EUCloudEdgeIoT.eu
UNLOCK-CEI

Commercial Feasibility Tool CEI-LING®

CEI - Leadership, Innovation, Navigation, Growth

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D4.2 – Commercial Feasibility Tool CEI-LING®
CEI - Leadership, Innovation, Navigation, Growth

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Glossary of terms

Item	Description
AI	Artificial Intelligence
CAPEX	Capital Expenditure
CBR	Cost-Benefit Ratio
CEI	Cloud-Edge-Iot
CES	Customer Effort Score
CLV	Customer Lifetime Value
CPA	Cost Per Acquisition
CPL	Cost Per Lead
EU	European Union
GDPR	General Data Protection Regulation
IoT	Internet Of Things
IP	Intellectual Property
IT	Information Technology
KPI	Key Performance Indicator
MetaOS	Meta-Operating Systems For The Next Generation Iot And Edge Computing Cluster
ML	Machine Learning
MTBF	Mean Time Between Failures
MTTR	Mean Time To Repair
NGIoT	Next Generation Internet Of Things
NPS	Net Promoter Score
NPV	Net Present Value
OPEX	Operational Expenditure
PoC	Proof Of Concept
R&D	Research And Development
ROI	Return On Investment

Keywords

Cloud-Edge-IoT; Computing; Continuum; Demand-Supply Dialogue; Communication; Engagement

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Executive Summary

This document has been prepared as part of WP4 of the UNLOCK-CEI project that aims to *unlock the potential for accelerating the deployment of the Cloud-Edge-IoT (CEI) computing continuum… focusing on the demand side drivers and challenges and the technology-driven innovations and business opportunities driving demand value chains.*

Its primary objective is to establish a comprehensive self-assessment framework, CEI-LING®, tailored for technology developers, with a particular focus on those working in the **Meta-Operating Systems for Next Generation IoT and Edge Computing Cluster**. The CEI-ING® framework is designed to facilitate an in-depth evaluation of the applicability, value chains, and key market opportunities for their technological innovations. More expansively, it serves as a foundational interface between demand and supply stakeholders, offering a platform to discern how and where edge and metaOS solutions can generate tangible business value.

While the primary audience for this document is developers specialising in edge and metaOS technologies, its scope extends to a decision-makers across industry who are considering investments in edge solutions.

The document is structured around four key areas:

- Conceptual model: providing an outline of the theoretical model on which the tool is based to assess how prepared a company is to adopt Cloud-Edge-IoT technologies.
- Methodology: explaining the methodology approach that underpins the tool and how it should be used
- Mathematical Model: outlining the mathematical model used to evaluate the degree of readiness for CEI technology adoption.
- Feasibility Framework: describing each of the KPIs included in the tool to help understand their significance.

The rapid evolution of the Internet of Things (IoT) and the burgeoning reliance on data-intensive applications have led to a paradigm shift from centralised cloud computing to edge computing. This transition, which brings computation closer to the source of data, aims to minimise latency, reduce bandwidth usage, and enhance overall system performance. However, the journey towards embracing edge computing technologies involves intricate considerations, requiring a detailed evaluation through a set of Key Performance Indicators (KPIs) to determine the feasibility of this integration.

The CEI-LING Framework

The CEI-LING framework is designed with versatility and adaptability at its core, recognising that no single industry or company archetype can fully represent the diversity of market needs. Its architecture is flexible, enabling customisation to suit the unique demands of various business environments, from the dynamic tech startup scene to the structured world of financial institutions and the creative domain of marketing agencies.

The conceptual framework was developed around several critical dimensions: organisational performance measurement, external environmental analysis, motivational assessment, and capacity evaluation. These dimensions are pivotal in evaluating an organisation's ability to adapt effectively to CEI technologies and have been considered when defining (i) the 6 hierarchies that give structure to the CEI-LING model and (ii) for the 249 key performance indicators that are used for assessing whether CEI technologies add value to the business. These hierarchies are:

- Organisational Hierarchy
- Economic Hierarchy
- Technology Hierarchy
- Legal & Regulatory Hierarchy

- Industry & Market Hierarchy
- Risk & Compliance Hierarchy

While comprehensive, the CEI-LING is not exhaustive. It is worth noting that with regard to the assessment of regulation and certification of CEI technologies, no uniform, cross-sector metrics, or procedures are future-proof as initial approaches to regulating and certifying data and AI systems are still emerging.

The structure for each component of the framework is as follows:

HIERARCHY				
SUB HIERARCHY				
PHASE	Characterisation	Design & Plan	Deployment	Operation
Relevance	High	Low	Low	High
INDICATOR DESCRIPTION				
Indicator name	Indicator number	Description		Indicator Type
MEASURING INFORMATION				
Units	Frequency	Evaluation formula		

It is worth remembering that in any case, this is the first step in a lengthier process that seeks to validate the framework in multiple environments and ensure that its use can help organisations, large and small, identify how and when CEI technologies can help them achieve real business outcomes.

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1 Introduction

1.1 Context and purpose

This deliverable forms a crucial component of the UNLOCK-CEI project that aims to *unlock the potential for accelerating the deployment of the Cloud-Edge-IoT (CEI) computing continuum… focusing on the demand side drivers and challenges and the technology-driven innovations and business opportunities driving demand value chains.* It has been prepared under Work Package 4: Tech Developer Engagement, under Task 4.2: Commercial Feasibility Tool. Its primary objective is to establish a comprehensive self-assessment framework tailored for technology developers, with a particular focus on those working in the **Meta-Operating Systems for Next Generation IoT and Edge Computing Cluster**. The framework is designed to facilitate an in-depth evaluation of the applicability, value chains, and key market opportunities for their technological innovations. More expansively, it serves as a foundational interface between demand and supply stakeholders, offering a platform to discern how and where edge and metaOS solutions can generate tangible business value.

Originally, the methodology was intended to primarily utilise the Demand-Side Readiness Radar for identifying potential synergies. However, the evolving nature of the industry and the need for a broader perspective have led to the integration of additional information sources. This includes insights gathered from a series of workshops, engaging participants from a diverse spectrum of industries such as telecommunications, manufacturing, healthcare, and smart city development. The number of workshops and the range of participants involved have significantly contributed to the enrichment of the framework.

The inclusion of these varied perspectives has been instrumental in the evolution of the framework, allowing it to adopt a more holistic approach. The interactions and exchanges among professionals from these different sectors have greatly enhanced the framework's capacity to address a broader range of challenges and opportunities present in the IoT and Edge Computing domains. This enriched approach ensures that the framework is not only comprehensive but also adaptable to the dynamic and multifaceted nature of the technology landscape.

1.2 Target audience

While the primary audience for this document is developers specialising in edge and metaOS technologies, its scope extends beyond this group, making it a valuable resource for a broader range of stakeholders. This includes business strategists, and decision-makers in various industries who are considering investments in edge solutions.

The document provides these stakeholders with a comprehensive understanding of the intricacies and potential of edge and metaOS technologies. By doing so, it enables them to make well-informed assessments regarding the viability, strategic alignment, and potential return on investment of these technologies. This is particularly crucial in an environment where edge computing is rapidly evolving and becoming increasingly integral to various sectors.

Furthermore, the insights offered in this document can assist stakeholders in identifying emerging trends, understanding market dynamics, and recognising the competitive advantages that edge technologies can offer. This knowledge is invaluable for those looking to stay ahead in a technology-driven market, ensuring that their investments are not only sound but also forward-thinking.

This document is complemented by previous deliverables which address the market potential and value chain members respectively:

- Deliverable 2.1 Readiness Framework and Service Requirements
- Deliverable 3.2– Sector-specific service requirements, data flows and revenue streams in Cloud-Edge-IoT value networks.

1.3 Document Structure

The document is structured around four key areas:

- Conceptual model: providing an outline of the theoretical model on which the tool is based to assess how prepared a company is to adopt Cloud-Edge-IoT technologies.
- Methodology: explaining the methodology approach that underpins the tool and how it should be used
- Mathematical Model: outlining the mathematical model used to evaluate the degree of readiness for CEI technology adoption.
- Feasibility Framework: describing each of the KPIs included in the tool to help understand their significance.

Annex A contains detailed information on each of the indicators and how they should be measured. Annex B is the basic, non-coded framework that will be validated and then including into an easy-to-use application.

2 Background

2.1 General approach

The development of a conceptual model as the foundation for a framework aimed at evaluating a company's readiness to adopt edge technologies require a multifaceted approach:

- Firstly, the conceptual model serves as a systematic tool for understanding the intricate dynamics of Cloud, Edge, and IoT technologies. It aids in dissecting and categorising critical factors in the adoption process, such as infrastructure needs, data handling, security protocols, and integration hurdles. This comprehensive understanding is crucial for businesses to grasp the full spectrum of implications these technologies have on their operations.
- Secondly, by establishing a common language and framework, the conceptual model enhances communication and collaboration among various stakeholders. This shared understanding is vital for ensuring that all aspects of technology adoption are thoroughly considered, and any potential challenges are proactively identified and addressed.
- Thirdly, the conceptual model acts as a blueprint for the evaluation framework. It delineates various hierarchies and criteria essential for assessing an organisation's readiness, encompassing aspects like technical capabilities, organisational maturity, workforce expertise, financial viability, and strategic congruence. This structured approach allows organisations to conduct a holistic analysis of their strengths and areas for improvement in relation to CEI technology adoption.
- Finally, its adaptability to different industry contexts and specific use cases ensures that the evaluation framework remains relevant and practical for a diverse range of organisations, regardless of their industry, size, or market position.

2.2 Context and demand for feasibility

The imperative to gauge an organisation's adaptability to CEI (Cloud, Edge, and IoT) technologies stems from their profound potential to revolutionise business operations and the current ambiguity surrounding the technological landscape. This paradigm shift necessitates a thorough understanding of an organisation's preparedness to integrate these technologies and modify their workflows accordingly.

CEI technologies, known for their disruptive nature, demand a methodical assessment of an organisation's capabilities to assimilate them effectively. It is crucial for companies to scrutinise their existing infrastructure, data management protocols, and technical acumen to ascertain their capacity for integrating edge technologies. In the absence of robust evaluation mechanisms, organisations are at risk of neglecting essential readiness aspects, potentially impeding successful adoption and limiting their ability to capitalise on the advantages of edge computing.

Moreover, the CEI domain is marked by a diverse array of technical solutions and frameworks. Given the multitude of suppliers, platforms, and methodologies available, organisations face the challenge of navigating this extensive landscape to identify solutions that best align with their unique requirements. Adaptability assessment tools are instrumental in pinpointing the most appropriate technical solutions, ensuring compatibility with existing systems, and facilitating seamless integration, thereby minimising implementation costs.

The development of such tools is not only crucial for assisting companies in evaluating their readiness to embrace the transformative nature of edge computing and identifying infrastructural and expertise gaps. They also play a vital role in guiding the wider industry. These tools provide essential insights for technology providers and integrators to benchmark their solutions and value propositions effectively. This is the core objective of CEI-LING, a tool designed to bridge these critical gaps and support organisations in their journey towards embracing the future of edge computing.

2.3 Existing frameworks and unique challenges to market deployment of CEI solutions

The prevailing array of assessment tools for technology adoption predominantly concentrates on well-established technologies or incremental advancements. As a result, these tools often offer guidance rooted in existing best practices and proven methodologies, which are not entirely applicable to the unique context of CEI (Cloud, Edge, and IoT) technologies. Traditional advisory tools are found lacking when it comes to addressing the distinct challenges and opportunities presented by these emerging technologies.

Cloud-Edge-IoT, like other disruptive technologies, heralds transformative shifts in business models, operational processes, and industry landscapes. They compel organisations to adopt innovative thinking and embrace new methodologies that may diverge markedly from conventional standards.

These considerations underscore the need for a novel assessment tool, one that is specifically designed for disruptive technologies. Such a tool would recognise the unique characteristics of these innovations, which are often accompanied by a high degree of uncertainty and necessitate organisations to undertake calculated risks.

An assessment tool tailored for CEI technologies would evaluate various critical factors, including market dynamics, technological viability, strategic implications, and potential risks. It would offer a comprehensive framework for organisations, whether they are on the demand or supply side, enabling them to assess the readiness of their existing systems, benchmark their value propositions, gauge the impact of disruptive technologies on their operations, and formulate effective strategies for adoption and utilisation.

The development of a bespoke, CEI-focused assessment tool is imperative to address the specific challenges and opportunities these innovations present. It acknowledges the need for a divergent approach and equips all stakeholders in the value chain with the necessary guidance, resources, and frameworks. This tool is instrumental in facilitating successful adoption and exploitation of disruptive technologies, thereby fostering innovation and enhancing competitiveness in the swiftly evolving digital landscape.

2.4 Scope of application

The framework and its accompanying assessment tool are expertly crafted to guide both technology providers and clients in navigating the adoption of cutting-edge technologies. This tool conducts a comprehensive evaluation of the diverse options available in the market, considering a spectrum of factors. These range from broader aspects like economic conditions and societal impact to more technical elements such as functionality, performance, scalability, and compatibility.

For technology providers, this tool serves as an essential platform to highlight their products and differentiate themselves in a competitive landscape. It enables them to emphasise the unique aspects of their solutions and how these address specific business challenges, a critical factor in a market where standing out is essential for gaining a competitive advantage. On the other hand, for client companies, the tool aids in evaluating their readiness to embrace edge technologies. It examines various dimensions, including existing infrastructure, data management capabilities, cybersecurity measures, and organisational culture. This all-encompassing assessment equips clients with a clear picture of potential challenges and prerequisites for successful technology integration, guiding them towards informed decisions about incorporating edge technologies into their business processes.

By serving both technology providers and clients, the tool aims to create a collaborative ecosystem and promote the exchange of knowledge. It encourages dialogue between the two parties, enabling technology providers to better understand the unique needs and challenges of clients, and to customise their offerings accordingly. Clients, in turn, gain insights into the latest technological innovations and market trends. This reciprocal understanding and information sharing enable clients to make strategic decisions and establish partnerships with technology providers that align with their needs and goals.

3 Conceptual model

3.1 Overview of approach

The conceptual model has been developed through a triple lens of industry adoption, value chain dynamics and end application:

3.1.1 Industry adoption context

Industries are currently positioned at a pivotal crossroads with the advent of disruptive technologies. Rapid advancements in fields such as Cloud-Edge-IoT are not only reshaping business models but are also fundamentally transforming entire industries. The integration of these disruptive technologies into existing business frameworks presents considerable challenges. They often require significant modifications to current processes, systems, and organisational structures. Furthermore, the inherent risks, uncertainties, and complexities that accompany these innovations underscore the need for companies to meticulously evaluate their adaptability and preparedness for such changes. An industry comprises a diverse array of organisations, each made up of individuals and interdependent groups with varied objectives, work methodologies, training backgrounds, and even personality types. Each sector within an industry may operate with its unique processes and workflows, driven by specific goals and the technologies deemed most suitable for achieving these objectives.

All entities, whether on the supply or demand side, encounter challenges in adopting these transformative technologies, which introduce substantial alterations to their standard business operations. As organisations evolve and pursue success, they must not only adapt to their environment but also embrace technological advancements. This adaptation often leads to increased specialisation, heightened interdependence among different work groups, and a rise in organisational complexity.

In such a scenario, a conceptual model becomes an invaluable asset. It aids in assessing an organisation's capability to effectively adopt and integrate disruptive technologies. This model lays the groundwork for developing a framework that assists organisations in identifying critical factors and dimensions crucial to the technology adoption process. With a conceptual model, companies can evaluate various elements, including their existing infrastructure, technological expertise, organisational culture, and strategic alignment. This assessment helps them to identify potential obstacles and challenges that may act as barriers to the successful integration of disruptive technologies. Additionally, it enables organisations to chart a course for the necessary changes, investments, and resources required to bolster their adaptability.

Additionally, the conceptual model and subsequent framework provide a unified language or taxonomy, fostering a common understanding among all stakeholders involved in the adoption process. This mutual comprehension is vital for effectively managing change and ensuring a seamless transition towards these disruptive technologies.

Finally, the conceptual model allows for the tailoring of the evaluation process to suit specific industry needs, economic contexts, regulatory environments, organisational structures, and strategic objectives. It takes into account industry-specific challenges, regulatory demands, and technological trends. This level of customisation ensures that the evaluation is precisely aligned with the unique requirements and circumstances of each organisation, leading to more accurate adaptability assessments and better-informed decision-making.

3.1.2 Value chain dynamics

A critical factor in the adoption of disruptive technologies is the inherent variability among companies at different stages of the value chain. Each entity within this chain has distinct roles, responsibilities, and dependencies, significantly impacting their readiness and approach to adopting new technologies. For example, upstream entities like suppliers or raw material providers may encounter challenges and opportunities that differ markedly from those faced by downstream players such as distributors or end-users.

The level of technological maturity and available resources can vary considerably along the value chain. Companies nearer the upstream end might have less interaction with advanced technological innovations, necessitating substantial investments in both infrastructure and expertise to fully integrate disruptive technologies. In contrast, downstream companies are often more aligned with technology-driven approaches and may be better positioned for quicker adoption.

Acknowledging these variances and customising the assessment framework to address them enables organisations to pinpoint their unique challenges, strengths, and needs. This understanding facilitates the development of bespoke strategies, efficient resource allocation, and enhanced collaboration with other value chain participants, fostering successful technology adoption.

Furthermore, the framework supports benchmarking, allowing organisations to measure their readiness and product value propositions against industry standards and competitors.

The conceptual model and framework offer a structured methodology that takes into account the distinct characteristics of companies, their positions in the value chain, and industry-specific nuances. This approach is key to devising targeted strategies for effective technology adoption.

3.1.3 Application Focus

As previously mentioned, the primary goal of the conceptual model is to lay the groundwork for an assessment framework and its subsequent tool. This tool is designed to evaluate a company's commercial offerings in relation to its competitors and to determine how well these offerings align with market demand. It achieves this by employing various use cases as benchmarks or examples to assess the company's market position and adaptability.

By analysing these use cases, the framework offers insights into the competitive landscape, enabling organisations to identify areas for benchmarking and improvement. It helps decision-makers evaluate if their current product offerings meet market demands and pricing expectations, or if adjustments are necessary to maintain competitiveness.

Through a range of diverse use cases, the advisory tool assists companies in assessing their commercial offerings, market competitiveness, and adaptability. By providing benchmark comparisons and highlighting potential areas for enhancement, the tool equips organisations with the information needed to make informed decisions, develop growth strategies, and improve their market positioning. Ultimately, this tool aids companies in aligning their offerings with market demands, staying ahead in competitive environments, and navigating the complexities of digital transformation successfully.

3.2 Key elements in scope

The conceptual framework is structured around several critical dimensions: organisational performance measurement, external environmental analysis, motivational assessment, and capacity evaluation. These dimensions are pivotal in evaluating an organisation's ability to adapt effectively to CEI technologies.

- **Environment**: the framework places significant emphasis on understanding the external environment, recognising its crucial role in an organisation's success, especially when adopting transformative technologies. It involves a thorough examination of the economic, political, sociocultural, environmental, demographic, and technological factors that influence the organisation's operational context. This comprehensive analysis helps organisations anticipate and adapt to external changes, ensuring their strategies are well-aligned with environmental dynamics.

- **Capacity**: focuses on assessing an organisation's ability to utilise its resources effectively in the competitive market. The framework examines various components such as technological infrastructure, expertise, financial resources, and organisational culture. This evaluation provides a complete picture of the organisation's preparedness for embracing new technologies, highlighting areas of strength and identifying potential gaps.
- **Motivation**: aims to understand the driving forces behind an organisation's decision to adopt new technologies is crucial. The framework considers motivations like enhancing operational efficiency, improving customer experience, gaining competitive advantage, fostering innovation, and responding to industry trends. By aligning these motivations with the adoption process, the framework helps organisations focus their efforts where emerging technologies can have the most significant impact, guiding strategy and resource allocation.
- **Performance measurement**: the framework extends beyond traditional measures of effectiveness and efficiency to include variables like morale, innovation, turnover, adaptability, and change orientation. These factors are increasingly important in a landscape influenced by diverse stakeholder preferences. By incorporating these dimensions, the framework enables organisations to align their activities with the adoption of CEI technologies, ensuring they remain attuned to stakeholder needs and responsive to market changes.

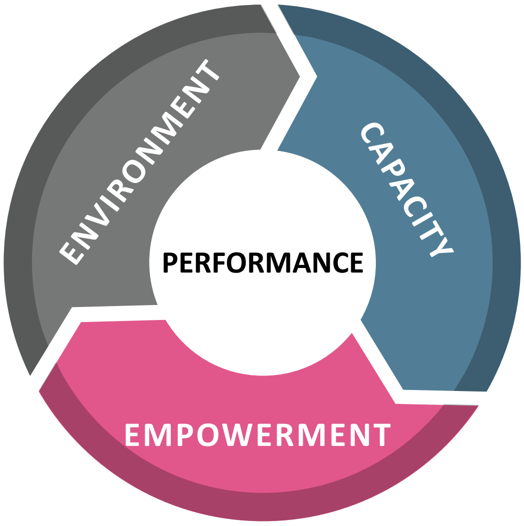


Figure 1. The basic concept

3.3 Environment

The conceptual model is designed to assess and navigate the enabling environment, crucial for adapting to the rapidly evolving technological landscape. It employs a comprehensive matrix, focusing on three integral components:

Regulatory framework (rules)

Encompasses the formal legal and regulatory structures, including laws, regulations, and codes, that directly impact an organisation's approach to technology adoption and adaptation. Understanding this framework is essential for organisations to ensure compliance and to navigate the legal landscape effectively while adopting new technologies.

Organisational culture

This aspect delves into the informal norms, values, traditions, and societal expectations that influence organisational behaviour in the context of technology. It recognises that an organisation's internal culture plays a pivotal role in how it responds to and integrates new technologies. By aligning technological adoption with the prevailing organisational culture, companies can facilitate smoother transitions and more effective integration of new systems.

Competencies and resources

This component analyses the available labour market, resources, assets, limitations, infrastructure, and technological capabilities at an organisation's disposal. It involves a thorough assessment of both tangible and intangible assets that can support or hinder the adoption of new technologies. Understanding these elements helps organisations identify their strengths and areas for development, enabling them to make strategic decisions about resource allocation and capability building.

These three components are interconnected and mutually influence one another within the enabling environment. By comprehending and navigating these interdependencies, organisations can strategically position themselves for success in a dynamic business landscape where technology plays a crucial role.

3.4 Capacity

The framework to assess organisational capacity to adopt technologies from the CEI continuum, the conceptual model identifies eight interconnected areas that build the foundation of an organisation's performance, each consisting of multiple sub-components:

- Strategic leadership
- Organisational structure
- Human resources
- Financial management
- Infrastructure
- Programme management
- Process management
- Inter-organisational linkages

Strategic leadership

The comprehensive set of activities aimed at guiding and steering an organisation towards the fulfilment of its mission. At its essence, strategic leadership involves establishing clear objectives for the organisation and providing guidance to employees and stakeholders to achieve those objectives. Due to the impact that adopting CEI technologies has both in the industry and in a company, the decision of adopting them must be an ultimate outcome of an effective strategic leadership reflection that involves envisioning the future, setting clear objectives, and aligning resources and efforts towards achieving those goals. The conceptual model integrates three primary dimensions: leadership per se, strategic planning, and niche management with the purpose of providing insights and recommended actions that can drive the organisation towards success in an ever-changing technology landscape.

- **Leadership per se:** evaluated based on four essential qualities, each comprising specific competencies:
  a. Collaboration.
  b. Innovation.
  c. Integration.
  d. Production.
- **Planning**: Strategic planning plays a crucial role in evaluating a company's ability to adapt to disruptive technologies. It is an organised and creative process that guides the organisation towards its future goals, examining opportunities, threats, and constraints..
- **Niche management**: In today's highly competitive landscape, organisations must establish a unique position in the market by offering something distinct. Niche management involves identifying and focusing on a valuable capability that sets the organisation apart from competitors.

Organisational Structure

The organisational structure plays a crucial role in how a company adapts to technological advancements, particularly in the context of Cloud-Edge-IoT (CEI) technologies. This structure involves the division of labour, assignment of roles and responsibilities, and coordination of efforts. The assessment framework evaluates the structure's adaptability and responsiveness to CEI technological changes, focusing on the dynamic adjustment of roles and responsibilities to optimise performance in a technology-driven environment.

Human Resources

Human resource management is vital in the adoption of CEI technologies. The framework examines three primary aspects:

- **Planning**: This involves forecasting human resource needs specific to CEI technology adoption, identifying required skills and competencies.
- **Staffing**: It focuses on recruiting and integrating employees with the necessary skills for implementing and leveraging CEI technologies.
- **Development and assessment**: This area emphasises continuous training, skill development, and performance evaluations to ensure the workforce is proficient in CEI technologies.

Financial Management

Financial management is key to readiness for adopting CEI technologies. The framework assesses the organisation's financial strategies, focusing on the alignment of budgeting with CEI technological goals and the establishment of transparent financial systems. It evaluates the organisation's ability to manage funds effectively, ensuring financial resources are strategically allocated towards CEI technology adoption.

Infrastructure

The framework evaluates the organisation's existing infrastructure, including facilities, technology, and critical assets, in the context of CEI. It identifies infrastructural gaps and assesses whether the current setup can support the adoption of CEI technologies, considering factors like scalability, compatibility, and future-readiness.

Programme Management

Programme management is scrutinised for its role in transforming strategic objectives into actionable plans for CEI technology adoption. The framework examines the organisation's ability to manage large-scale projects, focusing on planning, implementation, and evaluation processes. It assesses how these elements contribute to the organisation's readiness for adopting CEI technologies.

Process Management

Process management is essential for aligning daily operations with broader organisational goals in the CEI context. The framework evaluates how processes are integrated across the organisation, ensuring they support the adoption of CEI technologies. It looks at common systems and operations, including problem-solving, planning, decision-making, communication, and monitoring, ensuring they are effectively applied across all departments.

Inter-organisational links

The assessment of inter-organisational linkages is crucial for understanding how a company interacts with external entities in the CEI landscape. The framework examines existing and potential collaborations, focusing on how these relationships can support the adoption of CEI technologies. It evaluates the organisation's ability to exchange knowledge, foster innovation, and engage in collaborative ventures, which are vital for navigating the challenges and opportunities of CEI technologies.

3.5 Empowerment

When developing a framework to assess a company's readiness to adopt disruptive technologies, particularly CEI technologies, it is essential to delve into the motivational aspects that define the organisation's character and influence its performance. While some organisations excel in challenging environments, others approach change and risk with greater care. Two factors can help understand the right approach to CEI:

- Purpose

- Culture

Purpose

The concept of 'Purpose' in the framework is pivotal. It should mirror the organisation's goals and objectives, providing a forward-looking direction for technology-based enhancements. The purpose is not just about setting objectives but about tapping into the collective aspirations and motivations of the organisation's members.

- **Emotional appeal**: the purpose should resonate on an emotional level, motivating individuals and aligning with their aspirations.
- **Consistency and alignment**: serving as a benchmark for evaluating whether the organisation's actions and decisions are consistently aligned with the adoption of CEI technologies.
- **Inspiration and motivation**: it should inspire and motivate members, fostering behaviours conducive to the successful adoption of CEI technologies.

Culture

'Culture' in the framework is about bringing the purpose to life and facilitating its achievement. Assessing organisational culture involves understanding the extent to which it supports or hinders change and technology adoption.

- **Diagnosing culture**: the framework analyses organisational culture to gauge its alignment with change and technology adoption. This involves understanding the shared assumptions, values, and beliefs that influence how members approach CEI technologies.
- **Complexity of culture**: recognising that organisational culture is multifaceted and not a monolithic entity. The framework acknowledges the complexity and time required to fully understand an organisation's culture.
- **Culture's role in motivation**: articulating how culture contributes to organisational motivation and, consequently, to overall performance in the context of adopting CEI technologies.

Incorporating these aspects of organisational motivation into the assessment framework enables companies to evaluate their readiness for embracing disruptive technologies. It also helps in proactively identifying and addressing any motivational barriers that might hinder their adaptation efforts in the rapidly evolving CEI landscape.

3.6 Performance

When developing a framework for assessing a company's readiness to adapt disruptive technologies, analysing organisational performance becomes a critical step in the assessment process. However, measuring performance remains a challenging issue within organisational theory. The framework uses an approach based on identifying organisational goals, involving the perceptions of multiple stakeholders.

In this framework, organisational performance is defined as the overall result that combines individual, team, and programme performance. Every organisation has its own way of measuring and communicating its performance. While multiple interpretations of performance exist, conventional benchmarks in most sectors and development areas provide some direction for understanding performance.

Stakeholders are interested in how an organisation defines its results and communicates them to different audiences. Each stakeholder group has its own interests and concept of what constitutes good performance. Beneficiaries at the programme level are primarily concerned with programme performance and secondarily with organisational performance. Employees have a crucial stake in the organisation's performance as it directly affects their livelihood. Other stakeholders, such as citizens, funders, politicians, and investors, have their own views of organisational performance.

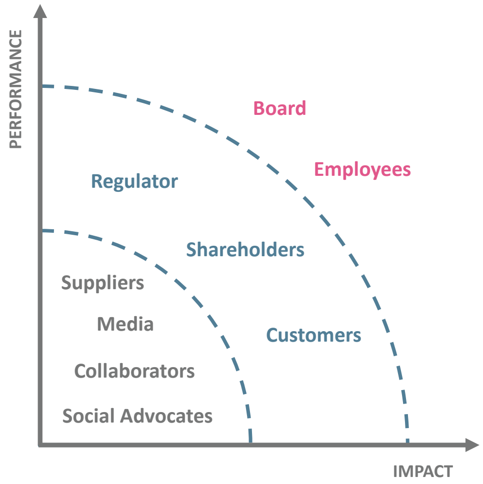


Figure 2. Impact of performance by stakeholder

To develop a comprehensive framework for understanding organisational performance, it must consider multiple dimensions while emphasizing four main elements of organisational performance:

- Effectiveness
- Efficiency
- Relevance
- Financial feasibility.

Effectiveness

It serves as a starting point for assessing performance. It refers to the extent to which an organisation fulfils its goals and objectives, aligned with its purpose as defined by its function. Organisational effectiveness is essential for achieving desired outcomes, in this case, the adoption of exponential technologies that potentially will impact the company.

Efficiency

Relates to the organisation's ability to optimise its resources while delivering goods and services within resource constraints. In the case of the assessment framework, it measures the ability to fulfil the adoption of CEI technologies with projected resources.

Relevance

Facing such an impactful change as adopting CEI technologies requires the company's purpose for making that decision to be aligned with the needs of its stakeholders.

Financial feasibility

Even if an organisation demonstrates effectiveness, efficiency, and relevance, it can still face collapse if it lacks the ability to generate benefits while meeting its functional requirements in the short, medium, and long term.

4 Methodology

4.1 Adopting CEI. A comprehensive approach with the CEI-LING framework

The rapid evolution of the Internet of Things (IoT) and the burgeoning reliance on data-intensive applications have led to a paradigm shift from centralised cloud computing to edge computing. This transition, which brings computation closer to the source of data, aims to minimise latency, reduce bandwidth usage, and enhance overall system performance. However, the journey towards embracing edge computing technologies involves intricate considerations, requiring a detailed evaluation through a set of Key Performance Indicators (KPIs) to determine the feasibility of this integration.

The CEI-LING Framework

The CEI-LING framework is designed with versatility and adaptability at its core, recognising that no single industry or company archetype can fully represent the diversity of market needs. Its architecture is flexible, enabling customisation to suit the unique demands of various business environments, from the dynamic tech startup scene to the structured world of financial institutions and the creative domain of marketing agencies.

Customisation and adaptability

CEI-LING's customisability extends beyond industry applicability to address the specific needs of individual companies. It acknowledges that businesses, regardless of their size or market capitalisation, have their own unique processes, objectives, and challenges. CEI-LING is engineered to not only manage these unique aspects but to utilise them as opportunities, aligning with the company's strategic goals, operational specifics, and adapting to the changing market conditions. **It is up to the CEI solution provider to select the KPIs that can best help evaluate the feasibility of that particularly solution for any given operational environment**.

Forward-thinking design

CEI-LING is developed with a forward-thinking design philosophy, prepared to accommodate and evolve with changes in market trends, technological advancements, and shifts in consumer behaviour. This ensures its relevance and effectiveness in the long term, capable of scaling and adapting in line with the growth and transformation of the businesses it serves.

Comprehensive KPI evaluation

The CEI-LING framework offers a comprehensive approach to evaluating the readiness of organisations to adopt edge computing technologies. It involves a meticulous assessment of various Key Performance Indicators (KPIs), critical to understanding an organisation's preparedness in the context of its unique operational environment and the broader commercial landscape.

Flexibility in KPI Weighting

A key feature of CEI-LING is its inherent flexibility, crucial given the varied nature of industries and global markets. Recognising that certain KPIs may be more relevant in some contexts than others, CEI-LING allows users to assign weights to each KPI based on their specific organisational needs and market conditions. This weighted system ensures that the assessment process is finely tuned to reflect the priorities most relevant to the organisation's situation.

Strategic Application of KPIs

The effective use of CEI-LING depends on the users' deep understanding of their industry trends, competitive landscape, and internal organisational processes. This understanding is essential for a critical evaluation of each KPI, ensuring that the weighting assigned to each is strategic and informed, leading to an accurate and reliable reflection of the organisation's readiness to adopt edge computing technologies.

4.2 Weighting Phases and KPIs

4.2.1 Weighting different phases in CEI technology implementation

In the implementation of Cloud-Edge-IoT (CEI) Technologies, each phase has its unique importance and risks:

- **Characterisation phase**: the weight of each Key Performance Indicator (KPI) is assigned based on how Edge Computing aligns with business objectives. A higher weight is given if planning is crucial to the project's success.
- **Design & plan phase**: lays the foundation for implementation and deployment. Weights might reflect operational risks, integration complexities, or deployment costs.
- **Deployment phase**: critical for assessing implementation success, weights in this phase may focus on return on investment (ROI), system stability, and performance improvements.
- **Operation phase**: involves strategy implementation, managing deliverables, and enhancing results. Weights could be assigned to support systems, user training, and feedback mechanisms, focusing on efficiency and adaptability.

4.2.2 Weighting KPIs

KPIs are essential for evaluating the effectiveness of Edge Computing implementation, with varying weights based on their relevance:

- **System performance KPIs:** These might include latency, bandwidth usage, or data processing speed, carrying more weight if the goal is to enhance performance.
- **Cost-related KPIs**: For organisations focusing on cost savings, KPIs like capital expenditure (CAPEX), operational expenditure (OPEX), and total cost of ownership (TCO) are more significant.
- **Security KPIs**: In industries where security is crucial, KPIs related to data breaches, system integrity, and compliance standards are prioritised.
- **Scalability and flexibility KPIs**: Organisations aiming for growth will focus more on KPIs related to scaling and adapting the infrastructure.

Customising weights is crucial, reflecting the strategic priorities and operational realities of the organisation. This approach allows for a tailored analysis, aligning the impact of Edge Computing with the organisation's vision and operational imperatives. Weights should be dynamic, evolving with changes in the business environment, technological advancements, and shifts in organisational strategy.

4.2.3 Baseline measurement

Baseline Measurement is vital for strategic technology enhancements, especially when upgrading to edge computing technologies. It involves recording the current performance of the computing infrastructure using predefined KPIs, providing a foundation for subsequent evaluations and a clear before-and-after performance snapshot.

Key aspects of Baseline Measurement include:

- **Clarity on current performance**: establishes a clear understanding of current efficacy and limitations.
- **Targeted improvements**: identifies specific areas for potential enhancements through edge computing.
- **Quantifiable impact**: enables measurement of tangible benefits from technology investments.
- **Validation of performance goals:** validates whether the implemented technologies have delivered expected benefits.

The methodology involves data collection, analytical monitoring, selecting appropriate time frames, repeat measurements, thorough documentation, and stakeholder engagement. This process provides a roadmap for technological evolution and a lens to assess the value of new technology investments.

4.2.4 Comparative analysis post-implementation

After implementing edge computing technologies, KPIs are re-measured to understand the impact. This post-implementation data is compared with the baseline to assess performance improvements, cost savings, energy efficiency, scalability, reliability, and alignment with business objectives.

This comparative analysis provides invaluable insights into the tangible benefits, ensuring that the transition to edge computing is not just a technological upgrade but a strategic business decision with measurable results. It's a methodical approach that ensures full potential harnessing of edge computing for growth and innovation.

4.3 The mathematical model

The feasibility of adopting Cloud-Edge-IoT technologies presents a complex decision matrix for any organisation. To navigate this, a mathematical model employing a system of weighted averages can be constructed to evaluate how implementing these technologies might influence various Key Performance Indicators (KPIs). This model allows for a nuanced analysis, giving precedence to those KPIs that align closely with the organisation's strategic goals and operational demands.

At the core of this model lies the weighted average calculation, which is pivotal in ensuring that each KPI is evaluated on its face value and significance to the organisation. The weighted average is a means to compute the mean of a set of values, each multiplied by a specified weight that reflects its importance. The general formula for calculating a weighted average is:

$$Weighted\ Average\ (WA) = \frac{\sum(\omega_i \times x_i)}{\sum \omega_i}$$

Where:

ω_i represents the weight assigned to the i[th] data point,

x_i represents the value of the i[th] data point,

To use mathematical model effectively, it will be important to identify and assign weights to each phase and key performance indicators (KPIs) under the methodology section.

To apply this model to KPIs for Edge Computing, let's define $Weighted\ Average\ Edge\ Computing\ (WA_{EC})$ as the weighted average impact on the KPIs after implementing Edge Computing technologies:

$$Weighted\ Average\ Edge\ Computing (WA_{EC}) = \frac{\sum(\omega_{KPI} \times IMP_{KPI})}{\sum \omega_{KPI}}$$

Where:

$\omega_{KPI}$is the weight assigned to each KPI reflecting its importance,

$IMP_{KPI}$is the measured improvement or detriment on each KPI due to edge computing.

Each KPI is assigned a weight based on strategic importance. For instance, if latency is critical for real-time data processing in an organisation, it may be assigned a higher weight than other KPIs.

The value of IMP_{KPI} represents the percentage change in each KPI due to the adoption of edge computing. This could be a positive or negative value, indicating an improvement or detriment. For example, if Edge computing is predicted to reduce latency by 30%, then IMP_{KPI}= -0.30 \)

In the context of assessing the impact of adopting edge computing technologies, the use of weighted averages allows an organisation to quantify the potential benefits and costs associated with such a transition. The term "negative weighted average impact" might seem counterintuitive at first, as "negative" typically connotes something undesirable. However, within certain analytical frameworks, particularly those dealing with cost-benefit analyses or performance improvements, a negative result can signify a positive outcome.

For instance, if KPIs such as response time or system downtime are considered, a negative value could indicate a reduction in these metrics, which in turn would suggest an improvement in system performance. Thus, in this hypothetical scenario, a negative weighted average impact implies that adopting edge computing is anticipated to lead to favourable outcomes.

The process is as follows:

- **Assignment of weights and values**: Each KPI is assigned a weight reflecting its importance to the organisation's objectives. Additionally, an expected change in performance is estimated for each KPI after implementing CEI technologies.
- **Calculating the impact:** For each KPI, the estimated change in performance is multiplied by its weight. If the change is an improvement (e.g., reduction in response time), this might be represented as a negative value.
- **Aggregating the results**: These individual weighted impacts are then aggregated to calculate a total weighted average impact.
- **Interpreting a negative result**: In this model, a negative weighted average impact would mean that, on balance, the improvements (cost reductions, performance enhancements) outweigh any negative impacts (cost increases, performance degradation).

While the mathematical model based on weighted averages is a valuable tool in the decision-maker's arsenal, providing a structured and quantitative assessment of the feasibility of adopting edge computing, its accuracy hinges on the careful selection and weighting of KPIs and the realistic prediction of improvements. To achieve the best outcome, this model should be part of a broader feasibility study that incorporates various assessment tools and analytical perspectives, ensuring a well-rounded and informed decision-making process.

EXAMPLE:

Let us consider a hypothetical organisation that wants to evaluate its Key Performance Indicators (KPIs) to assess the potential impact of new CEI technologies. The organisation decided to use the weighted average method to analyse the KPIs, including the frequency of security breaches, the average time to detect a breach, and the average time to respond to a breach. Each of these KPIs offers insight into the organisation's security posture and the potential effectiveness of the new technology.

Step 1: Identifying and Weighting KPIs

The organisation identifies that the most critical aspect of their cybersecurity is the frequency of security breaches, which directly correlates with reputational damage and financial loss. Therefore, they assign a weight of 50% to this KPI. The average time to detect a breach is given a weight of 30%, as quicker detection is essential, but not as critical as the occurrence of the breach itself. Lastly, the average time to respond to a breach is 20%, reflecting its importance but recognizing that prevention and detection are higher priorities.

- frequency of security breaches: 50%
- average time to detect a breach: 30%
- average time to respond to a breach: 20%

Step 2: Collecting Baseline Data

Before implementing the new technology, the organisation records the current KPI values: there are an average of 4 breaches per quarter, it takes an average of 48 hours to detect a breach, and 72 hours to respond to one.

Step 3: Predicting Improvements

The organisation consults with cybersecurity experts to estimate what will be the required improvement in their cybersecurity processes to be able to adopt their CEI new technologies. They estimate that the frequency of breaches must be reduced by 50%, detection time improved to 12 hours, and response time reduced to 24 hours.

Step 4: Calculating the Weighted Average Impact

Using the weighted average formula, the organisation calculates the impact for each KPI:

For frequency of breaches:

Weight of Frequency of security breaches				50%
Phase	Chacterization	Design& Plan	Deployment	Operation
Relevance in phase	0	0	50%	100%
VALUES				
Original value	4	4	4	4
Objective	2	2	2	2
Distance	-50%	-50%	-50%	-50%
Weight	25%	25%	25%	25%
Weighted average				-50%

For detection time:

Weight of Frequency of security breaches				30%
Phase	Chacterization	Design& Plan	Deployment	Operation
Relevance in phase	0	0	50%	100%
VALUES				
Original value	48	48	48	48
Objective	12	12	12	12
Distance	-75%	-75%	-75%	-75%
Weight	25%	25%	25%	25%
Weighted average				-75%

For response time:

Weight of Frequency of security breaches				20%
Phase	Chacterization	Design& Plan	Deployment	Operation
Relevance in phase	0	0	50%	100%
VALUES				

Original value	72	72	72	72
Objective	24	24	24	24
Distance	-67%	-67%	-67%	-67%
Weight	25%	25%	25%	25%
Weighted average				-67%

Step 5: Aggregating the Results

The aggregate weighted impact is:

	Frequency	Detection	Response time
KPI Weights	50%	30%	20%
KPI Value	-50%	-75%	-67%
RESULT	-92%		

Step 6: Interpreting the Results

An aggregated weighted average impact of -92% suggests that the organisation would need to significantly overhaul its cybersecurity practices before it could benefit from CEI technologies.

5 CEI-LING. The Feasibility Assessment Tool

5.1 Outline

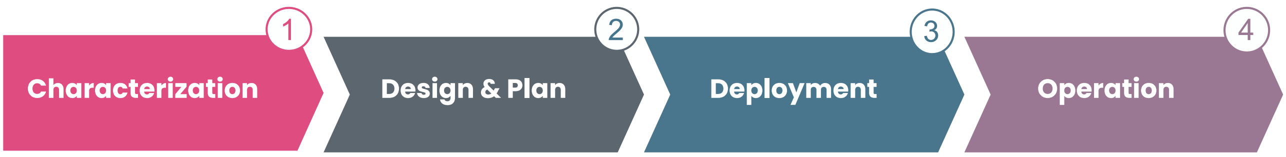
Cloud – Edge Computing and Internet of Things products and services encompass diverse constructs characterised by variations in both structure and complexity. These variances can include integration into software architectures and, when relevant, incorporation into complete physical systems, like vehicles, production facilities, or robots. Within the realm of technical literature, there remains a notable absence of a standardised or universally accepted methodology for articulating the composition of these constructs.

Cloud-Edge-IoT technologies and applications are initially conceived and developed in controlled settings that resemble laboratory conditions, where circumstances can be anticipated and managed. Nonetheless, the real-world scenarios CEI systems encounter during operational deployment often deviate significantly from these controlled laboratory conditions.

Unfortunately, many CEI prototypes and pilots unsuccessfully progress from the prototype stage to becoming market-ready products or services. The decisive factors for failure in deployment can generally be divided into five categories:

- Unrealistic expectations
- Use case-related aspects (unbalanced cost-benefit ratio, high complexity)
- Organisational boundary conditions (low budget, legal hurdles)
- Lack of key resources (data availability, specialist expertise)
- Technological problems (model instability, lack of transparency, susceptibility to manipulation).

The CEI-LING tool offers feasibility framework to assess CEI technologies and services and understand and mitigate potential points of failure. In the context of CEI projects, the CEI-LING should enable early identification of problems and requirements to understand the financial and technical feasibility of a given CEI technology or service. The process involves distinct phases that span planning, design, development, and operational aspects to support successful implementation:



Evaluation of the basic feasibility of the CEI solution from a technical and economic point of view.	Planning the implementation of CEI technologies(including resource availability and performance evaluation).	Implementation of the CEI technologies	Use and monitoring of the CEI technologies system in practice.

Figure 3: Classification of the life phases in the context of the guide.

The value of the CEI-LING framework is two-fold:

- It allows the supplier and use of the CEI technologies to come to a shared understanding of the adoption process and whether actions may need to be taken to support successful outcomes.
- It references current best practice in the field of CEI deployment to identify what actions are likely to be most successful in a given environment.

While comprehensive, the CEI-LING is not exhaustive. It is worth noting that with regard to the assessment of regulation and certification of CEI technologies, no uniform, cross-sector metrics, or procedures are future-proof as initial approaches to regulating and certifying data and AI systems are still emerging.

As stated earlier, the conceptual framework was developed around several critical dimensions: organisational performance measurement, external environmental analysis, motivational assessment, and capacity evaluation. These dimensions are pivotal in evaluating an organisation's ability to adapt effectively to CEI technologies and have been considered when defining (i) the 6 hierarchies that give structure to the CEI-LING model and (ii) for the 249 key performance indicators that are used for assessing whether CEI technologies add value to the business. These hierarchies are:

- Organisational Hierarchy
- Economic Hierarchy
- Technology Hierarchy
- Legal & Regulatory Hierarchy
- Industry & Market Hierarchy

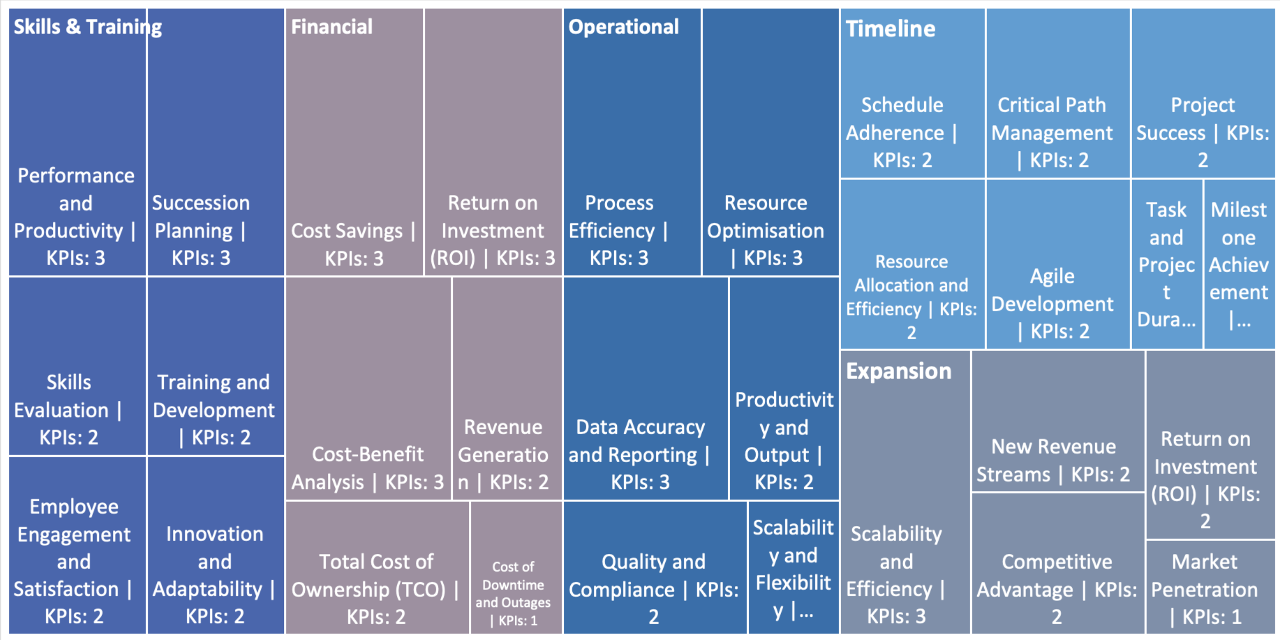
The structure for each component of the framework is as follows:

HIERARCHY				
SUB HIERARCHY				
PHASE	Characterisation	Design & Plan	Deployment	Operation
Relevance	High	Low	Low	High
INDICATOR DESCRIPTION				
Indicator name	Indicator number	Description		Indicator Type
MEASURING INFORMATION				
Units	Frequency	Evaluation formula		

Figure 4: Structure of the guide, coding of the solution aids and linking of the guide with the solution aid catalogue

5.2 Organisational hierarchy

The KPIs are distributed as follows:



5.2.1 Skills & Training

5.2.1.1 Skills Evaluation

Competency Levels: Percentage of employees who meet or exceed the required competency levels for their roles.

This requires an assessment of the CEI competency levels and the identification of any training needs. Competency must be assessed against specific skills sets necessary for each part of the CEI system or subsystem and include technical and non-technical skills.

Skill Gap Analysis: Measure of the gap between desired and actual skill levels in the organisation.

The skills gap analysis can be performed alongside the competency analysis as its primary function is to identify where skills gap can put CEI technology customisation, integration and/or ongoing operations at risk. Once identified, the organisation can decide whether to recruit for those skills in-house or whether to seek outsourced expertise.

5.2.1.2 Training and Development

Training Participation Rate: Percentage of employees who participate in relevant training programs.

The Training Participation Rate is a metric to ensure that internal teams have the understanding and skills to successfully implement and use CEI technologies. The content of training must differ according to the level of technical expertise but it likely to be required across multiple functions. CEI technology providers could include this in their offering to increase internal traction and the successful exploitation of the CEI solutions by their clients.

Training Effectiveness: Evaluation of the impact and improvement resulting from training initiatives.

The effectiveness of the training has a direct impact on the value extracted from the CEI deployments. Once again, it should be cross-functional and be followed up with an assessment.

5.2.1.3 Performance and Productivity

Utilisation: Measure of how effectively employees apply their skills in their daily work.

CEI technologies can lead to a more productive company overall. CEI solution providers will not be able to access data for this KPI directly but may be able to work with their clients to understand how performance is measured, the role that the CEI system can play in augmenting that performance and identifying metrics that support the analysis of productivity.

Quality of Work: Evaluation of the quality and accuracy of work employees produce.

Removing the risk of human error is one of the potential benefits of CEI. As with the above KPI, the CEI solution provider would need to work with the client to understand how this could be measured and tracked.

Efficiency: Assessing the speed and effectiveness of completing tasks or projects.

This KPI is closely linked to both previous metrics and measures the degree to which CEI technologies can help organisation increase efficiency. CEI solutions may involve automations across multiple fronts and remove the need for manual tasks.

5.2.1.4 Employee Engagement and Satisfaction

Skill Satisfaction: Employee satisfaction with their own skill development and growth opportunities.

This KPI is based on the human-CEI interface and seeks to determine how the introduction of the CEI technologies is perceived by the employees who must operate it. It has a component of skills as well as productivity, analysing the degree to which the CEI system is perceived bring value to the tasks to be performed.

Employee Retention: Retention rate of skilled employees within the organisation.

Retaining skilled employees is crucial for edge computing adoption, as they possess the necessary knowledge and experience. High turnover can disrupt operations, increase costs, and create knowledge gaps. A strong retention rate ensures essential skills continuity, supports long-term competitiveness, and encourages growth within the organisation, allowing it to fully leverage advanced technologies.

5.2.1.5 Succession Planning

Leadership Pipeline: Percentage of employees who possess the necessary skills to step into leadership roles.

A strong leadership pipeline is crucial for the successful adoption of edge computing technologies. It ensures a continuous flow of skilled executives who can drive strategic vision, oversee deployment, and lead teams. This pipeline enables businesses to respond to new challenges, capture opportunities, and adapt to the dynamic requirements of edge computing, fostering innovation and competitiveness.

Succession Readiness: Evaluation of the organisation's readiness to fill critical positions with skilled employees.

Succession readiness is crucial for the successful adoption of edge computing technologies. It involves identifying and nurturing emerging leaders to ensure a skilled workforce can take over when needed. This proactive approach prevents knowledge gaps and bottlenecks, ensuring a smooth transition and continued success in the fast-paced digital landscape.

Bench Strength: Measure the talent pool's depth and breadth of skills.

Bench strength, or having a reservoir of qualified experts ready to step into crucial roles, is imperative for effectively implementing CEI technology. CEI requires a workforce able to adapt and develop swiftly in response to altering technology landscapes. A strong bench strength guarantees that the company is well-prepared to handle unanticipated changes in staffing, whether due to attrition or the requirement for specialised skills.

5.2.1.6 Innovation and Adaptability

Skill Agility: Measure employees' ability to acquire new skills and adapt to changing job requirements.

Skill agility is of critical relevance in the effective deployment of edge computing technologies. These quickly developing systems demand a staff that can swiftly adapt to new problems and evolving skill requirements.

Skills in CEI can soon become obsolete. The capacity to continuously update and/or acquire new skills as needed is critical to maintaining systems updated.

Knowledge Sharing: Employees are able to share their skills and knowledge.

Knowledge sharing is crucial for successfully adopting edge computing technologies, as it accelerates learning, addresses challenges effectively, and fosters a collaborative environment in which new CEI opportunities can be explored and problems tackled more effectively across different departments.

5.2.2 Timeline

5.2.2.1 Schedule Adherence

Adhering to a timeline is of essential importance when examining the viability of adopting edge technologies, both from a supplier's and an end customer's standpoint. It allows both parties to plan and deploy resources properly, ensuring a smooth integration process.

On-Time Delivery: Percentage of tasks or projects completed within the planned or agreed-upon deadlines.

On-time delivery is critical for both suppliers and clients when considering the feasibility of utilising CEI technology. Suppliers' reliability and commitment to a seamless implementation are proved by meeting deadlines. End customers can analyse the viability of integrating edge technologies without delays, benefiting from a clear timeframe for resource allocation and informed decision-making.

Schedule Variance: Measure of the deviation between the planned schedule and the actual timeline.

Schedule variance is a crucial factor in assessing the feasibility of adopting edge technology. It helps suppliers maintain trust with clients, identify delays promptly, and ensures project timelines are met. On the client side, schedule variance helps assess the project's alignment with strategic objectives and potential business damage.

5.2.2.2 Task and Project Duration

Lead Time: Total time required from the initiation to the completion of a task or project.

This KPI refers to the total time from initiation to completion of a task or project. On the client side, understanding the total project duration helps plan, budget, and evaluate integration within operational timelines and resource constraints.

5.2.2.3 Resource Allocation and Efficiency

Resource Utilisation: Measure how effectively resources (e.g., employees, equipment) are utilised within the specified timeline.

The efficiency of resource utilisation within a given timeframe is an important factor in determining the feasibility of implementing CEI technology. It ensures that people, assets and data are available when and where they are needed, avoiding costly delays and downtime.

Bottlenecks and Delays: Identifying and reducing bottlenecks or delays that hinder the progress of tasks or projects.

Linked to be above, the early identification of bottlenecks that can impact the implementation or ongoing deployment of the CEI technologies can help to either prevent or mitigate their effects.

5.2.2.4 Milestone Achievement

Milestone Completion: Percentage of milestones achieved according to the planned timeline.

The identification and completion of milestones that signal progress in the CEI implementation process can help understand whether a given CEI solution is feasible.

5.2.2.5 Critical Path Management

Critical Path Analysis: Identification and management of tasks that are critical to the overall project timeline.

Linked to the above KPI is Critical Path Management. It enables both the CEI technology provider and the client to prioritise tasks and milestones, minimising project delays and expense overruns.

Critical Path Variance: Measure the deviation between the planned critical path and the actual progress.

Analysing the variance from the critical path is also an indicator of an organisations ability to benefit from a CEI technology, particularly if this analysis seeks to find the causes of the deviation and understand whether they can be remedied.

5.2.2.6 Project Success

Time-to-Market: Time taken to bring a product or service to market from the initial concept or idea.

This KPI is relative and must be appropriate to the scale and complexity of the deployment. While in general terms a shorter TTT would be preferable, in some cases it could be an indicator that an immature CEI system is being deployed in the field.

Project Cycle Efficiency: Measure the efficiency and effectiveness of the project execution process.

This is an overarching KPI that signals a CEI's implementation efficiency and effectiveness on the basis of aims and the project plans.

5.2.2.7 Agile Development

Sprint Velocity: Measure the work completed within each sprint or iteration.

Agile development involves measuring work completed within sprints or iterations to steadily progress towards the completion of the CEI project.

Burn-Down Rate: Tracking the rate at which tasks or use cases are completed and removed from the backlog.

Evaluating work completed during each sprint or iteration is a key input to determining the practicality of using CEI technology. Delays may occur for internal reasons (lack of human resource, technological or data problems…) or for external reasons (client does not have the data available in the format needed or cannot provide access to infrastructure). An analysis of the burn-down rate will be a key input for CEI feasibility.

5.2.3 Financial

5.2.3.1 Cost Savings

Cost Reduction: Percentage decrease in operational costs achieved through technology adoption.

The percentage reduction in operational expenses achieved through CEI technology implementation is a crucial metric. This metric guides strategic decisions for both technology providers and clients.

Process Efficiency: Measure improved efficiency and productivity resulting from technology implementation.

The quantification of enhanced efficiency and productivity largely determines the viability of adopting CEI technologies. This quantification will vary according to the domain in which the CEI technologies are deployed. It is likely to come from processes that lead to optimisation and/or automation.

Cost Avoidance: Quantification of costs avoided by addressing issues or risks through technology solutions.

CEI solutions can result in cost avoidance by eliminating the costs associated to risks (e.g. data leakage) that are prevalent in less automated or solely cloud-based solutions. Once again, the KPIs will differ according to the precise nature of the solution.

5.2.3.2 Revenue Generation

Revenue Growth: Percentage increase in revenue attributed to adopting new technologies.

This KPI is focused on identifying revenue uplift which can in turn justify further investment in CEI technologies and align them with broader business goals. It is useful to define this uplift in narrow terms, i.e. as a percentage of the revenue generated in the business unit that made the CEI investment.

Market Expansion: Measure new market opportunities captured through technology implementation.

Tapping into new markets represents strategic expansion, increasing revenue streams, and diversifying risk. This KPI validates the CEI's role as a catalyst for business growth.

5.2.3.3 Return on Investment (ROI)

ROI Calculation: Financial assessment of the return on investment achieved through technology adoption.

The financial return on investment (ROI) is a crucial metric for evaluating the economic viability and strategic value of adopting new technologies. It helps suppliers determine the profitability of edge technology, gauging market demand, setting price points, and projecting future growth. A positive ROI can justify further investment, while a negative ROI may indicate strategic re-evaluation.

Payback Period: Time to recoup the initial investment through cost savings or increased revenue.

The payback period is a crucial metric for assessing the feasibility of adopting edge technologies. It indicates the time it takes for an investment to repay its initial cost from the cash flows it generates. A shorter payback period can make investments in new technologies more attractive, enabling quicker fund recovery and reinvestment.

Cost-to-Savings Ratio: cost savings achieved to the total cost of technology implementation.

The cost to savings ratio is a financial metric for assessing the feasibility of adopting advanced technologies. It compares the investment cost to the savings generated over time, indicating the technology's efficiency and market competitiveness. A favourable ratio indicates the technology's innovation and economic viability, potentially increasing market share. On the other hand, a lower ratio indicates a higher return in savings for every euro spent, making the investment more attractive.

5.2.3.4 Cost of Downtime and Outages

System Availability: Percentage of uptime or availability of systems and applications after technology implementation.

The percentage of uptime or system availability following the implementation of edge technologies helps analyse their feasibility and business continuity. High uptime is synonymous with productivity and profitability for client, reducing the risk of revenue loss due to system failures. It also reflects the efficiency of the technology infrastructure, impacting overall organisational performance.

5.2.3.5 Total Cost of Ownership (TCO)

TCO Calculation: Evaluation of the total cost of owning and operating the technology solution over its lifecycle.

Total cost of ownership (TCO) is a metric that encompasses all costs associated with a technology's acquisition, operation, and maintenance throughout its lifecycle. It is an indicator that is used by finance departments to consider whether or not a longer term business case can be made for the investment.

Cost Components: Identifying and assessing various cost components, such as licensing, maintenance, training, and support.

Assessing cost components like licensing, maintenance, training, and support helps to structure pricing models, determine service package inclusions, and anticipate support requirements, impacting profitability and the business case.

5.2.3.6 Cost-Benefit Analysis

Cost-Benefit Ratio: Ratio of the monetary benefits derived from technology adoption to the associated costs.

The cost-benefit ratio (CBR) is a metric for evaluating the financial feasibility of adopting CEI technologies from both supplier and client perspectives. It helps determine potential profitability and justify development costs. Understanding this ratio allows suppliers to set strategic price points and adjust features to optimise the cost-benefit balance.

Cost-Benefit Timeframe: Time from investment to returns on the technology.

The timeframe for the expected benefits of adopting edge technologies to accrue is used by customers allocate limited capital to investments that meet internal ROI benchmarks within an acceptable period. A shorter payback period mitigates risk and increases the attractiveness of adopting new technologies, making it a critical metric in feasibility analysis.

Net Present Value (NPV): Calculating the present value of expected benefits and costs over a defined period.

This is used to make informed decisions about the long-term financial benefits of their technology investments. It compares the immediate and ongoing costs of adopting a technology against expected benefits, prioritising investments that offer greater value over their lifecycle.

5.2.4 Expansion

The adoption of edge technologies is influenced by various factors such as market penetration, customer engagement, new revenue streams, scalability, and building a competitive advantage. Market penetration indicates the success and profitability of the technology, while customer engagement and satisfaction are crucial for sustainable business growth. Innovative technologies can diversify income sources, reduce reliance on existing products, and protect against market fluctuations. Scalability is essential for operational growth without excessive investments, especially for end customers and suppliers. A competitive advantage gained through technology can be game-changing for suppliers, offering efficiency gains, cost savings, and improved customer experiences.

5.2.4.1 Market Penetration

Market penetration indicates the extent to which a new technology is adopted within a specific market. High market penetration indicates successful adoption and robust demand. It also acts as a barrier to entry for competitors, solidifying the supplier's market position. From the end customer's perspective, market penetration helps gauge the technology's reliability and acceptance, suggesting industry standardisation and ease of integration.

Geographic Expansion: Measure successful entry into new geographical markets using technology solutions.

The success of technology solutions in new geographical markets demonstrates the scalability and adaptability of the technology across different regions and consumer bases. This validates the universal appeal of the technology, leading to increased sales and reduced risks. It also signifies the technology's robustness and the opportunity to create a global user base.

5.2.4.2 New Revenue Streams

Adopting edge technologies requires thoroughly exploring new revenue streams, scalability, and competitive advantage. Suppliers can tap into new revenue streams by offering innovative technology solutions, while end customers can diversify their offerings or improve service delivery. Scalability ensures the technology solution can adapt to evolving demands, ensuring its long-term viability. Competitive advantage is sought by both parties, with suppliers focusing on market differentiation and end customers leveraging technology to outperform rivals or enter new markets.

Diversification of Revenue: Percentage of revenue derived from new markets or customer segments targeted through technology initiatives.

The percentage of revenue from new markets or customer segments due to technology initiatives helps suppliers understand how their technologies are being adopted and adapted to different market contexts, enabling them to plan future development. On the other hand, end customers see the revenue from new markets accessed through the CEI technologies as validation of the business case and a possibility to expand use even further.

Partnership Revenue: Revenue generated through technology-driven partnerships or collaborations.

Partnership Revenue refers to the income earned from alliances or collaborations that are facilitated or enhanced by technology. It encompasses earnings from joint ventures, co-developed products, or services resulting from CEI tech-based partnerships.

5.2.4.3 Scalability and Efficiency

Scalability and efficiency are crucial factors in evaluating the adoption of edge technologies. Scalability refers to a technology's ability to handle increasing workloads without performance loss, ensuring the technology can grow with the customer base. On the other hand, efficiency refers to its ability to operate efficiently with minimal waste and maximum productivity, ensuring profitability and competitive pricing. These factors indicate a technology's long-term viability and potential to deliver ongoing value, making them essential considerations in technology adoption.

Increased Operational Capacity: Measure of increased operational capacity achieved through technology adoption.

The operational capacity of technology adoption signifies improved service delivery, increased business volume, and the ability to scale operations to meet market demands. For end customers, it signifies increased output, better service, and business growth without incurring significant costs. This measure reflects the value added by the new technology, its impact on productivity, and its potential for business expansion, and is a key input to informed investment decisions in edge technologies.

Process Automation: Percentage of processes automated using technology, resulting in improved efficiency and scalability.

CEI technologies are key to automating many business processes. A higher automation rate reduces manual intervention error rates, and lower operational costs, resulting in increased margins and competitive pricing. It also frees up valuable resources, allowing suppliers to reallocate human capital to strategic tasks. End customers benefit from streamlined operations, increased production speeds, and enhanced reliability, enabling them to scale operations without increasing costs or resources.

Cost per Unit: Reduction in the cost per unit of production or delivery due to technology-driven efficiency gains.

Edge technologies can significantly reduce costs per unit of production or service delivery, providing a competitive edge for suppliers. These cost efficiencies can derive from automated processes, optimised resource utilisation, and streamlined supply chains enabled by advanced technologies such as IoT, AI, and cloud computing. These innovations lead to reduced waste, lower labour costs, and improved operational efficiency.

5.2.4.4 Competitive Advantage

Edge technologies provide a competitive advantage for suppliers and end customers serving as the base for new data-driven products or services. This competitive advantage can also arise from the ability to control and orchestrate data, deciding which data is processed and analysed in the cloud, and which is actioned at device level.

Differentiation: Measure the organisation's ability to differentiate itself from competitors through technology solutions.

An organisation's ability to differentiate itself through technology solutions can attract new customers and retain existing ones, leading to revenue growth and market leadership. Employing distinctive technologies can improve operational efficiency, customer engagement, service delivery, customer satisfaction, brand loyalty, and market premium command.

Time-to-Market: Reduction in the time taken to bring new products or services to market through technology adoption.

Technology adoption significantly reduces the time it takes to market new products or services, benefiting suppliers and end customers. For suppliers, this can lead to higher market share, stronger brand recognition, and industry standards. End customers can access the latest innovations more quickly, enhance productivity, improve customer experience, and solve real-time challenges, particularly given the increase rate of technological development.

5.2.5 Operational

Edge technologies are adopted by suppliers and end customers based on metrics such as process efficiency, productivity, resource optimisation, quality, compliance, and data accuracy. These metrics help in reducing operational costs, improving competitiveness, and reducing waste. They also help in ensuring high-quality outputs and strict compliance, reducing errors and legal penalties. For customers, these metrics lead to more reliable products, faster service delivery, better customer service, and competitive pricing.

5.2.5.1 Process Efficiency

Process efficiency directly impacts profitability, service quality, and customer satisfaction. For suppliers, it impacts cost management, pricing strategies, and market competitiveness, leading to faster production times, reduced waste, and better resource use, lowering costs and enhancing product value.

Cycle Time: Average time taken to complete a specific task or project.

Assessing the average time required for tasks or projects related to CEI also has an impact on resources efficiency. The average time taken for tasks or projects directly influences an organisation's competitiveness and the success of the onboarding process for CEI technologies.

Process Cost: Reduction in costs associated with the process due to technology-enabled efficiencies.

The adoption of edge technologies is influenced by the reduction in costs associated with processes due to technology-enabled efficiencies. This helps suppliers justify investment in new technologies, impact market competitiveness, and potentially lead to higher profit margins.

Error Rate: Percentage of errors or rework reduced because of technology implementation.

When evaluating the adoption of edge technologies, the percentage of errors or rework reduced due to technology implementation reducing costs and time associated with rework. This metric helps quantify the direct impact of technology on operational excellence.

5.2.5.2 Productivity and Output

Productivity reveals the efficiency gains of technology, such as faster production times, increased throughput, and resource efficiency. This reduces operational costs and improves the supplier's ability to meet customer demands and scale operations effectively. Productivity also helps customers understand the return on investment in adopting new technologies.

Output Increase: Percentage increase in the overall output or productivity achieved through technology adoption.

The percentage increase in overall output or productivity achieved through technology adoption validates the effectiveness of investment in technology, enhancing production capabilities, reducing task completion time, and delivering higher volumes of products or services without increasing costs. This metric can also highlight areas where technology provides a competitive edge, such as quicker turnaround times or higher-quality outputs.

Task Completion Time: Reduction in the time taken to complete individual tasks or processes using new technology.

The time taken to complete tasks using new technology demonstrates increased efficiency, productivity, cost savings, and strategic initiatives. This demonstrates the tangible benefits of technology investments and can differentiate a supplier in a competitive market. Quicker task completion also leads to faster time-to-market for new products or services, enhancing responsiveness to market demands.

5.2.5.3 Resource Optimisation

Resource optimisation enhances business performance and sustainability, allowing suppliers to offer competitive pricing or invest in innovation. End customers benefit from better service levels, quicker response times, and personalised experiences. Cost savings indirectly benefit customers through potential price reductions or improved product offerings. Effective resource optimisation is essential for creating value and maintaining a responsive supply chain.

Resource Allocation: Optimisation of resources (e.g., human resources, equipment) through technology-driven resource planning and allocation.

Adopting edge technologies requires effective resource allocation for both suppliers and end customers. For suppliers, proper allocation of financial, human, and technical resources is crucial for successful integration, leading to improved operational efficiency and innovative product development. End customers benefit from improved product quality, enhanced service delivery, and better support structures. Edge technologies offer advantages like data-driven insights and automation, allowing for more efficient resource allocation. Effective resource allocation supports the technical, logistical, and financial pillars of edge technology adoption, benefiting both suppliers and customers.

Inventory Management: Improvement in inventory management processes, resulting in reduced inventory levels and improved turnover rates.

Edge technologies, such as IoT devices, RFID tags, and analytics, can significantly improve inventory management, leading to optimised stock levels, reduced waste, and better demand forecasting. This reduces inventory capital and risks of stockouts or overstock. End customers can expect reliable product availability, faster delivery times, and a more satisfying purchasing experience. Real-time data analysis allows for swift market changes, increasing supply chain resilience. Evaluating the impact of edge technologies on inventory management is crucial for cost savings, operational efficiency, and improved customer service, ensuring a competitive advantage in today's dynamic market.

Asset Use: Increased use and efficiency of physical assets through technology-enabled tracking and monitoring.

Edge technologies enhance the use and efficiency of physical assets, benefiting both suppliers and end customers. For suppliers, these technologies reduce idle time and increase throughput, improving return on investment and reducing production costs. End customers benefit from consistent product quality, faster service delivery, and potentially lower prices. Efficient monitoring and use of assets lead to reliable and timely services, affecting customer satisfaction and loyalty.

5.2.5.4 Quality and Compliance

Defect Rate: Reduction in the number or percentage of defects or errors in products or services due to technology adoption.

Edge technologies can significantly improve production processes, quality control, and reliability for suppliers, leading to lower costs and improved profit margins. On the other hand, high-quality, error-free products build brand trust and loyalty for end customers. Consistent delivery of defect-free products can be a competitive advantage in an era where consumer reviews influence market perception. A measurable decrease in product or service errors indicates the potential for enhanced market position and financial performance, validating the investment in such technologies.

Compliance Adherence: Improve compliance with regulatory requirements or industry standards through technology-enabled controls.

Edge technologies are crucial for enhancing compliance with regulatory requirements and industry standards. Suppliers must meet or exceed these standards to avoid legal penalties, maintain operational licensing, and ensure uninterrupted business operations. Implementing edge technologies can lead to cost savings, fine avoidance, and a reputation for reliability and integrity. End customers value products or services that comply with regulations, enhancing trust and confidence in the brand.

5.2.5.5 Data Accuracy and Reporting

Accurate data and reliable reporting are crucial for assessing the adoption of edge technologies from both supplier and end customer perspectives. For suppliers, accurate data is essential for strategic decision-making, forecasting, and performance measurement, impacting operational efficiency and profitability. For end customers, accurate data signifies trust and reliability in products or services. Robust reporting mechanisms ensure transparency, allowing customers to see tangible benefits like improved service delivery times or enhanced product features. Accurate data and reporting enable both parties to monitor and verify the tangible returns on technology investments, ensuring the feasibility and practicality of edge technologies.

Data Integrity: Improvement in the accuracy, consistency, and reliability of data captured and managed using new technology.

Adopting edge technologies requires improved data accuracy, consistency, and reliability. CEI technology enhances data accuracy and consistency using automated tools and IoT sensors across cloud and edge platforms. It ensures data reliability and security through advanced encryption and secure transmission protocols in CEI integrations and enables real-time data processing and validation with edge computing and sophisticated algorithms for accurate, actionable insights.

Reporting Efficiency: Reduction in the time and effort required to generate reports or access real-time operational data through technology solutions.

Edge technologies allow for agile decision-making, cost savings, and enhanced productivity. Based on immediate data availability. Real-time data access empowers customers with control and transparency. The ability to swiftly manipulate and retrieve data is a key metric for the robustness and effectiveness of edge technologies, enabling smarter, data-driven strategies for both suppliers and customers.

Data Accessibility: Improved access to relevant and timely operational data for decision-making.

Access to relevant and timely operational data is crucial for suppliers' and end customers' adoption of edge technologies. Suppliers gain situational awareness, enabling informed decisions and better resource management.

5.2.5.6 Scalability and Flexibility

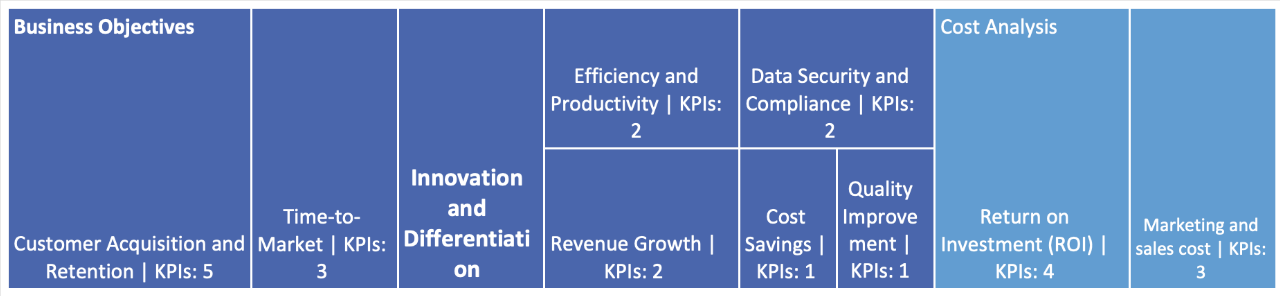
Scalability and flexibility are crucial in evaluating edge technologies, as they enable suppliers to adapt to changing demands and manage resources efficiently. Scalability allows for minimal risk before full deployment and aligns with market growth. Flexibility allows for adaptability to various scenarios and integration with existing systems, ensuring long-term viability. End customers benefit from scalability, which allows services to grow with their demands, providing a seamless experience. Flexibility allows for personalised interaction and a tailor-fit solution.

Scalability Achieved: Measure of the organisation's ability to scale operations seamlessly and efficiently using new technology.

Scaling operations using new technology increases capacity without compromising performance or incurring costs, indicating the robustness of their technology infrastructure. End customers need seamless scalability to maintain operational continuity and support growth and increases confidence in the ROI.

5.3 Economic hierarchy

The KPIs are distributed as follows:



5.3.1 Business Objectives

Aligning business objectives with edge technologies ensures the strategic deployment of tangible benefits and aligns with strategic goals. Suppliers benefit from enhancing their value proposition, meeting market needs, and supporting market expansion, innovation, and competitive differentiation. End customers benefit from technology supporting operational goals, efficiency, and competitive advantage. If technology doesn't align with business objectives, it risks becoming a distraction rather than a tool for advancement.

5.3.1.1 Cost Savings

Costs achieved through the adoption of new technologies.

The indicator measures the financial savings or cost-effectiveness improvements attributed to using new technology within a company, including reduced operating expenses and optimised procedures. A high number indicates effective cost reduction or optimisation, enhancing the company's financial preparedness.

5.3.1.2 Efficiency and Productivity

Operational improvement: Improvements in operational efficiency and productivity

The indicator evaluates an organisation's operational efficiency and productivity by adopting strategies and technology to reduce expenses, minimise inefficiencies, and optimise workflows, leading to higher profitability and integrating modern technologies.

Time-saved process cycle times or output per unit of resource.

This statistic evaluates the time saved in operations or output compared to resources used, assessing the effectiveness of technology in improving resource allocation, reducing processing time, and enhancing efficiency, which is crucial for a seamless transition to modern technologies.

5.3.1.3 Revenue Growth

Increased Sales

Increased sales is a crucial financial metric demonstrating a company's capacity to grow its revenue by dominating the market and integrating technology, which could lead to further financial advantages.

Average Transaction Value

The average transaction value statistic measures the average monetary value of individual client transactions. Increased transaction values suggest a more substantial customer base and higher revenue, potentially aided by advanced technologies and data analytics.

5.3.1.4 Customer Acquisition and Retention:

Customer acquisition and retention indicate the technology's reliability, meeting user needs, and integrating well with existing processes. These metrics ensure the investment in edge technology is justified and strategically sound for future growth and success, ensuring the technology's value proposition.

Customer Acquisition and Retention: Improvement in customer acquisition and retention rates due to enhanced technology capabilities.

These metrics indicate the technology's impact on customer attraction and retention. In so far as CEI solutions can guarantee data and business sovereignty, better exploitation of data and greater efficiency through automation, to name a few, they are likely to be market differentiators.

Customer Satisfaction: Rating or feedback from customers on their satisfaction with technology-enabled experiences.

High satisfaction levels drive loyalty and decrease the costs related to customer acquisition. Low rates can be an indicator of technological failure somewhere along the value chain. Taking the temperature through quantitative or qualitative satisfaction metrics is part of understanding the value of the CEI across different operational environments and can help to identify where adaptations need to be made.

Customer Lifetime Value (CLV): Assessment of the long-term value generated from customers acquired through technology initiatives.

Customer Lifetime Value (CLV) represents the total value a customer provides to a business over their entire relationship. It validates the technology's impact, and reduces the costs associated to customer acquisition.

Customer Acquisition Rate

This metric measures the rate at which the company acquires new customers. The company's readiness to adopt innovative technology is crucial, and it may be assessed by evaluating the success of its marketing tactics and client acquisition processes. Technology can significantly enhance the optimisation of these procedures.

Customer Churn Rate

The customer churn rate measures the frequency with which consumers end their association with the organisation. Lower churn rates indicate improved customer retention, highlighting the need to utilise technology to boost customer satisfaction and loyalty, ultimately strengthening financial stability.

5.3.1.5 Time-to-Market:

Time to Market New Products, Release Updates (Response to Customer Demands)

This metric assesses customer happiness using various approaches, including as surveys and feedback. Ensuring customer satisfaction is crucial for achieving financial preparedness, as contented customers are more inclined to interact with the company's offerings and establish brand loyalty, typically facilitated by technology-driven enhancements.

Trailing 12 Months (TTM) Release Update

This metric measures the aggregate number of product releases and updates within the last 12 months. A higher numerical value signifies a proactive approach in integrating technology and implementing continuous improvements, demonstrating the company's commitment to being up-to-date and competitive.

Trailing 12 Months (TTM) to Customer Demands

This evaluates the level of alignment between the company's product updates and consumer expectations during the preceding 12 months. This alignment showcases the company's ability to adapt to client preferences and prioritise IT investments accordingly.

5.3.1.6 Quality Improvement

Customer Complaints

Customer complaints indicate the number of issues raised by customers. This statistic identifies areas where technological solutions could improve customer experience and reduce the frequency of complaints, hence contributing to financial preparation.

5.3.1.7 Innovation and Differentiation

Number of New Products or Features

This indicator quantifies the number of new items or features the company has introduced. A higher numerical value signifies the company's readiness for innovation and its capacity to utilise state-of-the-art technologies for product development and diversification.

Patents Filed

The number of patents filed represents the entire quantity of patents that the company has formally registered. A higher numerical value signifies a strong commitment to innovation and the development of unique technologies, indicating readiness for the incorporation of contemporary technology.

Market Share: Percentage of the target market captured or penetrated through technology-enabled expansion.

Market share signals a company's competitive positioning and can be used to influence market trends and standards. A large market share indicates strong brand recognition, a large customer base, and greater influence over trends. This can encourage adoption among new and existing customers. From the end customer's perspective, a significant market share indicates industry validation and trust in the technology. It also indicates a stable supplier capable of continuous support and innovation, especially in rapidly evolving technologies.

5.3.1.8 Data Security and Compliance

Data Breaches

Data breaches occur when an unauthorised intrusion into and compromise of confidential data exists. This statistic emphasises the importance of dedicating resources to technology improvements to guarantee data security and protection, especially in financial readiness.

Regulatory Compliance Violations

RCV quantifies the number of violations or occurrences of non-compliance with relevant regulations. Integrating technology to guarantee regulation adherence is essential for financial readiness as it mitigates legal liabilities and the associated monetary sanctions.

5.3.2 Cost Analysis

5.3.2.1 Marketing and sales cost

CPA Through New Technologies

Cost Per Acquisition (CPA) is a quantitative measure that calculates the cost of acquiring a fresh consumer through advanced technologies. A lower CPA indicates the effective use of customer acquisition techniques and cost-effective technology adoption.

CPL Through New Technologies

The Cost Per Lead (CPL) is calculated using advanced digital strategies to assess the cost of generating leads. Efficient use of technology in lead generation leads to a reduced cost per lead (CPL), improving financial readiness by lowering marketing expenses.

Average Cost of Converting a Lead into a Paying Customer

This statistic measures the average cost of converting generated leads into paying customers utilizing technical methods. A lower average cost indicates the capacity to convert leads efficiently, which is vital in attaining financial readiness and profitability.

5.3.2.2 Return on Investment (ROI)

Training Costs over Cost Savings

The evaluation assesses the costs related to training and the monetary advantages derived from technology implementation. Implementing cost-effective training methods and adopting technological improvements can result in financial optimisation and savings by reducing training prices.

Training Costs over Revenue Growth

This metric assesses the correlation between training costs and the subsequent rise in revenue, offering valuable insights into the impact of training on overall financial success. The efficacy of income-boosting training underscores the need to invest in technology for financial prosperity.

Training Costs over Productivity Improvements

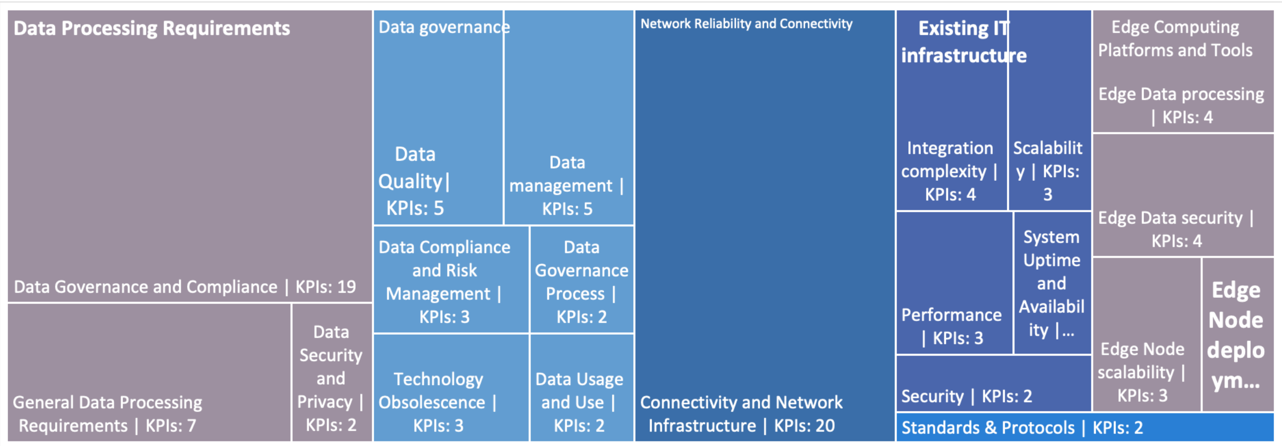
This analysis evaluates the costs related to training and the productivity enhancements realised via technology adoption. The importance of cost-effectiveness in training operations and the possibility for financial growth through the implementation of technology are highlighted by the decrease in training expenses resulting from gains in productivity.

Maintenance Costs over Cost Savings

This examination focuses on the expenditures associated with technology maintenance and the monetary advantages derived from cost savings. It is necessary to deploy efficient technology maintenance plans and have sufficient financial resources to reduce maintenance charges.

5.4 Technology hierarchy

The KPIs are distributed as follows:



5.4.1 Existing IT infrastructure

The existing IT infrastructure plays a vital role in facilitating the implementation of edge technologies by suppliers and end customers. It hampers their capacity to create, deploy, and support modern technologies, impacting the pace of implementation, cost, innovation, and customer service. The capacity of end users to incorporate and fully utilise edge technologies without major investments or disruptions is determined by the compatibility, modernity, and scalability of their IT infrastructure. Adopting a system may be impeded by an obsolete or incompatible infrastructure, which would need expensive improvements. An IT infrastructure that is strong and flexible guarantees a seamless transition, improving the efficiency of operations and ensuring the continuation of the company.

5.4.1.1 System Uptime and Availability

System uptime and availability are crucial for evaluating the feasibility of adopting edge technologies. High uptime ensures continuous service delivery, trust, and satisfaction among end users. Downtime can disrupt service, leading to customer dissatisfaction and potential revenue loss.

Overall uptime of IT infrastructure

The operational availability of IT signifies the supplier's proficiency in delivering dependable services and capability to support cutting-edge technologies. A high uptime indicates stability and dependability, which are crucial for the successful integration and performance of edge technologies in any operational ecosystem.

Number of downtime incidents

The frequency of downtime issues in the current IT may indicate weaknesses in their existing systems. These weaknesses could be further aggravated by the increased need for edge technologies, which typically necessitate continuous data flow and processing at the network's peripheral. This may prompt a re-evaluation of whether their infrastructure can accommodate the demanding needs of edge computing or if changes are required. For end customers, frequent periods of system unavailability can have a domino effect on the continuity of company operations and the efficiency of processes, as edge technologies are designed to provide immediate data processing and real-time analysis. If the infrastructure fails to ensure continuous availability, the advantages of edge technology become irrelevant, potentially leading to substantial interruptions in the customer's business operations.

5.4.1.2 Scalability

Scalability is of utmost importance for edge technologies, as it allows systems to adjust to expansion without requiring major revisions. The current IT infrastructure must be capable of accommodating dynamic applications, guaranteeing performance that will remain relevant in the future and allowing for cost-effective updates.

Resource use ratio

Assessing the viability of implementing edge technology heavily relies on the resource use ratio of the current IT infrastructure. The metric assesses the use of computing and storage resources, determining if the existing infrastructure can handle increasing workload without substantial additions. Significant use levels may suggest the necessity for optimisation before incorporating more devices. An optimised ratio guarantees efficiency and possible durability, particularly for cutting-edge technology, and maximises the present investment prior to allocating funds for future resources.

Resource capacity planning

Assessing the practicality of implementing edge technologies for suppliers and end relies on accurately predicting the need for infrastructure changes or expansions to accommodate edge technologies' growing data volume and processing requirements. Effective capacity planning is crucial for suppliers to maintain service quality and uptime while expanding operations. This safeguards their reputation and ability to serve clients efficiently. For end customers, effective planning allows them to predict future resource needs, preventing possible bottlenecks resulting in system failures or reduced performance.

Peak demand performance

Evaluating the viability of implementing edge technology for suppliers and end consumers helps both parties to understand the existing capacity of their infrastructure to handle augmented workloads and dispersed computing activities without any decline in performance. Edge technologies are frequently used to enable quicker processing and real-time analytics. A surge in demand can result in service disruptions or slow performance.

5.4.1.3 Performance

Suppliers require a strong and flexible IT infrastructure to effectively connect with edge technologies. This is necessary to ensure they can provide the stated speed, latency, dependability, and data processing capabilities at the network's edge. Deficiencies in current systems may result in congestion, system malfunctions, or vulnerabilities in security.

Response time of critical application

The responsiveness of critical applications reflects the supplier's capacity to provide real-time data processing and services typically required by cutting-edge technology. Slow response times may indicate the need to improve infrastructure to fulfil the high-speed demands of edge computing, a crucial aspect for tasks like AI-powered data analysis or interactions with IoT devices. Latency in important applications could undermine the advantages offered by edge computing, as edge technologies strive to handle data near its source.

Throughput rate

The throughput rate indicates the amount of data that can be processed in a specific period. If the existing infrastructure cannot handle a high data transfer rate, end users may not experience the anticipated performance enhancements resulting from the edge technology adoption.

Latency depending on levels of criticality

High latency levels can potentially impair the fundamental advantages of edge technology, particularly where even small-time intervals can determine the outcome of an application, such as in autonomous vehicles or online gambling, significant delays in data transmission could result the failure of the whole system.

5.4.1.4 Security

Edge computing increases the vulnerability to attacks by spreading processing tasks across multiple devices at the network's edge. Exploiting any weakness in the current infrastructure can compromise the security and privacy of data transmitted across the network. Suppliers must guarantee that their infrastructure can meet the heightened security requirements of edge technologies to preserve confidence and safeguard their and their customer's data.

Number of security incidents related to infrastructure

The quantification of security incidents in the current IT infrastructure is a crucial measure for evaluating the feasibility of incorporating edge technologies from the viewpoints of both suppliers and end users. Frequent security events may indicate weaknesses in the existing system that could be worsened by introducing edge technologies, resulting in greater opportunities for system failures and unauthorised access.

Number of vulnerability risks

Edge computing typically entails processing and storing data near its origin, which may augment the possible attack surface if vulnerabilities are not sufficiently mitigated. Conducting a comprehensive assessment of these risks is essential to guarantee that the implementation of edge technologies does not give rise to supplementary vulnerabilities in the system. The presence of numerous untreated vulnerabilities is likely to discourage potential customers.

5.4.1.5 Integration complexity

Suppliers need to consider the level of complexity when integrating new edge solutions with legacy systems, as it directly affects the amount of effort and resources needed. Integration of high complexity can result in extended deployment durations, escalated expenses, and heightened susceptibility to integration flaws, impacting service continuity and performance. Suppliers must evaluate this intricacy to facilitate a seamless shift to edge computing and uphold their competitive advantage in the market. Conversely, end customers must evaluate the potential effects of edge technology on their operations. Complicated integrations may need substantial modifications to current procedures or perhaps result in interoperability problems, impacting productivity and the user experience.

Time taken for integrations

The integration time of existing IT infrastructure impacts business continuity and return on investment. Prolonged integrations can increase labour costs and delay technology benefits, reducing supplier attractiveness. End customers may experience longer disruptions to daily operations, impacting productivity and profitability. The integration time can also dictate adoption strategies, such as a phased approach to mitigate risks.

Resources used for integrations

Resource-intensive integrations can affect profitability, limit supplier capacity, and lead to operational disruptions. Resource-intensive integrations can inflate project costs and timelines for suppliers, while end customers may face opportunity costs and operational disruptions.

Number of compatibility challenges

High compatibility issues can lead to extensive customization, increased costs, and disruptions to business operations. End customers may face longer integration periods, increased adaptation costs, and additional staff training. Understanding and minimising compatibility challenges is essential for smooth, cost-effective technology integration and delivering enhanced performance and efficiency promised by CEI technologies.

5.4.2 Data governance

Effective implementation of CEI technology relies heavily on data governance, as it harnesses the substantial quantities of data produced by devices, sensors, and interactions with other systems. Efficient data governance guarantees the data's systematic and secure collection, storage, management, and sharing. Ensuring data accuracy, integrity, and compliance with privacy requirements is essential in CEI, as it frequently involves sensitive information. Effective data governance also enables data integration, optimising the potential of CEI technologies by providing high-quality and dependable data for informed decision-making, improved customer experiences, and optimised operational efficiency while minimising the risks associated with data misuse or breaches.

5.4.2.1 Data Quality

Data Accuracy: Percentage of accurate and error-free data in the system.

The technologies heavily rely on real-time decision-making and insights derived from data collected from multiple devices and sensors. Inaccurate or insufficient data can lead to incorrect conclusions, faulty automation, and unreliable system output. This key performance indicator (KPI) relates to data discrepancies, the absence or inaccuracy of information, and likely origins of mistakes, enabling focused enhancements and risk reduction. The objective is to continually maintain a data accuracy rate of 95% or above.

Data Completeness: Percentage of required data elements that are present and populated.

Data completeness refers to measuring the proportion of necessary data items that are present and completed. High levels of data completeness ensures that the systems can access all information necessary to operate effectively. This KPI focuses on identifying gaps and missing data elements. The objective is to achieve high data completeness rate, of >90%.

Data Consistency: Degree of consistency and uniformity of data across systems.

CEI technologies frequently involve integrating data from various sources, devices, and platforms. Data inconsistencies, such as discrepancies in formats, definitions, or structures, can lead to misinterpretations, errors, and hampered interoperability among CEI components.

Data Timeliness: Measure of freshness of the data based on defined timeframes.

Data timeliness refers to how up-to-date data is within specific periods. Depending on the domain in which the Edge technologies are deployed, access to data av in real-time or near-real-time, while important, may or may not be crucial.

Data Integrity: Measure of data reliability and the absence of duplication or corruption.

Data integrity evaluates the dependability and absence of duplication or corruption in data. Understanding whether CEI systems can be subject to data poisoning for instance, may have a significant impact on operations. In systems that involve ML, the impact can be compounded over time.

5.4.2.2 Data Compliance and Risk Management

Some CEI may deal with large amounts of sensitive data. Non-compliance can lead to legal issues, reputation damage, and loss of customer trust. Efficient data compliance systems protect businesses from data breaches and ensure ethical data handling.

Compliance Adherence: Percentage of data assets compliant with relevant regulations (e.g., GDPR, HIPAA, PCI-DSS).

Some CEI technologies may deal with large amounts of sensitive data. Non-compliance can lead to legal issues, reputation damage, and loss of customer trust. Efficient data compliance systems protect businesses from data breaches and ensure ethical data handling.

Risk Mitigation: Identification and mitigation of data-related risks and vulnerabilities.

Data protection procedures are implemented to mitigate risks associated with unauthorised access, data corruption, and other potential hazards. Implementing this approach not only ensures adherence to applicable regulations, but also fosters trust among stakeholders and users that CEI technologies are deployed with a strong and responsible focus on data security. This reduces the likelihood of data-related incidents and enables more secure and dependable operations.

Data Security Breaches: Number of data security incidents or breaches that occurred and their impact.

Organisations can assess the effectiveness of their security measures and strengthen their defences proactively by understanding the frequency and importance of security incidents. By analysing past breaches, they may identify vulnerabilities, enhance security protocols, and implement robust safeguards to prevent future invasions. Monitoring security breaches is a crucial part of ongoing CEI technology operational deployment.

5.4.2.3 Data Governance Process

Data governance refers to an organisation's policies for ensuring that data is collected, stored, managed, shared and used in a structured and safe manner. Data governance processes within the context of CEI technologies serve to mitigate the formation of data silos, guarantee data accuracy, and establish a framework for effectively managing extensive and heterogeneous datasets, as well as securing regulatory and customer compliance.

Policy and Standard Adoption: Percentage of data-related policies and standards adopted and implemented.

A high compliance rate signifies that a corporation places significant importance on data management and is committed to safeguarding data by following to legal rules and implementing optimal procedures. It provides confidence that data is handled in an ethical and accountable way, fostering trust in CEI outputs.

Data Governance Maturity: Assessment of the organisation's overall data governance maturity level (e.g., using frameworks like CMMI-Data).

Implementing a well-defined framework for data governance ensures efficient and ethical management of data throughout the entire organisation and reinforces a systemic approach to CEI data stewardship and use.

Data quality monitoring

Data quality monitoring ensures the precision, comprehensiveness, and dependability of processed data. Suppliers must have robust methods to check data quality, ensuring reliable insights and decision-making. Effective data quality monitoring is essential for operational success in edge technologies, particularly in healthcare and autonomous systems.

Data Integration and Aggregation

Data integration and aggregation processes consolidate and manage data from various sources. Suppliers must offer advanced technology to handle diverse data streams in edge computing environments, ensuring their solutions provide organised insights. This is essential for customers to effectively use edge technology, as it allows for thorough analysis and informed decision-making. Aggregation helps condense large amounts of data into manageable formats, especially in limited bandwidth or storage capacity.

5.4.2.4 Data Usage and Use

Data Utilisation: Tracking the extent to which data is being used by the organisation.

Efficient utilisation of data ensures that firms are maximising their return on investment in CEI by identifying opportunities for improvement and optimisation. By understanding how and when an organisation uses data to inform decisions, the CEI solution provider can improve integration with operational practices.

Data Monetisation: Revenue generation or cost savings achieved through effective data governance and use.

The ability to monetise data can be a significant inducement for an organisation to embrace CEI technologies. It increases the ROI and can give rise to new products and services. Exploring the possibilities to monetise data may also lead to further opportunities to deploy CEI technologies.

5.4.2.5 Data management

The customer's data management practices directly influence their readiness for edge technologies. If the current infrastructure ensures data integrity, security, and accessibility, they can make real-time decisions without significant investment. Inadequate data management may require significant modifications or enhancements, impacting technological upgrades' cost, complexity, and scalability. Therefore, a thorough assessment of data management practices is essential for determining the practicality and potential benefits of integrating edge technologies within an organisation's IT landscape.

Data growth rates

Suppliers must design robust data storage solutions, processing power, and network bandwidth provisions to accommodate the growing data volume. Data growth rates influence end customers' infrastructure readiness, impacting strategic planning for storage solutions, processing capabilities, and network upgrades. The introduction of CEI technologies may exacerbate existing challenges unless addressed with appropriate scaling strategies. Analysing data growth rates ensures the deployment aligns with long-term data management strategies and infrastructure capabilities.

Data retention periods

Suppliers must ensure edge solutions are compatible with clients' data lifecycle management policies, allowing for storage, archival, and deletion without overextended storage needs or compliance risks. End customers' data retention policies determine the length of data storage needed, affecting the choice of edge technology. Adherence to retention policies is essential for legal compliance, making understanding the intricacies of data retention essential for aligning edge technology deployment with existing data governance frameworks and ensuring practical and legal viability.

Storage use levels

The feasibility of implementing edge technologies depends on the data storage levels within existing IT infrastructure. Suppliers must consider their current storage capacities to determine if additional investments are needed to support the data surge caused by edge devices. Storage solutions must be scalable to accommodate the rapid increase in data volume without costly upgrades. End customers must consider their capacity to handle new data streams generated by edge devices, as inadequate storage could lead to additional expenses for expansion or cloud-based solutions.

Data Inventory: Percentage of data assets identified, documented, and included in the data inventory.

Inventory ensures comprehensive visibility into an organisation's data resources, enabling efficient management, retrieval, and data analysis as required. It also ensures the timely availability of relevant data for optimal performance of CEI technologies while also mitigating the risks of data silos and loss. Ensuring transparency in data assets guarantees the proper handling of sensitive information and facilitates data governance, compliance, and security activities.

Data Governance Cycle Time: Time taken to implement data governance processes, such as data requests, approvals, and changes.

The effectiveness of CEI applications may be hindered by lengthy approval procedures or delayed data request timelines that result in delays in accessing and utilising data. It may be possible to shorten approvals for changes to access by categorising different types of datasets. This would shorten the time needed to CEI roll-out into new areas or departments.

5.4.2.6 Technology Obsolescence

The feasibility of adopting edge technologies depends on the level of technological obsolescence within the existing IT infrastructure. Outdated systems may pose challenges in integrating cutting-edge solutions, potentially affecting deployment costs and complexity. End customers may lack the necessary computing power, compatibility, or security features for new edge applications, affecting performance and scalability. Assessing the degree of technological obsolescence is crucial to determine if the existing IT environment is prepared for transitioning to or coexisting with modern edge technologies, ensuring investments in new technologies deliver value and a competitive edge.

EOL hardware percentage

Suppliers may struggle to integrate new technologies due to outdated systems, which may not support advanced functionalities or interoperability standards. End customers face increased downtime due to hardware failures and lack of supplier support, especially for edge computing. EOL hardware may not meet performance requirements for data-intensive workloads.

EOL software percentage

Suppliers may face compatibility issues and security vulnerabilities, while end customers may face performance bottlenecks and potential security liabilities. Unsupported software may not receive updates or patches, exposing systems to new threats and failing to meet regulatory compliance standards. EOL software may also struggle to process and analyse data generated at the edge efficiently, hindering the performance and scalability of edge computing solutions.

5.4.3 Data strategy

A robust data strategy ensures that edge technologies integrate with existing data ecosystems, provide real-time insights and scale with data volume and velocity. This not only meets market needs but is also future proofs against evolving trends. Effective data management allows end customers to leverage edge computing's immediate processing power, transforming vast data streams into actionable intelligence with minimal latency. Without strategic data oversight, organisations may face data silos, security vulnerabilities, and suboptimal analytics, hindering the full potential of edge technology investments.

5.4.3.1 Standards & Protocols

Standards and protocols ensure interoperability, security, and compatibility across various systems and devices. Suppliers benefit from adhering to these standards to integrate with a broad ecosystem, while end customers benefit from secure data exchange between edge devices and central systems. Compliance with industry-specific standards can influence regulatory contexts and customers' decisions to adopt a particular technology.

Number of standards used.

Suppliers must develop versatile technologies to handle various data formats and protocols, while end customers must ensure compatibility and seamless integration with existing systems. Compliance with a broad range of data standards indicates the maturity and robustness of edge technology, instilling confidence in its reliability and effectiveness in different use cases.

5.4.4 Data Processing Requirements

Suppliers can design edge computing solutions that can handle the volume, velocity, and variety of data generated at the edge, ensuring their technology meets the specific operational needs of the client, such as autonomous vehicles, smart manufacturing, and healthcare monitoring systems. Matching data processing requirements with edge technology capabilities ensures sound investment and successful implementation for both parties.

5.4.4.1 General Data Processing Requirements

Volume of data involved in each process.

The volume of data in a process helps evaluating edge technologies adoption by suppliers and end customers. High volumes can strain traditional processing centers, causing delays and increased costs. Suppliers should design robust edge computing solutions for local processing for end customers to benefit from local data analysis, leading to immediate decision-making and efficiency improvements.

Data error rates

Elevated mistake rates may signify deficiencies in the data management capabilities of edge technology, which could result in system malfunctions.

Data ingestion rate

Data ingestion rates indicate the amount of data that can be collected and processed within a specific period. Suppliers with efficient data ingestion capacity have a competitive advantage in real-time analytics scenarios like IoT environments and streaming services. High intake rates enable efficient data use in industries like financial trading, emergency response, and real-time monitoring.

Data source connection success rate

The success rate of data source connections measures the reliability of connections between edge devices and networks, ensuring accurate real-time data transmission. High success rates indicate strong technology, ensuring optimal performance in various situations. This success rate directly impacts the feasibility of integrating edge technologies into end customers' operations, as disconnected links can lead to operational interruptions, safety hazards, or missing insights.

Time to set up a data connection

The time it takes to establish a data connection impacts the speed and flexibility of deploying edge computing solutions. Suppliers can showcase their efficiency with a quick setup time, giving them a competitive advantage. End customers need quick integration of edge technologies, but extended setups can delay project schedules, increase labour costs, and hinder real-time data use. Therefore, the duration of setup directly impacts edge technology feasibility and profitability.

Data reconciliation rate

The data reconciliation rate measures accuracy. A high reconciliation rate indicates the technology's ability to combine and harmonise data, prevent data errors and ensure uninterrupted operations.

Number of data duplication incidents

The frequency of data duplication affects the efficiency of data administration. High duplication rates can lead to higher storage costs, unnecessary data accumulation, and potentially inaccurate analytics. Suppliers must prioritise streamlined data processing capabilities to help optimise analyses and cloud computing resources.

Data validation success ratio

Suppliers with high data validation success ratios demonstrate the strength and reliability of their edge solutions, ensuring knowledge and actions derived by edge technologies are based on verifiable and high-quality data.

ETL process time

The ETL process duration measures the efficiency of data preparation and integration, enabling quick data retrieval and analysis. Extended ETL durations can compromise the agility of edge computing solutions, making them less attractive in time-sensitive environments.

Percentage of data successfully aggregated.

This is a measure of the efficiency of merging data from various sources into a standardised format. High success rates demonstrate the technology's ability to combine and analyse data streams.

Number of data gaps

Advanced technologies rely on constant data flow for real-time analysis, but data gaps can disrupt this process, leading to imprecise analytics and potential harm to automated judgments. Frequency and handling of data gaps measure the effectiveness of data collection and processing systems.

Number of data aggregation errors

Data aggregation errors indicate the precision and dependability of data merging. Suppliers may face challenges if they encounter large aggregate errors, which could compromise the reliability of their edge solutions. Inaccuracies can lead to flawed analytics and automated systems.

Cost per data source integration

The cost per data integration represents the financial implications of incorporating new data streams into an existing system. Suppliers must optimise this cost to provide competitive edge solutions while maintaining high quality. High integration costs can hinder the expansion of edge technologies, especially when combining data from multiple sources.

5.4.4.2 Data Security and Privacy

Edge technology adoption is heavily influenced by data security and privacy, as these factors directly impact trust and compliance. Suppliers must prioritise implementing strong security measures to protect client data and maintain trust in their edge solutions. This is not just a technical requirement but also an advantage in the competitive market. End customers must have confidence in the technology's ability to protect sensitive data from unauthorised access and maintain compliance with privacy requirements across different jurisdictions, especially considering strict regulations like GDPR. The effectiveness of data security and privacy policies directly impacts the practicality of using edge technologies.

Access right management

The implementation of edge technologies for suppliers and end customers requires careful consideration of data access rights management. Suppliers must control and maintain access privileges to ensure only authorised users can access the devices and data they produce or handle. Ensuring the security of sensitive data and maintaining the integrity of the edge computing ecosystem are crucial. Strong access right management systems can enhance the trustworthiness of products and prevent unauthorised data breaches. End users need efficient control of data access privileges to retain authority over their resources and ensure compliance with data governance standards. The level of sophistication and efficacy in managing data access rights directly impacts the confidence of both suppliers and customers in edge technologies.

Privilege escalation incidents

Privilege escalation incidents indicate unauthorised elevated access rights to a system. They signal weak security in edge solutions and compromised defences against advanced cyber threats. Suppliers must track and understand the frequency and nature of these incidents to enact effective security protocols.

Consent management effectiveness

Suppliers must demonstrate their ability to create solutions that comply with data protection rules like GDPR to efficiently handle user permissions and data usage consents to ensure compliant use of data across a decentralised network of devices.

5.4.5 Network Reliability and Connectivity

The viability of edge technology implementation relies heavily on the network's dependability and connection. Suppliers rely on reliable networks for continuous data exchanges, essential for edge technologies like autonomous vehicles, smart grids, and IoT devices. Poor connectivity can impair the functioning of these technologies, reducing user experience and potentially causing service outages. End consumers, on the other hand, require uninterrupted network stability to handle the large amounts of data handled at multiple locations. Disruptions in connectivity can hinder the prompt processing of data, negating the benefits of edge computing, such as decreased latency and enhanced operational efficiency.

5.4.5.1 Connectivity and Network Infrastructure

Edge technologies require robust connectivity and network infrastructure for efficient communication and data exchange. Suppliers need strong connections for low-latency and high-reliability, while end consumers' adoption depends on their network infrastructure. Inadequate connectivity can cause data congestion and decreased efficiency.

Total downtime hours

The duration and frequency of system downtime are crucial for evaluating the viability of edge technologies minimising disruptions is essential for efficient deployment, as prolonged inactivity can weaken supplier dependability, damage customer confidence, and diminish perceived excellence.

Average time to resolve network issues.

The mean time to resolve network problems is crucial for the successful implementation of edge technologies, as it affects customer satisfaction and confidence in the supplier's ability to handle and assist with edge infrastructure. Prompt resolution of network issues significantly impacts the dependability and efficiency of edge applications, which are vital for corporate operations and end customers. Extended problem resolution can lead to operational delays and financial detriment, making a low mean time to fix network issues essential for effective implementation and operation of edge technologies.

Uptime Percentage

The uptime percentage of IT infrastructure indicates robust infrastructure, allowing suppliers to deploy edge technologies without risk of system failures.

Latency

Latency is a key factor in determining the practicality of using edge technologies, as it impacts data processing and insights delivery. Suppliers value low latency as a competitive advantage, especially in applications like autonomous vehicles or real-time analytics. End users also consider latency when evaluating edge solutions, as high latency can undermine its benefits like faster reaction times and improved customer experiences. Reducing latency is essential for fully utilizing edge computing's capabilities and ensuring its adoption is beneficial.

Latency variations during peak usage

Latency fluctuations during high usage are crucial for assessing the viability of edge technologies, as they demonstrate the network's ability to handle heavy traffic without a decline in performance. Suppliers rely on consistently low latency, especially during peak periods, as evidence of strong and expandable edge solutions. Latency spikes during peak usage can deter end consumers, especially for real-time data processing processes like online transaction systems or industrial automation. Therefore, the key to effective deployment and long-term usefulness of edge technologies is their ability to consistently provide high performance while minimising latency fluctuations.

Average bandwidth use

Edge technology's viability is determined by average bandwidth use and delays during peak usage. Suppliers must ensure their solutions can handle heavy workloads without significant delays, which can negatively impact real-time applications. End customers should know bandwidth usage and latency to predict data flow bottlenecks. Even small increases in latency can negatively impact services like streaming, cloud gaming, and autonomous vehicle telemetry. Therefore, it's crucial to ensure edge technologies operate robustly and efficiently, especially during high demand, by effectively utilizing bandwidth and minimising latency.

Congestion occurrences

Edge technology implementation relies on network efficiency in handling data flow. Frequent congestion can lead to issues for suppliers, particularly those relying on fast data transfer. High congestion can cause latency, reduced throughput, and subpar service performance. Network congestion directly impacts the feasibility and efficiency of edge technologies, causing slower response times and service outages. Effective control and congestion reduction are crucial for efficiently executing edge technologies, impacting their dependability and user experience.

Percentage of available bandwidth

Accessible bandwidth is a critical factor in evaluating the effectiveness and efficiency of edge technologies, especially for real-time analytics and decision-making applications. Suppliers need a lot of bandwidth to provide data-intensive services and handle increased data traffic. Insufficient bandwidth can lead to network congestion, latency, and reduced performance of edge applications, compromising localised data processing and analysis. Therefore, ensuring a significant allocation of accessible bandwidth is essential for the seamless operation and expandability of edge computing services, influencing consumers' decision to adopt such services.

Number of connected devices

The number of interconnected devices is a key factor in assessing the feasibility of edge technologies, as it significantly impacts network burden and data administration. Suppliers must understand the number of devices needed for their edge technology to ensure performance and scalability. The number of devices end customers use affects the edge infrastructure and data processing scale, necessitating advanced edge computing systems. Therefore, the quantity of interconnected devices directly impacts the development, execution, and operational administration of edge technologies, influencing their feasibility and efficacy.

Traffic growth rates

The growth rate of traffic is crucial for determining the viability of edge technology implementation for both suppliers and end customers. Suppliers benefit from increased data processing and reduced latency, incentivizing investment in cutting-edge technology. Clients face potential performance limitations and higher costs due to increased network traffic. Edge technologies offer a solution by allowing data processing closer to the source, reducing network congestion, and ensuring timely data analysis. Understanding and adjusting to traffic growth rates is essential for optimizing data management and making informed decisions in the digital environment.

Time to add new network nodes

The time it takes to add new network nodes is a key factor in assessing the viability of edge technology adoption. Suppliers need to quickly deploy these nodes to meet the growing demand for edge solutions, allowing them to cater to a larger customer base and maintain market competitiveness. End customers benefit from a shorter timeframe, allowing them to quickly access edge computing benefits, handle data, and use real-time analytics. Therefore, reducing the time needed for network node integration is essential for both parties.

Number of Security Incidents

This metric measures the overall number of security incidents, including both breaches and vulnerabilities, minimising the occurrence of events is crucial for ensuring financial readiness, as it demonstrates a robust security posture enabled by robust technology solutions that protect critical data and assets.

Number of intrusion attempts

The practicality of implementing edge technology depends on the number of intrusion attempts. Suppliers should prioritise building strong security infrastructure in their edge solutions to protect client data, maintain confidence, and ensure product reliability. End customers also emphasise the importance of secure deployments. Investing in edge solutions with enhanced security capabilities can protect against potential threats and secures important assets.

Number of failover events

Failover refers to the automatic switching to a redundant or standby system, server, or network when the primary system fails or is temporarily shut down for servicing. It is a critical process in maintaining continuous operations and ensuring system reliability, particularly in edge computing environments where data processing and decision-making occur close to the data source. Failover mechanisms are designed to minimise downtime and data loss, maintaining service availability and operational continuity in the event of hardware failures, software crashes, or other disruptions. High failover incidents indicate vulnerabilities in edge solutions.

Time to transfer between network nodes

Suppliers should reduce transfer time to optimise data flow across network nodes, allowing rapid processing and analysis at the network's edge. This enhances the efficiency of edge solutions, improves performance, and appeals to potential clients. Consumers value reduced transfer times for real-time data processing, prompt decision-making, and improved user experience.

Mean Time Between Failures (MTBF): Measure of the average time between technology-related failures or outages.

The operational reliability of edge technologies is largely determined by the percentage of uptime and Mean Time Between Failures (MTBF). High uptime percentages and longer MTBFs indicate stable systems crucial for business operations and customer satisfaction.

Mean Time to Repair (MTTR): Measure of the average time taken to restore systems or applications after a failure.

Mean Time to Repair (MTTR measures the average time required to repair a system or application after failure. A low MTTR signifies the reliability and ease of repair, especially for mission-critical technology, while, a low MTTR is desirable for end customers, as it reduces non-operational time, maintains business continuity, and reduces the impact of technology-related disruptions. This indicates a lower maintenance burden and potentially lower ownership costs, as quicker repairs often lead to reduced labour costs and productivity loss.

Connectivity availability in remote locations

Implementing edge technology in remote areas will require demonstrating an ability to provide reliable services despite limited access to centralised computing resources.

5.4.6 Edge Computing Platforms and Tools

Assessing the feasibility of deploying edge technologies relies on evaluating the qualities of edge computing platforms and tools, as these factors impact edge solutions' capabilities, performance, and flexibility. The functionality of providers' platforms and tools determines the range of applications they can support, their smooth integration with existing systems, and their ability to meet specific customer requirements, such as processing power, storage capacity, and real-time data analysis. The characteristics of edge computing platforms significantly influence the infrastructure investment choices end customers make. They must evaluate whether these tools can effectively handle their workload demands, seamlessly integrate with their operating environment, and accommodate their future needs, considering ease of use, maintenance and overall reliability of the technology.

5.4.6.1 Edge Node deployment

Deploying edge nodes determines infrastructure distribution and processing resource proximity. Strategic positioning of edge nodes ensures low-latency, high-bandwidth services, reducing transmission time and potential failure points. The speed and reliability of data processing are significantly influenced by their placement and concentration, impacting CEI efficiency and scalability.

Time to deploy new edge computing nodes

The deployment time of a new edge computing node demonstrates the infrastructure's efficiency and adaptability to changing requirements. This ensures rapid service expansion and tackles challenges like increased demand or broader geographical reach. Delays in scaling up edge computing capabilities can result in operational inefficiencies.

5.4.6.2 Edge Data processing

Edge data processing directly impacts data-based decision-making, reducing the need for continuous communication with centralised data centres, and saving the costs associated with data transmission. Local processing can also help ensure uninterrupted functionality in situations with inconsistent internet access.

Maximum data processing volume at edge node

Edge technology adoption is heavily influenced by the maximum data processing capacity at an edge node, which determines edge solutions' scale and ability to manage data efficiently. This capacity is crucial for data-intensive customers, as it determines the range of applications supported by edge computing. Businesses that produce large amounts of data and require quick, on-site analysis, such as video surveillance analytics or high-frequency trading, must prioritise this aspect. The maximum capacity for processing data evaluates the performance capabilities of edge nodes.

Data processing time at Edge node

Edge technology adoption is influenced by the processing time at edge nodes, which directly impacts the speed at which data is transformed into practical insights. Suppliers gain a competitive edge by offering quick processing times, allowing immediate action in applications like smart factories and critical infrastructure monitoring. Rapid data processing is equivalent to efficiency and is crucial for clients seeking cutting-edge solutions. The processing time determines end customers' systems' real-time capabilities, affecting operational delays and response efficiency. Shorter processing times enhance overall responsiveness and efficacy.

Latency reduction versus centralised processing

Edge technologies' adoption is largely influenced by their ability to reduce latency compared to centralised processing, which directly impacts data-driven processes. Suppliers find this advantage, as it allows faster processing times, crucial for applications like autonomous systems and real-time analytics. This reduces latency for end consumers, resulting in faster response times and more agile operations. The degree to which cutting-edge technologies can decrease latency is a key factor in investing in edge computing infrastructure.

Real-time data analytics capabilities

Real-time data analysis is crucial for evaluating the acceptance of edge technologies and enhancing operational efficiency. Suppliers must offer robust analytics to provide instant insights and actions, benefiting businesses like healthcare monitoring and financial trading. This feature enhances user experiences and provides a competitive advantage in situations where rapid insights and response time set one apart from others.

5.4.6.3 Edge Data security

Edge computing's practicality relies heavily on data security, as it safeguards sensitive data. Suppliers must prioritise robust security measures to maintain credibility and integrity of their edge solutions. As edge computing expands network perimeters, data processing at the edge is crucial for end customers to maintain confidentiality. Vulnerabilities on devices beyond conventional security perimeters can lead to significant data exposure. Ensuring edge data security is essential for regulatory compliance, consumer confidence, and ecosystem protection from cyber risks.

Number of security incidents at Edge Node

The frequency of security incidents at edge nodes is a key indicator of the adoption of edge technologies, as it reflects the security strength of the edge infrastructure. Suppliers with fewer incidents demonstrate a robust security posture, gaining customer trust and a competitive edge. A higher rate of incidents may indicate vulnerabilities that could compromise data integrity, disrupt operations, and cause reputational harm.

Percentage of vulnerabilities patched.

The percentage of vulnerabilities addressed is a key metric for assessing the effectiveness of edge technology, as it demonstrates its resilience to cyber-attacks. Suppliers with high patching rates demonstrate a strong commitment to security and can promptly address potential threats. The success rate of fixing vulnerabilities affects end consumers' confidence in edge technology's ability to protect sensitive data and maintain consistent functioning. The rate at which patches are applied is crucial for assessing the safety and well-being of an edge system, which influences the decision-making process for its implementation and expansion.

Percentage of encrypted data

The proportion of encrypted data in edge computing nodes is crucial for evaluating the viability of edge technology for providers and end users. Suppliers should prioritise robust security measures to protect confidential data and maintain consumer trust. End users, on the other hand, require secure edge computing settings to ensure data protection, minimise unauthorised access, and prevent data breaches.

Degree of compliance with encryption standards

The adherence to encryption standards in edge computing nodes offers a high degree of confidence that data and node operations will be protected.

5.4.6.4 Edge Node scalability

The scalability of edge nodes is crucial for both suppliers and end customers when evaluating the practicality of using edge technologies. Suppliers need to expand their edge infrastructure to meet increasing client needs, handle larger projects, and stay competitive in a rapidly changing market. End customers need edge solutions that can easily incorporate or eliminate nodes as data volumes grow, ensuring responsiveness and efficiency.

Number of edge-connected devices

The number of edge-connected devices significantly influences the success of edge technologies for suppliers and consumers. A larger market and demand for edge solutions lead to increased investment in development and innovation. This can lead to more efficient products and increased competitiveness. The number of devices directly influences the efficiency of real-time data processing and analytics. However, increased device numbers may strain network bandwidth and cloud resources, making edge computing more appealing for applications requiring minimal delay and optimal performance.

Edge network max device capacity

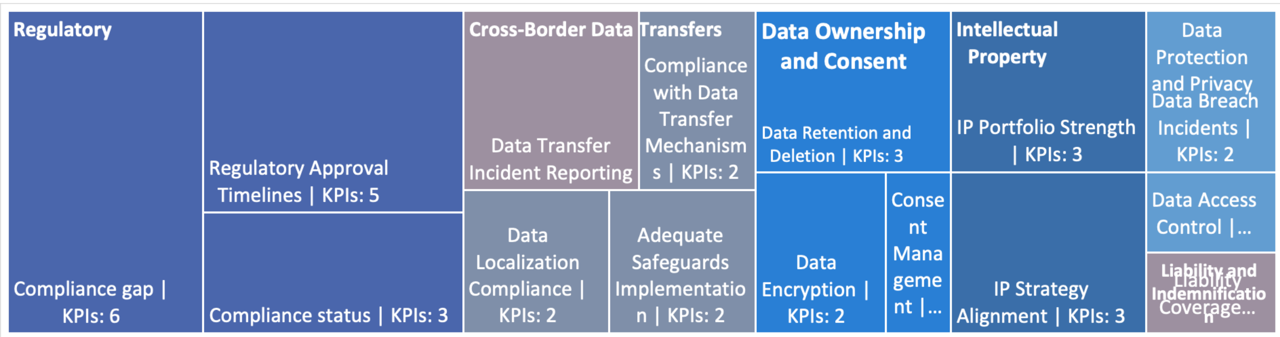
The maximum number of edge network-connected devices is crucial for suppliers to determine the scalability and capacity of their edge solutions. A larger capacity indicates better market expansion and competitiveness. It also affects end customers' ability to deploy apps and services at the edge, ensuring performance and efficiency. Understanding and synchronizing with the maximum capability of edge network-connected devices is essential for ensuring edge technologies can efficiently meet data-intensive applications.

Time to add a new edge node

The time it takes to integrate new edge nodes is a key factor in evaluating edge technology's practicality for providers and end users. Quick deployment of edge nodes demonstrates their ability to meet the growing demand for edge solutions, maintain competitiveness, and quickly access edge computing benefits. Shorter integration times improve agility, responsiveness, and overall effectiveness of edge technology use.

5.5 Legal & Regulatory Hierarchy

The KPIs are distributed as follows:



5.5.1 Regulatory and Compliance Requirements

Compliance with legal and regulatory requirements is crucial when adopting CEI technologies, as they often involve collecting, storing, and processing personal data. International laws, such as GDPR in the EU, protect these technologies. Businesses must also adhere to anti-discrimination laws and intellectual property laws to avoid legal issues. As CEI technologies often operate across borders, ensuring ethical deployment and avoiding infringement on others' IP rights is essential. Compliance with international laws and regulations can be complex yet necessary.

5.5.1.1 Compliance gap

Compliance gaps are crucial for organisations adopting edge computing technologies, impacting their ability to meet regulatory requirements and industry standards. Edge computing involves processing sensitive data at the network's edge, posing security and privacy concerns. Bridging these gaps is vital for data security, reputation, and legal avoidance. As data privacy laws evolve, demonstrating compliance becomes even more critical. A robust compliance strategy ensures edge computing aligns with high security and privacy standards, fostering trust and minimising breaches and regulatory penalties.

The extent of compliance gaps

To adequately prepare for implementing CEI technologies, it is essential first to define the scope of compliance gaps inside companies. It is meant to summarise the status of organisations within the legal landscape, proposing the degree of modifications that need to be made before they fulfil regulatory criteria for deploying CEI technology. The purpose of this document is to ensure that it achieves its intended purpose.

Number and severity of gaps

It is necessary for businesses that intend to employ CEI technology to possess concrete evidence of the total number of compliance gaps as well as the possible impact of such gaps. It enables decision-makers to address each of them precisely, ranking based on severity and urgency, thus avoiding the legal issues that might be incurred because of not satisfying regulatory requirements.

Compliance degree with relevant regulations

Businesses would benefit from a valuable stimulus to further investigate their legal practices if the degree of conformity with applicable rules was considered. This key performance indicator gives an overview of how important it is for companies to comply with regulations. When taken together with the key performance indicators (KPIs), it enables organisations to successfully prepare for implementing CEI technology in terms of their legal requirements.

Compliance score

Similarly to the previous section, the compliance score provides an overarching picture of how ready businesses are to implement CEI technologies. It makes it possible to compare one company's performance to that of others in the same industry and makes monitoring the progress made internally easier. Managers can witness how particular activities in terms of legal approach affect the compliance score, and they may understand what steps need to be performed for the company to align itself with laws and regulations about CEI technology.

Degree of adherence to regulations

In the same way that the size of compliance gaps can indicate how prepared legal departments are for implementing CEI technologies, the degree of adherence to regulations can show how well-prepared legal departments are. This key performance indicator places more of an emphasis on the legal safeguards that are currently in place than it does on the regulatory requirements that are lacking in various organisations regarding the application of CEI technology.

Degree of certifications adopted.

Organisations may need to demonstrate compliance with the regulatory framework surrounding the deployment of CEI technology using certifications that they've already implemented. It is essential to consider how relevant the certifications are to each CEI technology project.

5.5.2 Data Protection and Privacy

Several jurisdictions have implemented distinct legislation concerning data protection and privacy, such as the General Data Protection Regulation (GDPR) in the European Union (EU). These frequently necessitate companies to acquire informed consent from individuals prior to gathering and handling their personal data, as well as to offer transparency regarding their use. Data protection and privacy are crucial factors to consider in the context of deploying and operating CEI technologies, as this data is essential for their functioning. Organisations are required to have strong data security protocols to safeguard personal data from breaches and unauthorised entry, thereby preventing potential legal consequences, monetary penalties, and sanctions. Data protection legislation confers specific entitlements to persons over their data, including the entitlement to access, rectify, or erase their information. CEI technologies should be created and authorised in a manner that enables persons to exercise their rights. When data breaches or privacy violations occur, individuals have the option to initiate legal action or lodge complaints against the responsible businesses. Complying with data protection regulations can serve as a legal defence in such lawsuits.

5.5.2.1 Data Breach Incidents

Number of data breaches

The frequency of data breaches serves as an indication of the susceptibility of organisations and their security systems, as well as the possible magnitude of regulatory compliance deficiencies. An elevated frequency of breaches indicates that a business should enhance their data protection and privacy practises. Implementing CEI technologies without proper preparation may heighten the probability of additional security breaches, as well as potentially harm the data owners and the organisation.

Number of incidents involving sensitive information

The frequency of sensitive information incidents is crucial for evaluating the practicality of implementing edge technology for suppliers and end customers. These incidents can impact suppliers' security procedures and customer confidence. Suppliers with high incidents may struggle to gain consumer trust for their edge technologies, which require stringent data security measures. End customers' frequency indicates the effectiveness of their existing infrastructure in protecting sensitive data. Edge technologies, while offering reduced latency and localised data processing, also introduce additional vulnerabilities due to the involvement of more devices and potentially less secure environments. Therefore, the frequency of security events involving confidential data directly impacts the perceived risk associated with edge technology implementation.

5.5.2.2 Data Access Control

Data subject rights requests.

Data subjects has many rights pertaining to their personal data. Users have the right to request access to their information and to request modifications, additions, restrictions, deletions, and other changes to it. This key performance indicator (KPI) pertains to the record-keeping of requests made by companies. It captures the conduct of data owners and ensures that data is utilised in compliance with applicable legislation, hence preventing any legal consequences.

5.5.3 Data Ownership and Consent

The adoption and operation of CEI systems requires careful consideration of data ownership and consent, given the substantial volume of personal data at stake. Within the legal and regulatory framework, it is crucial to establish the precise allocation of legal rights and obligations pertaining to the data in question. Frequently, the entity that gathers the data assumes ownership, although data ownership can differ based on circumstances and relevant legislation. Establishing data ownership is crucial, especially when supplier partnerships are necessary for implementing CEI technology. This should be clearly defined in contractual agreements. Having a clear understanding of who owns the data can avert conflicts and legal complications in the future. Likewise, it is important to acquire permission from those who possess the data using clear and comprehensible methods, as mandated by applicable rules like GDPR. Consent is a mandatory legal obligation that guarantees the lawfulness of data processing. Data owners should be informed about the aims of data collection and processing and provided with the option to either provide consent (opt in) or withdraw consent (opt out) at their discretion. Organisations are required to keep records of consent, documenting the specific details of when and how it was received. This is necessary to prove compliance and give evidence in the event of legal challenges.

5.5.3.1 Consent Management

Opt-in/Opt-out ratio.

Monitoring and documenting the rates at which users choose to opt in or opt out can provide significant insights for companies to comprehend user behaviour patterns and evaluate the suitability of their consent acquisition methods. Additionally, it is crucial for showcasing adherence to data protection legislation that mandate companies to acquire informed permission and enable individuals to exercise their rights to revoke their data.

5.5.3.2 Data Encryption

Use of encryption techniques

Encryption techniques are essential for ensuring data security, privacy, and compliance. Recording the application of various methodologies throughout a business aid in assessing their suitability for safeguarding sensitive data from unauthorised access and cybersecurity breaches. It also ensures the integrity of data during its transfer or storage. It is important to evaluate the appropriateness of procedures within their specific context.

Adherence to encryption best practices

Legal departments should evaluate the extent to which organisations adhere to encryption best practises prior to implementing CEI technologies. Noncompliance with industry standards and applicable rules signifies a significant likelihood of data breach occurrences, which can result in severe legal consequences for businesses.

5.5.3.3 Data Retention and Deletion

Percentage of data retention policy adherence

Complying with data retention standards shows adherence to broader regulations about data protection and privacy. Organisations should strive to maximise this Key Performance Indicator (KPI) to prevent legal issues.

Data deletion success rates

To guarantee companies are protected in legal disputes, it is crucial to maximise the success rates of data erasure. Individuals possess the entitlement to retract their personal data at any given time, and the absence of this right being granted by organisations might result in legal consequences.

Average time taken to fulfil data deletion requests.

Tracking and recording the mean duration for an organisation to delete user data is a clear measure of their ability to recognise and handle requests. CEI technologies rely on huge amounts of user data, hence exacerbating the complexity of this work. Therefore, companies should try to reduce this key performance indicator prior to implementing CEI technology, to decrease the likelihood of unlawfully utilizing data.

5.5.4 Cross-Border Data Transfers

When implementing CEI technology, it is crucial to consider cross-border data transfers due to the differing data protection and privacy rules across jurisdictions. The General Data Protection Regulation (GDPR) of the European Union (EU) establishes specific criteria for the transfer of data to other jurisdictions. When organisations engage in worldwide operations or establish contractual agreements with foreign suppliers, it is imperative that they adhere to certain international regulations. Transferring data across borders can often pose security problems, especially when data is sent across international boundaries and legal obligations may necessitate businesses to guarantee data security throughout all phases. Organisations must acquire informed consent from individuals in specific situations before sending their data internationally to address the supplementary risk.

5.5.4.1 Compliance with Data Transfer Mechanisms

Approved data transfer mechanisms recognised by relevant regulations.

Approved data transfer mechanisms, as recognised by pertinent rules, pertain to the use of legally authorised techniques and frameworks for transferring personal data across international boundaries, while maintaining adherence to data protection and privacy regulations. Prior to implementing CEI technology, it is imperative for businesses to adopt these processes to prevent data breaches throughout the transfer process and mitigate potential legal repercussions.

Percentage of data transfers utilizing compliant mechanisms.

This KPI evaluates whether a business utilises data transfer mechanisms that adhere to compliance standards. It quantifies the use of compliant methods as a percentage to motivate action inside organisations. To avoid legal consequences, it is imperative to maximise this percentage.

5.5.4.2 Data Localisation Compliance

Compliance percentage of data localization requirements imposed.

Data localization requirements refer to legislation or legal mandates that dictate the specific locations where organisations are obligated to keep and process categories of data. This key performance indicator (KPI) quantifies the proportion of instances in which businesses adhere to certain criteria, a metric that should be optimised to mitigate legal conflicts and their associated repercussions.

Percentage of data stored or processed in compliance.

To ensure compliance with applicable requirements, it is important to optimise the percentage of data that is held and processed in accordance with these regulations. It is worth noting that the regulatory framework on data privacy and protection does not allow for any exemptions.

5.5.4.3 Adequate Safeguards Implementation

Ratio of encrypted data transfer

Identifying the ratio of encrypted data that is being transferred across borders is essential to monitor and manage the risk involved in the process. This KPI should be considered in conjunction with previous KPIs, such as the rate of encryption. Being these high, organisations are likely to be well prepared for adopting CEI technologies and operating them internationally.

Ratio of anonymisation data transfer

As above, identifying the ratio of anonymised data that is being transferred across borders is essential to monitor and manage the risk involved in the process. A high KPI suggests organisations are likely to be well prepared for adopting CEI technologies and operating them internationally.

5.5.4.4 Data Transfer Incident Reporting

Number of cross border data transfer incident

The number of security incidents targeting sensitive information during-cross border transfers reveals vulnerabilities and weak points within organisations and their privacy policies. Organisations facing frequent incidents should look at previous KPIs regarding the type of data they usually transfer across borders and take relevant measures to mitigate the risk, before adopting CEI technologies.

incident response time

The incident response time reflects the capacity of organisations to detect and manage security threats, attacks, or breaches. Deploying CEI technologies, cybersecurity risks will likely increase, which will require faster reactions to such incidents.

Incident regulatory notification

This KPI refers to the ability of organisations to promptly notify relevant regulatory authorities of security incidents with regards to user data. This obligation is detailed by laws and different jurisdictions explain how such incidents should be reported. Failure to report data breaches or other security incidents can have legal consequences for organisations.

5.5.5 Intellectual Property

When implementing CEI technologies, it is important to consider the Intellectual Property (IP) that organisations own or generate within the framework of legal and regulatory requirements. These technologies encompass cutting-edge algorithms, software, procedures, and information that can be safeguarded against unauthorised use or duplication through intellectual property rights, such as patents and copyrights. In addition, they can be utilised to ascertain the ownership of AI models, datasets, and training procedures employed in CEI technologies, while also streamlining contractual agreements among organisations, suppliers, and developers. Organisations may preserve their competitive advantage, foster more innovation, and attract investment by safeguarding intellectual property (IP) related to CEI technologies. This is particularly important as they navigate legal obstacles in the rapidly changing field of AI and machine learning.

5.5.5.1 IP Portfolio Strength

Number of granted patents.

Documenting the number of granted patents gives organisations an overview of the unique tools and methods available to them to integrate into the implementation process of CEI technologies. Reviews of new potential patents should be performed during the process of developing and deploying the CEI technologies if applicable.

Number of trademark registrations

Documenting trademark registrations are useful when adopting CEI technologies, as they can render the latter distinguishable in the market and seamlessly associate them with an organisation’s brand.

Number of IP assets

Reporting the number of overall IP assets of an organisation can be a useful summary of their competitive advantage, which can be utilised in the CEI technology implementation. That said, their legal department must also ensure that deployed CEI technologies do not pose risks to existing IP assets, exposing patents or incorrectly using protected data, for example.

5.5.5.2 IP Strategy Alignment

IP protection against new technology adoption

As mentioned above, the protection of against new CEI technology adoption is pivotal. Quantifying this KPI may require organisations to perform a risk assessment, regarding potential risks IP assets may face due to CEI technologies, determine how to mitigate them, and calculate a “readiness score”.

Number of IP infringement incidents

The number of past IP infringement incidents should be considered in conjunction with the previous KPI to determine the effectiveness of organisations’ IP strategies and capacity to prevent further IP violations related to the deployment of CEI technologies. Potential corrective measures taken since the last IP infringement should be considered.

Number of successful IP enforcement actions

This KPI refers to legal actions, litigation, or measures taken by organisations to protect their IP rights, with a favourable outcome (victory or settlement). It reflects the efficiency of the organisations’ legal departments in protecting their IP, which would be essential in the case of adopting CEI technologies.

5.5.6 Liability and Indemnification

CEI technology can provide multiple hazards, including data breaches, privacy infringements, and inaccuracies in automated decision-making. Liability and indemnification clauses serve to distribute these risks among various entities, including the organisation, contractors, and service providers, therefore specifying the obligations of each party. These pertain to a range of previously mentioned subjects, encompassing data privacy, security, and intellectual property. Liability and indemnification provisions guarantee that collaborating parties adhere to legal requirements, handle sensitive data in accordance with applicable laws and regulations, have implemented essential cybersecurity measures, and have resolved intellectual property-related concerns. In addition, they can safeguard investments by specifying possible financial redress and recompense in case of issues or conflicts, given that CEI technology can be rather expensive. Essentially, these measures safeguard parties from potential legal responsibilities and establish a systematic method for resolving legal matters and conflicts that may occur during the implementation and use of CEI technology.

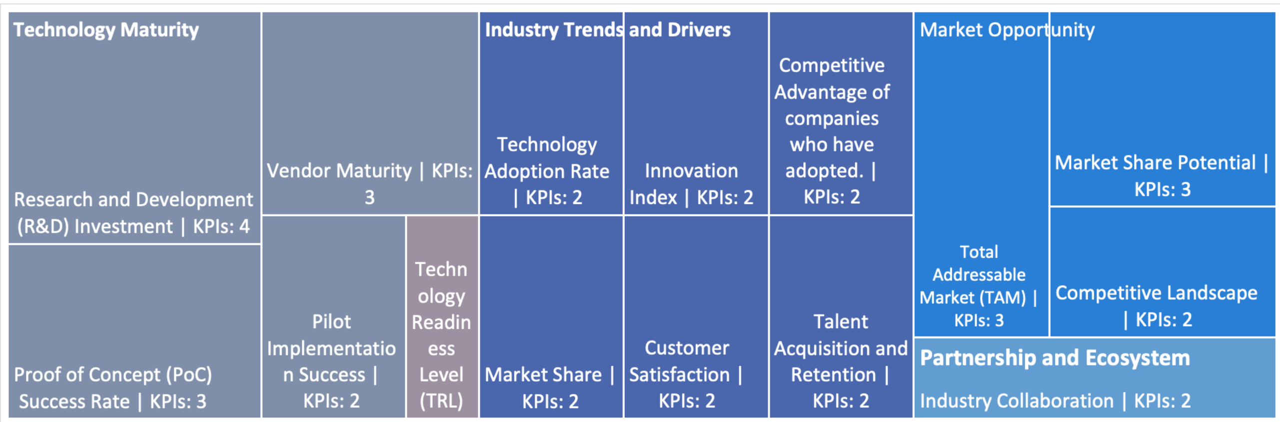
5.5.6.1 Liability Coverage

Coverage limits

In the context of liability coverage, coverage limits refer to the maximum amount of money organisations can receive by their insurance policy for a covered claim or loss. It may apply to financial implications from data breaches, compensation for IP disputes, legal action against suppliers, underperformance of the deployed CEI technologies etc. This KPI helps them identify the risk that they can allow for in the adoption of CEI technologies.

5.6 Industry & Market Hierarchy

The KPIs are distributed as follows:



5.6.1 Industry Trends and Drivers

Industry trends frequently emphasise the necessity for the customisation and integration of technologies. For instance, researchers and developers are exploring the use of Conversational AI to facilitate patient interactions, Edge Computing to provide real-time monitoring, and IoT to connect medical devices in the healthcare industry. Gaining insight into these patterns enables businesses to develop tailored solutions that address precise industry requirements. Industry trends and drivers can provide organisations with benchmarks and technical insights, such as acceptable latency times in Edge Computing, expenses related to various implementation options, and interoperability problems. Essentially, they provide businesses with information about the changing environment, potential advantages, and difficulties, allowing them to make well-informed choices to remain competitive and meet industry-specific requirements.

5.6.1.1 Technology Adoption Rate

Number of organisations adopting

The number of organisations in a particular industry that adopt CEI technologies may indicate their implementation's impact. Organisations are not encouraged to follow an imitation strategy but explore the potential benefits of CEI technologies and evaluate whether they should adopt them.

Growth rate over time

The growth rate of CEI technologies over time implies their maturity and potential. A significant increase in the growth rate may indicate these technologies have surpassed the pilot stage and can be deployed for commercial advantage. Organisations should identify whether their strategic goals align with an early- or late-stage adoption.

5.6.1.2 Market Share

Volume of technology within the industry

As mentioned above, the volume of CEI technologies within a given industry may suggest their maturity, applicability, and potential impact.

Evolution of market share for organisations that have adopted edge computing.

The evolution of the market share of selected organisations that have adopted Edge Computing points toward the commercial benefits of this technology in a particular industry. This KPI should be considered cautiously and in context. Direct organisation comparisons may not be meaningful due to internal and external differences.

5.6.1.3 Innovation Index

New product or service launches

The number of new products or services launched in the market after adopting CEI technologies indicates the potential for business growth. Yet, this KPI does not apply to all industries or organisations, as CEI technologies can be used for various purposes, including improving internal processes.

Volume of R&D investments

The average volume of R&D investments informs organisations of the pre-work required to adopt CEI technologies successfully. Figures from individual organisations can also be looked at, if available, to detect trends between the amounts invested in R&D and the success of the technology implementation, patents obtained, etc.

5.6.1.4 Competitive Advantage of companies who have adopted.

Increased revenue

The increase in revenue of companies that have adopted CEI technologies reflects the potential financial benefits of such technologies. However, this KPI may be influenced by factors other than the adoption of CEI and should be used consciously.

Operational efficiency

This KPI refers to the CEI-powered operational efficiency of organisations in the market. Post-deployment efficiency should be compared to pre-deployment figures, which may not be publicly available or affected by other company decisions.

5.6.1.5 Customer Satisfaction

Net promoter score (NPS): measure of customer loyalty and likelihood to recommend the organisation based on technology-driven interactions.

NPS measures the loyalty of customers and the likelihood of them recommending an organisation. Quantifying the effect of technology-driven interactions on such elements may indicate whether the technologies have been implemented effectively in the appropriate context and eventually whether they provide a tangible benefit to the organisation.

Customer Effort Score (CES): assessment of the ease and convenience of customer interactions facilitated by technology.

CES encourages organisations to evaluate the smoothness and appropriateness of their technology deployment process, as this is likely reflected in the ease and convenience of interactions between customers and the technologies at hand.

5.6.1.6 Talent Acquisition and Retention

Employee satisfaction: measurement of employee satisfaction levels through surveys or feedback tools facilitated by technology.

Employee satisfaction is essential for organisations who want to adopt CEI technologies, as training and upskilling of their personnel is likely going to be needed. CEI technologies can be complex, and employees should be motivated enough to learn how to use and manage them at full potential.

Employee feedback: quantity and quality of employee feedback collected through technology-enabled platforms.

Employee feedback is essential for organisations to improve internal processes and increase job satisfaction. That said, collective, relevant, helpful feedback can be challenging, so quantity and quality should be monitored. The role of technology-enabled platforms in receiving such feedback should be examined.

5.6.2 Partnership and Ecosystem

Ecosystems and partnerships potentially existing within them play an essential role in shaping the adoption of CEI technologies. Organisations can access a wider pool of expertise, skills, and resources through their ecosystem and relevant partnerships. This can be particularly valuable in markets and industries where CEI technologies are complex and require specialised expertise. They can also leverage the latest developments and share knowledge, speeding up innovation. Alliances can facilitate practically any aspect of adopting new technologies, providing support and experience in complying with regulatory requirements, minimising costs, and mitigating associated risks. In short, partnerships within an ecosystem can foster growth, efficiency, and competitiveness, especially in the rapidly evolving CEI market.

5.6.2.1 Industry Collaboration

Number of industry partnerships

Identifying the number of established partnerships in their ecosystem is vital for organisations adopting CEI technologies. It provides an opportunity for organisations to document relevant partnerships they are contributing to and others that could benefit them strategically or technically with CEI technologies.

Number of joint ventures or consortiums

The number of CEI-related joint ventures or consortiums in a market may indicate the feasibility of adopting CEI technologies as standalone organisations. Organisations should assess whether they have the capacity and resources to proceed with such a process and compete with existing joint ventures and consortiums, for which they must consider complementary KPIs.

5.6.3 Market Opportunity

Market opportunity is the potential for growth, profit, and success within a specific market or industry. Assessing factors, including the market size, market growth rate, and specific segments or niches that present promising opportunities, helps organisations understand the growth potential for CEI technologies within their industry. Organisations must position themselves effectively to tailor their strategies and align their efforts with market potential. Market opportunity is significant for organisations looking to enter new markets or expand their presence in existing ones through the adoption of CEI technologies, as it provides an overview of opportunities to retain or acquire new customers. Another essential aspect to consider within market opportunity is the competitive landscape. Understanding the level of competition, the key players, and their strategies enables organisations to identify gaps and opportunities where CEI technologies can thrive. Understanding their rivals can also reveal emerging industry trends and drivers that help organisations adapt their CEI strategies to the forces shaping the market and ensure they can capitalise on them. Finally, market opportunity is directly linked to revenue and profitability, enabling organisations to estimate KPIs, such as return on investment (ROI), from adopting CEI technologies.

5.6.3.1 Total Addressable Market (TAM)

Market size

The market size helps assess the commercial viability of adopting CEI technologies, as a larger market size generally indicates a more significant potential customer base and opportunity to scale up, increasing return on investment. Larger markets also tend to have a better-developed technology ecosystem, including infrastructure, service providers, and talent pools. However, they can also be competitive and require more resources for organisations to establish a foothold.

Market growth rate

A market's growth rate is a good indicator of the range of available opportunities for businesses operating there. High-growth markets with more commercial prospects will benefit more from CEI technologies.

Market segments

Defining the exploitable segments of a market helps organisations tailor their growth strategies. In the case of adopting CEI technologies, organisations need to keep track of the features they could reach using such technologies.

5.6.3.2 Market Share Potential

Current market share

An organisation's market share may indicate the intensity of competition in their industry or market. Organisations should cross-reference with internal data and KPIs to determine the reasons behind their current market share, their goals in terms of market share growth, their capacity to achieve those, and how CEI technologies can help.

Market share growth

Organisations monitoring the market share growth clearly understand their position and influence in the market and can make better-informed decisions. This KPI should be considered in context: adopting CEI technologies can help organisations boost their market share growth when they observe stagnation or achieve even higher growth rates.

Revenue projections

Revenue projections for the CEI technology adoption stage and the foreseeable operation period should be made. This will help organisations plan their finances and assess risks related to deploying CEI technologies based on market data and predictions. This KPI needs to be considered with more information, such as organisations' cost projections, project-specific risk assessments, etc.

5.6.3.3 Competitive Landscape

Number of competitors

Competition is one of the leading market forces. Organisations should define the number of their (primary) competitors, as it helps with benchmarking and staying up to date with their performance. This KPI should be considered along with other information, such as whether competitors have deployed CEI technologies, to determine how an organisation can stand out in its market.

Value proposition

Analysing the value proposition of key players from the market, particularly those who have potentially implemented CEI technologies, challenges organisations to improve their own further. The latter can create a metric that reflects value proposition clarity, relevance, and effectiveness.

5.6.4 Technology maturity

Technology maturity is critical in adopting CEI technologies from a market and industry perspective. Mature technologies have typically been adopted and used by various businesses across various industries, undergone market validation, and proven their relevance and effectiveness. This ensures organisations are not taking unnecessary risks but focusing on utilizing the best technologies for their specific needs. An ecosystem of established service providers, consultants, and integrators in mature markets and a more comprehensive range of experienced and credible suppliers exist. Being an early adopter of cutting-edge technologies, such as CEI, can offer a significant competitive advantage. It requires expertise and flexibility, as their implementation and usage should continuously adapt alongside emerging industry standards, norms, and regulations. The acceptable level of technological maturity depends on each organisation, its strategy, skills, and overall capacity to manage such demanding and uncertain processes.

5.6.4.1 Research and Development (R&D) Investment

Level of investment in R&D

The volume of R&D investments in a particular technology (or technological area) is potentially indicative of the maturity of that technology. Mature technologies are usually more straightforward and less risky to deploy and use due to the scale of testing and the immediate availability of relevant information. At the same time, successfully adopting less mature technologies can help organisations gain a significant competitive advantage. Organisations must find the correct maturity regarding their industry, goals, and capabilities.

R&D expenditure as a percentage of revenue

This KPI measures an organisation's investment in R&D against its total revenue. It indicates the importance attributed to R&D by that organisation, which likely translates to their readiness to adopt relevant technologies. It implies the organisations' internal technical maturity.

R&D team size

The size of the R&D team indicates the importance attributed to R&D by that organisation and, thus, their technical and technological readiness to adopt relevant technologies.

Number of patents filed.

The number of patents filed in a specific industry through the CEI technology deployment process can indicate uniqueness of the technology and serve as protection against IP infringement.

5.6.4.2 Technology Readiness Level (TRL)

Current TRL level

The Technology Readiness Level (TRL) is an official measure to assess the maturity and readiness of a technology for deployment, typically ranging from 1 (immature) to 9 (fully mature). Based on TRL, organisations must determine their intended purpose and capabilities to determine whether adopting CEI technologies is relevant.

5.6.4.3 Proof of Concept (PoC) Success Rate

Number of successful PoC

Proof of Concept (PoC) refers to small-scale projects or tests to validate a concept or idea's feasibility, practicality, and potential. Identifying the number of successful PoC related to CEI technologies gives organisations insight into the requirements of implementing CEI technologies in different business contexts, industries, and markets, allowing them to make informed decisions.

PoC completion time

The completion time of (successful) PoC can be used to estimate the time required for an organisation to implement a CEI technology successfully. A full-scale adoption is expected to last longer and be more complex than a PoC due to organisations' unique processes, particular technology systems, and specific requirements.

Evaluation of PoC

The evaluation of PoC involves an assessment of the feasibility, practicality, and potential of a specific CEI technology. These elements should match an organisation's purpose for adopting such a technology and its identified capacity to manage the adoption process.

5.6.4.4 Pilot Implementation Success

PoC completion rate

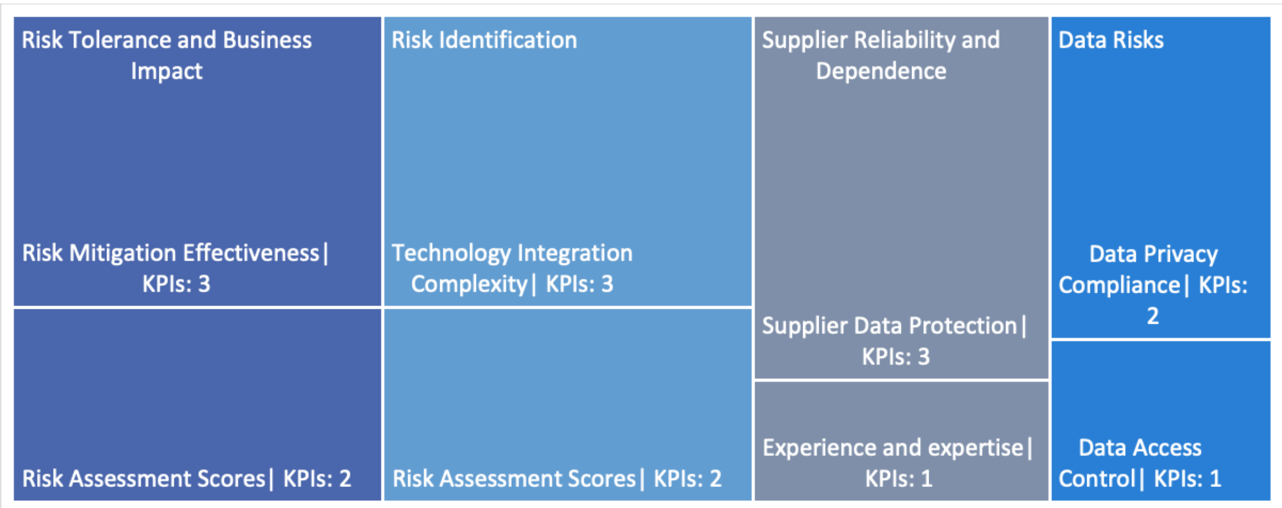
This KPI is fundamental as it considers PoC that did not reach the completion stage. New advanced technologies, such as CEI, are likely to fail or be given up before PoC is completed, which does not allow for measuring success rates or completion times. Organisations should determine their confidence in adopting CEI technologies based on applicable PoC completion rates.

Number of objectives achieved.

Identifying the number of objectives different CEI technologies achieved at their pilot implementation stage can help organisations decide whether proceeding with the adoption is feasible and whether they should wait for the technologies to develop further or better prepare internally. This KPI could also lead to organisations adjusting their objectives for adopting CEI technologies.

5.7 Risk & Compliance Hierarchy

The KPIs are distributed as follows:



5.7.1 Risk Tolerance and Business Impact

5.7.1.1 Risk Assessment Scores

Number of identified risks

This KPI quantifies the total count of potential risks identified within the scope of CEI technology adoption. This includes any challenges, vulnerabilities, or threats that could impact the successful implementation of these technologies, such as data security vulnerabilities, interoperability issues, or regulatory compliance challenges. The number of identified risks serves as a foundational KPI. A higher count suggests a thorough risk assessment, which is crucial in gauging technological adaptations' readiness level and feasibility. Identifying and acknowledging risks early in the process enables organisations to plan and strategise effectively.

Impact of risk on business

This KPI evaluates the potential influence and consequences of identified risks on the organisation's core business operations. It quantifies how significantly these risks could disrupt daily business activities. Assessing the impact of risks provides a clear understanding of their significance. Organisations with a high adoption readiness level should be able to evaluate the extent of the impact and manage risks with minimal repercussions on their core operations, making this KPI vital in determining preparedness for adopting CEI technologies.

5.7.1.2 Risk Mitigation Effectiveness

Reduction in identified risks due to mitigation actions.

This KPI assesses the decrease in the number of identified risks because of implemented mitigation actions, for instance, enhanced security protocols, training and awareness programs, regular vulnerability assessments and contingency planning. The reduction in identified risks directly measures the effectiveness of risk mitigation strategies. A substantial reduction indicates that mitigation actions successfully address and minimise potential threats, signifying robust readiness for CEI adoption.

Time taken to adopt mitigation actions.

This KPI assesses the time it takes for the organisation to adopt and implement mitigation actions once risks are identified. The efficiency in adopting mitigation actions is critical for readiness. A shorter duration suggests a swift response to risks, ensuring timely protection. This KPI indicates a proactive approach to risk management and readiness for CEI technologies.

Costs attributable to risk

This KPI evaluates the financial costs directly attributable to identified risks. It encompasses expenses such as security investments, legal fees, or financial losses incurred due to risks. Understanding the costs associated with identified risks is essential for technological feasibility assessment. It allows the organisation to budget and allocate resources effectively, ensuring financial preparedness for CEI adoption.

5.7.2 Risk Identification

5.7.2.1 Risk Assessment Scores

Number of identified risks by severity

This KPI quantifies the count of identified risks categorised by their severity levels using a scale from 1 to 3. For example, it tracks how many risks are deemed low (1), moderate (2), or high (3) in terms of potential impact. Assessing risks by severity on a 1 to 3 scale aids in prioritising mitigation efforts. A comprehensive view of the distribution of risks across these severity levels informs the readiness assessment, allowing for focused strategies for CEI adoption.

Number of identified risks by probability of occurrence

This KPI quantifies the count of identified risks based on their probability of occurrence, measured on a scale from 1 to 3. For example, it tracks the number of risks with low (1), moderate (2), or high (3) probabilities. Evaluating risks by their probability on a 1 to 3 scale helps understand the likelihood of occurrence. This knowledge enables the organisation to allocate resources and develop contingency plans tackling the most relevant and probable risks, contributing to readiness for CEI adoption.

5.7.2.2 Technology Integration Complexity

Technology integration time

This KPI measures the time it takes to integrate CEI technologies into the existing infrastructure. It assesses the duration from the initiation of integration efforts to the completion of the integration process. Tracking the time for technology integration is essential for readiness evaluation. A shorter integration time implies efficient implementation, ensuring a swift transition to CEI technologies.

Technology resource requirements

This KPI evaluates the personnel and equipment resources needed for CEI technology integration using a scale with 3 levels: high, moderate, and low. It quantifies the human resources and technology assets required. Understanding resource requirements on a 3-level scale (high, moderate, and low) is crucial for preparedness. It allows the organisation to correctly allocate the necessary personnel and equipment and determine potential resource gaps, ensuring a smooth transition to CEI technologies.

Areas involved.

This KPI identifies and categorises the specific areas within the organisation that are directly involved in CEI technology integration. It delineates the departments, teams, or units engaged in the integration process. Knowing the areas involved clarifies responsibilities and coordination requirements. This information aids in ensuring that all relevant components of the organisation are prepared for CEI technology integration when creating the technology adoption plan.

5.7.3 Data Risks

5.7.3.1 Data Privacy Compliance

Private policy adherence ratio

It measures an organisation's consistency in following data privacy regulations. Suppliers with high adherence demonstrate dedication to data protection and their ability to provide secure solutions. This adherence enhances consumer trust by ensuring data is managed in compliance with the supplier's privacy standards. It also serves as an indicator for end customers to assess their readiness to use edge technologies while safeguarding data privacy. Maintaining a high adherence ratio ensures compliance with privacy regulations, upholding consumer trust, and influencing the reliability and feasibility of edge technology solutions.

Consent management effectiveness

This Key Performance Indicator assesses an organisation's efficiency in acquiring, overseeing, and controlling user or customer approval for the use of their personal information. As previously stated, the gathering and analysis of this data is an essential component of implementing and managing CEI technologies. However, data owners retain the right to view, rectify, or erase their information at any given time. Organisations must adhere to this right to avoid encountering legal repercussions.

5.7.3.2 Data Access Control

Time to resolve privilege escalation incidents.

This KPI specifically targets the duration required to identify and address instances of privilege escalation, rather than their occurrence rate. It is similarly efficient for evaluating the security protocols implemented by businesses and identifying the required enhancements for adopting CEI technologies.

5.7.4 Supplier Reliability and Dependence

5.7.4.1 Supplier Data Protection

Supplier data protection assessments

Prior to entering contractual partnerships with suppliers and at key junctures during the collaboration, it is imperative to conduct supplier data protection reviews. Since suppliers frequently handle personal data for businesses, it is crucial to assess their data privacy and management practises to avoid potential legal complications that may have an impact on the organisations.

Number of data breach incidents related to suppliers.

The frequency of data breach occurrences affecting suppliers serves as a significant indicator of suppliers' dependability and dedication to safeguarding data and privacy, which also applies to contracting organisations. Failure to safeguard personal data from breaches and illegal access can result in legal responsibility for both suppliers and companies.

Ratio of effective contractual obligations

The proportion of enforceable contractual obligations of suppliers is a direct measure of the likelihood of a particular supplier fulfilling their responsibilities. It may also indicate the frequency of data breaches experienced by the supplier and the level of data protection and privacy practises they have established. The legal significance of this KPI may vary depending on the degree of deployment of the CEI technology.

5.7.4.2 Experience and expertise

Successful implementations

This KPI quantifies the number of successful technology implementations conducted by the supplier, indicating the supplier's track record of successful project executions.

6 Conclusion

6.1 Overview

This document has established a detailed and systematic framework that businesses, whether technology suppliers or end-users, can leverage to assess their readiness for integrating Cloud-Edge-Internet of Things (CEI) technologies. While it still needs to be validated and further adjusted in the next stages of design, it has been designed to be tailored to the unique challenges and opportunities specific to each organisation, taking into account its position within the value chain and industry-specific traits.

At its core is its link to strategic objectives and operational realities through the selection of Key Performance Indicators that can align the context for CEI deployment from both the provider and the end-user's perspectives. Thus, CEI-LING offers both data-driven (quantitative) and narrative-based (qualitative) metrics for readiness assessment, based on:

- Adaptability and customisation: the model presents a versatile framework that organisations can utilise to gauge their readiness for CEI technology implementation, while also maintaining the flexibility to accommodate distinct challenges and opportunities. It considers the organisation's niche in the value chain, industry-specific factors, and other unique characteristics.
- Holistic evaluation: it extends beyond technical considerations of CEI technology integration to how these technologies align with the broader organisation, including culture and strategy, connectivity, data and many other rubrics relevant for CEI integrations.
- Technological complexity: it recognises that adopting advanced technologies requires companies to orchestrate new and legacy systems, existing and new skills and, possible new approaches to calculating ROI.

6.2 Next Steps

As mentioned, this document and its accompanying annex is the first step in developing the CEI-LING tool which must now go through further business and technical refinement.

From a business standpoint, the immediate step involves conducting a thorough analysis of the model. This is crucial to confirm its relevance and applicability to the assessment's objectives, ensuring the model's accuracy, reliability, and adaptability to various scenarios through workshops with MetaOS and business end users.

On the technical front, CEI-LING's development requires work on two planes:

- The development of the user interface (UI) and user experience (UX), to create an intuitive and user-friendly tool that allows customisation of KPIs according to their domain relevance. I
- In parallel, the backend design integrating the mathematical model by translating algorithms into programmable code, and establishing a database system for data storage and retrieval.

Transitioning the mathematical model from theory to practical application hinges on its real-world performance. Here piloting with a diverse selection of organisations representative of the model's target user base would be critical and confirm its flexibility, scalability, and accuracy, thereby providing valuable data for analysis. Thus, the final stage involves comprehensive testing, including unit, integration, and user testing, to ensure the tool's functionality and reliability.

Post-launch, the tool requires ongoing monitoring and updates to sustain its effectiveness, incorporating user feedback and adapting to changes in assessment requirements or the underlying mathematical principles. Other support actions might include designing training materials and creating fora for organisations to exchange views and practices on how to overcome some of the barriers to fruitful adoption of CEI technologies that CEI-LING may have unearthed.

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