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Artificial intelligence — Data quality for analytics and machine learning (ML) —

Part 5: Data quality governance framework

Intelligence artificielle — Qualité des données pour les analyses de données et l'apprentissage automatique —

Partie 5: Cadre pour la gouvernance de qualité des données

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ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

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Foreword

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This document was prepared by Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 42, *Artificial intelligence*.

A list of all parts in the ISO/IEC 5259 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Introduction

To address data quality properly without wasting critical resources, the organization's governing body can set the strategic direction for the use of analytics and machine learning (ML) and can oversee the quality of the needed data.

The data quality governance framework for analytics and ML assists the governing body in establishing a data quality governance within its organization with adequate controls across different layers of the organization throughout the data life cycle (DLC).

The framework can be used by both the governing body and management to interact and ensure the establishment of an effective data quality governance for analytics and ML at all levels in the organization.

The framework can be applicable regardless of an organization's size and type; and used in conjunction with other parts of the ISO/IEC 5259 series.

Artificial intelligence — Data quality for analytics and machine learning (ML) —

Part 5:
Data quality governance framework

1 Scope

This document provides a data quality governance framework for analytics and machine learning (ML) to enable governing bodies of organizations to direct and oversee the implementation and operation of data quality measures, management, and related processes with adequate controls throughout the data life cycle (DLC) model according to ISO/IEC 5259-1.

This document can be applied to any analytics and ML. This document does not define specific management requirements or process requirements according to ISO/IEC 5259-3 and ISO/IEC 5259-4 respectively.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 5259-1, *Artificial intelligence — Data quality for analytics and machine learning (ML) — Part 1: Overview, terminology, and examples*

ISO/IEC 22989:2022, *Information technology — Artificial intelligence — Artificial intelligence concepts and terminology*

ISO/IEC 38505-1, *Information technology — Governance of IT — Governance of data — Part 1: Application of ISO/IEC 38500 to the governance of data*

ISO/IEC 38507:2022, *Information technology — Governance of IT — Governance implications of the use of artificial intelligence by organizations*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 5259-1, ISO/IEC 22989, ISO/IEC 38505-1 and ISO/IEC 38507, and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
data creator
role within an organization responsible for generating, collecting and curating data from data sources

3.2
data owner
organization that is in the position to obtain, create, and have significant control over the content, access and distribution of data

Note 1 to entry: A data owner does not necessarily have a legal status with respect to data.

[SOURCE: ISO/TR 14872:2019, 3.4 — modified, Note 1 to entry replaced]

3.3
data steward
role within an organization responsible for ensuring that data-related work is performed according to policies and practices as established through data governance

[SOURCE: ISO/IEC TS 38505-3:2021, 3.9]

3.4
direct
communicate desired purposes and outcomes

Note 1 to entry: Within the context of governance of IT, directing involves setting objectives, strategies, and policies to be adopted by the members of the organization, to ensure that the use of IT meets organization's business objectives.

Note 2 to entry: Objectives, strategies, and policies can be set by management if they have the relevant authority delegated to them by the governing body.

[SOURCE: ISO/IEC 38500:2024, 3.1]

3.5
executive manager
person who has authority delegated from the governing body for implementation of strategies and policies to fulfil the purpose of the organization

Note 1 to entry: Executive managers can include roles which report to the governing body or the head of the organization or have overall accountability for major reporting function, for example Chief Executive Officers (CEOs), Heads of Government Organizations, Chief Financial Officers (CFOs), Chief Operating Officers (COOs), Chief Information Officers (CIOs), and similar roles.

Note 2 to entry: In management standards, executive managers can be referred to as top management.

3.6
governance
human-based system comprising directing, overseeing and accountability

[SOURCE: ISO/IEC 38500:2024, 3.3]

3.7
governing body
person or group of people who have ultimate accountability for the whole organization

Note 1 to entry: Every organizational entity has one governing body, whether or not it is explicitly established. When the organization is not an organizational entity, the term governing group is applicable where "governing body" is used throughout this document.

Note 2 to entry: A governing body can be explicitly established in a number of formats including, but not limited to, a board of directors, supervisory board, sole director, joint and several directors, or trustees.

Note 3 to entry: ISO management system standards make reference to the term "top management" to describe a role that, depending on the standard and organizational context, reports to, and is held accountable by, the governing body.

[SOURCE: ISO/IEC 37000:2021, 3.3.4]

3.8
monitor
review as a basis for appropriate decisions and adjustments

Note 1 to entry: Monitor involves routinely obtaining information about progress against plans as well as the periodic examination of overall achievements against agreed strategies and outcomes to provide a basis for decision making and adjustments to plans.

Note 2 to entry: Monitor includes reviewing compliance with relevant legislation, regulations, and organizational policies.

[SOURCE: ISO/IEC 38500:2024, 3.8]

3.9
principle
fundamental truth, proposition or assumption that serves as foundations for a set of beliefs or behaviours or for a chain of reasoning

[SOURCE: ISO/IEC 37000:2021, 3.2.1]

3.10
strategy
organization's overall plan of development, describing the effective use of resources in support of the organization in its future activities

Note 1 to entry: involves setting objectives and proposing initiatives for action

[SOURCE: ISO/IEC/IEEE 24765:2017, 3.4001]

3.11
management layer
organizational layer where exercise of control and supervision is performed within the constraints of governance

3.12
operational layer
organizational layer where daily routine operational tasks are performed

4 Abbreviated terms

CDO	chief data officer
CEO	chief executive officer
DLC	data life cycle
DQ	data quality
DQMLC	data quality management life cycle
DQP	data quality processes
DT	digital transformation
IT	information technology
ML	machine learning
PII	personally identifiable information
SW	software

HW hardware

5 Data quality governance in the context of analytics and ML

5.1 Foundation

Data for analytics and ML has its own set of unique characteristics compared to the traditional data generally used in business settings. The quality of training data plays a key role in the decision-making process using an ML model without human intervention. It is very important to produce quality outputs.

In order to safeguard data quality for analytics and ML effectively, a governing body should have adequate visibility into how data quality can impact analytics and ML.

Data quality can impact the results of analytics and ML if the input data have a problem with data quality characteristics such as accessibility, auditability, identifiability, portability, understandability, currentness, effectiveness and efficiency; and dataset quality characteristics such as accuracy, balance, consistency, scalability, diversity, effectiveness, generalizability, precision, relevance, representativeness, similarity and timeliness. A more detailed list of data and dataset quality characteristics and their definitions are described in ISO/IEC 5259-2. A governing body should understand these data quality characteristics and reflect them in its governance arrangements when consuming and producing data throughout the DLC model according to ISO/IEC 5259-1.

5.2 Ambiguous responsibilities for data

The data used by analytics and ML can be provided by a great number of third parties and the functionality of the analytics and ML model can be primarily dependent on the data used. In this case, determining the relevant party becomes a critical issue if an ML model produces an inaccurate or incorrect inference or prediction due to an anomaly in data collected from multiple sensors or systems. In this case, an organization can have a system in place that can determine the cause (data or otherwise) if an ML model produces undesirable outcomes.

In addition, data for analytics and ML can be collected in various ways, including Internet search and posts on social media services. Despite the greater convenience from the diverse usage of such data, it is important to exercise caution due to serious problems that these kinds of data can present, such as privacy violations.

Data quality governance for analytics and ML entails a greater complexity in comparison to data quality issues that involve only a single data source. The governing body should understand that there should be clear roles and responsibilities established on how data for analytics and ML should be handled and processed throughout the entire DLC within and across organizational boundaries.

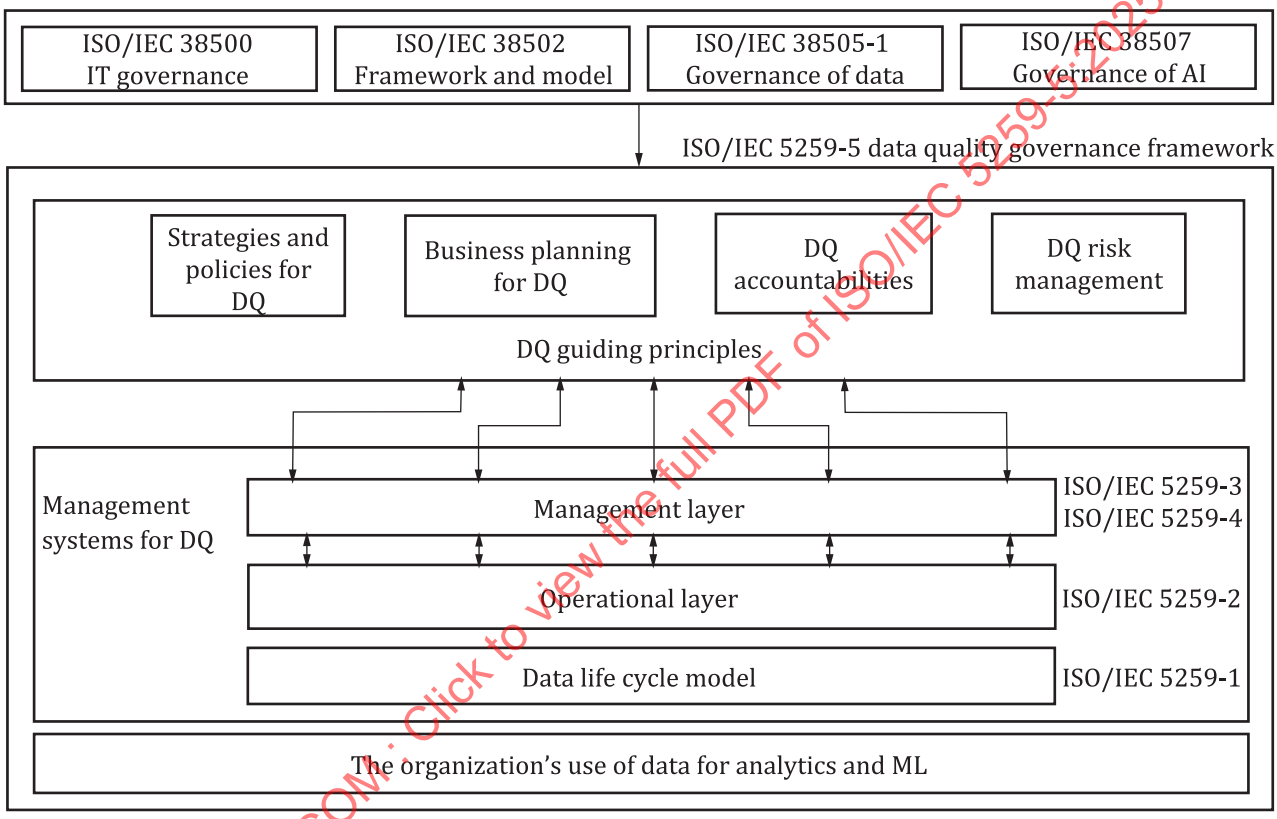
5.3 Purpose and justification

A holistic data quality governance framework for analytics and ML is needed for an organization to have adequate control throughout the DLC model according to ISO/IEC 5259-1. The data quality governance framework enables the governing body to direct and oversee the implementation and operation of data quality measures according to ISO/IEC 5259-2, data quality management requirements and guidelines according to ISO/IEC 5259-3 and the data quality process framework for various types of ML according to ISO/IEC 5259-4 throughout the DLC. The goal is to enhance trust in data for analytics and ML applications and services by mitigating data quality-related risks, making informed decisions, empowering effective and efficient operations across the organization.

The approach for an organization to enhance trust in data for analytics and ML should be to establish a robust and cross-cutting data quality governance framework across different levels of the organization with clear roles and responsibilities on how data should be handled and processed (see Figure 1). This document describes a data quality governance framework with which an organization develops its own data quality governance. The framework is applicable regardless of an organization's size and type. Individual organization's actual governance arrangement can differ according to their organizational structure, maturity and other relevant factors. Both the governing body and management can use the framework to

empower organizational stakeholders to ensure that an effective data quality governance for analytics and ML is established at all levels in the organization.

While a broader overview of governance of IT and data is available in ISO/IEC 38500 and ISO/IEC 38505-1 respectively, the general terms of governance implications of the data use in AI systems can be found in ISO/IEC 38507:2022, 6.4. This document elaborates basic guidelines provided by those International Standards for the purpose of establishing data quality governance for analytics and ML. This document emphasizes that the roles of the governing body are to set the direction for aligning data quality strategy with organization's business objectives and to establish the data quality accountabilities throughout and across different layers of the organization. This approach to governing data quality for analytics and ML ensures that management and operational layers' obligations for monitoring data quality characteristics are in line with the organization's strategy for analytics and ML. Each element of the governance framework in ISO/IEC TR 38502 is referenced in this document with a description of how each element is used in the context of data quality governance for analytics and ML.



Key

guide

direct and oversee

Figure 1 — Relationship between data quality governance framework and the rest of ISO/IEC 5259 series

NOTE The data life cycle model of ISO/IEC 5259-1 in Figure 1 is derived from data life cycle framework in ISO/IEC 8183. For more information on data life cycle framework, see ISO/IEC 8183.

6 Data quality governance framework

6.1 General

Figure 1 shows the cross-cutting key elements of the data quality governance framework and how it relates to the ISO/IEC 5259 series. The goal is to help the organization establish an effective data quality

governance by providing a governance framework with guiding principles on the governance of data quality for analytics and ML.

This clause explains the elements of the data quality governance framework in Figure 1.

6.2 DQ guiding principles

Data quality guiding principles express the desired behaviour of relevant individuals and groups across the organization to produce data with specific data quality characteristics for analytics and ML in order to achieve organization's business objectives in relation to analytics and ML systems. The governing body should ensure that the data quality principles are applied to the organization's data quality governance across management and operational processes related to the data quality for analytics and ML. The governing body should also take the initiatives and leadership to oversee the effective and timely implementation and adoption of data quality principles as directed by its management.

The followings are examples of data quality principles in relation to each element of the framework:

— Strategies and policies for DQ: An organization should ensure that data quality strategies and associated policies are aligned with the organization's current and future intent of achieving ML supported organization's business objectives.

— Business planning for DQ: An organization should ensure that strategic plans to achieve the data quality strategies are developed through its business planning process and those plans are supported through proper resource allocations.

— Management processes for DQ: An organization should establish data quality metrics on all relevant aspects of data quality with effective management controls on how data are handled and processed at each DLC phase to ensure data quality requirements are fully supported.

— DQ accountabilities: An organization should establish the oversight mechanisms through which those personnel with responsibility and authorization are held accountable for the required outcomes within the data quality strategies and policies.

— DQ risk management: An organization should have proper risk management capabilities to assess and mitigate risks associated with the DQP in ISO/IEC 5259-4 and the management practices in ISO/IEC 5259-3 to achieve ML supported organization's business objectives.

— The organization's use of data for analytics and ML: An organization's use of data for analytics and ML to achieve its ML supported organization's business objectives should be subject to the strategies and policies defined as part of the data quality governance framework as well as the management processes for DQ.

6.3 Strategies and policies for DQ

The following practices are associated with the strategies and policies for DQ:

— The governing body should ensure that data quality strategies and associated policies are set to attain the ML supported organization's business objectives.

— The governing body should ensure that the data quality strategies include ways to improve any shortcoming against the data quality principles set forth in this document.

— Managers should ensure that the data quality policies are established and enforced to address data quality principles, specific requirements set by the governing body and the stakeholders.

6.4 Business planning for DQ

The followings are the practices associated with business planning for DQ:

— The governing body should ensure that strategic plans to achieve the data quality strategies are developed and budgets and other resources to execute the plans are allocated.

— During the planning process, the governing body should ensure that the strategic plans for data quality are aligned with the organization's current and future intent of achieving ML supported organization's business objectives.

— If the governing body delegates its authority then managers can develop the strategic plans for data quality to achieve ML supported organization's business objectives.

6.5 DQ accountabilities

The followings are the practices associated with DQ accountabilities:

— The governing body is accountable for achieving ML supported organization's business objectives and formulating data quality strategies. Implementation of data quality strategies are delegated to managers.

— The governing body should ensure that the oversight mechanism is established to oversee managers achieving the required business outcomes (e.g. ML supported organization's business objectives are achieved through data quality management throughout the DLC) within the data quality strategies and policies.

— Managers are responsible for monitoring and assessing data quality performance and conformance throughout the DLC phases and are accountable to the governing body for the required outcomes.

— Managers' responsibility, authority and accountability are determined by the governing body according to ISO/IEC TR 38502.

6.6 DQ risk management

The followings are the practices associated with DQ risk management:

— The governing body should set policies on internal risk control over the phases of the DLC model in ISO/IEC 5259-1, the DQP in ISO/IEC 5259-4 and management practices in ISO/IEC 5259-3, taking into account the organization's risk appetite for both outsourced and in-house data-related processes, ML supported organization's business objectives and regulatory requirements.

— Managers should establish an appropriate system of internal risk control by inserting risk management principles and practices over the phases of the DLC model in ISO/IEC 5259-1, the DQP in ISO/IEC 5259-4 and management practices in ISO/IEC 5259-3. Managers should first assess risk, and then ensure that risks are mitigated depending on the level of the risk. During this entire process, managers may ensure that the risk management principles and framework as defined in ISO/IEC 23894 are followed.

— Managers should ensure that risk management reports are produced to facilitate informed decision making about risk by appropriate decision makers in reporting lines outlined by the governing body.

— The governing body should ensure that roles, responsibilities, authority, and accountability and reporting arrangements associated with data quality risk management are clearly defined.

— The governing body should ensure that on-going monitoring of the internal risk control system is performed.

6.7 Management processes for DQ

The followings are the practices associated with management processes for DQ:

— Managers should ensure that data quality measures on all aspects of data quality are defined with effective management controls within the data quality strategies and policies throughout the phases of the DLC model according to ISO/IEC 5259-1 across different layers of the organization.

— Regular monitoring at appropriate intervals and feedback on data quality should be given to management to track the data quality performance toward the goals.

— If appropriate, feedback should be provided to the data owners for improvement.

7 Responsibilities of governing body

7.1 Understand the strategic importance of data quality

In the market environment where fierce competition constantly demands innovative products and services along with productivity improvements, ML is considered to be a key technology for business innovation regardless of industry sector. The results learned from the data and the ML model are applied to improve customer experiences, achieve process innovations and create new business models. The achievement of the ML supported organization's business objectives requires a massive amount of data that fulfils data quality characteristics according to ISO/IEC 5259-2. Using data that do not meet the data quality characteristics can produce unintended consequences which can conflict with organization's business objectives and acceptable risk.

The governing body should understand the importance of data quality to achieve the ML supported organization's business objectives. The governing body should ensure that the organization understands how a focus on data quality helps achieve organization's business objectives.

7.2 Establish enabling environment for data quality governance

The governing body should ensure that the enabling environment for the data quality governance for analytics and ML is established and sustained. Figure 2 gives an illustrative example for such an environment. The governing body works with appropriate executive managers or is advised to identify all stakeholders to establish a DQ committee for driving the adoption and transformation of the governance of data quality in the organization.

For example, when the organization's ML supported organization's business objectives are aligned with revenue growth involving customer-related divisions, then the executive managers of those divisions and the divisions with the data quality related agenda should be identified as members of the DQ committee of the governing body. The DQ committee assists the governing body in directing and overseeing the management of data quality for analytics and ML.

The DQ committee should ensure that all the stakeholder groups in the organization are identified, engaged and are aligned with the data quality strategy to achieve ML supported organization's business objectives. As indicated in Figure 2, the stakeholder groups can include data owners, data stewards and experts from data quality, analytics and ML, infrastructure and software teams. The data owners collaborate with the ML and data quality experts in the following ways:

— to build, run and manage ML models with relevant data. That is:

  a) to create data correctly for ML;

  b) to help the experts interpret and validate data correctly for ML;

  c) to collect and monitor data trends, identify changes in data trends and if appropriate, update the ML models periodically in order to reflect changes in ML production data.

— to change their work practices and business processes according to the way of the ML system being designed;

— to educate the involved personnel to contribute to achieving the ML supported organization's business objectives.

During this process, data stewards need to ensure that data policies and standards within the stewards' domain are applied as established. In addition, new personnel such as data quality personnel can be recruited, which requires the personnel involvement from the human resource function. In the case that there is a digital transformation (DT) team responsible for the organization-wide DT, then the personnel from the DT team can be involved.

In relation to ISO/IEC TS 25058:2024, when a new dataset is introduced or an existing dataset is modified, change management should be performed to ensure the quality of software into which analytical and ML models are integrated to provide a seamless service for the service users. In order for the managers to perform these tasks, executive managers, as applicable, should participate as DQ committee members as

appropriate. The DQ committee is also responsible for maintaining and further improving the governance of data quality.

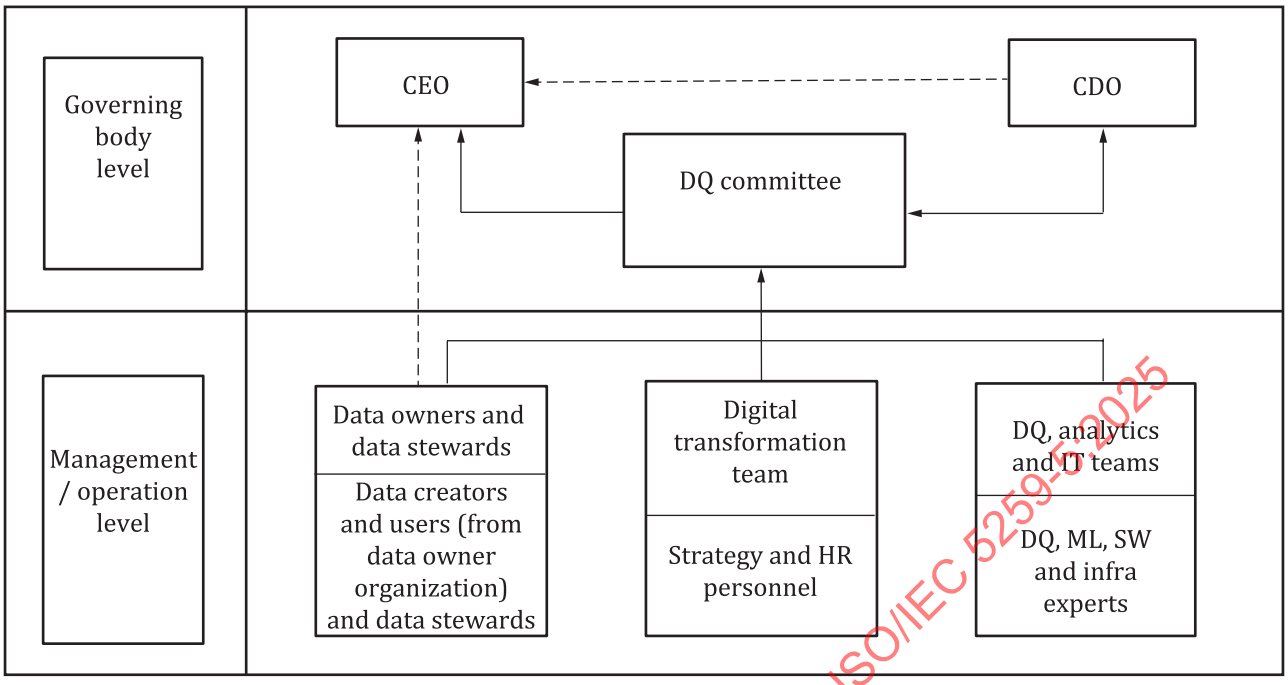


Figure 2 — An example of the enabling environment for data quality governance

In those stakeholder groups, awareness should be developed about the purpose and objectives of data quality governance for analytics and ML and their roles and responsibilities in this respect. The awareness sessions can be held and cover the following agenda:

— strategic importance of data quality to achieve ML supported organization's business objectives;

— need for data quality governance;

— roles and responsibilities of the stakeholders;

— principles of the data quality governance framework.

The sessions are iterative. While in the first cycle, the concepts and the contexts of the governance of data quality for ML can be explained, in the subsequent rounds, more refined details and roles and responsibilities can be explained.

7.3 Formulate data quality strategies

The governing body should provide leadership in formulating data quality strategies to attain the ML supported organization's business objectives. The governing body should ensure that the organization's overall organization's business objectives, legal requirements, competitor's data capabilities and organization's maturity level of data management practices are taken into consideration during the strategy formulation process. The governing body should understand that the responsibility for the overall strategy-formulation process rests with the governing body and the responsibility for implementing the data quality strategy to achieve ML supported organization's business objectives rests with management. The governing body should ensure that the delegation to the management is through the DQ committee.

7.4 Business planning for data quality

The governing body should ensure that the strategies are converted into plans and budgets for implementation and control. If authority is delegated by the governing body, managers can develop the strategic plans for data quality including data quality goals, gaps, plans and programs. Once the organization's broad data quality goals, gaps and plans to accomplish the goals are formulated, it is possible for organizations to initiate change programs to fill the gaps.

Both strategic planning and implementing the change program can be delegated to the managers. However, the governing body should ensure that the delegation is through the DQ committee to ensure transparent delegation of authority according to ISO/IEC TS 38501. While the delegation can be made, the governing body approves the strategic plans including the change program. The governing body should understand the organization's readiness for any major changes suggested as part of the strategic plans and ensure that there is an organizational commitment, capability and resources to undertake the required changes.

The governing body should also periodically review the organization's evolving environment to determine if there is a need to review, and when appropriate, revise ML supported organization's business objectives and associated data quality strategies and plans. The governing body should ensure that the DQ committee assists the governing body in setting directions for the governance of data quality as well as overseeing the management of data quality for analytics and ML. Consideration should also be given to the specific roles of the existing governance structure according to ISO/IEC 38507:2022, Figure 3.

7.5 Data quality risk management capability

The governing body should ensure that the organization has proper risk management capabilities and culture to mitigate risks associated with DLC model phases in ISO/IEC 5259-1, the DQP in ISO/IEC 5259-4 and management practices in ISO/IEC 5259-3 to achieve ML supported organization's business objectives.

The governing body should develop DQ risk management capabilities by setting policies on internal risk control and by allocating human resources with the required knowledge. The governing body should ensure that the policies are set, the resources are allocated and managers reflect risk management policies, principles and practices into the DLC, the DQP and management practices. More broad guidance for the role of governing body in AI risk management is described in ISO/IEC 23894.

The governing body should ensure that the frequency of producing risk management reports and distribution is set to facilitate informed decision-making about risk by the appropriate decision makers, especially the governing body.

In sum, the governing body should do the following:

— delegate the responsibility and authority to managers to implement risk-based DLC, DQP and management practices;

— ensure that the risk-based DLC, DQP and management practices are integrated with the organization's existing overall risk management framework;

— direct the organization to use the adopted risk-based DLC, DQP and management practices;

— monitor the risk management results through defining a clear line of accountability and reporting arrangement.

7.6 Set policies to ensure data quality

The governing body should have sufficient visibility into the data quality governance process such that data quality policies are set to achieve the broad data quality goals as well as different AI stakeholder requirements such as regulators requirements.

The policy statements can include types of decisions that can be made by specific data quality structures and individuals in the organization. For example, the change programme to accomplish the data quality goals can require the organization to change its operations and processes, which can in turn result in changes to organizational structure. The allocation of responsibility, delegation of authority and accountability of those

data quality related structures and decisions both during and after the change activities can be articulated in data quality policy statements. Effective integration of data quality policies with the data quality management practices, processes and operations ensures proper resource creation and action output in achieving ML supported organization's business objectives.

The policy statements can also address an organization-wide approach to managing data and IT architecture to ensure data quality in achieving ML supported organization's business objectives. The data quality governance requires an integrated data architecture and IT infrastructure that are designed and agreed upon within and across organizational boundaries. Through the agreed upon and integrated data architecture and IT infrastructure, organizational members can be assured the entire process in which data are created, entered and stored safely and in compliance with legal requirements, then shared and utilized for analytics and ML.

The governing body should ensure that roles and responsibilities (e.g. data owner, chief data officer, data supply chain officer and data stewards) are established with proper authorities within and across organizational boundaries. Responsibilities, authority and accountability of those roles should be articulated in the data quality policies. Articulating such policies ensures that architectural decisions made by management are aligned with the organization's data quality strategy to achieve its ML supported organization's business objectives. The governing body should ensure that management establish comprehensive sub-policies for data architecture and IT infrastructure, including consistencies in data taxonomy.

The policies on internal controls to handle risks associated with the DLC phases, the DQP and management should also be included in the policy statements. Taking into account the organization's risk appetite and ML supported organization's business objectives and legal requirements, such policies guide the organization in terms of how risks associated with the DLC phases, the DQP and management are properly handled and managed.

According to ISO/IEC TS 38501, policy statements can specify the following:

— governing body's reserve powers and the extent to which authority is delegated to managers (the governing body typically retains involvement in approval of major investments, oversight of programs and projects with a major impact on the business and approval of key risk management practices);

— the types of decisions made by data quality related structures and individuals in the organization;

— the responsibility and authority for policies;

— IT-related architecture decision making;

— sourcing strategies and decisions;

— specific roles of the existing governance structure in relation to the data quality governance – governance steering group, risk committee and audit committee;

— risk appetite;

— internal control requirements for risk management;

— reporting requirements by management.

The governing body should ensure that the data quality policies are communicated to guide management actions.

The governing body should ensure that delegating policy development and the subsequent oversight of achieving required outcomes are through the DQ committee specified in 7.2. Although the governing body can delegate developing the data quality policies, the governing body should approve the data quality policies considering the implications of the policies for achieving ML supported organization's business objectives and legal requirements.

The governing body should ensure that the policies undergoes a periodic review to reflect changes in the external and internal environments such as changes in legal requirements.