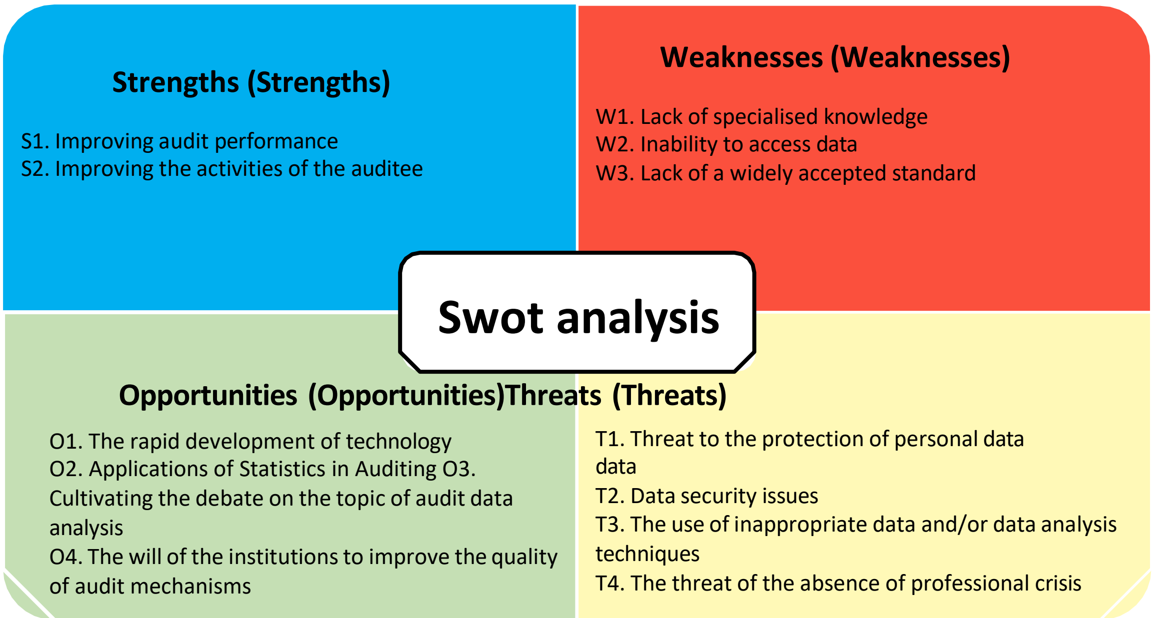
Data analytics is the science-art of analysing and correlating raw data in order to extract information and conclusions about the characteristics of a population. Many of the techniques and procedures of data analytics can be automated by programming a variety of software processes and algorithms that process raw data and produce results (data mining).

Audit data analysis is a culture much broader and deeper than traditional analytical investigative processes. It involves the use of powerful software tools and statistically complex procedures. Audit data analysis allows exploring new ways of managing and utilizing large sets of audit-related data from internal and external sources to produce audit evidence during risk assessment, substantive testing and audit testing.

3.1 SWOT analysis

Each Audit Entity may, as a good practice, include in the Audit Strategy the objectives, rules, procedures, tools and methods for the collection, management, analysis and presentation of audit data. A SWOT analysis, presented below, can contribute to the design of an audit data analysis strategy, taking into account the strengths achieved, seizing opportunities, addressing weaknesses and preventing threats.

Figure 6: *SWOT analysis*



3.1.1 Strengths

The adoption of the culture of using analytical audit data is a modernization in the field of auditing, improves quality and changes the trade-off of the cost-benefit balance of the audit, bringing added value to the auditor, which is transferred to the auditee.

S1. Improving audit performance

The use of analytical audit data enhances the mix of audit approaches and methods and improves the effectiveness, efficiency and economy of the audit. Many of the audit work and tests that were performed on a sample-based basis, weighing the cost and the desired reasonable assurance of the audit, can be designed and performed alternatively:

- ➔ On the entire population of transactions and activities.
- ➔ Examination of data populations is done with high speed using technology, at a lower cost, on a more frequent basis and without a site visit to the subject. Several tests, either on the implementation of procedures or on the flow of transactions/activities, can be put under continuous audit, with the auditor and auditee agreeing in a dynamic process on the monitoring of specific audits through intelligent information systems which are audit-oriented and provide specific real-time reporting. Examining data across a population reduces the risk of audit and access errors and fraud and enhances the evidence and assurance for the expression of an audit opinion.

➔ Risk-based and exception-based. The analysis of a population's data enables the identification of
risks and exceptions (outliers and patterns) and leads to focused testing, rather than selecting a random sample. Even if a small random sample is initially selected, this can be used as a basis for initial pilot testing and, from the analysis of the results, identify areas of risk on which an additional 100% audit can be focused. By analysing the data, problem areas can be identified more quickly and the scope and cost of the audit can be reduced. At the same time, greater validity and accuracy of the audit opinion documentation is ensured.

S2. Improving the activities of the auditee

The added value gained from the analysis of data and the more timely and accurate identification of problems is translated into recommendations and suggestions (action plans) to improve the quality of the auditee's activities and safeguard the interests of the funding bodies. The auditee gains quality services from the audit and timely improves its management and monitoring processes of its activities towards avoiding risks and errors that would result in both a real cost (revenue shortfall, waste of resources, financial corrections/recoveries from funding bodies) and a reduction of reputation.

3.1.2 Weaknesses

It is to be expected that from the adoption to the effective application of data analysis in auditing, every Audit Body encounters weaknesses that it has to address.

W1. Lack of specialised knowledge

The auditors and other staff of the Audit Entity may not have the appropriate expertise and skills to extract and analyse large numbers of data. Addressing this weakness requires the employment of specialised staff in the fields of IT and statistics and the continuous training of auditors themselves in new technologies and data analysis techniques. As a good practice, it is recommended that a special unit or team be set up to design the audits and produce a methodology geared to the analysis of large amounts of data. All this requires an additional cost that not all audit bodies, especially those with a smaller activity, can bear. The cost of training could be covered either by funding through Programmes or by partnerships between the Audit Bodies.

W2. Inability to access data

Access to data is not always possible, due to: the lack of interoperability (interface) between information systems or the reluctance of the auditee to provide his data to the auditors, often invoking the privacy policy. Cultivating a culture of e-cohesion and audit ethics can overcome these obstacles.

W3. Lack of a widely accepted standard

Although international auditing standards provide for analytical investigation procedures and risk analysis in audit work, and as the international standard setters have documented the results of working groups on the topic of audit data analysis, there is currently a lack of consistency or a widely accepted analytical standard. There is no specific regulation or guidance that covers all uses of data analysis in an audit and it may not be feasible to have one. This leads Audit Entities to set their own principles and develop their own data analysis tools with their own resources.

3.1.3 Opportunities

The world of auditing must evolve, taking advantage of the opportunities provided by the development of information technology and statistical science.

O1. The rapid development of technology

The development of the internet and the sophisticated intelligent information systems, which most economic operators use to digitise their activities, are reservoirs of large volumes of raw data that can be extracted in a targeted manner, summarised, presented using Business Intelligence Software and used for auditing purposes. The culture of electronic consistency and interoperability between information systems, with the help of BI technology, makes it possible to synthesise data from many independent sources.

O2. The Applications of Statistics in Auditing

The application of statistical methods and the development of algorithms for data mining and analysis in the field of auditing, combined with the widespread use of BI software, put the auditing profession on a new basis and trajectory.

O3. Fostering discussion around the topic of audit data analysis

The challenges and motivations brought about by the culture of audit data analysis in the field of auditing are feeding the debate around the topic, which is evolving in academia, in the field of audit bodies/companies, as well as in working groups[2] coordinated by the international organizations that establish auditing standards.

O4. The will of the institutions to improve the quality of audit mechanisms

The executive at national and European level, civil society and investors are interested in strengthening audit mechanisms in all areas of economic activity. To this end, bodies are being set up and rules and audit procedures are being established. In addition, funding is being strengthened through programmes to modernise audit methods and procedures using business intelligence (BI) technology.

3.1.4 Threats

Access to large amounts of data (big data) and their analysis in order to draw reliable conclusions and make appropriate decisions, pose certain risks / threats, which should be prevented or dealt with.

T1. Threats to the protection of personal data

In case the data is leaked intentionally and used by third parties other than the auditees-auditors concerned, then the privacy and confidentiality of the data and the institutional framework for the protection of personal data (EU GDPR Regulation - 2016/679)[3] is violated. To avoid this unpleasant situation, the auditee-auditor cooperation must be governed by Codes of Ethics and Confidentiality.

T2. Data security issues

The leakage of data may be due to interception by illegal activity such as phishing or hacking. To counter such activities, continuous upgrading of the security of information systems and the internet in general is required. Access to data in information systems should be classified and require specific authorisation.

T3. The use of inappropriate data and/or data analysis techniques

The completeness and correctness of the extracted data may not be guaranteed, especially in cases where extraction from multiple data storage systems is required. Also, the application of appropriate data analysis techniques is not always guaranteed. These result in misleading or biased conclusions being drawn and, as a consequence, an erroneous audit opinion. Addressing this threat requires qualified staff in IT and Statistical Analysis who are continuously trained.

T4. The threat of the absence of professional crisis

Auditors and their professional judgement cannot be completely replaced by computers and data analysis algorithms. The reasonableness of the conclusions of a technical/statistical analysis should be assessed, and the uncertainty involved should be taken into account.

[2] https://www.iaasb.org/publications/exploring-growing-use-technology-audit-focus-data-analytics

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32016R0679

3.2 Workflow in Audit Data Analysis (Workflow)

A typical procedure that can be followed in data analysis includes the following 7 steps.

Figure 7: *Workflow in Audit Data Analysis*

Step 1: **Identification of auditing objects/objectives of the data analysis**	In any audit, to arrive at the right answers and conclusions we need to ask the right questions. Initially, in each audit, a mapping of the audit points should be done in the context of an audit questionnaire, and those audit points (characteristics-variables) that could be examined by analysing data from a population of transactions/activities should be marked. It should be stressed that it is neither possible nor necessary to express all audit items as data analysis items. Identifying the appropriate audit points that can be examined by data analysis is a problem multifaceted and it is not possible to provide

predefined answers. Each Audit Body - most likely in each audit - has to deal with different audit objects. However, the audits of each Audit Body can be grouped together on the basis of common characteristics. Common characteristics include common audit objects (audit points). Therefore, similar audits can be carried out with a common questionnaire and the audit points to be addressed by data analysis can be predefined.

Some indicative audit items that could be subject to analytical investigation and data analysis are the following:

A. Financial data of the Accounts

- ✓ Comparison over time of the financial information in the audited entity's accounts.
- ✓ Comparison of the certified financial figures of the audited entity's accounts for the current financial year with the expected figures based on budgets and forecasts.
- ✓ Comparison of the financial results of the audited entity's accounts for the current financial year with the corresponding results of the industry in which the audited entity operates.
- ✓ Study the relevance of the financial figures of the audited entity's accounts for the current financial year to non-financial information.

B. Funding

- ✓ Check for double financing (double financing)
- ✓ Conflict of interest (conflict of interest)
- ✓ Accounting and financial indicators

C. Risk-based fraud audits (red flags)[4]

[4] *The ACFE (Association of Certified Fraud Examiners) website presents an extensive library of anti- fraud data analysis tests. It is an interactive tool that presents, by type of fraud risk, various red flags that can be considered in data analysis testing (www.acfe.com/fraudrisktools-tests.aspx).*

- ✓ Risks of Corruption (Corruption)
- ✓ Risks of misuse of assets
- ✓ Risks of Fraud in Financial Assets

Step 2:

Investigation of available data sources and the accessibility to them

Having concluded that a given audit subject can benefit from a data analysis solution, the next step is to investigate the availability of data sources (databases and information systems, surveys, internet, interviews, cameras) to determine the feasibility of data collection.

The possibility to collect data includes ensuring accessibility to data sources while respecting the confidentiality of personal data. Therefore, the auditee-auditor cooperation should be governed by a Confidentiality Agreement.

Step 3:

Design and application of mining techniques and determination of the time and frequency of data extraction

Once the availability of data has been ensured, extraction techniques should be designed and implemented with a defined frequency. In particular:

- ➔ The data mining process can be automated by developing interoperability (interfaces) between information systems and using business intelligence (BI) software. The Audit Body may have access to the auditee's information system or the data may be entered and stored in a database (information system) of the Audit Body through the development of web services as part of an e-cohesion partnership. In other cases, the data may be requested by the Audit Body by submitting requests through a Help Desk process that may have been agreed with the auditee. However, there may also be cases where the Audit Body does not have access to the primary data but can order the body holding the data to supply the data to the carry out a specific analysis of them, with a view to benefiting from the result of the analysis.

➔ Data pumping can be done periodically or in real time. The Audit Body should
limits the reporting times that the data of interest to the audit must have. For this reason, it should agree with the auditee (perhaps formally by signing cooperation protocols) on the deadlines for providing the data. The reporting times may be linked to the end of a typical Accounting Period, which is described in a legal framework, or to the achievement of milestones or targets. However, some of the data may be obtained at different frequencies based on the design of the audit work and the characteristics of the distribution of data populations. Some data may even be provided in real time if the audit is designed on a continuous audit basis by the Audit Body.

Step 4:

Assessment of data quality

Data intended for an analysis should first be assessed for quality. The reliability of the data is a prerequisite for the reliability of the analysis and the conclusions to be drawn from it. The famous 'garbage in - garbage out' principle captures the need to feed any data analysis process with appropriate data. Appropriate data is complete and accurate data in relation to the audit objective.

It is important that the entity that holds the primary data and therefore knows the structure of the data and the principles and problems associated with micro-data collection and coding, understands the audit objective, so that it can advise and provide the Audit Body with the appropriate data.

The Audit Body, once it has secured and stored the data and before it starts the analysis, must, in cooperation with the data owner, follow a data cleansing procedure. This process is an audit task and includes, by way of example:

- ✓ checking for missing values, which may have been inadvertently not extracted from the database or not entered in the database until the time of extraction.
- ✓ examining the reconciliation of analytical data from the auditee's accounting information systems with the auditee's official reports and statements.

Step 5:

Selection and use appropriate techniques and algorithms data analysis

The data and its format (structured/unstructured) have a significant impact on the choice of the most appropriate analysis algorithm. Their preparation (possible transformations to smooth the data) is in many cases the most demanding part of the whole process. Data analysis refers to a combination of software and various quantitative and qualitative analysis techniques used to identify trends, patterns, variability, deviations, anomalies and exceptions within a data set.

In data analysis we find the following types of analysis, based on the broader purpose:

1. Descriptive data analysis. Descriptive analytics describe what happened over a given period of time. Methods are applied that attempt to summarize raw data and extract some form of useful information that can be interpreted by the auditor. In a sense, the aim is to detect and describe what happened in the past. Automatic summarization is the process of shortening a set of data computationally to create a subset (summary) that represents the most important or relevant information about the audit item from the total content.

   The summary of the data may relate to:

- numerical data (qualitative and quantitative variables) and includes techniques of Descriptive Statistics (frequency tables and charts, numerical measures of position: mean, median, predominant value, percentiles, minimum value, maximum value, etc, measures of dispersion: range, interquartile range, variance, standard deviation, coefficient of variation, etc., measures of asymmetry and kurtosis, use of empirical symmetric distribution rule or Chebyshev's rule in a non-symmetric distribution),
- texts (controversial words or sentences), images (controversial pictures) and videos (important/revealing frames).

The generation of summary reports is an evidence base in audit work and helps to study the distribution/behaviour of data, fill in missing values, identify and investigate outliers and reveal risks on audit items.

2. Diagnostic Data Analysis (Diagnostic). This analysis focuses on:

- The comparative evaluation of actual events/transactions: a) with the expected ones based on specifications / milestones/ targets / budgets / timelines, b) with those of the past, and c) with those of the industry (benchmarking). The aim is to identify and interpret any discrepancies and assess their significance.
- On why something happened. Methods are applied to detect plausible cause-and-effect relationships between different variables (Correlation and Regression). Drill down techniques are also applied to explore the root causes of a problem in a department or area.

- Checking for irregular duplicate values and double financing by applying data matching techniques.
- The reperformance of calculations and procedures.
- Exploring anonymous or undefined datasets, applying diagnostic models such as: clustering, text mining, visualizations, process mining, etc.
- The application of other diagnostic techniques such as Benford's Law, Bayesian models, decision trees, neural networks, simulation models, factor analysis, discriminant analysis, analysis of variance, etc.

3. Predictive Data Analysis (Predictive). It aims to predict the future and make forecasts based on the estimation of patterns and trends in the given data set. Regression techniques/models are applied for forecasting based on cause and effect relationships, Logit Regression for forecasting the probability of an event (e.g. fraud) based on explanatory variables, Chronological Series Analysis (ARIMA/GARCH) for forecasting based on inherent patterns in the chronological data.
4. Prescriptive Data Analysis (Prescriptive). This analysis takes into account the weaknesses and errors identified in the processes in place and the diagnosed causes of these and focuses on recommendations and action plans to address/treat them. The main concern is to safeguard the processes in order to avoid errors, irregularities and phenomena of corruption and fraud, but also to optimise operations and processes in accordance with the principles of effectiveness, efficiency and economy.

   Dynamic simulation models can be applied to the prescriptive analysis to design optimal processes.

Step 6:

Selection and use of data analysis software

As already mentioned, the data sources are usually large structured databases held in integrated information systems. Utilizing special business intelligence (BI software) software enables the extraction of data populations and variables and their management and analysis with special audit software (CAATs, such as ACL, IDEA, CaseWare, etc.) and statistical packages (e.g. SAS, SPSS, etc.) that provide many technical analysis capabilities.

A progressively increasing number of audit apps, which can serve to simplify audit work, are available on the market. The software providers may not yet have fully standardised the apps according to a common audit data standard, but many have extensive libraries of scripts that can be adapted to various data formats, as well as export software that allows access to traditional data and enterprise resource planning (ERP) systems (e.g. SAP and Oracle). Also, many of the software have the ability to be customised, on demand by the customer.

Smaller Audit Entities that do not have the resources to purchase or custom-develop audit and audit data analysis software can implement data analysis technology, taking advantage of the many sources of free software and training materials currently available. For example, the open source R or Python software have one of the largest libraries of applications. These software may be despised by auditing bodies because they are not validated and oriented exclusively for auditing. While these concerns are justified, given that open source software may be less user-friendly than commercial software, their usefulness should not be ignored.

An extensive list of audit software, allowing anyone interested to carry out an adequate market research, is presented in the following websites:

- ✓ https://www.capterra.com/audit-software/
- ✓ https://www.softwareadvice.com/ie/audit/
- ✓ https://financesonline.com/best-auditing-software/
- ✓ https://www.goodfirms.co/blog/best-free-open-source-audit-software-solutions

The European Commission, in the framework of the co-funded Programmes and in order to help the Managing and Audit Bodies to meet the requirements of the Regulations on fraud prevention and audit, has developed the Arachne software[5]. It is an integrated IT tool for data mining and continuous data enrichment and at the same time a risk scoring tool with more than 100 risk indicators classified into specific categories to help Managing and Auditing Authorities prevent and detect errors and irregularities among projects, beneficiaries, contracts and contractors. Arachne has been in operation since September 2015, is being fed back and continuously improved.

Arachne draws and synthesizes information from various sources including two external databases (Orbis and World Compliance). These two databases feed information on public reputation and financial and personal information on economic operators, which is updated quarterly and combined with Arachne's internal database, which is continuously fed by the Managing Authorities with data on projects and contracts. These sources are combined weekly to update the risk scores.

Step 7:

The software and algorithms used in auditing will in no way replace the software and algorithms used in auditing.

[5] *https://op.europa.eu/en/publication-detail/-/publication/71c53825-fbb9-11e5-b713-01aa75ed71a1/language-en*

Extraction of results, interpretation and conclusions / Presentation Results	auditor and his professional judgement. However, they help to improve the productivity and accuracy of the auditor's work. The auditor, using the capabilities of technology and the science of data analysis, is required to synthesise and interpret the information, assess the significance of any weaknesses, discrepancies and errors and reach appropriate reasonable conclusions, expressing the audit opinion with reasonable assurance. Audit software shall provide the possibility of presenting audit results in tables and graphs. The clarity in the presentation of the results in the audit report makes the documentation of the conclusions more convincing and contributes to their easier acceptance by the auditees.

Considering the above, it can be concluded that an Audit Body can benefit from the Art of Data Analysis and improve the quality of audit services, benefiting: for itself and its reputation, for the auditee to whom the added value is transferred, but also for third party stakeholders.

As a good practice, the audit body may keep a register of data analysis cases. In particular, for the purpose of documenting its audit work, each audit should reflect in the audit approach the instances of the audit items to which data analysis was applied. For this purpose, the following Table X may be completed. As a consequence, Table X can be fed with information from all audits of the Audit Entity and constitute a register of data analysis cases, which will be a valuable knowledge management tool to help standardise its audit work, while at the same time it can be made available and used by other Audit Entities as part of a know-how exchange process.

Table X - *Register of data analysis cases*

A/N	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
	Audit object/objective	Source : data/accessibility	Mode and frequency of data extraction	Assessment of the quality of data	Data analysis technique/algorithm	Data analysis software	Conclusions / Method of Presentation
1							
2							
3							
4							
5							
...							

For more information and knowledge in the field of Data Analysis in auditing one can refer to the internet. The following links are provided as examples:

Introduction to Audit Analytics
https://www.youtube.com/playlist?list=PLauepKFT6DK8nsUG3EXi6lYVX0CPHUngj

Special Topics in Audit Analytics
https://www.youtube.com/playlist?list=PLauepKFT6DK-PpuseJtSMlly-YBhaV4TH

SAMPLING AND RISK ANALYSIS IN AUDIT PROCEDURES

4

CHAPTER 4 - Sampling and risk analysis in audit work

This sampling guide has been prepared to provide guidance on the basic principles for sampling and risk analysis procedures, as well as information on the most commonly used and appropriate sampling methods in the Audit Bodies. The International Standards on Auditing (ISA 530 - Audit Sampling) and Sampling Theory provide guidance on the use of audit sampling and other means of selecting items for testing when designing audit procedures.

It should be noted that the application of sampling in audit work is institutionalised and applied in the context of EU co-financed programmes from EU funds. In particular, Member States' Audit Authorities apply sampling on the basis of EU Regulations (as applicable) and for this purpose, a detailed "Guide to Sampling Methods for Audit Authorities (EGESIF 16-0014-01 20/01/2017)" has been issued[6] .

4.1 System Audits - Risk Analysis - Sampling

A management system is a set of interdependent administrative authorities (bodies/entities), structured with a specific organisational structure, which apply comprehensive procedures and develop individual activities with the objective of sound financial management.

Audits of management systems aim to assess the effectiveness of the implementation of the procedures under which they operate and provide an audit opinion on the level of assurance provided by the system (audit assurance) or, alternatively, an assessment of the internal audit risk.

4.1.1 Audit Risk Model

Both audit design and system evaluation use data that can feed back into a multiplicative model of audit risk.

where

$$AR = IR \times CR \times DR$$

[6] https://ec.europa.eu/regional_policy/sources/docgener/informat/2014/guidance_sampling_method_en.pdf

- Audit Risk is the risk that an incorrect audit opinion may be expressed on the reliability of the Management System and on the legality and regularity of transactions. That is, it is the risk of expressing: (a) a qualified or adverse opinion when there are no material deficiencies/errors or (b) an unqualified opinion when there are material deficiencies/errors.

  Audit Risk and Audit Assurance are complementary concepts. That is, low risk means high assurance and vice versa. The Audit Risk is set in advance at a low acceptable level (e.g. 5%) so that the audit opinion is expressed with a high level of reasonable assurance.

- Inherent Risk, which is inherent in a system, is the probability of a significant error occurring in the absence of internal and external audit.
- **Internal Audit** Risk is the probability that internal audit will not detect significant errors.
- Detection Risk is the probability that a significant error will not be detected by the external audit.

4.1.2 Selection of a sample of Bodies and Processes for audit based on Risk Analysis

<u>Step I</u>

According to the multiplicative audit risk model, three types of risk can be assigned to each audited system (Institution/entity):

- **Intrinsic** Risk (IR). It is composed of factors describing the complexity of the entity's system, such as the amount and number of transactions, the number and type of projects, the number of activity areas, the role of the entity, the legal form, etc.
- **Internal Audit** Risk (CR). It concerns the reliability of the system and results from the assessment of its operation on the basis of the main processes (fundamental requirements).

IR&CR risks may be scored from 0 to 1 expressing the corresponding risk probabilities. Intrinsic Risk (IR) and Risk

Internal Audit (CR) jointly define the Risk of Material Misstatement in the absence of external audit RMM (Risk of Material Misstatement) which is scored from 0 to 1 and is derived from the product $IR \times CR$.

- Risk **of** non-detection (DR): can be calculated on the basis of the audit risk multiplier model. Since the Audit Risk is derived from the formula: $AR = RMM \times DR$, the Non-Detection Risk
  (DR) for each operator is determined as $DR = AR/RMM$.

<u>Step II</u>

Based on the risks corresponding to each audited system (Institution/entity), the priorities, objectives and scope of audits can be prioritised. In particular,

- Entities can be ranked in descending order of risk of material misstatement (RMM) and the most "risky" ones can be checked as a priority. The Audit Entity may also prioritise specific categories of entities by assigning weights and quotas per category.
- In the design of each audit, objectives may be prioritised on the basis of the internal audit risk (CR) assessment and, in particular, on the risk associated with key processes (fundamental requirements).
- The extent of the tests of audits, if they are carried out on a sample basis, is affected by the DR. The DR may be used to estimate the confidence level (1-a or 1-DR), which is one of the parameters for calculating the sample for the audit tests during system verification (see point 4.1.3)

The Risk Analysis is applied for the planning/scheduling of audits and audit missions and is specified and described in the Audit Strategy of the Audit Entity and/or the Audit Program Memorandum of each audit mission. In particular, the risk factors (variables) to be used, the scales for measuring the variables and the values assigned to them, as well as the prioritisation of objectives and the scope of the audits are described. A model Risk Analysis and Audit Prioritization table is presented in Appendix 4.a.

4.1.3 Sampling in the Audit Tests

In the context of systems audits, Tests of audits are performed by the auditor as evidence to support the assertion that the procedures in a management system are implemented and that any observed deficiencies fall within tolerable deficiencies/deviations. Where tests of audits are performed on a sample basis, a statistical or non-statistical sampling approach may be applied based on professional judgement as to the most effective way of obtaining sufficient appropriate evidence to support the assertion.

Since for system audits, the auditor's analysis of the nature and cause of errors is important, as well as the simple absence or presence of errors, a non-statistical sampling approach might be appropriate. The auditor may in this case choose a fixed sample size of objects to be examined for each key process (key audit) of the system. However, professional judgement should be used to apply a targeted or risk based sampling, taking into account relevant risk factors, in order to set the priorities and scope of the audit. If a non-statistical approach is used, then the results cannot be statistically projected to the population.

Attribute sampling is a statistical approach that can help the auditor determine the level of system reliability and assess the percentage of deficiencies observed in a sample. This method is used in audit testing to provide documentation whether the rate of deviation in the implementation of a procedure exceeds a tolerance (specification) and to assess the level of internal audit risk. Attribute sampling asks binary questions/assertions of 'YES or NO' about the compliance of a procedure with respect to some limits/specifications/conditions. The results from the examination of the sample items can be statistically projected to the population.

In particular, each test considers the following pair of hypotheses:

H_0 : percentage of deviations $\leq$ tolerable percentage of deficiencies H_1 : percentage of deviations $>$ tolerable percentage of deficiencies

Where attribute sampling is applied, the following points shall be followed and described as a minimum in the audit approach:

The audit objectives sampled and their importance	The sampled audit objects/attributes/checkpoints to be tested are processes (or process stages) described in the design of the management system and are usually questions in the audit questionnaire. Examples of attributes tested are: - The Managing Entity shall publicise the calls for proposals, allowing sufficient time for potential beneficiaries to submit their proposals (testing on a sample of calls). - The Managing Authority checks the funding applications for completeness (testing on a sample of funding applications). - The Management Entity examines whether a request for amendment of a contract provides all the supporting documents that substantiate the need for amendment (test on a sample of requests for amendment of a contract). A complete list of the features sampled during the system audit shall be marked in the audit questionnaire. Some of the procedures may be classified as high severity.
The tolerable rate of deviation ***(tolerable deficiencies/ deviations)***	Tolerable percentages of deviation or tolerance (specification) limits (e.g. 10%, 25%) are defined for the application of a procedure, - both when planning the sampling and in particular for determining the sample size, - as well as when assessing the significance of the deviations, i.e. the answer " NO" or "Significant Deviation" relates to the absence of a characteristic at a rate exceeding the threshold of the "tolerable deviation rate".

The sampling unit (sampling unit) and the respective populations

The sampling unit is related to the auditled characteristic, e.g. notices, applications, requests, tenders, contracts, inspections, verifications, payment requests, etc.

The subject populations are delimited both in relation to the type of sampling units and to the time period covered by the audit.

The sample size and the sampling parameters

For Feature Sampling, the calculation of the sample size "n" can be done with the formula[7] :

$$n = \frac{{}^2z \times p \times (1 - p)}{T^2}$$

Where the sampling parameters:

- **z** is the percentage point of the standard normal distribution associated with the desired confidence level[8] set in the test, taking into account either one-sided (1-a), or
two-sided (1-a/2) confidence levels[9] . Indicative

[7] *When the population size (N units) is small, i.e. if the final sample size represents a large proportion of the population (typically more than 10% of the population) the adjusted formula can be used:*

$$n = \frac{{}^2z \times p \times (1 - p)}{T^2} / (1 + \frac{{}^2z \times p \times (1 - p)}{N \times T^2})$$

[8] *The desired level of confidence is determined on the basis of professional judgement, taking into account the Risk of Non-Detection (DR).*

[9] *According to the chosen confidence level, the used value z is calculated from the Standardized Normal Distribution, which corresponds to its (1 - a)% percentage point, where (1 - a)% is the specified confidence level when the focus is only on the calculation of the Upper Deviation Limit (UDL) or only the Lower Deviation Limit (LDL). Where the calculation of a Confidence Interval is required, these values are increased as they are now equal to (1-α/2)%. Taking into account the fact that when estimating the variance/error, the focus is only on the Maximum Deviation Limit (LDL), it is considered optimal, for reasons of economy and efficiency of testing, that the mapping of the confidence level to the z value is determined on the basis of the approach leading to one-sided confidence limits. The 'α' is called the statistical significance level and represents the probability of a type I error in a statistical test, i.e. the probability of a statistical test hypothesis being incorrectly rejected (false alarm). In the case of a test of a characteristic, a type I error means that the tester falsely concludes that the deviation exceeds the tolerance limit. Note that z values for various confidence levels (1-α) can be calculated in Excel with the function =NORMSINV(1-α).*

Prices z for various levels confidence levels are presented in the table below

Trust level	60%	70%	80%	90%
one-sided: Price $z_{(1-a)}$	0.253	0.524	0.842	1.282
two-sided: Price $z_{(1-\alpha/2)}$	0.842	1.036	1.282	1.645

- ***p*** is the anticipated population deviation rate, estimated from historical data or observed from a pilot sample.
- ***T*** is the maximum tolerated rate of deviation

Note that the tolerable deviation rate should be higher than the expected population deviation rate as, if this is not the case, the test is not fit for purpose (i.e. if a 10% deviation rate is expected, setting a tolerable deviation rate of 5% is pointless because more deficiencies are expected to be observed in the population than is set as tolerable). However, in the case where it is deemed appropriate to conduct a test without being able to determine the expected rate of deviation in order to estimate the rate of deviation on the basis of a sample, then the highest possible accuracy in estimation for a given confidence is achieved by taking a sample size resulting from setting p=0,5. Note that,

- as p approaches 0.5 (ceteris paribus), the sample size increases,
- as T decreases (ceteris paribus), i.e. when a tighter tolerance limit is set, the sample size increases,
- as the confidence (1-a) required to draw conclusions (ceteris paribus) increases, the z value and hence the sample size increases.

A sample size calculation template is presented in the spreadsheet Annex 4.b

The sample selection method (sample selection method)	After calculating the sample size, the sample, i.e. the sampling units, is selected. The selection must be based on probability theory and, therefore, a random number is given to each population unit and the sample units are selected based on the order of the random numbers. Therefore, each unit of the population has an equal probability of being selected in the sample. Note that some population units may be given a different weighting based on risk or other decision criterion and thus a different probability of selection.
The stratification of the population	When planning the sampling, the population of units may be divided into strata (for representativeness or risk) and quotas may be set to apportion the sample size according to the size or risk of each stratum. In this case, the sampled units shall be selected randomly per stratum (with a limitation of at least 3 units per stratum).
The population inference process	In each audit test, the number of deviations observed in the sample, divided by the number of items in the sample (i.e. the sample size), is the Sample Deviation Percentage **ps.** This percentage is an estimator of the deviation rate in the population. In the case where a sample has been selected on the basis of stratification, the percentage of deviation per stratum can be calculated. In the case where in a audit test the *ps* is higher than the tolerable deviation rate (*ps>p)*, the claim that the audited process in a management system is not substantiated, since it is estimated that the deficiencies exceed the tolerance limit. In this case, the audit team may test additional units by extending the initial tests (initial sample) (not necessarily in a random manner and perhaps to the entire audited population, if this is is feasible), in order to be led to safer

conclusions with the greatest possible certainty and accuracy. On completion of the tests on the total sample (initial sample and extension), if *ps>p* then 'NO' is selected to apply the audited procedure.

In addition to the above quantitative assessment, the monitoring team must also carry out a qualitative assessment, which should take into account any compensatory/mitigating factors that may justify the choice
'YES' for the application of the audited procedure, even though the audit tests indicate that the percentage of deviation exceeds the tolerable percentage of deviation p.

Based on the audit tests and indications
"YES"/"NO" for the implementation of each procedure in a management system, the level of assurance of the system (Audit Assurance) is assessed and, therefore, the assessment of the level of internal audit risk is fed back. The assessment of the management system is a complex bottom-up hierarchical analysis starting with the audit tests of each process and ending with the rating of the whole system. The management system evaluation process is presented in Chapter 5.

For cases where the sample size is large enough (e.g. larger than 30 units), the Upper Limit of Deviation (ULD) can be calculated as follows:

1. Estimation accuracy (SE) (sampling error) is calculated as a measure of the uncertainty associated with the projection (extrapolation). The precision is given by the following formula

$$S\mathrm{K} = z \times \frac{{}_{s}p \times (1 - p\,)_{s}}{\sqrt{n}}$$

2. The achieved Upper Limit of Deviation (ULD = $_{ps}$ + SK) is calculated, which is a theoretical figure based on the sample size and the number of

of deviations presented and represents the maximum percentage of population deviations at the specified confidence level[10] .

3. If p_s is lower than the tolerable deviation rate and ULD is higher than the tolerable deviation rate, then the selected sample is not sufficient to form an opinion on the materiality of the deviation based on the desired level of confidence.
4. In the latter case (3) additional units for the audit tests are required in order to draw more reliable conclusions.

Feature sampling is a general method and therefore some variations can be applied for specific purposes. Among these, discovery sampling and stop-or-go sampling serve specific needs.

Localisation sampling aims to audit cases where a single error would be critical. For example, when investigating some procedures for which some of the population units are at higher risk or are more important than others, they may be tested regardless of random selection. In these procedures, priority for audit is given to the high risk/significance population units, which are identified based on the audit judgment of the Audit Team. In addition, tracer sampling is particularly oriented towards detecting cases of fraud. Based on attribute sampling, this method is not suitable for projecting results to the population if errors are found in the sample. Tracer sampling is suitable for specific system audits.

Stop-or-go sampling results from the frequent need to reduce the sample size as much as possible. This method aims to conclude that the population error rate is below a

[10] *For example, if the confidence level is set to be 90%, the actual percentage of deviations in the population is less than the ULD with a probability of 90%. That is, if the process of taking a random sample and calculating the corresponding ULD is repeated many times, then the actual percentage of deviations will be less than the maximum deviation limit in 90% of cases.*

predefined level at a given confidence level, by examining as few data samples as possible. Sampling shall stop as soon as the expected result is achieved. This method is also not suitable for projecting results to the population, although it may be useful for evaluating the audit conclusions of the system.

4.2 Audits of Financial Statements - Sampling

4.2.1 Sampling of expenditure/revenue

The design and application of sampling techniques in the context of expenditure/expenditure audit should aim at reducing the audit burden and balancing the cost-benefit of audits, taking into account various parameters, risks and constraints. The design of a regular audit programme based on sampling is described in the Audit Strategy of the Audit Body. In particular, the documentation of the sample selection process is a planning document accompanied by worksheets.

The following basic steps are followed in the design and implementation of sampling techniques:

<u>STEP 1</u>:

Definition of the purpose/objective of the sampling (purpose/objective)

In order to estimate the level of error in the population of expenditure or revenue (over-statements/under-statements) declared in the accounts of an accounting year[11] and, therefore, to ensure that the Audit Body is able to issue a valid audit opinion, a random and representative sample is selected by applying sampling rules.

<u>STEP 2</u>:

Determination of the Population and Sampling Unit (Population/ Sampling Unit)

The population consists of the declared expenditure/revenue related to a management system for a reference accounting period (year) (e.g. 1/1/N to 31/12/N).

[11] *The accounting year is usually 12 months.*

A sampling unit is defined as an object (e.g., project) or subject (person or entity)[12] depending on the characteristics of the population and the physical object of the units. If the population is stratified, the same sampling unit is defined within each stratum, but it may be different between strata.

The object of the audit shall be the expenditure/receipts declared in the accounting year of the reference year for the units selected in the sample.

Identification/Reconciliation of the Population with the declared expenditure

Prior to the selection of the samples, a reconciliation process shall be carried out between the expenditure of the populations from which the samples are to be selected and the accounting events reported in the accounting records. If the two figures do not agree, the difference must be justified. In particular, the base population will normally consist of positive values, while any negative balances should be taken into account in a separate population of accounting events.

STEP 3:

Selection of Sampling Method (Sampling Technique)

The sampling method can be statistical or non-statistical depending on the number of units in the population.

A. Statistical Sampling

In populations that include a large number of units (empirically >150 units), the application of statistical sampling methods is recommended. These ensure:

i) the random selection of sample items (random or systematic random selection); and

ii) the use of probability theory to evaluate sample results, including the measurement and audit of sampling risk and the designed and achieved accuracy (sampling error).

[12] *As defined and coded in an Accounting Statement or an Information System.*

The table below presents 2 commonly used statistical sampling methods used interchangeably based on population characteristics and expected error.

Monetary Unit Sampling (Monetary Unit Sampling - MUS)[13]	**Simple Random Sampling** (Simple Random Sampling - SRS)
Appropriately applied to a population where (expected to be) observed: • Large variation in values between sample units. • Errors (amounts) with high variability between audited entities and, in principle, depending on the size of the audited value. Conversely, the corresponding error rates will have little variation. • Relatively high percentage of sample units with an occurrence of error.	Appropriately applied to a population where (expected to be) observed: • Little variation in values between sampling units. • Errors (amounts) with little variability between the units audited.

B. Non-Statistical Sampling

A non-statistical sampling method may be used at the professional discretion of the audit body, in duly justified cases, in accordance with internationally accepted audit standards and in any case where the number of population units is insufficient to allow the use of a statistical method.

Non-statistical sampling does not allow the calculation of precision (sampling error) and therefore there is no audit for audit risk. Therefore, non-statistical sampling should only be used in cases where statistical sampling cannot be applied.

[13] The *Standard MUS Approach (Standard MUS). Another common sampling method in auditing is the conservative MUS approach (conservative MUS), the presentation of which is outside the scope of this Guide.*

In practice, the specific situations that may justify the use of non-statistical sampling are related to population size. In particular, when a very small population is to be tested, whose size is not sufficient to allow the use of statistical methods, i.e. the population is smaller than or very close to the proposed size of a statistical sample. It is not possible to state the exact population size below which non-statistical sampling is deemed appropriate, as it depends on many population characteristics, but empirically this threshold is <150-300 units. The final decision must of course take into account the balance of costs and benefits associated with each of the methods.

<u>STEP 4</u>:

Sample Size Calculation (Sample Size) - Sampling parameters (Sampling Parameters)

Depending on the sampling method applied, the sample size is determined. The sample size is a function of some sampling parameters. Regardless of the sampling method, 3 are the main parameters:

- ✓ The level of confidence - the higher the level of confidence we seek from audit work, the larger the sample size.
- ✓ The variability of errors - the higher the heterogeneity of errors, the larger the sample size.
- ✓ The design accuracy set at a desired threshold. This is usually the difference between the tolerable error (materiality level e.g. 2%) and the expected error. The smaller this difference, the larger the sample size.

A. Statistical Sampling

The sample size is calculated with a statistical function, depending on the sampling method. The Table below shows the sampling parameters for the sample size calculation in the cases of MUS and SRS methods.

MUS	SRS
$n = \left(\frac{BV * z * \sigma_r}{TK - AK}\right)^2$	$n = \left(\frac{N * z * \sigma_e}{TK - AK}\right)^2$
$\boldsymbol{BV}$: the Book Value of the population	N: the number of population units
$\boldsymbol{\sigma_r}$: *standard dev*iation of the error *rates*. Given that at the time At the time of calculating the sample size, the audits have not yet been carried out, the standard deviation is not known, so it is estimated on the basis of historical data or through a pilot audit sample.	$\boldsymbol{\sigma_e}$: *Standard Dev*iation of the errors. Given that at time to calculate the sample size, the standard deviation is not yet known, so it is estimated on the basis of historical data or through a pilot audit sample.
$\boldsymbol{z}$: is the percentage point of the standard normal distribution associated with the desired level of confidence. The Confidence Level is defined as the degree of certainty about the accuracy of the error estimate. In practical terms, this means that the application of the sampling method leads not only to a (point) estimate of the error in the population (i.e. the most likely value of the error in the population based on the analysis of the errors detected in the sample) but also to an upper limit of error. For example, if the confidence level is set to be 90%, the actual value of the error in the population is less than the error ceiling with a 90% probability[14] . The value of the confidence level is determined based on the assessment of the BMS. The level of confidence (high, medium, low) of the BSI is combined each time with a corresponding confidence level to calculate the random sample size, in order to ensure in each case a high audit assurance (and correspondingly low audit risk).	

Reliability System	Low	Medium/ Low	Medium/ High	High

Trust level	90%	80%	70%	60%

The confidence level is related to the value of the coefficient z of the standard normal distribution. The mapping of the confidence level to the value of z can be determined by considering either one-sided (1-α) or two-sided (1-α/2) confidence levels[15] . Indicative z values for different confidence levels are presented in the table below:

Trust level	60%	70%	80%	90%
one-sided: Price $z_{(1-a)}$	0.253	0.524	0.842	1.282
two-sided: Price $z_{(1-\alpha/2)}$	0.842	1.036	1.282	1.645

Tolerable Error (TE): usually identified with the materiality threshold, which is a threshold above which the error is considered material (e.g. 2% of population expenditure/revenue).

The Anticipated/Expected Misstatement (AE): this parameter equals the amount of error expected to be found in the population from conducting the tests. To estimate the value of this parameter in the most realistic way, historical error data, ancillary data on improving management systems, professional judgement or a combination of these are used to estimate the value of this parameter. Also, the value of the expected error should be chosen so that the planned precision does not exceed the tolerable error (e.g. 2%) of the population's expenditure/revenue. As a general rule, based on historical data, the value of the expected error is firstly calculated as a weighted mean of the errors of previous years.
accounting periods and shall be adjusted in order to achieve the planned

[14] *That is, if the procedure of taking a random sample and calculating the corresponding maximum error limit is repeated several times, then the actual value of the error will be less than the maximum error limit in 90% of the cases.*

[15] *According to the chosen confidence level, the used value z is calculated from the Standardized Normal Distribution, which corresponds to its (1 - a)% percentage point, where (1 - a)% is the specified confidence level when the focus is only on the calculation of the Upper Deviation Limit (UDL) (over-statements) or only the Lower Deviation Limit (LDL) (under-statements). Where the calculation of the Confidence Interval is required, these values are increased as they are now equal to (1-a/2)%. The 'α' is called the statistical significance level and represents the probability of a Type I error in a statistical test, i.e. the probability that an initial statistical test hypothesis will be incorrectly rejected (false alarm). In the case of an attribute test, a Type I error means that the tester falsely concludes that the deviation exceeds the tolerance limit. Note that z values for various confidence levels (1-α) can be calculated in Excel with the function =NORMSINV(1-α).*

Accuracy. Weighting factors may give decreasing weight to the past.

Note that in addition to the sample calculation based on a mathematical formula, some restrictions may be imposed on:

- Minimum sample size. When expressing an opinion based on the estimates from a sample, usually the minimum sample size should be 30 units, so that the normality assumption of the estimator's distribution is guaranteed. Also, in any case a statistical sample should not be less than 3 units, so that the precision of the estimate, which is a function of the standard deviation of the estimator, can be calculated.
- Maximum sample size (capping). Where the mathematical formulae indicate a very large sample size, the sample may be reduced to a smaller size, taking into account the trade-off between cost and benefit.

B. Non-Statistical Sampling

In non-statistical sampling, the sample size is calculated using professional judgement and taking into account the level of assurance provided by the system audits and system assessment. The ultimate objective is to obtain a sample size sufficient to enable the Audit Body to reach valid conclusions about the population and to produce a valid audit opinion.

The minimum sample size, provided that the reliability of the system is high, could cover at least 5% of the population units and 10% of its expenditure/revenue. In cases where the reliability of the system is not high the sample size should be larger.

There is no hard and fast rule for selecting the sample size based on the level of confidence from the system checks, but the following thresholds could be used as an indication, which can be changed based on professional judgement and the risk of material misstatement.

System Reliability	Recommended Coverage as to:	
	the population units	*the population values*
High	5%	10%
Medium/High	5-10%	10%
Medium/Low	10-15%	10-20%
Low	15-20%	10-20%

***STEP 5*:**

Population stratification (Stratification) and sample allocation

The expenditure population may be divided into different strata in order to design a stratified sampling. Usually, stratification is chosen when there is heterogeneity between some parts of the population, while within each stratum there is homogeneity. The main reasons for recommending such a design are discussed below.

Risk-based stratification of population units

The population may be divided into sub-sets-strata based on the risk of the sampling units, in order to represent each stratum in the sample, taking into account different parameters per stratum: confidence level, expected error, standard deviation. In this case of stratification, the sample is larger for strata with higher risk and vice versa, and the result is to enhance the accuracy of estimates from the sample to the population.

Stratification by type of population units

The population may be divided into sub-sets-strata based on the type of sampling units in order to enhance the representativeness of the sample. In this case, the sampling design shall ensure that different types of population units are covered during the sampling design. Some possible strata may be: financing funds or financial instruments, state aid, public aid, public projects, Operational Programmes, types of projects, entities.

Stratification based on the size of expenditure/income of population units

The population can be divided into high value items and low value items. This stratification:

- It is imposed in the case of selection of sample units based on value size (case of the MUS method), where the population units with a value greater than the sampling interval constitute the high value stratum and are tested as a whole.
- It is recommended in non-statistical sampling methods in order to achieve greater coverage in terms of expenditure/revenue. In non-statistical sampling, high value units can be defined at professional judgement. In particular, a cut- off value may be set as an amount or percentage above which units are considered high value. In general, high-value units are a few units that stand out in terms of expenditure/input size from the rest (extreme high values). In the high-value layer, either all units can be tested or a sample of units can be selected (in case there are several).

Stratification by Period

Sampling may be applied in two or more periods (multi-period sampling). Such a design is recommended in order to spread the audit burden over the entire audit period. In particular, when expenditure/revenue is declared consecutively in an accounting period, waiting until the end of the period to collect all the declared values (total population) is not a one-way street. Alternatively, it may:

✓ to estimate (forecast-forecasting) the population (units and values) of the whole period,

✓ to calculate the sample size

✓ the total period can be divided into sub-periods (time layers),

✓ the total sample size to be allocated to each subperiod,

✓ at the end of each sub-period, the sample corresponding to that sub-period is selected; and

✓ in the event that the initial projection deviates from the actual population, the initial design shall be revised and, if necessary, additional units shall be selected from the sub-populations of the first and intermediate sub-periods.

Division of the sample into layers

The design of a stratified sampling with "M" layers can be:

✓ Top-Down (Top-Down)

In this case, a total sample size is calculated for the whole population and then apportioned to each stratum 'A'.

	MUS	SRS
Proportional Allocation	$_An = \frac{BV_A}{BV} \times n$	$_An = \frac{N_A}{N} \times n$
Optimal Allocation *(takes into account the sampling risk per stratum through the standard deviation of the estimator)*	$n_A = \frac{BV_h \times \sigma_{rh}}{\sum_{i=1}^{M} BV_i \times \sigma_{ri}} \times n$	$_An = \frac{N_A \times \sigma_{eA}}{\sum_{i=1}^{M} N_i \times \sigma_i} \times n$

✓ Bottom-Up (Bottom-Up)

In this case, the sample size is calculated separately in each layer using separate parameters, based on the characteristics of each layer.

STEP 6:

Sample selection (sample selection)

After determining the sample size and dividing it by strata, the selection of sampling units follows. Whether statistical or non-statistical sampling is applied, it is recommended to ensure the random selection of sampling units, stratified by stratum. The following selection methods are the most common.

Random Selection or Equal Probability Selection ***(Random or equal probability selection)***	The random selection method is mainly related to the simple random sampling method, where the following steps are followed: 1. Initially, random numbers are generated via software and assigned to each population unit. 2. The population units are then sorted by random numbers (ascending or descending), by stratum. 3. Finally, the units are selected in random number order to form the sample, per stratum.
Systematic selection based on the size of the value ***(Systematic selection proportional to size)***	This method is linked to the MUS method and each unit has a probability of selection based on its value. The following steps are followed: 1. After determining the sample size by strata, it is necessary to identify the high value units (if any) of the population in each stratum. These will belong to an individual high value stratum and will be tested at 100 %. The cut-off value for identifying this stratum is equal to the ratio between the book value (BV) of the population and the sample size n. All units whose book value is higher than the cut-off value (BV_i > BV/n) are included in this stratum. 2. The sample size "n_s" corresponding to the remaining units (low value units) is the difference between "n" and the number of high value sampling units. 3. In the population layer of "low value units", random numbers are generated by software and assigned to each population unit.

	4. The population units are sorted by random numbers (ascending or descending). 5. The population is divided into equally spaced sampling intervals (SI). The sampling interval is defined by dividing the book value of the population by the sample size (BVs/ns). 6. A random starting point (Euro) is selected (a random number within the 1ου sampling interval) and the first unit of the sample to which this random Euro belongs (based on the cumulative distribution of the value of all units) is selected, coming from the 1ο sampling interval. 7. With a sampling step equal to the sampling interval, one additional sample unit is selected from each subsequent sampling interval.
Systematic Random Selection ***(Systematic selection)***	In the systematic selection method, the following steps are followed: 1. First, random numbers are generated by software and assigned to each population unit. 2. Population units are sorted by random numbers (ascending or descending), by stratum. 3. The population is divided into equally spaced sampling intervals per stratum. The sampling interval is defined by dividing the number of population units N by the sample size n. 4. A random starting point, a random number within the 1ου sampling interval, is selected, and the first unit of the sample corresponding to the starting point, coming from the 1ο sampling interval, is selected.

	5. With a sampling step equal to the sampling interval, one additional sample unit is selected from each subsequent sampling interval.

***STEP 7*:**

Multi-stage sampling or sub-sampling (multi-stage sampling or sub-sampling)

According to the above procedure, the units in the sample of 1st stage are selected. As a rule, each unit selected in the sample is checked for all its costs/revenues. However, in the event that it is not feasible to cover all the expenditure/revenue of a 1st stage unit due to the large number of its individual items (documents or payments), then a sub-sample is selected.

The decision to apply sub-sampling shall be taken by the audit team, according to its professional judgement and taking into account that the subjects or audit items are similar and their number does not allow them to be tested as a whole.

To apply sub-sampling, the audit group:

1. It receives detailed expenditure/expenditure data (payments, documents) recorded in the accounting systems of the auditees.
2. Check and ensure the reconciliation of these figures with the total expenditure of the selected unit of the 1st stage.
3. Selects the sub-sample (usually with the assistance of a specialised sampling unit within the Audit Authority).
4. The documentation of the application of sub-sampling is described in the audit report in the "Audit Approach" section.

For the selection of the sub-sample, one of the above methods may be applied. However, the same method with the same parameters of the 1st stage is usually applied. In general, it is recommended to apply a statistical method in case a statistical sampling method has been applied in the 1st stage. When a non-statistical method is applied, it is recommended that the sub-sample size is at least 30 units or else covers more than 10 % of the unit value of the 1st stage.

An alternative sampling method applied, usually in sub-sampling, is Regional Clustering. This method is recommended, in order to reduce the burden and cost of testing, in where the objects or subjects are highly geographically dispersed and audit of their physical object is required. This method assumes a high degree of homogeneity between clusters, i.e. there are no reasons to suggest variation in risk from cluster to cluster. A random sample of clusters (minimum 3 clusters) shall be selected initially using the selection methods presented in step 6. A sample of subjects or objects in each cluster shall then be selected. The sample size in each cluster is usually fixed.

In the event that errors with a significant financial impact are identified in the sub-sample, the audit team may extend its audit to the whole population in order to identify the actual error to be corrected. In this case, the error shall be the total error identified in the population and not the one calculated as the estimated error.

It is noted that it is good practice for the process of projecting the error from the sub-sample to the population to be reviewed by a special unit within the Audit Authority that deals with sampling issues. The review is appropriate to reduce the risk of computational errors that may lead to over- or underestimation of the projected error in the context of the application of multistage sampling.

STEP 8:

Conclusion - Induction

As mentioned in step 1, the purpose of sampling is to estimate the level of error in a population of expenditure/expenditure.

The projection process:

- ✓ It is performed on the population of each stratum sampled and then the Total Error Rate (TER) is calculated as a weighted average. In the case where multi-stage sampling has been applied, then the projection is made from the bottom up, i.e. from the last stage to the first.
- ✓ It depends on the sampling method applied and in particular on the method of selection of sampling units, as described below.

Random Selection or Equal Selection Probability ***(Random or equal probability selection)***	There are 2 ways of projecting the error E from the sample of n units in the population. 1. Ratio estimation (Ratio estimation) $K = BV \times \frac{\sum_{i=1}^{n} K_i}{\sum_{i=1}^{n} BV_i}$ *It is applied in the case where there is a positive correlation between the error amounts and the audited accounting values, i.e. large error amounts in large values.* 2. Estimation of the average amount of error per unit (Mean-per-unit estimation) $K = N \times \frac{\sum_{i=1}^{n} K_i}{n}$ *It is applied in the case where there is no positive correlation between the error amounts and the audited accounting values.*
Systematic selection based on the size of the expenditure ***(Systematic selection proportional to size)***	• First, the sum of the error amounts detected in the high-value units (EH), which are tested as a whole, is calculated: $K_h = \sum_{i=1}^{n_h} K_i$ • The projected error amount in the residuals layer (ES) is then calculated: $K_s = SI \sum_{i=1}^{n_s} \frac{K_i}{BV_i}$ • Finally, the two amounts are added together: $E = K_h + K_s$

The Projected Error (E) is the most likely (based on the sample data) error value for the population (of each stratum). Once the TER is calculated for the total population, it is compared to the specified materiality level (e.g. 2%) to determine whether it is significant (greater than the tolerable level).

In the case of statistical sampling, it is possible to measure and audit the sampling risk (sampling error/

sampling error (SE)), i.e. the achieved precision. Thus, taking into account the sampling error, the Upper Limit Error (ULE) is calculated, which is a value that the actual value of the error does not exceed with a predefined probability (which is identical to the confidence level). The calculation of SE and ULE is shown below:

	MUS	**SRS**
Sampling error	$SK = z \times \frac{{}_{r}S}{\sqrt{n_s}} \times BV_s$ ${}_{r}S$: *Standard Deviation of the error rates, in the sample excluding high value units.*	$SK = z \times \frac{{}_{e}S}{\sqrt{n}} \times N$ ${}_{e}S$: standard deviation of the errors in the sample *(Standard Deviation of the errors)*.
Maximum Limit Error	$ULK = K + SK$	

It is noted that:

- Appendix 4.c presents a template spreadsheet for the calculation of the sample size and its stratification in the case of the "Stratified MUS" method.
- A template spreadsheet for the calculation of TER and ULE in the case of the "Stratified MUS" method is presented in Annex 4.d.

4.2.2 Sampling of other types of financial data/transactions

In other elements of an audited entity's financial statements, such as:

- Property or other assets
- Loans or other sources of financing liabilities

similar sampling techniques may be applied when the number of samples does not permit universal audit.

A special form of financing is the Financial Engineering Instruments (or tools). These can be loans, guarantees, venture capital investments, etc. In such cases, funding is often provided through successive tranches (advances) provided that the beneficiary has achieved defined milestones/targets. In these cases, the purpose of the audit is performance based and is required to provide reasonable assurance on the correctness and completeness of the results declared by the beneficiary. Where the application of sampling is required in such audits, the above mentioned techniques, including attribute sampling, could be adapted. A key difference is that the tolerance limit is set as the difference between the achieved results and the predefined milestones/targets.

CODING, CATEGORISATION AND ANALYSIS OF THE FINDINGS OF THE AUDITING

5

CHAPTER 5 - Coding, categorisation and analysis of audit findings

The audit findings constitute a wealth of data and valuable knowledge for the Audit Body, the auditees and third parties. In order to be able to manage this knowledge (knowledge management) the auditee should include the following good practices in its audit work.

5.1 Coding and digitalisation of audit findings

Each finding may be assigned a predefined code in relation to the audit item under which it was identified. The audit questionnaire can be a useful tool for recording coded findings. A standardised questionnaire used in a large number of similar audits could be designed with a hierarchical structure. In particular, a structured questionnaire might consist of three (3) coded hierarchical levels as an example:

1º Level: Fundamental Requirements / Objectives

2º Level: Assessment Criteria / Topics

3º Level: Questions (audit items)

Therefore, in a structured questionnaire, each question belongs to a group of audit items with common characteristics and is given a unique code (e.g. 3-digit). In such a design, the findings could be initially entered in the questionnaire, assigned to a question, and therefore receive the same code as the question. They would then be transferred to the audit report/report.

In order to enable the management and analysis of the findings, the findings should be coded and stored in databases (Information Systems). Audit bodies can design their questionnaires digitally and record the audit findings in the questions.

An indicative hierarchically structured audit questionnaire in which the findings could be recorded is presented below.

Standard Structured Audit Questionnaire

Fundamental requirement/Objective 1	**Findings**
Evaluation criterion / Theme 1.1	
Question 1.1.1	
Question 1.1.2	
Question 1.1.3	
…………	
Evaluation criterion / Theme 2	
Question 1.2.1	
Question 1.2.2	
Question 1.2.3	
…………	
Fundamental requirement/Objective 2	
Evaluation criterion / Theme 2.1	
Question 2.1.1	
Question 2.1.2	
Question 2.1.3	
…………	
Evaluation criterion / Theme 2.2	
Question 2.2.1	
Question 2.2.2	
Question 2.2.3	
…………	

5.2 Categorisation of audit findings

Each finding can be categorised according to its type/type, the existence of an economic impact, its significance and its nature. Some indicative categorisation rules are given below:

⇨ A coding of the findings, such as the one mentioned above, is also the first thematic categorisation of the findings based on the audit scope. This coding represents the type/cause of each finding.

⇨ In terms of their type, findings can be classified into predefined categories which may be provided for by a strict or more relaxed legal framework. As an example, the typology of findings in public procurement defined by the EU and applied to the Structural and Investment Funds can be mentioned (Annex 5.a).

⇨ In terms of their financial impact, findings can be classified as having a financial impact, having a potential financial impact, or having no financial impact.

⇨ Based on their significance, the findings can be distinguished:

- Important and not important. Significance may be linked to the financial impact of the findings, whereby when the impact exceeds a predefined threshold, the finding is considered significant.
- Whether or not they are linked to Fraud/Corruption.

- Based on a scale of importance according to their impact on the operation of a system. Such a scale is applied in the assessment of management and audit systems for EU co-financed programmes.

1	**It works well. No improvements or minor improvements needed improvements**	*No deficiencies or only minor deficiencies were found. These deficiencies do not affect, or have a minimal impact on the functioning of the assessed essential requirements/certification management bodies / systems. Recommendations (minor) may be made.*
2	**It works, but some improvements are needed**	*A number of shortcomings were identified. These deficiencies partly affect the functioning of the assessed key requirements/ certification/management bodies / systems. Recommendations are made and/or financial corrections are applied.*
3	**Partially functioning, substantial improvements needed**	*Serious deficiencies were found which expose the funds to the risk of irregularities. The impact on the effective functioning of key requirements/management certification bodies/systems is significant. Recommendations are made and/or financial corrections are applied.*
4	**Essentially does not work**	*Several serious and/or widespread deficiencies were found which put the funds at risk of irregularities. The impact on the effective functioning of the baseline requirements/ certification management bodies/systems under assessment is significant - the functioning of the baseline requirements/ certification management bodies/systems under assessment / systems are incomplete or non-existent. Recommendations are made and/or financial corrections are applied.*

⇨ As to their nature, the findings can be divided into:

- Systemic Errors, when their cause has well-defined common characteristics related to a function of the management and audit system, they highlight a serious deficiency and risk in the operation of the system and usually have a defined financial or potential financial impact.
- Anomalous Errors (Anomalous Errors) errors that are not representative of the population. These are exceptional cases of errors and are only classified as such in duly justified cases.
- Random errors are errors observed in a random sample that are neither systemic nor anomalous. Random errors may be randomly distributed throughout the population if they are detected in a representative sample. For random errors detected in a sample, the projection procedure shall be applied, based on the sampling method followed, in order to calculate the random projected error.

The categorisation of the findings is a very important task, so as to facilitate their analysis later on. It should be noted that it is more efficient for the classifying of the findings into categories to be done by the auditor who is most directly involved in the identification of the findings.

5.3 Analysis and use of audit findings

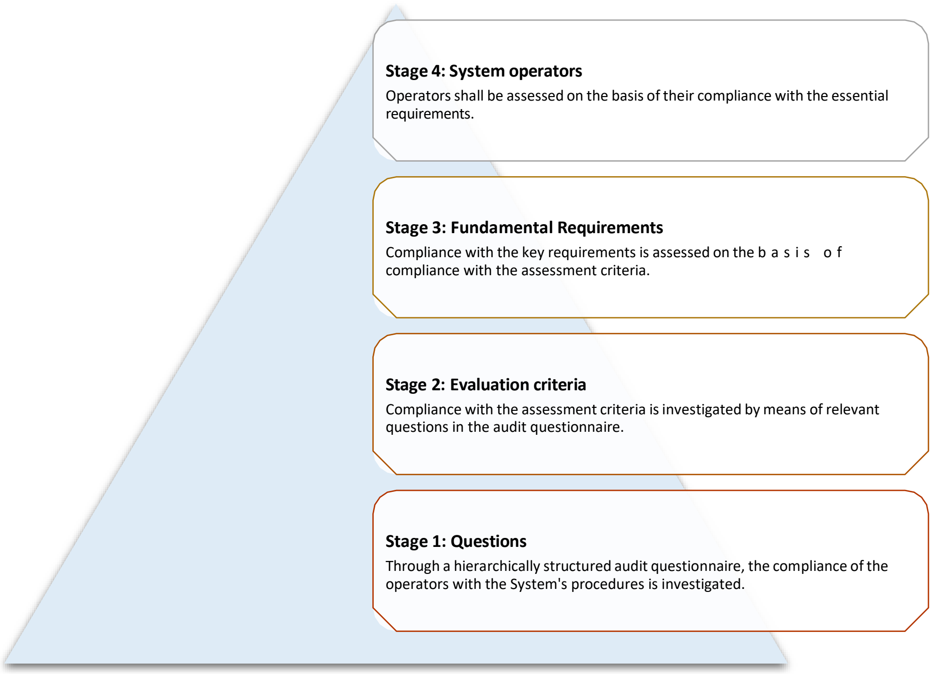
Analysis of audit findings is made easier once the findings have been coded, categorised and digitised. The analysis of findings can be done for the following purposes:

A. The evaluation of a Management System

Based on the audit tests, findings and 'YES'/'NO' indications for the implementation of each procedure in a management system, the level of assurance of the system (Audit Assurance) is assessed and, therefore, the assessment of the level of internal audit risk is fed back. The assessment of the management system is a complex bottom-up hierarchical analysis starting with the audit tests of each process and ending with the rating of the whole system.

According to the diagram below, the evaluation of a system can be based on a hierarchically structured questionnaire, following a bottom-up approach, which can be divided into four (4) stages

Figure 8: *Hierarchical System Evaluation Model*



The practice of recording and coding the findings on the basis of a hierarchically structured questionnaire, documents the outcome of the audit tests and feeds a bottom-up system of scoring the functioning of a system, mapping the causes and sources of any weaknesses. This process facilitates a prescriptive data analysis that contributes to the design of targeted action plans to address/cure any weaknesses.

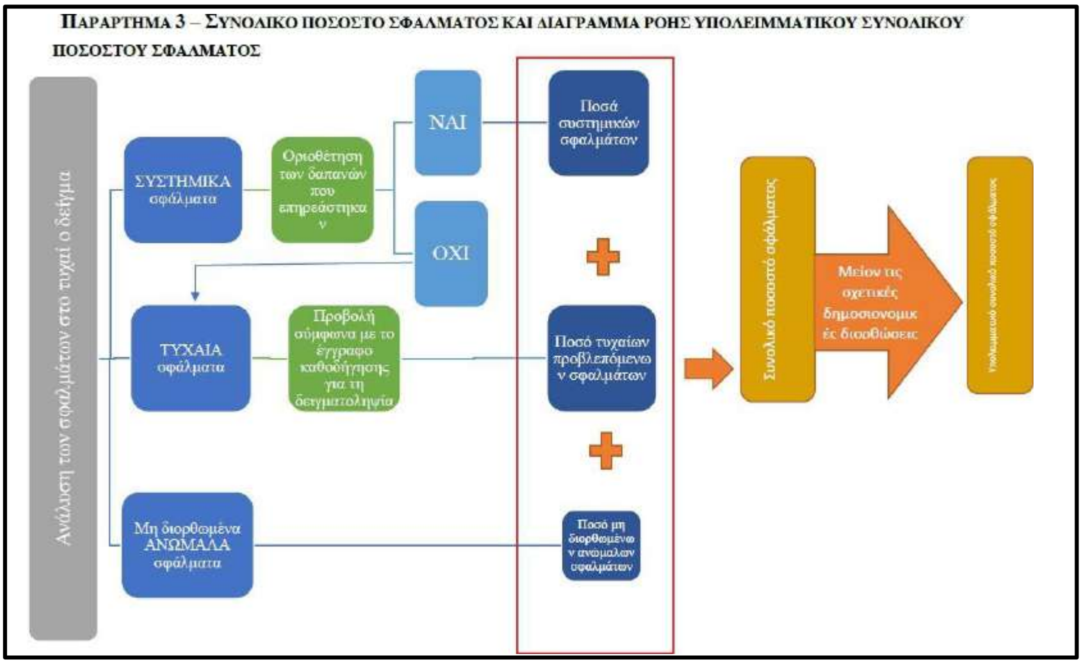
B. The evaluation of the errors of a sample

Where sampling is applied to the audits, the evaluation of the findings may be done with a view to drawing conclusions from the sample in the population. The sampling methods that have been applied also guide the process of projection or otherwise estimating the errors in the population. Chapter 4 lists the projection formulas for the methods presented.

However, by analysing the observed errors in a sample, and by carrying out additional checks and tasks, it may become apparent that some of the error is not random and may not need to be projected as random in the population. In particular, an error may be delineated as systemic and treated in the affected area or documented as anomalous.

As an example of an error analysis process, the process of calculating the total error and residual risk in the context of EU co-financed programmes is mentioned.

Figure 9: *Error analysis*



Source: Guidance EC - EGESIF_15-0002-04 (Annex 3) (19/12/2018)

C. The assessment of risks in future audits

The analysis of the findings of the audits of one or more Audit Entities may feedback into a risk analysis. In particular, audit findings indicate critical audit items (risk points) and risk areas (risky auditled entities) and therefore contribute to the planning of priority-based audits.

In this direction they can contribute to:

- ✓ A stratified analysis of the findings to illustrate the distributions of the frequency and significance of findings by audit subject and audited entity and to identify any variations, concentrations and correlations.

- ✓ A longitudinal analysis of the findings to identify any findings that are detected over time and do not comply, as well as entities that still appear with findings.

ELECTRONIC COHESION AND PERSONAL DATA PROTECTION 6

CHAPTER 6 – Electronic Cohesion and Data Protection

6.1 Electronic-Cohesion (e-cohesion)

The electronic coherence of the Agencies/Organisations/Authorities in the context of a Management and Audit System,

- ✓ is defined as the electronic communication and exchange of data and information between them,
- ✓ aims to reduce administrative burdens and bureaucracy, avoid duplication of information and documents and better and faster monitoring and audit of their activities,
- ✓ is achieved through the development of Information Systems and interoperability (interface) procedures between them.

In the context of the EU Structural and Investment Funds (ESIF) co-financed programmes, the requirements for electronic consistency in the Management and Audit Systems are described in the General Regulation (1303/2013[16]) and in the Executive Regulation 1011/2014.In particular, the spirit of the provisions refers to the obligation of Member States to ensure that all exchanges of information between Beneficiaries / Managing Authorities / Certifying Authority / Audit Body can be implemented through electronic data exchange systems. These systems shall facilitate interoperability with national and Union frameworks and allow the parties involved to submit all the information originating from them only once. According to the General Regulation, the minimum requirements for electronic consistency for those involved in the management and audit systems are:

- The principle of "one time only" entry (i.e. participants should not enter the same data more than once into the system and these data are available, with appropriate classified authorisation, to other participants)
- The concept of interoperability (data coded by beneficiaries must be shared between different actors)

[16] *1303/2013 (Article 122, paragraph 3), concerning the 2014-2020.*

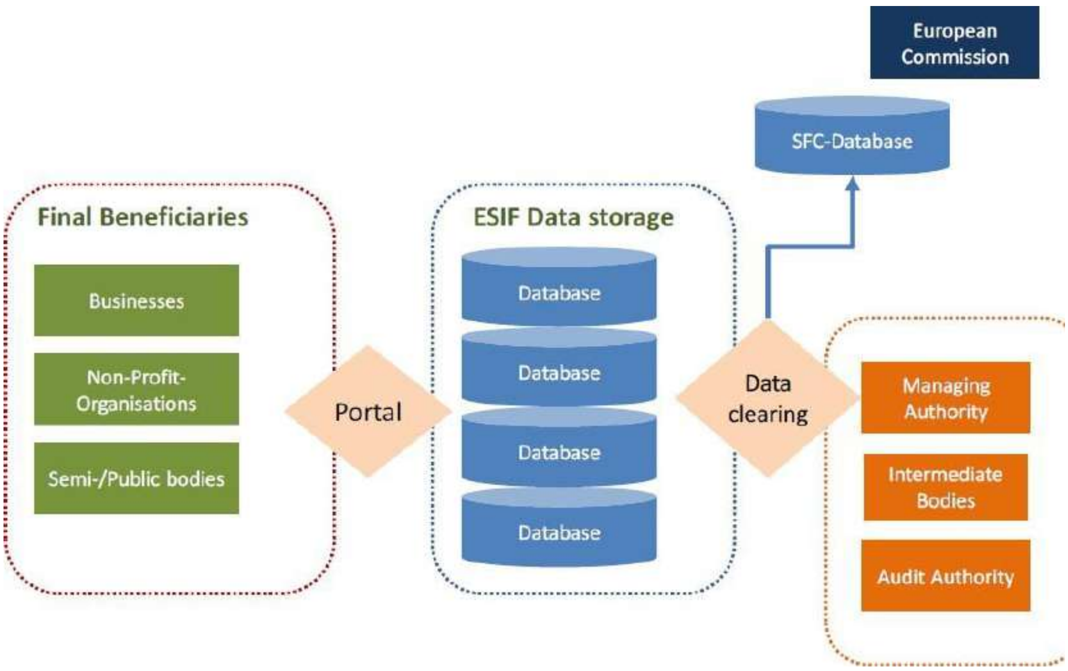
- Electronic audit trail (predefined transaction data and documents)
- Electronic data exchange systems guarantee: data integrity and confidentiality, user authentication, defined storage/retention rules

According to the Implementing Regulation 1011/2014, the minimum information required to be stored in information systems is defined and it is provided that electronic data exchange systems have at least the following functionalities:

- Interactive forms and/or forms pre-filled by the system based on the data stored in the successive stages of the procedures
- Automatic calculations if applicable
- Automatic built-in audits that limit repeated exchanges of documents or information as much as possible
- Warning messages generated by the system to inform the beneficiary about the possibility of carrying out certain actions
- Ability to monitor the progress of the project online, allowing the beneficiary to see where the project is at in its development
- Availability of all previous data and documents processed by the electronic data exchange system
- Access to the electronic data exchange systems is possible either directly through an interactive user interface (web application) or through a technical interface allowing automatic synchronisation and data transfer between the systems of the parties involved.

In Greece, the Special Service for the Integrated Information System (OPS) plays a central role in the implementation of e-cohesion in the context of the co-funded programmes. The following diagram illustrates the electronic exchange of information in the context of e-cohesion of the stakeholders involved in the co-funded programmes.

Graph 10: *Illustration of e-coherence in the co-funded programmes*



The example of the development of e-coherence between stakeholders in the shared management of co-financed programmes is a good practice and a guide for developing similar relationships in any inclusive management and audit system. The development of an e-coherence system requires the establishment of rules either through legislation or through the conclusion of cooperation protocols between the actors of a management and audit system. E-coherence is a gamble that must be won, incurring an upfront cost in planning with many paybacks.

In addition to the above benefits, e-coherence achieves:

- ✓ Transparency and complementarity. Electronic consistency can lead to greater transparency for authorities, as it is easier to maintain an overview of all the different tasks performed when collected in an electronic data storage system than in paper form. This advantage should be used by system authorities to identify similarities and opportunities to create synergies and complementarities between tasks.
- ✓ Transparency and external communication. An advantage of electronic systems is that it becomes easier to reuse the data and to reuse the data.

information for other purposes, such as external communication (e.g. for promotional or campaigning purposes) with policy makers, other stakeholders or the general public.

- ✓ E-government, e-submission, e-signature.
- ✓ Improve and simplify workflows and achieve continuous audit through the implementation of audit loops and automatic alerts.
- ✓ The availability of data in real time and in a format that allows for its processing. This enables better monitoring and audit of the implementation of procedures and the timely identification and treatment of obstacles and problems in the execution of tasks.
- ✓ Strengthening procedures to avoid double funding (claiming and receiving assistance for the same item of expenditure from different funding sources, whether from the EU, national, regional or local budget), as automatic checks can be carried out on the basis of a unique invoice number.
- ✓ Reduction of corruption due to the use of a chronological order of protocols when submitting funding applications.
- ✓ Greater security in the movement of data and documents by other means of exchange, such as email.

6.2 Data Security

How is security achieved in the exchange of data held in information systems in the context of e-cohesion? Secure data exchange means that:

- ✓ data must always be transferred through secure exchange systems/platforms and be traceable by authorised stakeholders. According to technical security standards (e.g. HTTPS) or security policy (e.g. ISO-27001), each stakeholder allowed to exchange information should have a unique username and password.
- ✓ Where changes to data already coded are allowed, it is recommended that the system shows who changed data and when and what changes were made.

- ✓ Different user rights must be assigned to different users, depending on their needs and roles (e.g. read only, edit but not delete, edit only specific fields, admin rights). The needs and rights of each user should be clearly identified and user profiles should be checked on a regular basis (e.g. every six months) to ensure that staff who have left or changed roles are assigned to the correct profile or that access rights have been revoked.
- ✓ Programme authorities must also ensure that data is stored and maintained securely to protect against accidents.
- ✓ In addition, for security reasons, internal and external stakeholders could be separated. External stakeholders could be given access to an interface.

6.3 Personal Data Protection

The available data are different from each other in terms of privacy, sensitivity and legal implications. In a data exchange network there should be codes of ethics and a formulated data exchange policy to ensure trust.

Data privacy and confidentiality must not be sacrificed under any circumstances, regardless of the potential benefits. Activities within the EU have, since May 2018, been bound by the General Data Protection Regulation (EU GDPR - 2016/679), which improves the privacy of personal data, enhances the rights of citizens to obtain information about the use of their personal data and, consequently, has forced operators to review their personal data management processes and inform individuals about the data collected and the ways in which it is used.

When data analysis is required, the most common approach is to anonymise the data using pseudo-codes, a process that eliminates all personal information, making it impossible to identify the individuals involved (de-identification).

Sensitive audit data refers to citizens and businesses. Sensitive data is not limited to personal data, but can also refer to data that is critical to the company's strategy, so deciding which data sets to share is not a simple process.

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ANNEXES

- ➔ Annex 4.a: Indicative Template of Risk Analysis - Audit Priorities
- ➔ Appendix 4.b: Indicative Attribute Sampling Template / Sampling Parameters - Sample Size)
- ➔ Annex 4.c: Indicative Sample Template for Stratified MUS Sampling / Sample Size and Distribution
- ➔ Annex 4.d: Indicative Sample Template for Stratified MUS Sampling / Calculation of the Estimated Error (TER & ULE)
- ➔ Annex 5.a: Typology of errors in public procurement - EU Structural and Investment Funds (EGESIF_15-0002-04 Annex 5)

➔ **Annex 4.a:** Indicative Template of Risk Analysis - Audit Priorities

Annex 4.a: Indicative Template of Risk Analysis - Audit Priorities

AUDITLED FORCE / ONTOTHTA	Intrinsic Risk Factors (IR)								Inherent Risk (IR)	Internal Audit Risk Factors (CR)								Internal Audit Risk (CR)	Risk of Material Error (RMM=IR*CR)	Risk of non-detection (DR=AR/RMM) (AR=5%)	SYSTEM AUDIT PLANNING [PRIORITIES - OBJECTIVES]			Comments
	IR1 Scale (1,..,4)	IR2 Scale (1,..,4)	IR3 Scale (1,..,4)	IR4 Scale (1,..,4)	IR5 Scale (1,..,4)	IR6 Scale (1,..,4)	IR7 Scale (1,..,4)	....		CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	CR1 Scale (1,..,4)	....				PERIOD 1	PERIOD 1	PERIOD 1	
Φ1									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ2									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ3									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ4									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ5									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ6									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ7									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ8									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ9									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ10									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ11									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ12									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ13									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ14									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
Φ15									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				
....									#DIAIR./0!									#DIAIR./0!	#DIAIR./0!	#DIAIR./0!				

➜ **Appendix 4.b:** Indicative Attribute Sampling Template / Sampling Parameters - Sample Size)

Sampling Parameters			*stratum 1*	*stratum 2*	*Stratum 3*	*Stratum 4*	*...*
SAMPLING UNITS **N** (Population of Operations)	>25 units	**25**	5	5	5	5	5
confidence level		90%					
Z (one-sided)		**1,282**					
Maximum tolerable deviation rate, **T**, (determined by the auditor; the tolerable levels are set by the Member State audit authority (e.g. the number of missing signatures on invoices under which the auditor considers there is no issue))		10,00%					
The expected population deviation rate **p**		3,00%					
Planned sample size	$n = \frac{z^2 \times p \times (1-p)}{T^2}$	**5**					
Adjusted Planned sample size (for small populations)	$n = \frac{z^2 \times p \times (1-p)}{T^2} / \left(1 + \frac{z^2 \times p \times (1-p)}{N \times T^2}\right)$	**5**					
sample size (min 3 units per statum)		**5**	3	3	3	3	3

➜ **Annex 4.c:** Indicative Sample Template for Stratified MUS Sampling / Sample Size and Distribution

Annex 4.c - Indicative Sample Template for Stratified MUS Sampling / Sample Size and Distribution			stratum 1	stratum 2	Stratum 3	Stratum 4	Stratum 5
Population characteristics	Book Value (declared expenditure/revenue in the reference period)	**5.000.000 €**	**1.000.000 €**	**1.000.000 €**	**1.000.000 €**	**1.000.000 €**	**1.000.000 €**
	sampling unit		Project	Project	Project	Project	Project
	Size of population (number of sampling units)	50	10	10	10	10	10
	Standard deviation of error rates (weighted average of the pevious years)		0,025	0,025	0,025	0,025	0,025
sample parameters	Weighted sum of variances of the error rates	**0,00063**					
	confidence level	75%					
	z (one-sided)	**0,67**					
	Expected error rate (as the weighted average of the Projected error rates (%) of the previous years)	Acc. yea	N-1	N-2	N-3		
		weight	70%	20%	10%		
		2,22%	2,10%	2,50%	2,50%		
	Antecipated error	**111.000**					
	Materiality level (maximum 2%; set by the regulation)	2,00%					
	Tolerable error (TE)	**100.000 €**					
	Weights for Allocation (Proportional)		20,00%	20,00%	20,00%	20,00%	20,00%
	Weights for Allocation (Optimal)		20,00%	20,00%	20,00%	20,00%	20,00%
	Planned sample size (n_n=n*(BV_n/BV))	**59**					
	Sample size - Proportional Allocation	60	**12**	**12**	**12**	**12**	**12**
	Sample size - Optimal Allocation	60	**12**	**12**	**12**	**12**	**12**
	Cut-off		83.333	83.333	83.333	83.333	83.333
	Number of operation with BV larger than cut-off and Sampling Interval						
	Book value of operations with BV larger than cut-off and Sampling Interval		100.000	-	100.000	-	100.000
	Book value of the remaining population (BV_s)		900.000 €	1.000.000 €	900.000 €	1.000.000 €	900.000 €
	Number of remaining operations to be selected (n_s)		11	12	11	12	11
	Sampling interval (for sample selection)		81.818	83.333	81.818	83.333	81.818

➔ **Annex 4.d:** Indicative Sample Template for Stratified Sampling Calculation of Estimated Error (TER & ULE)

Annex 4.d - Indicative Sample Template for Stratified MUS Sampling / Calculation of the Estimated Error Rate (TER & ULE)					
Sample results	**stratum 1**	**stratum 2**	**Stratum 3**	**Stratum 4**	**Stratum 5**
[1] Sampling interval	81.818	83.333	81.818	83.333	81.818
Sum of errors in units with BV larger than cut-off	0,00		10.000,00		0,00
[2] Sum of sample error rates of units with BV smaller than cut-off	0,50	0,00	0,00	0,50	0,00
*[1] * [2]*	*40.909*	-	-	*41.667*	-
[3] Book value of the remaining population (BV_s)	900.000	1.000.000	900.000	1.000.000	900.000
[4] Number of remaining units to be selected (n_s)	11	12	11	12	11
[5] Standard deviation of error rates for units with BV smaller than cut-off	0,020	0,020	0,020	0,020	0,020
([3]^2+[5]^2) / [4]	*29454545*	*33333333*	*29454545*	*33333333*	*29454545*

TER & ULE	
BV	5.000.000,00
Projected error (Random)	92.575,76
Precision (CE)	8.398,15
Upper limit of error	100.973,91
Total Error rate (%)	1,85%
Upper limit of the projected error rate (%)	2,02%

➔ A**nnex 5.a:** Typology of errors in public procurement - EU Structural and Investment Funds (EGESIF_15-0002-04 Annex 5)

Category	Ref. no.	Subcategory
Public procurement - Notice competition for the contract award and writing Obligations	1.1	Non-publication of a contract notice or unjustified direct award (i.e. illegal negotiated procedure without prior publication of a notice of competition)
	1.2	Artificial fragmentation of contracts works/services/supplies.
	1.3	Absence of justification for not subdividing the contract in lots
	1.4	failure to comply with - the time limits for receipt of tenders; or - the time limits for receipt of applications or not granting an extension of the time limits for the receipt of tenders where tenders are submitted important changes to the procurement documents
	1.5	Insufficient time or restrictions for potential tenderers to receive the tender documents tenderers/candidates
	1.6	Failure to publish the extension of time limits for receipt of tenders or failure to grant an extension time limits for the receipt of tenders
	1.7	Cases where the use of the competitive negotiated procedure or the negotiated procedure is not justified competitive dialogue
	1.8	Failure to comply with the procedure laid down in the Directive for the procurement of electronic and centralised supply contracts
	1.9	Failure to publish, in the notice of competition, the selection and/or award criteria (and the weighting them), or the conditions for the performance of contracts or technical specifications. Or failure to provide a sufficiently detailed description of the award criteria and the corresponding weighting. Or non-disclosure/publication clarifications/supplementary information.
	1.10	Use of - exclusion, selection, award or - selection criteria conditions for the performance of contracts, or - technical specifications that discriminate on the basis of unjustified national, regional or local preferences
	1.11	Use of - exclusion, selection, award or - selection criteria the conditions of performance of contracts or - technical standards that are non-discriminatory in the concept of the previous type of irregularity, but which

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		shall, however, restrict the access of economic operators
	1.12	Insufficient or inaccurate definition of the subject matter of the contract Contract
	1.13	Restriction of subcontracting
Public procurement - Evaluation of tenders	1.14	Have the selection criteria (or technical specifications) been modified after the opening of tenders or were applied in an incorrect manner
	1.15	Evaluation of tenders using award criteria that differ from the criteria set out in the referred to in the contract notice or in the tender specifications Or evaluation using additional award criteria not published
	1.16	Inadequate audit trail for the award of the Contract
	1.17	Negotiation during the award procedure, including modification of the qualifying offer during the award procedure Evaluation
	1.18	Irregular previous contacts candidates/bidders with the contracting authority
	1.19	Competitive negotiated procedure, with a substantial modification of the terms contained in the contract notice or in the specifications
	1.20	Unjustified rejection of abnormally low offers
	1.21	Conflict of interest with an impact on the outcome the procurement procedure
	1.22	Adulteration of a tender (detected by an agency competition / anti-trust)
Public procurement - Execution of the contract	1.23	Amendments to the elements of the contract, contained in the contract notice or in the specification
Public procurement - Other	1.24	Other
State aid	2.1	Failure to notify State aid
	2.2	Application of an incorrect aid scheme
	2.3	Incorrect application of the aid scheme
	2.4	Non-compliance with monitoring requirements
	2.5	Non-inclusion of the reference investment in the current aid scheme
	2.6	Failure to take account of revenue in the current scheme aids
	2.7	Failure to respect the incentive effect of the aid

	2.8	Non-compliance with the aid intensity
	2.9	Exceeding the minimum threshold
	2.10	Error in the application of the generic services economic interest
	2.11	Other State aid
Revenue-generating projects	3.1	Incorrect treatment of the resulting revenue by deed
	3.2	Incorrect calculation of the funding gap
Financial engineering instruments	4.1	Non-compliance with the execution details for portfolio funds
	4.2	Non-compliance with the rules for the selection of financial intermediaries
	4.3	Absence of necessary data in the business plan
	4.4	Absence / inconsistency of investment strategy with the objectives of the programme
	4.5	Modification of the structure of the MFIs that is not in line with the rules in force
	4.6	Absence of a financing agreement
	4.7	Absence of essential elements in the agreement Funding
	4.8	Breach of financing agreement: non actual payment of the national co-financing at the level of MFT
	4.9	Absence of a separate financial section in the framework financial institution
	4.10	Ineligible investments
	4.11	Ineligible final beneficiary
	4.12	Ineligible costs/management fees
	4.13	Incompatible State aid
	4.14	Incorrect use of interest generated by the contribution of the programme
	4.15	Incorrect use of resources returned
	4.16	Other financial engineering instruments
Lack of information or documents Documentation	5.1	Incomplete or incorrect information or documents Documentation
	5.2	Absence of an audit trail or incomplete audit trail
Ineligible project	6.1	Ineligible project
	6.2	Failure to achieve the project objective
Accounting and computing errors at level Project	7.1	Accounting and calculation errors at project level

Other ineligible costs	8.1	Expenditure incurred before or after the eligibility period
	8.2	Expenditure not paid by the beneficiary
	8.3	Expenditure not related to the project
	8.4	Expenditure outside the eligibility zone
	8.5	Ineligible VAT or other taxes
	8.6	Non-compliance with the rules for the purchase of land; or real estate
	8.7	Ineligible beneficiary
	8.8	Double funding
	8.9	Other ineligible costs
Environmental Rules	9.1	Non-compliance with environmental requirements (Natura 2000, EIA,..)
Equality of opportunity / No admission discrimination	10.1	Failure to respect the principle of equal opportunities
Information and publicity measures	11.1	Failure to inform the beneficiary about the support of the EU
	11.2	Lack of a plate
	11.3	Lack of a commemorative plaque
Simplified cost options	12.1	Incorrect methodology (ex ante, fair, verifiable and objective)
	12.2	Incorrect application of the methodology (ready to use or other)
Sound financial management Management	13.1	Non-compliance with the principle of good governance financial management
Data protection	14.1	Non-compliance with the rules on the protection of data
Performance indicators	15.1	Inaccurate output data
	15.2	Inaccurate results data

Category	Ref. no.	Subcategory
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	1.5	Insufficient time or restrictions for potential tenderers to receive the tender documents tenderers/candidates
	1.6	Failure to publish the extension of time limits for receipt of tenders or failure to grant an extension time limits for the receipt of tenders
	1.7	Cases where the use of the competitive negotiated procedure or the negotiated procedure is not justified competitive dialogue
	1.8	Failure to comply with the procedure laid down in the Directive for the procurement of electronic and centralised supply contracts
	1.9	Failure to publish, in the notice of competition, the selection and/or award criteria (and the weighting them), or the conditions for the performance of contracts or technical specifications. Or failure to provide a sufficiently detailed description of the award criteria and the corresponding weighting. Or non-disclosure/publication clarifications/supplementary information.
	1.10	Use of - exclusion, selection, award or - selection criteria conditions for the performance of contracts, or - technical specifications that discriminate on the basis of unjustified national, regional or local preferences
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	15.2	Inaccurate results data

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