The use of the iStar Framework for modeling tax compliance programs

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Abstract. *Modeling tax compliance programs is essential for organizations because these programs translate statutory obligations into organizational controls throughout the tax reporting lifecycle, requiring coordinated responsibilities, evidence generation, and data consistency across departments and third-party systems. Although traditional early requirements and process models are commonly used to model tax compliance programs, they are limited in capturing key dependencies among entities such as departments and outsourced systems. To address this gap, this study uses the iStar 2.0 framework as an alternative model to capture these dependencies. This framework focuses on representing actors, goals, and dependencies rather than processes. A proof of concept was conducted in a real-world scenario, where requirements were gathered through interviews and questionnaires and validated using the Delphi technique. The empirical results demonstrate the viability of the iStar framework for modeling and enriching tax compliance programs, highlighting responsibilities and quality attributes such as traceability and auditability. Therefore, the iStar 2.0 framework can be considered for modeling and enriching compliance programs.*

1. Introduction

Compliance programs are fundamental for ensuring organizational sustainability and preserving reputation by mitigating legal, operational, and financial risks. However, implementing and maintaining these programs is complex, as it involves interactions among multiple internal and external processes, integration with systems at different hierarchical levels, relationships with regulatory bodies, and compliance with applicable laws and regulations [de Lamboy 2018].

Implementing and maintaining tax compliance programs is especially challenging in scenarios involving complex tax systems, such as the Brazilian tax system, as highlighted by Coelho [Coelho 2021]. Compliance management occurs in an environment marked by high normative complexity, with laws that are frequently amended, ambiguous, and specific depending on the sector and organizational size [Cabello and Nakao 2021]. This volatility requires continuous monitoring of legislation and organizational adaptation [de Lamboy 2018].

The difficulty in establishing structured and adaptable programs largely stems from the challenges involved in eliciting and formalizing the needs that emerge from the legal and operational framework. Experiences in similarly complex regulatory contexts, such as the issue of fiscal and tax compliance in Nigeria described by Sunday S. Ogungbesan [Ogungbesan 2023], show that the success of a compliance program essentially depends on understanding the dependencies and interactions among the parties involved, as well as the individual interests of each party. Correctly identifying and modeling these interrelationships is necessary to ensure compliance effectiveness.

Although there is a wide set of techniques, including formal and informal modeling approaches such as model checking, ontologies, BPMN, UML, and Petri Nets, most focus predominantly on control flow and, to a lesser extent, on process data [Mustapha et al. 2020]. These representations have limitations in capturing strategic, organizational, and relational aspects that are fundamental to compliance, such as dependencies among agents, underlying motivations for actions, and commitments between parties.

Given normative complexity and the difficulties in articulating the various elements involved in compliance programs, it is necessary to use representational models capable of structuring these interrelationships in a clear and analyzable manner. In domains with high regulatory density and ubiquitous compliance requirements, the reuse of requirements in the form of Software Requirements Patterns (SRP) emerges as an alternative to support practitioners, since legal determinations under data protection and privacy regulations tend to recur across different software projects [Carneiro et al. 2024]. Although SRPs support reuse of recurrent legal requirements, they do not represent intentionality and dependencies among actors, which motivates the adoption of goal- and actor-oriented modeling.

The iStar framework is an approach for modeling early requirements, centered on the representation of actors' intentionality, strategic goals, institutional roles, and mutual dependencies [Yu 1995]. This framework has been applied in various domains and research areas, particularly in requirements engineering [Dalpiaz et al. 2016]. Rather than focusing solely on system functionality, iStar captures the organizational rationale that underlies decisions and behaviors, which is especially relevant when multiple actors interact with distinct responsibilities and interests. In normatively dense and organizationally complex contexts – such as compliance programs – this ability to render goals, delegations, ties, and constraints explicit becomes essential for structuring and analyzing needs that extend beyond purely technical aspects and encompass institutional commitments and regulatory obligations.

The absence of models that explicitly represent the intentions, dependencies, and commitments among organizational and operational components is a critical gap in current compliance programs. To address this issue, this study employs the iStar framework to conceptually model a tax compliance program, grounded in a classification of requirements as organizational, functional, and non-functional. The choice of iStar is appropriate for explicitly representing actors' intentionality, including dependencies and refinements such as goals and qualities. In contrast, other goal-oriented techniques, such as the NFR Framework, KAOS, and GRL, allow the definition and refinement of goals but do not explicitly represent dependencies between actors [Horkoff and Yu 2011]. This aspect is

essential in the context of a tax compliance program. Additionally, iStar has been adapted to better suit the industrial context presented in [Dalpiaz et al. 2016], and tool support for modeling is adequate [Pimentel and de Castro 2018].

This article is organized as follows. Section 2 presents the theoretical background on tax compliance, the iStar framework, and Requirements Engineering. Section 3 describes the methodological procedures adopted in the proof of concept. Section 4 presents the study, including the AS-IS and TO-BE models. Section 5 discusses the main results. Finally, Section 6 concludes the article and outlines future work.

2. The relationship between compliance and requirement modeling

Requirements Engineering can be adopted as a methodological approach because specifying such programs involves high structural complexity that requires coordination across multiple departments within the organization [de Lamboy 2018]. This need for rigor is also evident in other high-risk domains. Typically, safety-critical software is developed in environments regulated by norms and standards. Examples of safety-critical software are found in various domains, including aeronautics, where software must meet high-performance requirements while addressing significant safety and quality concerns [Costa and Marques 2024].

Silveira and Saad-Diniz [Silveira and Saad-Diniz 2015] present a structured set of elements that compose a compliance program, aimed at formalizing organizational practices of control and integrity. These elements range from the definition of institutional policies and values, assignment of responsibilities, monitoring mechanisms, and reporting channels, to external control processes, internal sanctions, and encouragement of continuous improvement.

From a Requirements Engineering perspective, these elements can be organized into organizational, functional, and non-functional requirements, according to their nature and the role they play within the organizational system. Business objectives, strategic mission, and organizational constraints can be mapped as organizational requirements. Properties such as auditability, traceability, and adherence to established standards can be mapped as non-functional requirements, as they define constraints and quality criteria that shape how these processes are executed across the organization. For this study, this distinction among organizational, functional, and non-functional requirements is adopted, recognizing organizational requirements as central to early requirements modeling.

To clarify the notation, consider a simplified compliance-related example. The Company may depend on the Administrative actor to send tax movement data, while the Administrative actor may depend on the ERP for resources such as tax files and reports. Internally, the Administrative actor may pursue goals such as issuing inbound and outbound documents and rely on operational tasks and system resources to achieve these goals, while also depending on qualities such as traceability and communication clarity. This simplified example shows how iStar can simultaneously represent who depends on whom, for what purpose, and under which operational or quality constraints.

Figure 1 provides an overview of iStar 2.0 and summarizes both (i) the social layer, which captures strategic dependencies among organizational actors, and (ii) the rationale layer, which details how an actor reasons internally in terms of goals, tasks, resources,

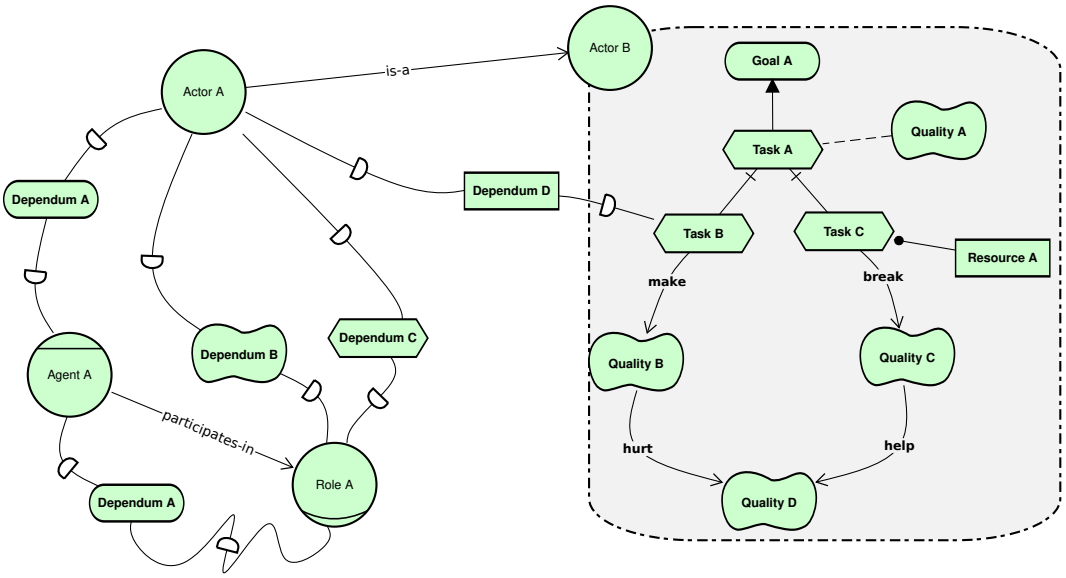

Figure 1. Overview of iStar 2.0 elements and relationships, graphically adapted by the authors from Pimentel and de Castro [Pimentel and de Castro 2018] and the iStar 2.0 language guide [Dalpiaz et al. 2016].

and qualities. The social layer corresponds to the Strategic Dependency (SD) view in iStar, representing inter-actor relationships and dependencies. In the social layer (left side), the model shows actor associations such as specialization (is-a) and participation (participates-in), as well as multiple dependency links that make explicit who depends on whom and for what (the dependum).

The rationale layer (right side, within the boundary) illustrates how an actor operationalizes its intentions: a goal (Goal A) is pursued through tasks that are decomposed via refinement (e.g., an AND-refinement), while tasks may require resources and contribute positively or negatively to qualities through contribution links (e.g., make, help, hurt, break). Actor A depends on Actor B through dependency D to obtain a resource (the dependum). Actor B, as the dependee, specifies how it will provide the dependum by linking the dependency to its internal rationale (e.g., Task B). This combination of explicit dependencies and intentional rationale provides the conceptual basis for the compliance-program modeling developed later in this work.

3. Methodology

This study used a proof-of-concept (PoC) strategy [Peffers et al. 2007] to assess the feasibility of applying the iStar 2.0 framework to model tax compliance programs in an industrial context. The methodological approach included five stages: (i) requirements elicitation, (ii) systematization and mapping of requirements to iStar elements, (iii) construction of the AS-IS model, (iv) collaborative development of the TO-BE model with domain experts, and (v) expert validation of the TO-BE model using the Delphi technique.

Requirements elicitation

Requirements were gathered through semi-structured interviews and an anonymous questionnaire adapted from [Souza and Santander 2011], with identifying fields removed to

preserve confidentiality. The instrument collected information about the company's operations, tax obligations, operational flows, stakeholder interactions, expected reports, data to be stored, process dependencies, frequency of use, expectations, and perceived impacts if identified needs were not addressed. This structure supported the identification of information related to organizational concerns, operational activities, and quality constraints associated with tax compliance practices.

Systematization and mapping of requirements

After elicitation, the collected evidence was organized into three analytical categories: organizational, functional, and non-functional requirements. This classification served as analytical support for translating empirical evidence into iStar 2.0 constructs.

Statements about intended outcomes, responsibilities, and institutional commitments were interpreted as goals; descriptions of concrete operational actions were represented as tasks; informational and technical artifacts were represented as resources; and expected quality properties or constraints were represented as qualities. Actors were identified from the organizational setting and modeled according to the iStar 2.0 typology.

Construction of the AS-IS model

Based on the mapped requirements, an AS-IS model was developed using iStar 2.0 to represent the current organizational setting observed during elicitation. This model was descriptive and grounded in the empirical evidence collected from the company. Its purpose was to make explicit the actors, intentional elements, and dependencies associated with the organization's current tax compliance activities.

Collaborative formulation of the TO-BE model

After the AS-IS model was established, a future-state TO-BE model was collaboratively developed with the support of a panel of 10 accounting professionals. These participants were selected for convenience, based on their availability, professional experience, and prior familiarity with tax compliance practices in organizational settings.

The experts received the material obtained during elicitation and were invited to analyze the current setting, identify weaknesses, and propose corrective actions and improvements. Their contributions were organized as organizational, functional, and non-functional requirements and used to support the reformulation of responsibilities, dependencies, and compliance-related artifacts in the TO-BE model. Thus, the TO-BE model was grounded not only in the baseline established by the AS-IS representation, but also in a collaborative, expert-based process.

Delphi-based validation of the TO-BE model

The TO-BE model was subsequently refined and validated through the Delphi technique [Okoli and Pawlowski 2004], using a second group of five specialists selected by convenience. To participate in this stage, experts were required to have formal specialization in Tax Planning or Tax Law, as well as professional familiarity with tax-compliance practices. The Delphi process was conducted in two iterative rounds.

In this stage, participants individually assessed the proposed model and recorded observations and recommendations regarding its clarity, completeness, and alignment

with compliance-program practices. Consolidated feedback was then returned to the participants in a subsequent round to support reassessment and convergence of opinions. Thus, the Delphi stage was used to evaluate and refine the collaboratively formulated TO-BE model, rather than to construct either the initial empirical representation of the current state or the first version of the future-state proposal.

Figure 2 summarizes the methodological path adopted in this PoC.

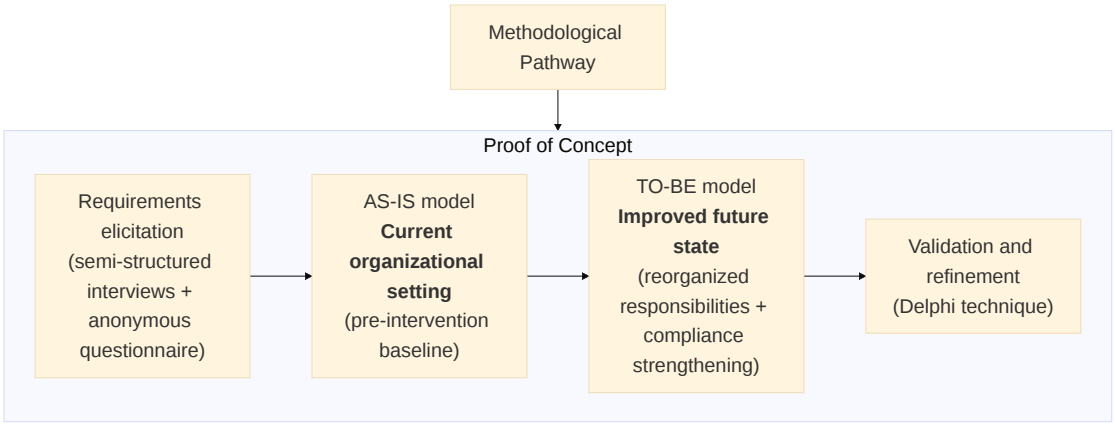

Figure 2. Methodological path adopted in the PoC: requirements elicitation, analytical classification, AS-IS modeling, collaborative formulation of the TO-BE model with Accounting experts, and Delphi-based validation with specialists in Tax Planning or Tax Law.

4. Study conduction

The study was conducted in a small Brazilian manufacturing company operating in the polyvinyl chloride (PVC) products sector, with an annual revenue of approximately BRL 20 million, more than 35 employees, and customers in over seven Brazilian states. The organization has limited formalization of tax-related processes and relies heavily on outsourced systems, creating a setting in which responsibilities and dependencies among organizational actors are central to the execution of tax compliance activities.

4.1. Modeling the current state (AS-IS)

Based on evidence collected through interviews and the questionnaire, an AS-IS conceptual model was constructed to represent the organization's current tax-related environment. Data collection took place over three months with three company collaborators, and the interviews were conducted by the first author. At this stage, the model was strictly descriptive and included only elements supported by the elicited evidence from the company context.

Actors were classified according to the iStar 2.0 typology [Dalpiaz et al. 2016], which distinguishes agents, roles, and generic actors. To represent both inter-actor dependencies and the internal rationale of the most relevant actors, a hybrid view was adopted, combining elements from the Strategic Dependency and Strategic Rationale views. This approach allowed key actors to be detailed in terms of goals, tasks, resources, and qualities, while less central actors were kept at a more abstract level to preserve model readability.

Entities with concrete manifestation and operational autonomy were modeled as agents, including organizations, individuals, and technical systems. In the AS-IS model, this group includes: (i) the Company, as the institutional actor where tax-related responsibilities are organizationally situated; (ii) the administrative employee, responsible for tax-related and operational routines, including document issuance and communication with the outsourced Accounting; (iii) the customer and supplier registration area, responsible for maintaining master data and executing registration routines according to operational needs; (iv) the outsourced Accounting, which acts autonomously in tax validation and the filing of ancillary obligations; and (v) the Enterprise Resource Planning (ERP) system, modeled as a technical agent due to its autonomous behavior in supporting tax and record-keeping operations.

In contrast, functions such as "Administrative" and "Registration" were modeled as roles, since they represent functional positions that may persist independently of the specific individual performing them. Actor naming was therefore adapted to the observed organizational reality while preserving confidentiality and emphasizing the functional nature of these responsibilities.

Table 1 consolidates the mapping between empirical evidence and the modeled elements. In addition to classifying the identified elements as organizational, functional, or non-functional requirements, the table also makes explicit the rationale for assigning them to iStar 2.0 constructs. This clarification is particularly important in cases where the distinction between goals and tasks may not be immediately obvious. For example, "Issue Inbound and Outbound Documents" was modeled as a goal because, in the elicited evidence, it was treated primarily as an intended operational outcome expected from the Administrative role, rather than as a fully decomposed procedure. Its realization may involve multiple underlying tasks supported by the ERP. Likewise, "Sell" was modeled as a goal because it represents the company's intended business state rather than a concrete operational action, whereas "Receive Goods" was modeled as a task because it refers to an observable activity performed in the inbound routine.

Based on this traceable mapping, the AS-IS model shown in Figure 3 was constructed to represent the organization's current state. From this structure, it was possible to identify the main dependency relationships among the modeled actors. These dependencies show how responsibilities are distributed across the operational environment and how their fulfillment depends on the actions, resources, and qualities associated with different actors.

Table 2 summarizes these inter-actor dependencies based on the collected evidence. For example, the Accounting actor depends on the Administrative actor for tax movement data, which enables tax assessment activities. Similarly, the Administrative actor depends on the ERP for tax files, reports, and system support required to perform invoice issuance and posting activities. Together, these dependencies clarify how tax-related responsibilities are operationally distributed in the organization even before the introduction of the compliance-oriented elements later proposed in the TO-BE model.

To improve traceability between the textual discussion and the diagram, the AS-IS model was organized so that the main actors and their dependencies correspond directly to the evidence summarized in Tables 1 and 2. Thus, the figure should be read not as an ex-

Table 1. Modeled elements based on empirical evidence and their classification.

Actor	Element	Requirement	iStar 2.0	Justification
Company	Sell	Organizational	Goal	Represents the company's core objective as an organization
Company	Profitability	Non-Functional (Performance)	Quality	Expected business property, without defining an action
Company	Competitiveness	Non-Functional (Attractiveness)	Quality	Desired strategic quality in relation to the market
Administrative	Receive Goods	Organizational	Task	Concrete action performed by the employee in the inbound process
Administrative	Issue Inbound and Outbound Documents	Functional	Goal	Represents an intended operational outcome expected from the Administrative role, whose realization may involve multiple ERP-supported tasks
Administrative	Send Tax Movement Data	Functional	Goal	Intentionality regarding sending data to the accountant
Registration	Customer and Supplier Registration	Functional	Goal	ERP registration according to operational needs
ERP	Database	Functional	Resource	Resource required to store tax data
ERP	Inventory	Functional	Resource	Technical element to control product inflows and outflows
ERP	Tax Files	Functional	Resource	Technical documentation required for verification and submission
ERP	Generate Report	Functional	Task	System operational function to support tax activities
Accounting	Tax Assessment	Organizational	Task	Accountant's strategic activity based on the data
Accounting	Record Documents	Functional	Task	Accounting entry action in its own system
Accounting	Compliance with Obligations	Organizational	Goal	Institutional goal of validating and filing obligations
Accounting	Processed Tax Documents	Functional	Resource	Expected outcome of processing tax data

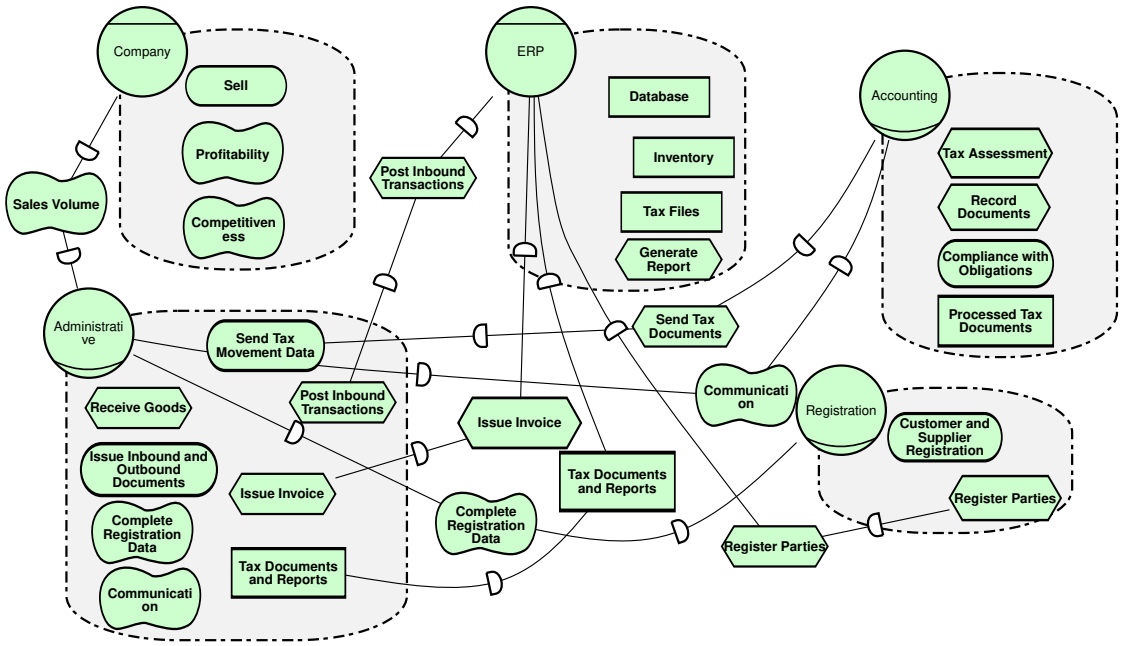

Figure 3. iStar model representing the organization's current scenario based on empirical evidence (AS-IS).

haustive operational flow, but as a conceptual representation of the current organizational configuration underlying tax-compliance activities.

Table 2. Dependency relationships among actors and their respective requirements.

Depender	Element	Type	Depends on (actor)	Requirement	Justification
Administrative	Post Inbound Transactions	Task	ERP	Functional Requirement	Requires access to the database, inventory, and tax files
Administrative	Issue Invoice	Task	ERP	Functional Requirement	Invoice issuance depends on generating the tax structure in the system
Administrative	Tax Documents and Reports	Resource	ERP	Functional Requirement	Requires XML files and reports generated by the ERP
Administrative	Complete Registration Data	Quality	Registration (Register Customer and Supplier – Goal)	Non-Functional Requirement	Completeness depends on the proper execution of registrations
Registration	Register Parties	Task	ERP	Functional Requirement	Depends on database access and processing
Accounting	Send Tax Movement Data	Task	Administrative (Send Tax Movement Data – Goal)	Functional Requirement	Tax assessment only occurs based on the fiscal information sent by the company
Administrative	Communication	Quality	Accounting	Non-Functional Requirement	Communication clarity depends on correct assessment and feedback with guidance

4.2. Modeling and mapping the future state (TO-BE)

Modeling the organization's future state involved reorganizing requirements and responsibilities related to compliance. This evolution was driven by the need to formalize administrative routines and make explicit the normative and technical constraints that shape how these routines should be performed. For this reason, the TO-BE model introduced a new actor, the Compliance actor, represented as an agent responsible for consolidating, maintaining, and disseminating technical standards and codes of conduct to guide other actors. By representing compliance as a distinct intentional actor, the model makes explicit the locus of accountability for normative resources and control activities, rather than embedding these commitments implicitly in the Company actor.

The definition of the TO-BE elements was guided by the compliance-program structure summarized in Table 3, which supported the organization of organizational, functional, and non-functional requirements and served as a reference for the future-state model.

4.2.1. Collaborative modeling with Accounting experts

Requirements were mapped to the structural elements of compliance programs proposed by Silveira and Saad-Diniz [Silveira and Saad-Diniz 2015] to support the construction of the future-state model. An expert panel was conducted with the support and guidance of one of the authors (moderator) and 10 accounting professionals. The experts were selected based on convenience, considering their availability, professional experience, and familiarity with tax compliance practices in organizational settings.

Participants received the material obtained during the initial requirements elicitation and were invited to propose corrective actions and improvements to the current

processes. These suggestions were then categorized as organizational, functional, or non-functional requirements.

Table 3. Qualitative association between compliance program elements [Silveira and Saad-Diniz 2015] and requirement types.

Compliance Program Element	Organizational Requirements	Functional Requirements	Non-Functional Requirements
Definition and communication of values and policies	Establishment of guidelines and organizational culture	Creation and dissemination of internal policies, definition of purposes and rules	Clarity, transparency, adherence to applicable legislation and standards
Top management accountability and governance plan	Institutional commitment, ethical leadership	Definition of roles and responsibilities for top and middle management	Governance, integrity, traceability
Employee capacity building and training	Culture of continuous learning	Training and update procedures	Usability, standardization, comprehensibility
Internal control and information system	Accountability for internal controls and data	Implementation of controls, monitoring of processes and information	Security, reliability, information availability
Whistleblowing channel (Hinweisesystem)	Ensuring confidentiality and ethical response to reports	Provision of a communication channel for irregularities	Privacy, anonymity, identity protection
External control and evaluation	Openness to independent auditing and regulatory compliance	External audit procedures, validation of controls	Impartiality, compliance with standards, auditability
Internal sanctioning measures	Commitment to internal justice and equity	Definition of disciplinary sanctions and enforcement of penalties	Equity, proportionality, traceability of decisions
Incentive structures and continuous improvement	Incentivizing a culture of integrity and innovation	Processes for reviewing and updating policies	Adaptability, sustainability, continuous improvement

The individual contributions were consolidated and discussed with the moderator, resulting in the collaborative formulation of the TO-BE model shown in Figure 4. This model represents the evolution of requirements as a compliance program proposal aligned with the company's current context.

4.2.2. TO-BE model: formalization of dependencies and compliance artifacts

Unlike the AS-IS model (Figure 3), in which dependencies among organizational areas are primarily based on operational interactions, the TO-BE model (Figure 4) formalizes these dependencies through the mediation of the Compliance actor, who assumes a central role in defining and disseminating the norms that govern process execution. Artifacts such as the "Technical Manual of Registration Rules," "Technical Manual for System Parameterization," "Code of Conduct," and "Administrative Assignments Rules" represent this increased normative formalization, supporting traceability, standardization, and compliance.

The TO-BE model also makes explicit how strategic organizational goals, such as "Compliance Policy" and "Tax Compliance," are connected to concrete operational tasks through dependency relationships. For example, the "Register Customer and Supplier" task performed by the Registration actor no longer depends solely on the ERP but also on the "Technical Manual of Registration Rules," making explicit that this activity must follow formally defined compliance criteria. Likewise, the "Validate Fiscal Movement" task performed by the Administrative actor is linked to the "Technical Manual of Archiving and Fiscal Data Rules" and to the goal of "Tax Compliance," thereby reinforcing a logic

of accountability[1] guided by technical standards and quality expectations.

This structure is further reinforced by the link between the company's strategic objective, "Compliance Policy," and the task "Implement Compliance Policy," which is assigned to the new Compliance actor. In this way, the model represents compliance as an explicit institutional function rather than as an implicit attribute of general business operations.

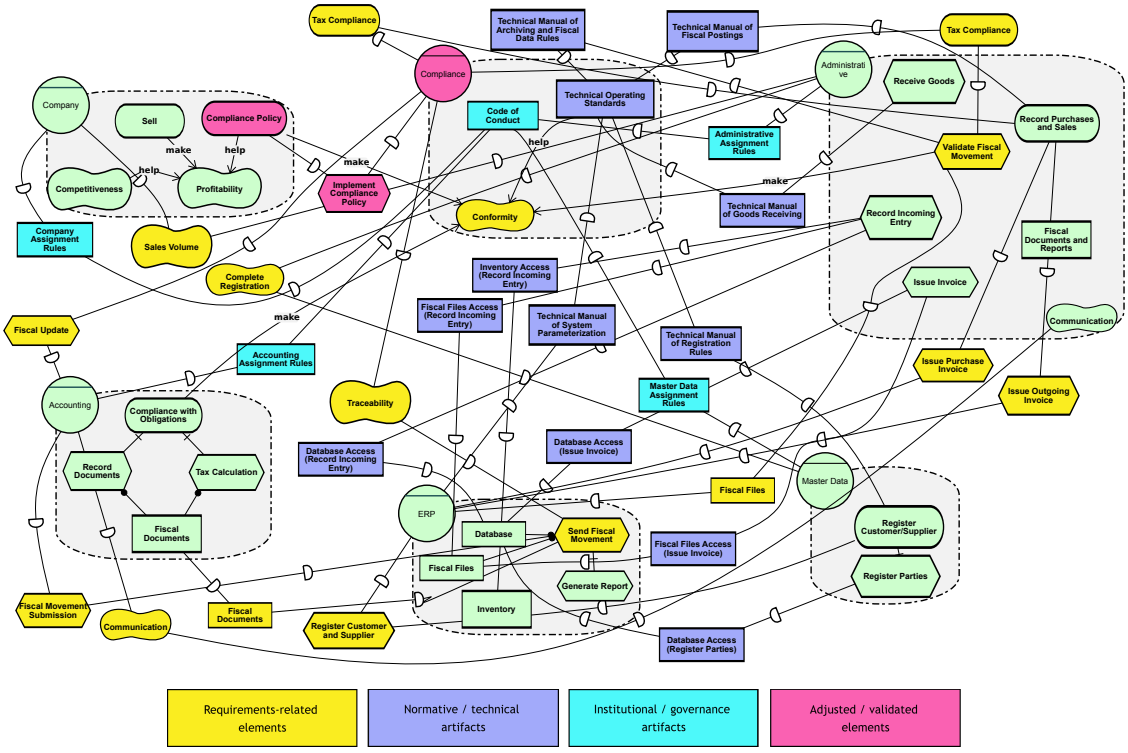

Figure 4. iStar model representing the organization's future scenario applied to the compliance program (TO-BE).

The interactions among the remaining actors (Company, Administrative, Accounting Office, Registration, and ERP) were refined by adding new elements and links representing both functional and non-functional requirements. Resources such as "Tax Documents," "Tax Files," and "Reports" are complemented by qualities such as "Traceability" and "Tax Compliance," indicating that task execution is expected to be auditable and standardized. For visual inspection, yellow highlights requirement-related elements introduced or refined in the model, while blue-toned elements denote institutional and normative artifacts added to govern execution.

4.2.3. Validation of the compliance model

The collaboratively developed TO-BE model was subsequently refined and validated using the Delphi technique with a second group of five specialists in tax planning or tax law.

[1]Accountability is an English term often used in public administration, corporate governance, and compliance contexts. It has no exact translation into Portuguese, but it is generally understood as a set of practices involving responsibility, transparency, and answerability.

In this stage, each participant individually reviewed the TO-BE iStar model and recorded observations and recommendations on a structured form. The assessments focused on the clarity, completeness, and alignment of the represented requirements with the structural elements expected in a compliance program.

The qualitative analysis considered the degrees of convergence and divergence among expert opinions across three evaluation dimensions: semantic (conceptual adequacy of the elements), structural (organization and coherence of the model), and normative (alignment with expected compliance practices). The Delphi study was conducted by the first author over approximately 10 hours, distributed across two iterative rounds over a two-week period.

In the first round, participants independently examined the model and provided comments on the structured form. In the second round, consolidated feedback and points of disagreement were returned to the participants for reassessment, enabling convergence across the three evaluation dimensions. Recommendations rated at least four were considered consensual and incorporated into the refined version of the model.

Because the validation materials contain sensitive organizational information, the full set of responses and annotated artifacts remains under the company's custody. However, anonymized summaries and aggregated findings are publicly available in the repository at `https://doi.org/10.6084/m9.figshare.29555078`. The resulting observations are systematized and discussed in Section 5. Overall, the Delphi process led to minor adjustments in the representation of certain dependencies and organizational roles, highlighted in magenta in Figure 4.

5. Results

The results from the PoC indicate that the iStar 2.0 framework was suitable for representing key elements of a tax compliance program in the analyzed organizational context. This finding is supported by the set of artifacts produced during the study, including the mapping of empirical evidence into intentional elements (Table 1), the identification of dependency relationships among actors (Table 2), the descriptive representation of the current state through the AS-IS model (Figure 3), and the propositional representation of an improved future state through the TO-BE model (Figure 4).

Together, these artifacts show that iStar enabled the representation of tax compliance not only in terms of operational actions, but also in terms of actor intentionality, delegated responsibilities, and institutional constraints. Organizational requirements were represented as goals, functional requirements as tasks and resources, and non-functional requirements as qualities associated with actors, goals, tasks, or normative artifacts. This structure supported an integrated representation of how tax-related responsibilities are distributed across the organization and how their fulfillment depends on technical, organizational, and informational conditions.

A relevant result of the modeling was the ability to incorporate compliance-specific elements that do not correspond directly to operational activities but still play a central role in governance and conformity. Normative artifacts such as manuals, rules, and codes of conduct could be represented as resources and linked to qualities such as traceability and tax compliance, making explicit how operational execution is conditioned

by institutional expectations. The models also revealed situations in which multiple goals or qualities converge on the same task, such as the validation of fiscal movement data, highlighting critical points in the compliance structure.

Another important result concerns the explicit representation of dependencies among actors. The models showed how tax-related activities depend on the interaction between the Company, Administrative, Registration, Accounting, ERP, and, in the TO-BE scenario, the Compliance actor. These dependencies made visible the distribution of responsibilities, the reliance on shared resources, and the role of quality constraints in guiding execution. In this respect, the resulting representations supported a more integrated view of the organizational structure involved in fulfilling tax obligations.

At the same time, the PoC revealed a limitation in using iStar 2.0 for this domain. In the analyzed case, some relationships involved dependency chains in which a strategic goal depended on a task, which in turn depended on a normative artifact or another intermediate element. Although these relationships could be represented through multiple direct dependencies, the model made end-to-end traceability harder to inspect explicitly, requiring additional interpretation to reconstruct the full chain of rationale. In normatively dense contexts such as tax compliance, this reduced the transparency of transitive dependency relationships.

The expert-based validation also produced positive results. Across the semantic, structural, and normative dimensions, participants considered the TO-BE model clear, coherent, and aligned with the expected elements of a compliance program. They also emphasized its practical usefulness as a support instrument for standardizing processes, clarifying responsibilities, and improving the traceability of tax obligations. The Delphi process led to minor refinements in the representation of certain dependencies and organizational roles, but did not compromise the overall consistency of the proposed model.

Finally, the results indicate that the TO-BE model should not be interpreted as a rigid or prescriptive structure. Rather, it functions as a flexible conceptual reference that can be adapted to institutional particularities, specific compliance objectives, and the dependencies observed in each organizational setting. From a Requirements Engineering perspective, this flexibility is relevant because it supports both the maintenance and future evolution of the model, as well as its possible articulation with governance practices and computational support systems.

6. Conclusion

Modeling tax compliance programs requires more than describing operational flows. It also requires representing organizational intentions, responsibilities, dependencies, and normative criteria that shape how tax-related activities are performed. This challenge is especially relevant in contexts marked by high regulatory complexity, such as the Brazilian tax system, where compliance depends on continuous coordination among multiple actors and constant adaptation to changing legal requirements [de Lamboy 2018, Coelho 2021, Cabello and Nakao 2021].

In this paper, we investigated the use of the iStar 2.0 framework to model the tax compliance setting of a Brazilian manufacturing company through a proof of concept. Based on empirical elicitation, AS-IS and TO-BE models were developed to represent the

current organizational configuration and a future-state compliance-oriented proposal. The results indicate that iStar was suitable for representing tax compliance not only in terms of activities and resources, but also in terms of actor intentionality, delegated responsibilities, institutional commitments, and quality constraints.

From a Requirements Engineering perspective, the main contribution of the study is to show that iStar can serve as a viable early-requirements approach for compliance modeling in contexts where the central issue is not only *how* processes flow, but also *why* actors act, *for whom*, and *under which constraints*. In the analyzed case, the framework supported the explicit representation of organizational dependencies among the company, administrative routines, outsourced Accounting, ERP, and, in the TO-BE scenario, the Compliance actor. It also allowed the incorporation of compliance artifacts, such as technical manuals and codes of conduct, as elements that qualify and constrain operational execution.

At the same time, the study revealed a limitation in representing dependency chains in a fully explicit and easily traceable manner. In the analyzed case, some strategic goals depended on operational tasks that, in turn, depended on normative artifacts or intermediate elements. Although such relationships could be represented through multiple direct dependencies, reconstructing the full chain of rationale required additional interpretation. This indicates an opportunity to further investigate how iStar can be complemented or extended in normatively dense domains such as tax compliance.

Future work includes applying the approach in other organizational contexts, comparing the resulting models with alternative goal- or process-oriented notations, and exploring integration with automated compliance verification mechanisms and complementary representational strategies.

Artifact availability

The artifacts associated with this study are openly available in Figshare at `https://doi.org/10.6084/m9.figshare.29555078`. The repository contains the replication package made publicly available by the authors for this study [Speck et al. 2025].

The package includes anonymized and curated materials that can be publicly shared to support transparency and reproducibility. Additional tools and supporting resources used in the study are described throughout the text. Due to confidentiality restrictions involving sensitive organizational information, the full set of raw company materials, validation annotations, and internal records cannot be disclosed. Nevertheless, the repository provides the publicly shareable artifacts associated with the proof of concept and the materials required to support inspection and partial replication of the study.

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