Enhancing Public Procurement Through GRC Management: Navigating the Evolving EU Regulatory Landscape.

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Abstract. The increasing complexity of the extensive regulatory frameworks in the European Union (EU) creates significant challenges for public procurement processes. Besides the existing Public Procurement Directives, new regulations, such as the Corporate Sustainability Reporting Directive (CSRD), the Corporate Supply Chain Due Diligence Directive (CSDDD), and the EU Taxonomy Regulation introduce intricate compliance requirements that strain existing procurement standards and systems. This paper explores the pivotal role of Governance, Risk, and Compliance (GRC) frameworks as enablers of legal interoperability and process optimization in this evolving landscape. The research first develops an overview matrix categorizing EU regulations from 2021 to 2027 based on their relevance and impact on public procurement. Building on this foundation, a second matrix maps tailored solution components to core challenges posed by high impact regulations, identifying critical areas requiring intervention. Synthesizing these findings, the paper proposes enhancements to current standards for electronic public procurement. These include extending the European Single Procurement Document (ESPD), introducing standalone reporting formats, and leveraging GRC software to manage compliance complexities. The study highlights the importance of integrating GRC frameworks with scalable, AI-driven solutions to foster legal interoperability and operational resilience. It therewith offers actionable insights for policymakers, for practitioners in the public procurement processes, and for researchers.

1. Introduction

Governance, Risk, and Compliance (GRC) are increasingly important for managing organizational frameworks, optimizing business processes, and ensuring adherence to a rapidly evolving regulatory landscape (Racz, Weippl, Seufert, et al., 2010). In an era shaped by resource scarcity, stringent environmental requirements, and demographic transformations, effective governance has emerged as a cornerstone for leveraging available resources efficiently while mitigating risks through compliance with clear and enforced regulations (Racz, Weippl, & Seufert, 2010). These principles are particularly significant within the European Union (EU), where the regulatory environment is becoming increasingly complex (Knill & Liefferink, 2021).

The EU has introduced several large-scale regulations to address pressing societal and environmental concerns. Notably, the Corporate Sustainability Reporting Directive (CSRD) (Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 Amending Regulation (EU) No 537/2014, 2022) seeks to enforce comprehensive environmental accountability, while the Supply Chain Due Diligence Act (Directive - EU - 2024/1760 - EN - EUR-Lex, 2024) mandates rigorous governance and transparency across supply chains. Complementary policies targeting carbon emissions, anti-money laundering, human rights protection, and whistleblower safeguards further underscore the criticality of compliance frameworks (Directive - 2019/1937 -

EN - Eu Whistleblowing Directive - EUR-Lex, 2019; Latest Update on Anti-Money Laundering and Countering the Financing of Terrorism Legislative Package - European Commission, 2024; Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex, 2020; Regulation - 2022/2554 - EN - DORA - EUR-Lex, 2022; Regulation - 2022/2560 - EN - EUR-Lex, 2022; Regulation - 2023/956 - EN - Cbam Regulation - EUR-Lex, 2023; Regulation - 2024/2847 - EN - EUR-Lex, 2024). Together, these regulatory advancements impose increased obligations on organizations to align their operational models with legal and ethical standards (Ionel Zamfir, 2020).

Public procurement, a sector already navigating an intricate web of legal and procedural requirements, is heavily affected by this regulatory transformation (Mohungoo et al., 2020). The intricate interplay between compliance and operational efficiency presents a dual challenge: meeting the new regulatory demands without compromising the inclusivity and functionality of procurement processes (Sonntagbauer & Bodiroza, 2009). The existing complexities in public procurement often dissuade private actors, particularly small and medium enterprises, from participation, stifling competition and innovation (Di Mauro et al., 2020; Flynn, 2018). To address these challenges, both contracting agencies (CAs) in the public sector and economic operators (EOs) participating in the public procurements must adopt comprehensive GRC frameworks that balance compliance imperatives with procedural efficiency (Vicente & Mira Da Silva, 2011). Multiple challenges on the maintenance of legal interoperability also have to be addressed (European Commission, 2017; Schmitz & Wimmer, 2023). Furthermore, implications of legal frameworks on current and future standards in public procurement need to be taken into account early (Guijarro, 2009).

This paper investigates the growing importance of GRC in public procurement and its potential role as an enabler of interoperability, along with the implications of new and forthcoming EU regulations. It delivers the following key contributions:

1. **Regulation matrix with an overview of new and recent EU regulations:** A structured matrix categorizing key EU regulations from 2021–2027 evaluates their relevance and potential impact on public procurement. By analyzing their regulatory requirements, the matrix highlights focus areas such as sustainability, supply chain due diligence, and carbon footprint assessments in public procurement procedures.

2. **Matrix mapping solution components and recommendations for the adoption of identified regulations:** Using the insights from the regulation matrix, the paper develops a second matrix mapping tailored solution components to core challenges in implementing these regulations. We develop actionable guidance for public administrations and economic operators. And we emphasize the role of GRC systems in achieving compliance and operational efficiency.

3. **Identification of gaps and enhancement potentials in the current standardization landscape:** We synthesize the two matrices and identify critical gaps in existing procurement standards, such as the need for standardized reporting formats and enhanced interoperability mechanisms. We propose enhancements, such as extending the ESPD and creating standards, to address these gaps and ensure regulatory alignment and process optimization.

Through these contributions, we emphasize the pivotal role of GRC as an enabler of regulatory adherence, legal interoperability, and process optimization. By integrating GRC principles with the established frameworks of interoperability, it is possible to mitigate the cascading effects of regulatory changes on procurement processes (Kalusivalingam et al., 2022). The paper aims to guide stakeholders in developing a more resilient and adaptive procurement ecosystem that addresses both compliance requirements and operational efficiency by means of structured GRC management.

The paper is structured as follows: Chapter 2 describes the research design. Chapter 3 elaborates on the theoretical background of related research topics based on academic literature. Chapter 4 presents an overview of relevant regulations, while chapter 5 proposes potential solutions to overcome the challenges of each high-impact regulation. Chapter 6 explores the impact on the standardization landscape. Finally, chapter 7 and 8 provide a discussion, closing thoughts, and future research needs.

2. Methodology and research design

This study employs Design Science Research (DSR) to explore and address the challenges of Governance, Risk, and Compliance (GRC) in public procurement. DSR is particularly suited for this research as it combines theoretical analysis of scientific literature (rigour cycle) and needs from practice (relevancy cycle) with solution development (design cycle) (Hevner & Chatterjee, 2010; Hevner et al., 2004). Three key questions guide this research:

1. **Which recent and upcoming EU regulations are most relevant to public procurement processes?**

2. **How can Contracting Authorities (CAs) and Economic Operators (EOs) effectively comply with these regulations while maintaining operational efficiency?**

3. **What are the impacts of these regulations on existing procurement standards, and how can those standards be enhanced to ensure compliance and interoperability?**

We systematically examined these questions through three interlinked research cycles along DSR, which build upon one another to integrate theoretical insights with practical needs. The first research cycle establishes the foundational state of the art by conducting a comprehensive review of academic literature and EU regulatory frameworks based on Webster and Watson (Webster & Watson, 2002). In total, 47 scientific sources and 8 regulatory sources were selected for analysis. We divided them into three categories: theoretical grounding (28 sources), regulation-focused studies (15 sources), and methodological references (2 sources).

The literature review employed a multi-step filtering process to ensure quality and relevance. Theoretical sources, initially numbering 143, were filtered through abstract and conclusion screening, followed by full-text evaluation, resulting in a final selection of 28 sources. Regulation-based studies began with 73 identified documents, which were screened in a similar way, leading to a final set of 15 sources. The search process utilized keywords such as "interoperability," "standardization," "public procurement," and "GRC" across databases including SCOPUS, Web of Science, and ScienceDirect.

In parallel, corresponding to the relevancy cycle in the DSR approach, EU regulations were analyzed through official documentation, legislative drafts, and European Commission policy analyses. Focus was on recent and upcoming regulations with high potential impact on public procurement. Key themes, such as environmental accountability, supply chain transparency, and legal harmonization, were identified and structured into a regulation matrix that categorized and evaluated their relevance.

The authors, with academic expertise in public procurement and regulatory interoperability, synthesized regulatory requirements and scientific findings to develop two practical artifacts: (1) a regulation impact matrix and (2) a solution mapping matrix. These are not merely summaries, but conceptual tools designed to support strategic implementation and compliance decisions in public procurement. The development of these artifacts aligns with the design cycle of Design Science Research and aims to bridge theory with practice by proposing actionable, replicable solutions.

The second research cycle builds on the insights from the regulation matrix by developing a second matrix that maps solution components to the core challenges posed by emerging EU regulations. This matrix serves as a practical artifact, providing actionable guidance for CAs and EOs to adopt the identified regulations effectively. Furthermore, the related legal publications and scientific sources are mapped to the corresponding findings.

The third research cycle synthesizes the findings of the first two matrices to identify critical gaps in existing procurement standards and proposes targeted enhancements. Research cycle two and three are mostly motivated by the design cycle of DSR, taking into account rigorous and relevant findings from the previous research steps.

3. Theoretical Background on Interoperability, GRC and Public Procurement

3.1 Interoperability

Interoperability is fundamental to public procurement, enabling seamless interaction between systems, organizations, and regulations (Gascó, 2012). It encompasses technical, semantic, organizational, and legal dimensions, each contributing to efficient information exchange and compliance (Kalogirou et al., 2020). The European Interoperability Framework (EIF) emphasizes the legal layer as the highest level of interoperability, ensuring regulatory alignment across jurisdictions and profoundly influencing the other three dimensions (European Commission, 2017; Kouroubali & Katehakis, 2019).

The legal layer is particularly critical in public procurement. Public procurement laws and policies are shaping how the procurement process must look like and how actors need to collaborate. Further new harmonized regulations, such as the Corporate Sustainability Reporting Directive (CSRD) and the Supply Chain Due Diligence Act, establish a unified framework for accountability and sustainability (Baumüller & Sopp, 2021; Sönnichsen & Clement, 2020). These gain importance also regarding awarding criteria (Sönnichsen & Clement, 2020). Misaligned regulations can hinder collaboration, creating inefficiencies and increased compliance costs (Guijarro, 2007). The EIF's emphasis on standardized legal instruments addresses these challenges, fostering consistent application across member states. Beyond the legal layer, interoperability depends on organizational, semantic, and technical standards, and on their successful alignment and integration. Organizational processes must align with regulatory requirements,

such as standardized evaluation criteria for sustainability (Schmitz et al., 2023). Semantic interoperability must ensure consistent understanding of data through common vocabularies and formats, critical for accurate reporting under directives like the CSRD (Wimmer et al., 2018). Technical interoperability relies on compatible systems and protocols, exemplified by the Peppol framework, which facilitates efficient data exchange in procurement. Interoperability is not static but evolves with regulatory and technological changes (Hellberg & Grönlund, 2013). Therefore, a closer look on interoperability along new regulations and GRC is advisable.

3.2 Governance, Risk, and Compliance (GRC)

Governance, Risk, and Compliance (GRC) has emerged as an essential framework for organizations navigating increasingly complex regulatory environments (Racz, Weippl, & Seufert, 2010). At its core, GRC integrates three interrelated functions: governance, which involves the alignment of organizational strategies and goals (Haugh & Bedi, 2023); risk management, which focuses on identifying, assessing, and mitigating potential threats; and compliance, which ensures adherence to laws, regulations, and internal policies. Together, these functions support in achieving organizational resilience and accountability while optimizing processes and resource allocation (Racz et al., 2010).

Recent research underscores the growing significance of GRC as a driver of regulatory adherence and operational efficiency. The introduction of regulations, such as the Corporate Sustainability Reporting Directive (CSRD) and the Supply Chain Due Diligence Act, further stress the need for robust GRC frameworks (Di Natale & Cordella, 2023). These frameworks are not only tools for compliance but also enablers of strategic decision-making, offering insights into risk exposure and areas requiring optimization. Organizations with integrated GRC systems can proactively manage risks and adapt to changing regulatory landscapes, gaining a competitive advantage (Zamfir, 2020).

Both public and private sectors benefit significantly from effective GRC management. Public administrations leverage GRC frameworks to maintain transparency and accountability while managing limited resources. For example, GRC processes help optimize procurement workflows, ensuring compliance with sustainability criteria and minimizing risks of regulatory breaches. Similarly, EOs utilize GRC systems to streamline reporting obligations, enhance supply chain oversight, and mitigate financial and reputational risks. In times of resource and personnel scarcity, the importance of GRC becomes even more pronounced. Efficient GRC management enables organizations to prioritize critical risks and deploy targeted measures, reducing administrative burdens while maintaining compliance. Optimizing GRC processes fosters greater organizational agility, allowing stakeholders to address emerging challenges effectively (Racz et al., 2010).

3.3 Public Procurement

Public procurement plays a pivotal role in public sector operations, accounting for a significant proportion of government expenditure across the EU (Siapera et al., 2023). As a highly regulated domain, it is directly influenced by legal interoperability, which ensures consistency and alignment of regulations across jurisdictions (Gualdi & Cordella, 2022). The European Interoperability Framework (EIF) identifies the legal layer as a critical enabler for achieving seamless procurement processes, emphasizing the importance of harmonized legal instruments to facilitate cross-border collaboration and compliance (Kalogirou et al., 2020).

The legal layer's impact on public procurement becomes particularly evident in the context of evolving EU regulations. Policies such as the Corporate Sustainability Reporting Directive and the Supply Chain Due Diligence Act introduce new criteria for supplier evaluation, requiring public administrations to integrate sustainability and accountability metrics into procurement decisions. These regulations highlight the dependency of procurement processes on clear and enforceable legal frameworks, which serve to reduce ambiguities and promote transparency (Hummel & Bauernhofer, 2024; Zamfir, 2020).

Academic research underscores the importance of governance, risk, and compliance (GRC) management in addressing the complexities of public procurement (Di Mauro et al., 2020; Okoye et al., 2024). GRC frameworks provide public administrations with the tools to navigate regulatory requirements effectively while optimizing procurement workflows (Racz, Weippl, & Seufert, 2010). By incorporating GRC principles, public administrations can mitigate risks, such as non-compliance or supply chain disruptions, and enhance the overall integrity of procurement processes (Vicente & Da Silva, 2011). The introduction of GRC management in public procurement also offers significant opportunities for improvement. Success factors identified in the literature include the use of standardized evaluation criteria (Qiao & Cummings, 2003; Siapera et al., 2023), enhanced interoperability of data systems (Abraham et al., 2019), and stakeholder collaboration (Ruijer, 2021). Their translation from policies to practice, a common challenge in e-procurement, could benefit from it as well (Hardy & Williams, 2008).

3.4 Synthesis of the interplay between GRC, interoperability and public procurement

The interplay between GRC, interoperability and public procurement demonstrates a cohesive relationship, where each concept reinforces the others. Regulations, as the driving force behind modern public procurement practices, are intricately tied to the legal layer of interoperability. This layer ensures that regulatory frameworks are harmonized across jurisdictions, fostering consistency in procurement standards and processes.

GRC frameworks are pivotal in bridging the gap between regulatory mandates and operational execution. Their integration into procurement practices provides a structured approach to compliance, enabling CAs and EOs to manage risks effectively while adhering to stringent regulations. By embedding GRC processes into the legal interoperability layer, organizations can streamline regulatory implementation, mitigate non-compliance risks, and optimize resources.

The close interconnection between these concepts underscores the necessity of further research and practical advancements in GRC as a supporting mechanism for regulatory implementation. Effective GRC frameworks not only facilitate compliance but also enhance interoperability by ensuring that procurement standards remain aligned with legal requirements and technical capabilities.

4. Evaluation of upcoming EU Regulations relevant to Public Procurement

Section 4 provides a comparative overview of relevant EU-Regulations that are planned or released in the timeframe from 2021-2027. Based on this overview, an evaluation of the regulations in regard to their expected impact on public procurement is conducted. Regulations with an expected high impact on public procurement are further analysed and put into perspective of findings from literature and current procurement procedures.

4.1 Overview of EU-Regulations impacting Public Procurement

In **Tab. 1**, we summarize key EU regulations and directives from 2021 to 2027, we categorize their areas of impact and provide an assessment of the expected impact of each regulation on public procurement. Regulations that exhibit no direct implications for public procurement processes are categorized with low impact. Regulations that necessitate changes in the behaviour of actors involved in public procurement procedures or influence the formal procurement processes are rated with medium impact. Regulations that significantly affect procurement content, standards, or processes—requiring the adoption of new frameworks or substantial adjustments—are rated with high impact.

The selection of the regulations is based on their legal scope, implementation timeline (2021–2027), and direct or indirect influence on public procurement procedures. Relevance was assessed based on whether a regulation introduces new reporting requirements, modifies procurement standards, or alters evaluation criteria for suppliers. While all listed regulations have some level of impact, the three with the most substantial and systemic implications—CSDDD, CSRD (in conjunction with the EU Taxonomy), and CBAM, are explored in greater detail in subsections 4.2 to 4.4. These were chosen because they require significant adaptations to current standards, and these introduce complex reporting and governance demands. Besides conducting a systematic analysis of these regulations, the authors consider themselves knowledgeable in the public procurement regulatory field, as they are collaborating in different research and standardization projects and initiatives at European and national level in Germany for more than a decade. They are members of the German "Cooperation Project on Digital Procurement"[1] funded by the German IT Planning Council, along which this research has evolved. Subsequently, we outline the main aspects of each identified EU regulation impacting public procurement in the EU.

The Regulation (EU) 2022/2560 on foreign subsidies aims to address distortions in the internal market caused by external subsidies. Public procurement processes require greater scrutiny of bids, particularly from non-EU entities, to ensure compliance with anti-subsidy measures. This will enhance fairness in procurement but may also increase administrative burdens in the processes.

The Digital Operational Resilience Act (DORA) introduces stringent cybersecurity standards for financial institutions and service providers. Public procurement will need to include robust cybersecurity criteria in tender specifications for ICT services, potentially raising procurement costs while strengthening system resilience.

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[1] https://digitale-beschaffung.de/, last accessed 26th April 2025

Tab. 1 - Overview of recent and upcoming EU regulations impacting public procurement across Europe.

Name/Subject of, number, and reference to regulation	Date of Planning	Date of Implementation	Summary Description of the Regulation	Category	Expected impact on public procurement
Regulation on foreign subsidies distorting the internal market (EU) 2022/2560 (Regulation - 2022/2560 - EN - EUR-Lex, 2022)	2022	December 2022	Addresses foreign subsidies that distort the internal market, ensuring fair competition.	Market Competition	Medium
Digital Operational Resilience Act (DORA) 2022/2554 (Regulation - 2022/2554 - EN - DORA - EUR-Lex, 2022)	2022	January 2025	Enhances digital operational resilience for the financial sector, improving ICT risk management and stronger cybersecurity standards for financial institutions.	Cybersecurity	Medium
Corporate Sustainability Due Diligence Directive (CSDDD) 2024/1760 (Directive - EU - 2024/1760 - EN - EUR-Lex, 2024; LkSG, 2021)	2021	January 2023 (DE), 2026 (EU-wide)	Mandates human rights and environmental due diligence in supply chains, promoting greater accountability in global supply chains; increased compliance requirements.	Sustainability	High
Whistleblower Protection Directive (2019/1937) (Directive - 2019/1937 - EN - Eu Whistleblowing Directive - EUR-Lex, 2019)	2019	2022-2023	Protects whistleblowers reporting breaches of EU law, encouraging transparency and accountability.	Governance	None
Corporate Sustainability Reporting Directive (CSRD) 2022/2464 (Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 Amending Regulation (EU) No 537/2014, 2022)	2021	January 2023 (Phased until 2026)	Expands sustainability reporting requirements for companies. Increased transparency in corporate sustainability performance.	Sustainability	High
EU Taxonomy Regulation 2020/852 (Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex, 2020)	2020	2022 (ongoing updates)	Provides a classification system for environmentally sustainable activities. Guides investments toward sustainable activities and supports green transitions.	Sustainability	High
EU Legislative Package on AML/CFT (Latest Update on Anti-Money Laundering and Countering the Financing of Terrorism Legislative Package - European Commission, 2024)	2021	2025-2026	Creates a centralized AML Authority and unifies AML/CFT measures across the EU. Stronger oversight and harmonized rules for combating money laundering and terrorist financing.	Financial Integrity	Medium
Carbon Border Adjustment Mechanism (CBAM) 2023/956 (Regulation - 2023/956 - EN - Cbam Regulation - EUR-Lex, 2023)	2021	October 2023	Introduces carbon pricing for imports to prevent carbon leakage. Encourages adoption of cleaner production methods and aligns global standards with EU policies.	Sustainability	Medium
Cyber Resilience Act 2024/2847 (Regulation - 2024/2847 - EN - EUR-Lex, 2024)	2022	2027	Requires manufacturers to integrate cybersecurity throughout product lifecycles.	Cybersecurity	Medium

The Supply Chain Due Diligence Act (and its EU-wide counterpart under the Corporate Sustainability Due Diligence Directive) requires companies to identify and mitigate human rights and environmental risks in their supply chains. This regulation will reshape public procurement by necessitating strict sustainability and ethical sourcing criteria, particularly for global supply chains. These criteria should be integrated into existing standards or require new standards with a structured format.

The Whistleblower Protection Directive enhances transparency and has no apparent impact on procurement procedures.

The Corporate Sustainability Reporting Directive (CSRD) expands corporate sustainability reporting requirements. This will indirectly influence procurement by encouraging contracting authorities to prioritize suppliers with detailed sustainability disclosures. Managing these report obligations is complex and very data intensive. It therefore needs to be supported by some kind of structured approach.

The EU Taxonomy Regulation provides a classification framework for environmentally sustainable activities, significantly impacting sectors such as construction, energy, and transportation. Public procurement processes need to be aligned with these standards, prioritizing suppliers and projects that support the EU's environmental objectives. An integration into existing procurement standards would be paramount for efficient implementation.

The EU Legislative Package on AML and CFT aims to combat money laundering and terrorist financing by strengthening oversight and harmonizing anti-money laundering measures across member states. Public procurement authorities will need to enhance due diligence processes, incorporating stricter prequalification checks and ongoing monitoring of contracts to mitigate financial crime risks. However this can likely already be achieved by extending some corresponding criteria, that are already part of the ESPD.

The Carbon Border Adjustment Mechanism (CBAM) introduces carbon pricing on imports to prevent carbon leakage. Public procurement will need to incorporate carbon footprint assessments into tender evaluations, especially in high-emission sectors, thereby promoting the use of low-carbon goods and services. Adjusting procurement standards to reflect these assessments in a structured form might be pivotal.

The Cyber Resilience Act mandates cybersecurity measures across the lifecycle of digital products, influencing procurement in technological domains. Contracting authorities must include cybersecurity requirements in contracts for digital goods and services, which could raise costs but will enhance security and resilience.

Finally, the EU Packaging Regulation 2025 promotes sustainable materials and efficient packaging solutions. Public procurement authorities will need to prioritize suppliers adhering to circular economy principles and resource efficiency, aligning with the EU's broader sustainability goals.

Based on the above assessment, the CSDDD, CSRD & EU-Taxonomy, and CBAM will have the highest impact on procurement procedures. These will likely necessitate changes to existing standards or the development of new standards. We, therefore, focus on these high-impact critical regulations in the subsequent subsections 4.2-4.4.

4.2 Corporate Supply Chain Due Diligence Directive (CSCDDD)

Literature has shown that risk management is a critical aspect of global supply chain management, as it addresses the uncertainties and challenges posed by economic policies, globalization, and disasters, which significantly affect organizational financial performance and national economies (Gurtu & Johny, 2021). Effective risk management in international supply chains requires a nuanced understanding of the unique economic, infrastructural, and geopolitical dynamics of each region. Businesses must prioritize tailored strategies that leverage advanced technologies and local collaborations to build resilience and ensure the smooth functioning of supply networks (Okoye et al., 2024). The voluntary approach to corporate social responsibility in supply chains, while initially promising, has proven insufficient to address the systemic issues of human rights violations, environmental degradation, and governance challenges in developing countries. Multinational companies often operate in contexts where weak regulatory frameworks fail to enforce accountability, allowing exploitative practices to persist (Weihrauch et al., 2023).

The Corporate Supply Chain Due Diligence Directive (CSDDD) represents a transformative regulatory measure aimed at fostering accountability and sustainability within global supply chains. Initially introduced in Germany, the CSDDD has influenced broader European Union (EU) initiatives to mandate corporate responsibility for human rights and environmental impacts along their entire supply chains. The regulation requires companies to identify, assess, and mitigate risks associated with human rights violations, child labor, and environmental degradation, emphasizing due diligence obligations that extend beyond direct suppliers to include indirect supply chain actors

(*Directive - EU - 2024/1760 - EN - EUR-Lex*, 2024). These combined factors make a structured GRC-Management paramount to cover the requirements set out by the CSDDD.

Moreover, the Act's emphasis on supply chain transparency necessitates enhanced interoperability among procurement systems (Schilling-Vacaflor & Gustafsson, 2024). Public administrations will require standardized tools and data formats to verify supplier compliance, potentially leveraging frameworks such as Peppol to facilitate the exchange of due diligence documentation. Economic operators, on the other hand, must invest in supply chain monitoring technologies and reporting mechanisms to provide verifiable evidence of compliance and risk based compliance systems (Gervais et al., 2023). While the CSDDD enhances accountability and ethical practices, it also introduces challenges, including increased administrative burdens and compliance costs. Smaller suppliers may face particular difficulties in meeting the requirements, potentially limiting their participation in public procurement (Smit et al., 2021). To address these issues, capacity-building initiatives and collaborative approaches between public administrations and private sector actors will be critical.

4.3 Corporate Sustainability Reporting Directive (CSRD) and the EU Taxonomy Regulation

The Corporate Sustainability Reporting Directive (CSRD) and the EU Taxonomy Regulation collectively represent a significant shift in how organizations disclose and evaluate their environmental, social, and governance (ESG) performance. The CSRD expands upon the existing Non-Financial Reporting Directive (NFRD), mandating comprehensive sustainability reporting for a wider range of companies, including small and medium-sized enterprises (SMEs) that meet specific thresholds. The EU Taxonomy complements the CSRD by providing a standardized classification system to assess the environmental sustainability of economic activities, offering a clear framework for evaluating alignment with the EU's climate and environmental objectives (Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 Amending Regulation (EU) No 537/2014, 2022; Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex, 2020).

In the context of public procurement, the CSRD and EU Taxonomy have far-reaching implications. Public administrations will need to integrate sustainability criteria into procurement workflows, requiring suppliers to provide detailed ESG performance data as part of the qualification process. This shift aligns procurement practices with broader EU objectives, such as achieving carbon neutrality and promoting sustainable development. Furthermore, this is a development towards less strictly awarding based on financial criteria, which has been long awaited by literature (Qiao & Cummings, 2003; Sönnichsen & Clement, 2020). However, it also places additional compliance obligations on economic operators, necessitating robust governance, risk, and compliance (GRC) frameworks to manage ESG reporting effectively (Hummel & Bauernhofer, 2024).

The requirement for standardized sustainability data under the EU Taxonomy highlights the critical role of interoperability. Public administrations will need interoperable systems to process and verify ESG data, ensuring consistency and comparability across suppliers. Economic operators, in turn, must adopt technologies that facilitate accurate data collection and reporting, reducing the risk of non-compliance. While these regulations drive progress toward sustainability, they also introduce challenges, including increased administrative workloads and potential barriers for smaller suppliers. Capacity-building initiatives and collaborative efforts will be essential to ensure equitable participation in public procurement processes.

4.4 Carbon Border Adjustment Mechanism (CBAM)

The Carbon Border Adjustment Mechanism (CBAM) is a pivotal regulatory tool introduced by the European Union (EU) to address carbon leakage and promote global climate objectives. CBAM imposes a carbon price on imports from non-EU countries that do not meet the EU's stringent emissions reduction standards. Initially focusing on sectors such as cement, iron and steel, aluminum, fertilizers, and electricity, the regulation aims to level the playing field for EU industries subject to the Emissions Trading System (ETS), while encouraging international partners to adopt greener practices (Regulation - 2023/956 - EN - Cbam Regulation - EUR-Lex, 2023).

For public procurement, CBAM presents both opportunities and challenges. The inclusion of carbon pricing in procurement evaluations aligns with the EU's broader sustainability goals, incentivizing the selection of suppliers with lower carbon footprints. Public administrations will need to integrate CBAM criteria into procurement frameworks, necessitating the assessment of carbon-related metrics during the supplier qualification and evaluation phases. This shift emphasizes the need for transparent and interoperable systems capable of verifying and reporting carbon emissions data accurately.

Tab. 2 – Solution Mapping Matrix.

Regulation	Solution	EO / CA	Description	Sources
CBAM	GRC-Software and solutions	EO	GRC software enables economic operators to monitor, calculate, and report carbon emissions to comply with CBAM requirements. It simplifies the management of cross-border trade data and ensures accurate adjustment calculations.	(Ambec, 2022; Lim et al., 2021; Racz, Weippl, & Seufert, 2010; Racz, Weippl, Seufert, et al., 2010; Regulation - 2023/956 - EN - Cbam Regulation - EUR-Lex, 2023; Vicente & Mira Da Silva, 2011)
CBAM	Development of new standardized approaches and data specifications	CA	CAs can develop standardized data templates and formats to streamline reporting and evaluation processes for carbon emissions, facilitating compliance with CBAM during procurement.	(Ambec, 2022; Gal & Rubinfeld, 2018; Lim et al., 2021; *Regulation - 2023/956 - EN - Cbam Regulation - EUR-Lex*, 2023; Schmitz & Wimmer, 2023; Siapera et al., 2023)
EU-Taxonomy	GRC-Software and solutions	EO	EOs can implement GRC tools to assess activities against EU-Taxonomy criteria, ensuring compliance and readiness for classification and reporting obligations tied to sustainable finance.	(Hummel & Bauernhofer, 2024; Racz, Weippl, & Seufert, 2010; Racz, Weippl, Seufert, et al., 2010; Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex, 2020; Vicente & Mira Da Silva, 2011)
EU-Taxonomy	Usage of qualification methods (e.g. ESPD)	CA	CAs can utilize qualification methods like the ESPD to assess suppliers' alignment with the EU-Taxonomy framework, ensuring sustainable activities are prioritized in procurement. This would necessitate the extension of said standards to incorporate EU Taxonomy-related criteria.	(Hummel & Bauernhofer, 2024; Qiao & Cummings, 2003; *Regulation - 2020/852 - EN - Taxonomy Regulation - EUR-Lex*, 2020; Siapera et al., 2023; Telles, 2017)
CSRD	GRC-Software and solutions	EO	EOs can deploy GRC software to automate and verify the accuracy of sustainability reports, improving data integrity and compliance with CSRD obligations.	(Directive (EU) 2022/2464 of the European Parliament and of the Council of 14 December 2022 Amending Regulation (EU) No 537/2014, 2022; Hummel & Bauernhofer, 2024; Racz, Weippl, & Seufert, 2010; Racz, Weippl, Seufert, et al., 2010; Vicente & Mira Da Silva, 2011)
CSRD	Development of new standardized approaches and data specifications	Both	Developing standardized reporting templates would help EOs to align with CSRD requirements by enabling structured sustainability disclosures that meet regulatory standards. At the same time, it would make it easier for CAs to verify the compliance.	(Gal & Rubinfeld, 2018; Schmitz & Wimmer, 2023; Siapera et al., 2023; Vicente & Mira Da Silva, 2011) (Hummel & Bauernhofer, 2024)
CSDDD	Usage of qualification methods (e.g. ESPD)	Both	EOs can adopt ESPD or equivalent qualification tools to demonstrate compliance with CSDDD obligations, such as human rights due diligence and environmental risk assessments.	(Directive - EU - 2024/1760 - EN - EUR-Lex, 2024; LkSG - Nichtamtliches Inhaltsverzeichnis, 2021; Gervais et al., 2023; Gurtu & Johny, 2021; Okoye et al., 2024; Schilling-Vacaflor & Gustafsson, 2024; Telles, 2017; Weihrauch et al., 2023)
CSDDD	GRC-Software and solutions	EO	EOs can use GRC tools to ensure and monitore adherence to CSDDD obligations, ensuring effective implementation of due diligence across supply chains.	(Directive - EU - 2024/1760 - EN - EUR-Lex, 2024; LkSG - Nichtamtliches Inhaltsverzeichnis, 2021; Gervais et al., 2023; Gurtu & Johny, 2021; Okoye et al., 2024; Racz, Weippl, & Seufert, 2010; Racz, Weippl, Seufert, et al., 2010; Schilling-Vacaflor & Gustafsson, 2024; Smit et al., 2021; Vicente & Mira Da Silva, 2011; Weihrauch et al., 2023)

Economic operators involved in public procurement must adapt to the CBAM framework by investing in emissions tracking and reporting capabilities. Suppliers from non-EU countries face additional compliance obligations, potentially increasing the cost of imported goods. While these measures promote sustainable practices, they may also limit the participation of smaller suppliers or those from regions with less developed regulatory frameworks. Despite these challenges, CBAM offers significant potential to drive systemic change. By internalizing the environmental costs of carbon-intensive products, the mechanism fosters innovation in cleaner production methods (Ambec, 2022). Other Authors argue that CBAM is not economically viable because of increased costs (Lim et al., 2021). To address compliance complexities and support equitable participation, capacity-building initiatives and international collaboration will be essential.

5. Implementation of regulations

The effective implementation and management of emerging EU regulations requires robust governance, risk, and compliance (GRC) processes. GRC frameworks provide a structured approach to navigate complex regulatory landscapes, ensuring that both public administrations and economic operators (EOs) can comply with legal requirements while optimizing resources and mitigating risks. By integrating GRC processes, organizations can manage regulatory obligations systematically, aligning compliance efforts with broader strategic goals.

To create the solution matrix in **Tab. 2**, we cross-referenced the findings from the regulation matrix in **Tab. 1** with solution approaches identified in the literature. Challenges were grouped by recurring themes (e.g., data complexity, reporting burdens), and solution mechanisms were mapped using both academic sources and implementation guidelines from EU institutions. This mapping supports targeted implementation planning and represents a core design artifact in our DSR approach. Successful implementation of the identified solutions depends not only on technical feasibility but also on organizational adoption. Public agencies must manage change effectively by training procurement officers, aligning internal workflows, and building trust in GRC-based tools. Resistance to change, especially in resource-constrained municipalities, remains a critical barrier that must be addressed alongside technical innovation.

6. Impact on current standards

The introduction of new EU regulations, particularly the Corporate Sustainability Reporting Directive (CSRD), the Corporate Supply Chain Due Diligence Directive (CSDDD), and the EU Taxonomy Regulation, has revealed several gaps in existing public procurement standards. The gaps primarily stem from the increased complexity and specificity of the reporting requirements introduced by these regulations onto public procurement. To ensure effective compliance, both Economic Operators (EOs) and Contracting Authorities (CAs) must address these challenges while avoiding inefficiencies and inconsistencies in the procurement process. The enhancement proposals presented in this section were developed by analysing the specific challenges identified in the regulation and solution matrices. Each proposed measure directly corresponds to at least one major gap found in procurement standardization and was assessed against feasibility and scalability criteria by the authors of this paper, which were also discussed along different meetings with the cooperation partners in the Cooperation Project Digital Procurement.

6.1 Gaps in the current standardization landscape

The CSRD and CSDDD require organizations to provide detailed sustainability and due diligence reports. However, these regulations fail to define standardized formats for generating and sharing such reports. For instance, while the European Sustainability Reporting Standards (ESRS) under the CSRD provide a comprehensive legal framework, they are highly complex and challenging to implement. Larger organizations with robust compliance mechanisms may struggle with the requirements but be able to tackle them somehow. However, for Small and Medium Enterprises (SMEs), these obligations may appear insurmountable due to the intricate technical details and lack of clear guidelines.

The lack of standardization impacts not only the EOs. CAs and auditors responsible for evaluating these reports face significant data governance related challenges, including: Inconsistent Data Quality; Process Inefficiency; Lacking transparency and system interoperability. Without standardized reporting formats, data from EOs will likely vary in quality, completeness, and structure. The lack of consistency and traceability in data reporting raises concerns about transparency and accountability in public procurement. Existing procurement standards, such as the European Single Procurement Document (ESPD), are not designed to handle the complexity of these new regulatory requirements. While ESPD contains related criteria, its current structure would be overburdened by the volume and specificity of the information required by the new regulations.

6.2 Potential solutions and enhancements to the status quo – a roadmap

To address the gaps in current procurement standards and meet the demands of new EU regulations such as the CSRD, CSDDD and EU Taxonomy, it is essential to introduce targeted updates and complementary solutions. These measures must not only enhance the adaptability of existing frameworks but also streamline compliance processes for both EOs and CAs. The following roadmap provides an integrated approach by outlining potential solutions and their corresponding benefits:

1. **Utilizing the ESPD Framework:** The European Single Procurement Document (ESPD) is well-positioned to serve as a foundation for integrating new regulatory requirements, especially for EO qualification. However, to accommodate obligations under the CSRD, CSDDD, and EU Taxonomy, the ESPD must be extended to include new qualification criteria. These criteria should address critical areas such as sustainability reporting, human rights due diligence, and environmental risk assessments. This adaptation would ensure that the ESPD remains a versatile tool for managing the increasing complexity of procurement standards without fundamentally altering its core structure.

2. **Specialized Standards for Complex Reporting Criteria:** Given the high complexity of the reporting requirements introduced by the new regulations, it is advisable to create distinct, standardized formats for each type of report. For example, sustainability reports aligned with the ESRS could be simplified for usability by SMEs, while supply chain due diligence templates and environmental impact assessments could be standardized to ensure consistency across industries. These standalone standards would mitigate the risk of overwhelming the ESPD structure and ensure a clear and manageable reporting process for EOs and CAs.

3. **Integration Through Evidence Documents:** To facilitate the seamless inclusion of these complex reports within procurement workflows, standardized reports should be treated as evidence documents. These technical documents could be attached to the ESPD during the pre-award phase, providing CAs with all necessary information while preserving the integrity of existing procurement processes. This approach would enable automated processing and verification of evidence documents, reducing administrative burdens and enhancing evaluation efficiency.

4. **Leveraging GRC Software Solutions**: The technical intricacies of the new reporting obligations necessitate the use of advanced Governance, Risk, and Compliance (GRC) software. These tools can assist EOs in generating compliant reports with consistent data quality and accuracy. Additionally, GRC solutions can support CAs by enabling efficient evaluation of submitted reports, improving data governance, and ensuring compliance with the regulatory framework. Such software solutions should be designed with interoperability in mind, ensuring seamless integration with existing procurement systems and standards.

5. **Alignment with the Pre-Award Process:** The design of new standards and reporting templates must align closely with the pre-award phase of public procurement. By doing so, the data collected and reported by EOs can be directly applied to qualification and evaluation criteria, minimizing redundancies and streamlining compliance efforts. This alignment would ensure that new regulatory requirements are embedded into procurement workflows without disrupting operational efficiency.

7. Discussion

In this paper, we offer three primary contributions: First, we identify and categorize EU regulations from 2021–2027 based on their impact on public procurement, forming the basis of a structured regulation matrix. Second, we map these regulations to solution components that illustrate how GRC systems can address regulatory challenges. Third, we propose enhancements to current procurement standards, particularly the ESPD, and outline a roadmap for integrating GRC into future procurement workflows. Together, these contributions show how GRC frameworks can enable legal interoperability, operational resilience, and regulatory compliance.

While supply chain management has been extensively researched over decades, sustainability and ESG topics are comparatively underexplored, reflecting their recent emergence in regulatory and industry priorities. GRC systems are critical enablers of interoperability, particularly legal interoperability, by aligning governance, risk, and compliance processes across jurisdictions. However, a significant challenge lies in the fragmented nature of existing approaches, which either address GRC generically or narrowly focus on specific regulatory topics. This lack of integration underscores a research gap: the need for comprehensive frameworks that combine domain-specific expertise with advanced technological solutions.

While overall the topic of upcoming regulations might seem like a future issue, which has minimal impact on current procurement procedures, its substantial impact over the next few years should not be underestimated. Growing scarcity of resources, demographic challenges, and the raising necessity for regulations make a solid GRC management as outlined in this paper paramount to meet the challenges of tomorrow. As the transformation and

practical implementation of standards has proven to be a lengthy process, this research highly advocates to start the important development steps towards integrating GRC management into interoperability design now. Beyond technical solutions, this study underscores the need for organizational readiness in adopting GRC frameworks. Stakeholders across public procurement systems—IT managers, compliance officers, procurement leads—must align on shared goals, data protocols, and evaluation criteria. Future work should, therefore, assess how varying organizational capacities affect GRC adoption and outcomes in different EU member states.

8. Conclusion and further research needs

This paper has investigated new and recent EU regulations, and how regulatory dependencies affect public procurement and interoperability. We identified GRC solutions as critical enablers for efficient adoption of regulations and legal interoperability. As core contributions, we developed a matrix of EU-regulations and an assessment of their impact on public procurement. Based on this analysis a second matrix has been developed to map potential solution components to the core challenges associated with highest impact on public procurement. Finally, we synthesized the findings of both matrixes into three concrete gaps, which current standards will face when trying to adopt the new regulations. Furthermore, five enhancements were put forward to the current standardization landscape that might help to overcome these gaps.

While the paper produced a good initial structured overview of future challenges, research gaps, and potential solutions, the individual solution components are not discussed in the needed degree of detail. The application of GRC and interoperability design for topics like CSRD, CSDDD etc. is a very complex topic and has to be addressed by separate studies individually. Furthermore, the proposed harmonization of domain expert knowledge and technical solutions requires further specification.

Future research can build on the findings of this study to address the limitations of this research. First, the development of a scalable GRC framework that prioritizes interoperability is essential to enable efficient regulatory compliance across different sectors and jurisdictions. Second, research should explore how to effectively integrate domain-specific expertise with technical solutions to create adaptable and practical compliance mechanisms. Third, the application of artificial intelligence to both the development and auditing of regulatory reports represents a promising but underutilized area, with potential to streamline reporting processes and improve evaluation accuracy. Finally, focused studies on individual regulatory packages, such as the CSRD or CSDDD, are needed to address their unique requirements and implications for public procurement. This will be instrumental in fostering legal interoperability, improving compliance processes, and ensuring that public procurement systems remain robust and adaptive in the face of ongoing regulatory changes. A promising avenue for future research lies also in the application of artificial intelligence (AI) for sustainability reporting and regulatory evaluation. AI systems could enhance the quality and consistency of data-driven reports, automate compliance checks, and generate actionable insights for procurement officers. However, this requires further exploration, especially regarding data governance, bias mitigation, and SME accessibility.

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Conflict Of Interest (COI)

There is no conflict of interest.

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