Modeling Value Canvas

A tool to rationalize the value of domain modeling

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Abstract. The absence of systematic approaches for assessing and communicating the value of modeling in practice poses significant challenges, particularly in contexts involving multiple stakeholders. This paper addresses this gap by introducing the Modeling Value Canvas, a tool designed to help users qualitatively assess and articulate the value of modeling solutions. The Canvas supports decision-making regarding whether, what, and how to model; facilitates the justification of modeling-related choices; and enhances the planning and reflection of modeling processes and outcomes. These four application goals were examined across five case studies. The results demonstrate the Canvas' usefulness in guiding modeling-related decisions and strengthening the articulation of modeling value across diverse organizational settings.

Keywords: Value · Risk · Canvas · Domain modeling

1 Introduction

Recent research in domain modeling[1] indicates that decisions to engage in modeling are often guided by intuition rather than formal analysis [28]. People experienced in domain modeling frequently choose modeling to address problems, as experience fosters expertise, allowing certain activities to become internalized and automatic [27]. However, while such intuition helps practitioners recognize the value of modeling from experience, it often leaves them unable to explicitly articulate to others why modeling is the right choice in a given situation.

Relying solely on intuition can be problematic, particularly when modelers collaborate with stakeholders or organizations that lack a strong modeling culture. In these contexts, a more explicit and rational justification of modeling is

[1] We use the term domain model to refer to structural conceptual models as defined in [9], which are models that describe structural regularities—such as types, attributes, relationships, and constraints—within a universe of discourse.

required to secure support. This challenge is common in practice. Stakeholder resistance to adopting modeling practices, languages, or tools ranks among the sixteen most prevalent and impactful pain points in domain modeling [35], with 57% of practitioners in [33] reporting experiencing this difficulty during their modeling initiatives. The inability to assess and articulate the value of modeling thus limits its adoption, investment, and sustained use in organizations.

The value of domain modeling has long been a central topic of discussion among both practitioners and researchers. The study in [8] introduced a first version of the Taxonomy of Modeling Goals, later extended in [28], which established that the value of modeling depends on the extent to which modeling initiatives achieve their intended goals. Advancing this discussion, [21] formulated the concepts of Return on Modeling Effort (RoME), Value in Action (ViA), and Retention of Modeling Effort (RiME), emphasizing the need for a more rigorous understanding of the costs and benefits of domain modeling. Further work in [32] examined how modeling creates value by mitigating risks, how external factors can threaten its value, and how it can even endanger other organizational assets. More recently, empirical studies have mapped situations in which modeling value is compromised and identified their potential causes [35,33].

Together, these studies underscore the theoretical and practical importance of understanding modeling value and have significantly advanced our knowledge of how value is created, lost, or retained. Nevertheless, the field still lacks a structured and systematic approach to assessing and explaining the value of domain modeling in practice. Addressing this gap, we introduce the Modeling Value Canvas, a practical and theory-informed tool designed to support qualitative assessment and articulation of modeling value. The Canvas is intended to assist modelers in: (i) deciding whether, what, and how to model; (ii) justifying modeling-related choices; (iii) planning modeling activities; and (iv) reflecting on modeling processes and outcomes. These four application goals were examined through five case studies.

The remainder of this paper is structured as follows. Section 2 reviews the theoretical foundations. Section 3 details the methodological approach. Section 4 introduces the Modeling Value Canvas. Section 5 describes the five case studies in which it was applied and reports qualitative findings. Section 6 concludes by summarizing the main contributions.

2 Modeling from a value and risk perspective

The concept of value is notoriously ambiguous and used differently across disciplines. Three meanings are especially common. Ethical value refers to guiding principles (e.g., "our company values integrity and diversity") [22]. Exchange value denotes what people are willing to pay for an item (e.g., "the value of my bicycle is 100 euros") [36]. Use value concerns the practical utility an object provides relative to specific needs (e.g., a transit pass is valuable to a commuter but irrelevant to someone who drives) [36].

Building on this notion of use value, we treat value as neither inherently positive nor negative. Events may enhance practical utility or diminish it; for example, burning dinner produces negative value by frustrating the need to eat. This perspective links value to risk. If value can be gained or lost, risk can be understood as the possibility of such loss. This view aligns with Rosa's [23] definition of risk as a situation in which something of human value is at stake, and the outcome is uncertain. The Common Ontology of Value and Risk (COVER) [26] formalizes this perspective, and we adopt its ontological commitments as the basis for analyzing the value and risk associated with modeling.

From a use-value perspective, the value of modeling depends on how effectively modeling solutions fulfill stakeholders' needs. Building on the framework proposed in [8], Valle et al. [28] empirically show that domain models serve ten purposes, grouped into functional and quality goals. Functional goals concern what modelers seek to accomplish through modeling or with the resulting model: intervening, understanding, problem-solving, communicating, documenting, and learning. Quality goals describe the conditions that enable these functional goals: minimizing effort, maximizing functional correctness, maximizing interoperability, and maximizing analyzability and modifiability.

Any object whose capabilities support these goals functions as a value enabler [26]. In [28], six model properties were identified as contributing to goal achievement: Reusability, Correctness, Completeness, Comprehensibility, Confinement, and Maintainability. Thus, any factor that strengthens these properties enhances modeling value; for example, good layout features improve diagram comprehensibility, and expressive modeling languages support accurate models.

From a risk perspective, domain models become threats to value when key properties are neglected. As shown in [32], models that are incorrect, hard to understand, outdated, unsuitable for use, misapplied, or poorly laid out can undermine modeling goals. Such threat objects may cause incorrect domain interpretations, flawed system integration, delays in development or bug resolution, and increased maintenance effort, ultimately leading to rework, schedule overruns, and additional costs.

Any object whose vulnerabilities hinder the achievement of modeling goals constitutes a risk enabler [26]. In [35], the authors identified sixteen of the most prevalent and impactful pain points in domain modeling and traced them to nine underlying causes: insufficient knowledge and experience among modelers and stakeholders, a weak modeling culture, misuse or disuse of methods, tools, and languages, and complexities inherent in the model, domain, or project. These factors are the main sources of threats in the modeling process.

3 Methodology

An overview of all methods and approaches applied in this study is presented in Table 1, while all materials and results are available in the Modeling Value Canvas repository [34]. The research follows the Design Science Research (DSR) methodology, reporting results from the three engineering cycle tasks proposed in [38]: problem investigation, treatment design, and treatment validation. To improve rigor and reliability, we also adopted the Echeloned Design Science Research (eDSR) approach [31], which structures the DSR process into five echelons: problem analysis, objectives and requirements definition, design and development, demonstration, and evaluation. This method decomposes the overarching DSR problem into hierarchical subproblems, enabling independent development, validation, and communication of intermediate results.

Table 1. An overview of all methods and approaches applied in the study

Engineering Cycle Task	**Design Echelon Type**	**Intermediate Artifact**	**Validation Criteria**	**Validation Technique**
Problem Investigation	Problem Analysis	Problem Statement	1) Evidence of the problem 2) Completeness of current solutions	1) Multi-method approach [28,32,35,33] 2) Available tools assessment
Treatment Design	Objectives and Requirements Definition	Domain Requirements	1) Fit to problem statement 2) Applicability 3) Feasibility	1-3) Logical reasoning 1-3) Agile approach
Treatment Design	Design and Development	Artifact Design	1) Design choice rationale 2) Consistency 3) Elegance	1) Conformity with COVER [26] 2-3) Evaluation sessions (research team)
Treatment Validation	Demonstration	Instance of Artifact	1) Fit to the domain-requirements 2) Completeness 3) Usability	1) Case study: CS1
Treatment Validation	Evaluation	Contextualized Artifact	1) Performance expectancy 2) Effort expectancy 3) Social influence 4) Facilitating conditions 5) Hedonic motivation 6) Learning value 7) Behavioral intention 8) Correctness	1-8) Case studies: CS2-CS5

Problem analysis. The problem addressed in this study concerns the difficulty of evaluating and articulating the value of modeling. Before analyzing how this value can be made explicit, we first sought to deepen our understanding of the notion of modeling value itself through the studies in [28,32,35,33]. Together, these studies form the foundation for the present research: by clarifying what needs to be analyzed and made explicit, we were able to design a tool to guide the qualitative assessment of modeling value.

To examine the problem from a broader perspective, we analyzed and evaluated eight tools that support business and engineering decision-making through value analysis [7,18,20,24,30] and risk analysis [11,13,16], as well as three general decision-making tools applicable to both perspectives [4,5,10]. As summarized in table 2, three recurring limitations emerge. First, most tools focus either on value creation or on risk mitigation, while those applicable to both perspectives remain generic. Second, several approaches concentrate on a single product, function, or process, overlooking enabling resources. Third, stakeholder goals are not systematically articulated, limiting traceability between value or risk assessments and the interests of affected actors. These gaps indicate the absence of an integrated instrument combining value and risk perspectives with resource and stakeholder-oriented analysis. Nonetheless, several useful design and conceptual ideas from these tools, particularly from the Value Proposition Canvas (VPC) [18], were incorporated into our proposed approach.

Table 2. Identified coverage gaps in existing value and risk decision support tools.

Tool	Value	Risk	Resource	Stakeholder Goal
Value Proposition Canvas [18]	+	-	-	+
Value Stream Map [24]	+	-	+	-
Value Chain Map [20]	+	-	/	-
Customer Journey Map [30]	+	+	-	+
Function Analysis System Technique [7]	+	/	/	-
Bow-tie Diagram [11]	-	+	-	-
Failure Modes and Effects Analysis [16]	-	+	-	-
Fault Tree Analysis [13]	-	+	-	-
SWOT diagram [4]	+	+	/	-
Brainstorming [5]	/	/	/	-
Thinking Process Map [10]	/	/	/	-

(+) Yes (-) No (/) Indirectly or Unstructured

Objectives and requirements definition. Based on the problem investigation, we defined the core domain requirements following the requirements engineering principles proposed in [12]. First, the Canvas shall support modelers in performing qualitative value assessments of modeling solutions (RQ1) and the resources required to deliver them (RQ2). Second, it shall support modelers in articulating and tracing the value of modeling solutions to stakeholder goals (RQ3). These requirements were iteratively refined during the design phase using an agile approach [14] supported by expert assessments and stakeholder evaluations.

Design and development. According to the authors in [3], collaborative tools take various forms, including procedures, material artifacts, and information systems. Although these tools effectively facilitate collaboration, most do not directly support the resolution of specific management problems. Rather than being tailored to particular classes of problems, they provide generic supportive functions. As a result, teams often rely on a collection of disparate tools, which may reduce effectiveness and increase the risk of divergence among members.

In modeling contexts, decision processes frequently involve ambiguous assumptions, interdependent choices, and multiple stakeholder perspectives. Such situations require a structured representation that explicitly organizes problem dimensions and their relationships. Within this perspective, the canvas constitutes an appropriate foundation for our proposal. Canvases are widely used to structure complex and interdependent problems in business and professional contexts through visual and modular representations [15,17,19,29]. By organizing key elements within a unified visual framework, a canvas decomposes complexity into explicit and manageable components. This format facilitates the articulation of assumptions, stakeholder alignment, and coherent decision development. The choice of a canvas is therefore motivated by its capacity to provide problem-specific guidance while preserving clarity and integrative structure.

To design the canvas, we followed the three design principles proposed in [3] for tools that support collaborative problem-solving. The first principle, problem framing, involved developing an ontology that captures all relevant elements and their relationships. For this purpose, we adopted the Common Ontology of Value and Risk (COVER) [26], which has been successfully applied to value and risk analysis in various contexts. The second principle, visual representation, consisted of deriving a concept map from the ontology and organizing the concepts into a logically structured empty problem space. The resulting visualization is the Modeling Value Canvas presented in figure 1. Its design was iteratively refined through five group sessions with the research team. Finally, the third principle, instantiation, involved implementing the visualization as a shared workspace to support collaborative solution prototyping. After finalizing the design, we created a printable template to be used with post-it notes and an online template using Canva.com to enable remote collaboration [34].

Demonstration. To assess how effectively the final design of the tool satisfied domain requirements, captured relevant information, and supported practical use, the first author applied it in a real-world case study (CS1) following the methodology described in [25]. The case used as an example was derived from an interview conducted by the first author in the context of [28]. Drawing on the experience gained during this application, the author produced a tutorial video and a guidebook [34] to introduce the tool and provide guidance for prospective users. The outcomes of this effort were subsequently reviewed, discussed, and validated by the research team.

Evaluation. The final evaluation of the tool followed a multiple-case study (CS2-CS5) method based on [25]. The evaluation process consisted of a hands-on session, an online form, and a semi-structured interview [1]. Participants completed the hands-on session independently, either individually or in groups, without the researchers' supervision. During the session, they watched a tutorial video, downloaded a guidebook, and completed either a printed or an online template of the Modeling Value Canvas [34] to address a real-world problem. Only the completed canvases were retained for analysis, and all identifiable information was anonymized. In the online form [34], participants provided basic profile information and described the context in which they used the tool; no personal data was collected. During the semi-structured interviews, participants met online with the first author and responded to questions [34] based on the Unified Theory of Acceptance and Use of Technology 2 (UTAUT2) methodology [37]. The meetings were recorded and transcribed, and a thematic analysis [6] was conducted on the transcripts. The transcripts were temporarily retained for analysis and then deleted. The results reported are based on the completed canvases, the form responses, and the coded data derived from the interview transcripts.

4 The Modeling Value Canvas

As illustrated in figure 1, the Modeling Value Canvas consists of three sequential sections: Stakeholder Profile, Solution Value & Risk Map, and Resource Value & Risk Map. Within these sections, value and risk ascriptions are further articulated through thirteen blocks: Stakeholders, Goals, Gains, Pains, Solution, Gain creator, Pain reliever, Pain creator, Gain threatener, Available resource, Missing resource, Value enabler, and Risk enabler.

Completing a canvas fosters clarity, stimulates brainstorming, and enables collective reasoning. The Modeling Value Canvas extends these benefits by structuring analysis around the alignment between the Stakeholder Profile and the Solution Value & Risk Map (FIT 1–2), and between the Solution Value & Risk Map and the Resource Value & Risk Map (FIT 2–3). Pursuing these alignments underpins rational, value-based decision-making. Additional guidance on using the Canvas is available in the accompanying tutorial video and guidebook [34].

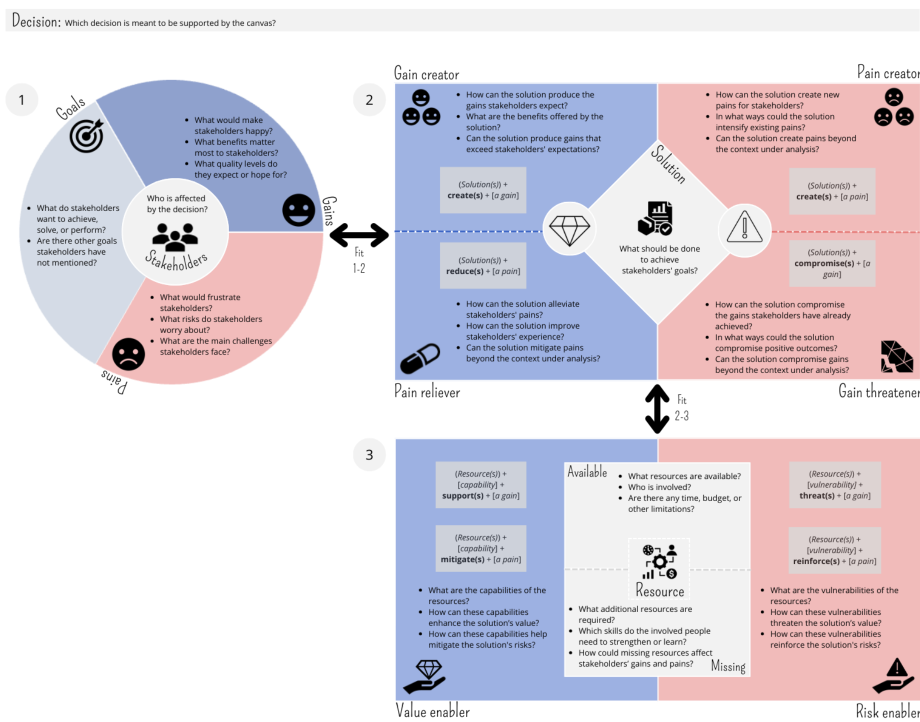

Fig. 1. The Modeling Value Canvas

4.1 Main goals

The Modeling Value Canvas can support decision-making across diverse modeling contexts by helping users to:

- **Decide:** support strategic decisions about whether and how modeling should be pursued in a given context. It helps clarify questions such as: Should we develop a model for this situation? Is modeling worthwhile under the given constraints? What scope and level of detail should the model cover?
- **Justify:** provide a structured basis for articulating and justifying modeling-related choices. It facilitates reasoning around questions such as: Why is this model an appropriate solution? Why is a graphical representation valuable here? Why was this particular modeling language or approach selected?
- **Plan:** facilitate collaborative planning of modeling activities and investments prior to implementation. It provides a structured view to address questions such as: Who should be involved in modeling? How much time and effort should be allocated? What resources are required to carry out the modeling work?
- **Reflect:** encourage post-hoc evaluation of modeling processes and outcomes. It supports reflection through questions such as: What was the actual value of modeling in this case? What risks or limitations emerged because of modeling? Was modeling ultimately worthwhile in this situation?

Demonstration. In case study CS1 [34], an IT team from an oil multinational was tasked with supporting the tax department in reducing tax-related errors, lowering operational costs, and improving the tax report creation process by developing three applications: a chatbot, a semantic search engine, and a tax predictor. To support these developments, the team produced three artifacts: an OntoUML model, an OWL model, and accompanying documentation. Based on an interview with the IT team leader, in which the project and its modeling activities were described, the first author applied the Modeling Value Canvas to *reflect* on the development and use of these modeling solutions. The Canvas was then used to examine the central decision: Was creating the modeling solutions to support the applications' development a worthwhile investment?

4.2 Stakeholder Profile

The *Stakeholder Profile* section presents the needs and concerns of one or more stakeholders affected by the decision the canvas is intended to support, focusing on their goals, gains, and pains. This section is composed of four blocks:

- `Stakeholders:` specifies the individuals or groups affected by the modeling-related decision and included in the analysis. *(CR[2]: Value and Risk Subject in COVER [26] and Stakeholder in VPC [18].)*
- `Goals:` refer to the objectives stakeholders seek to achieve, including both explicit aims and potential implicit needs. *(CR: Costumer jobs in VPC [18].)*
- `Gains:` capture what would satisfy stakeholders, the specific benefits and quality levels they expect from achieving their goals. *(CR: Gain in VPC [18].)*
- `Pains:` identify adverse outcomes, risks, and obstacles that may hinder goal attainment or cause dissatisfaction. *(CR: Pain in VPC [18].)*

`Goals` are typically broader in scope and not necessarily specific to modeling. For example, an Information Technology team may aim to develop an application, or developers may seek to improve system maintenance processes. `Gains`

[2] CR = Conceptual reference.

and `Pains`, however, depend on the purpose for which the Canvas is used. When it supports justification, planning, or reflection, they are interpreted within the context of modeling, since the solution is already known. In these cases, the task is to identify which benefits modeling can help achieve and which obstacles it can help avoid or mitigate. For instance, ensuring domain accuracy during application development or preventing excessive time consumption in system maintenance. When the Canvas is used for deciding, `Gains` and `Pains` are broader and grounded in stakeholders' needs, guiding the selection of an appropriate modeling solution. For example, if developers seek automated propagation of changes in a maintenance scenario, this gain may point toward a solution based on an ontology language such as OWL [2].

Demonstration. In CS1, several stakeholder groups could be considered, including company directors, the IT team, and the tax team. For simplicity, we focus on the IT and tax teams. Regarding `Goals`, the IT team aims to successfully develop the three applications, while the tax team seeks to improve the efficiency and reliability of the tax report process. In terms of `Gains`, the IT team values accurate information retrieval, and the tax team expects fast and easy access to reliable tax data. Concerning `Pains`, the tax team aims to reduce taxation errors, whereas the IT team is concerned about creating applications that are difficult to maintain or understand.

4.3 Solution Value & Risk Map

The *Solution Value & Risk Map* section presents a value-oriented perspective of a solution related to the decision the canvas is intended to support, focusing on value creation and potential value loss. This section is composed of five blocks:

- `Solution:` specifies the object of analysis, which may be singular (e.g., a model) or composite (e.g., a model's diagrams, documentation, or related applications) depending on the desired level of detail. *(CR: Product & Services in VPC [18].)*
- `Gain creator:` captures how a solution generates value by achieving gains. *(CR: Value object in COVER [26].)*
- `Pain reliever:` explains how a solution generates value by mitigating pains. *(CR: Value object in COVER [26].)*
- `Pain creator:` describes how the solution introduces or exacerbates pains. *(CR: Threat object in COVER [26].)*
- `Gain threatener:` explains how the solution hinders existing or expected gains. *(CR: Threat object in COVER [26].)*

When completing the `Gain creator` and `Pain reliever` blocks, the modeling solution(s) should be viewed as value object(s) [26]. One effective approach is to identify the goals of modeling in a given context, determine the model properties required to achieve those goals [28], and then analyze how these elements contribute to realizing stakeholders' gains and alleviating their pains [32]. For example, if a model aims to support system interoperability, completeness (w.r.t. the underlying domain conceptualization) is essential, as it ensures that all relevant concepts and system elements are represented.

Conversely, when addressing the `Pain creator` and `Gain threatener` blocks, the modeling solution(s) should be viewed as threat object(s) [26]. This involves identifying which model properties [28] are insufficiently addressed, how these deficiencies may become sources of risk, and under which conditions the model could jeopardize existing benefits or introduce new threats [32]. For example, poorly designed models reduce comprehensibility, leading to excessive maintenance effort that may compromise the project schedule.

When analyzing a modeling solution, it is essential to consider the modeling process through which it is developed and applied. As argued in [21], value in modeling can emerge both during model co-creation, for example, by fostering shared understanding and negotiation, and during model use, when models support analysis, communication, and decision making. The value of a modeling solution is therefore not inherent in the artifact alone, but also in the processes of its creation and use. The canvas frames the modeling solution as an artifact because its design is grounded in a use value perspective, which conceptualizes value in relation to practical utility. Accordingly, although the canvas centers on the artifact, its use requires reflection on the broader modeling process through which value is generated.

Demonstration. In CS1, the IT team produced three artifacts. For simplicity, under `Solution`, we focus on the OntoUML model. From a value perspective, under `Gain creator`, the semantic expressiveness of OntoUML can improve the accuracy of information retrieved and displayed by the applications. Developing the model also supports a structured understanding of the tax domain among developers and tax specialists. Under `Pain reliever`, a well-maintained model can reduce tax-related errors, improve information quality, and facilitate future maintenance by making the applications easier to understand. From a risk perspective, under `Pain creator`, the complexity and dynamic nature of the tax domain make model development demanding and may frustrate stakeholders; model creation may also extend the delivery time of applications. Under `Gain threatener`, accurate and efficient model development depends on active participation from the tax team, and limited availability or high workload may strain collaboration and jeopardize future projects.

4.4 Resource Value & Risk Map

The *Resource Value & Risk Map* section provides a value-oriented view of the resources (e.g., people, assets, finances, or time) that may influence the gains and pains associated with the solution, highlighting both value creation and potential loss. This section is composed of five blocks:

- `Available Resource:` lists the resources currently accessible for developing and applying the solution.
- `Missing Resources:` lists the resources required but not yet available.
- `Value Enabler:` explains how the resources' capabilities may support gains or mitigate pains. *(CR: Value enabler in COVER [26].)*
- `Risk Enabler:` explains how the resources' vulnerabilities may threaten gains or reinforce pains. *(CR: Risk enabler in COVER [26].)*

Resources function as `Value Enablers` or `Risk Enablers` depending on whether their capabilities support desired model properties or their vulnerabilities compromise them [28]. These assessments can be guided by analyzing the causes of modeling pain points [35,33]. For example, modelers themselves constitute a critical resource. Novice modelers often lack diagramming skills, which can lead to the *effortful diagramming* pain point, resulting in reduced comprehensibility and increased modeling time. Experienced modelers, by contrast, apply these skills to improve model comprehensibility.

Demonstration. In CS1, several resources could be examined, including the project budget, the modeling tools such as OWL and Visual Paradigm (VP), and the IT and tax team members. For simplicity, under `Available Resource`, we focus on VP and the team members. Under `Risk Enabler`, VP offers limited support for documentation and automation, which may hinder maintenance efforts. In addition, the tax team's limited modeling expertise increases the risk of overload and may extend model development time. Under `Value Enabler`, the IT team includes experienced modelers, who support the accuracy and quality of the model. VP also provides functionalities that facilitate the creation and layout of OntoUML models, helping to reduce model complexity and layout issues. Finally, under `Missing Resources`, methods that better support model documentation could be considered, since they may reduce maintenance problems and enable model reuse, thereby functioning as `Value Enabler`.

4.5 Fit and Decision-making

When using the Modeling Value Canvas, users are guided to examine the alignment between the *Stakeholder Profile* and the *Solution Value & Risk Map* (FIT 1-2), and between the *Solution Value & Risk Map* and the *Resources Value & Risk Map* (FIT 2-3). *FIT 1-2* occurs when the solution addresses key goals, alleviates major pains, and creates essential gains for stakeholders without introducing new severe pains. *FIT 2–3* occurs when critical resources are used to strengthen the solution's capabilities to deliver desired value and reduce vulnerabilities that could undermine it. Both fits are difficult to achieve and sustain, but the process of pursuing them is what drives effective decision-making.

Demonstration. A review of the completed Canvas for CS1 indicates that the OntoUML model would effectively support both teams in achieving their objectives, primarily by improving the development and quality of the three applications. These improvements would, in turn, reduce information inaccuracies and taxation errors. The available tools and the IT team's expertise would further strengthen the solution by mitigating risks related to complexity and inaccuracy. However, the analysis also reveals one unaddressed vulnerability: the risk of team frustration. Since no existing resource countered this issue, the Canvas exposes a clear gap requiring targeted intervention. Implementing a training program to foster a stronger modeling culture, for example, could enhance stakeholder understanding, reduce frustration, and better support the modeling effort.

5 Multiple-case study

5.1 Application context

The four application goals proposed for the Canvas were examined across five case studies involving six modelers. Their profiles are summarized in table 3, and the corresponding contexts and outcomes are described below. The completed canvases and detailed case profiles are available in [34].

Table 3. Participant profiles and case study involvement

Case	Goal	User	Ocuppation	Experience	Self-classification*
CS2	Decide	1	PhD Student	1–3 years	Advanced
CS3	Justify	1	Assistant professor	+6 years	Expert
CS4	Reflect	1	Consultant	1–3 years	Intermediate
CS5	Plan	3	1 x PhD Student and 2 x EngD Students	1–3 years	Beginners

*The self-declaration criteria used are presented in the form [34]

CS2. The Canvas was applied in a project at a South American financial company developing a neuro-symbolic chatbot that combines large language models with an ontology-based knowledge structure. A central challenge was maintaining the ontology in a highly dynamic commercial environment without relying on expert ontologists. The Canvas was used to assess whether modeling dynamic events was sustainable under long-term maintenance constraints, supporting a strategic decision about the scope of modeling and the need for dedicated expertise. As the participant noted, *"by modeling the canvas and presenting it to the company staff, you may eventually convince them that it is important to bring an ontologist into the chatbot improvement project."*

CS3. The Canvas was applied in a project aiming to improve the interoperability and reusability of ACM Information Systems competencies by transforming them into a machine-interpretable OWL ontology aligned with the Competence Reference Ontology (Core-O) and FAIR principles. It structured the reasoning for adopting an ontology-based solution over alternative representations, making explicit the expected value, assumptions, and trade-offs involved. In doing so, it provided a transparent framework to justify the modeling choice to collaborators. As the participant noted, *"by using the Canvas, I am forced to be very transparent about the artifacts I'm working with. It is not enough to be familiar with the technology or rely on the implicit knowledge I have from experience. This refinement and discussion add more value to the ultimate goal, which is to justify the modeling project."*

CS4. The Canvas was applied in a project aimed at improving accountability data exchange between healthcare providers and information-requesting parties in the Netherlands through linked data technologies. It was employed retrospectively to assess whether the ontology-based solution delivered the expected benefits, including reduced administrative burden, improved data quality, and positive stakeholder impact. The Canvas enabled a structured post-hoc evaluation of the modeling investment by contrasting anticipated and realized value and risks, thereby supporting reflection on whether the modeling effort was worthwhile. As the participant noted, *"The Canvas forces you to re-examine any contrasts between what is and what could be if a different decision had been made."*

CS5. The Canvas was applied in a research project on federated data infrastructures and trustworthy AI in the Netherlands, including improving chatbot accuracy through the integration of knowledge graphs and large language models. It was used to structure collaborative discussions about introducing and refining ontology-based modeling interventions. The Canvas supported the planning of modeling-related activities and investments by clarifying responsibilities, expected effort, and priorities prior to implementation. As the participants noted: *"I think we got a better picture, and it's also a good way of communicating and collaborating at the same time"; "I get the idea that it helps to not overlook certain factors in decision-making"; "I think it's a good conversation starter to take what we had here and then work with it."*

The selected cases constitute a representative sample of the Canvas's application. First, they span diverse decision-making situations across organizations of different sizes and sectors. Second, the Canvas was tested by users with varying levels of modeling expertise and occupying different professional roles, including consultants, academics, and industry practitioners. Third, it was evaluated against its four intended application goals. Finally, the study enabled an assessment of the Canvas both individually (CS2-CS4) and collectively (C5), across the two available formats: the online (CS2-CS4) and printed (C5) templates.

5.2 Qualitative analysis

The eight validation criteria proposed in table 1 were evaluated through qualitative analysis of the completed canvases and coded interview excerpts [34], organized according to the thematic map shown in figure 2.

Perceived impact on decision quality. Participants reported that the Canvas supported decision quality for five reasons: (i) it offers a clear visual structure for decomposing complex problems and organizing information; (ii) it increases stakeholder awareness by highlighting diverse needs, constraints, and interactions; (iii) it requires explicit justification of assumptions and modeling choices, strengthening the transparency and defensibility of reasoning; (iv) it helps uncover overlooked factors such as risks, dependencies, and contextual challenges; and (v) it improves collaborative dialog by providing a shared framework that reduces misunderstandings and supports cross-disciplinary co-creation.

Ease and difficulty of use. Participants reported that many elements became intuitive after initial familiarization, including interpreting categories and identifying enablers and risks. Early difficulties involved uncertainty about where to begin, how categories differed, and how to place specific information. Challenges also arose in phrasing notes and distinguishing closely related concepts. Participants emphasized that the Canvas works particularly well in collaborative settings, where discussion clarifies ambiguities and enriches insights.

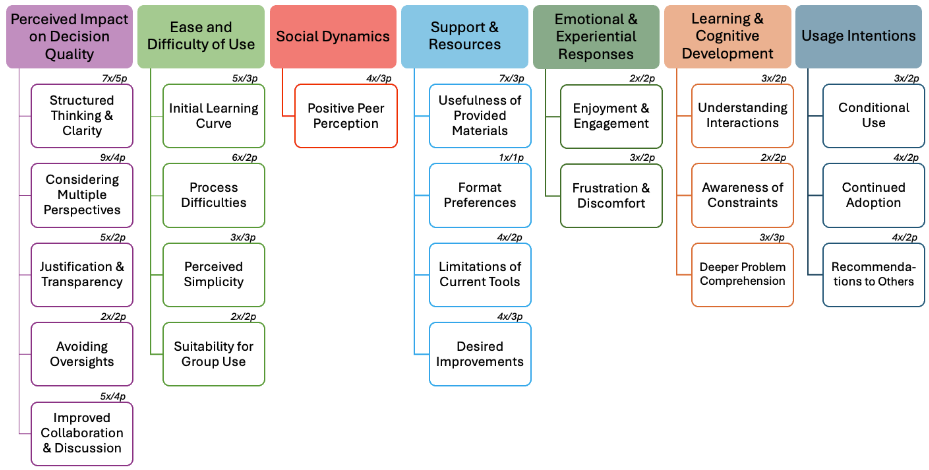

Fig. 2. Theme map. *The notation (x/p) indicates the number of times a code was identified (x) and the number of participants who expressed it (p).*

Social dynamics. Participants expected colleagues to view the Canvas positively and did not believe peer reactions would reduce their own willingness to use it. One participant noted that adopting the Canvas could support the diffusion of modeling practices and contribute to a stronger modeling culture within teams.

Support & Resources. Participants considered the support materials (templates, guidebook, and video) clear and helpful in clarifying unfamiliar concepts. Printed template supported collaboration, while the online one encouraged concise inputs. Limitations included text constraints and manual alignment in the online tool, overly detailed stylistic guidance in the guidebook, and a video perceived as too fast or shallow. Suggested improvements included clearer phrasing guidance, additional examples, curated catalogs of common elements, improved distinctions among related concepts, and layered structures to better organize input.

Emotional & Experiential responses. Participants described the Canvas as enjoyable, visually engaging, and more motivating than text-based formats. Negative reactions such as discomfort, confusion, and cognitive overload were linked to early learning challenges or uncertainty about the placement of information.

Learning & Cognitive development. Participants indicated that the Canvas encouraged deeper cognitive processing by helping them identify and analyze relationships among system components, such as resources, tools, people, and expertise, and understand how decisions propagate through these interdependencies. It also draws attention to limitations and practical constraints, clarifies the scope and complexity of the problem, and exposes hidden challenges relevant to decision-making. More broadly, the Canvas fosters reflective thinking by situating decisions within their context and helping users move beyond surface-level assumptions toward a more nuanced understanding of the problem space.

Usage intentions. Participants identified the Canvas as especially useful in multi-stakeholder settings, complex or layered problems, and situations with sufficient access to information. They expressed clear intentions to continue using the Canvas for decision-making, documentation, publications, and communication, and indicated willingness to recommend it in contexts of uncertainty, decision revision, or when clearer decision structures are needed.

Correctness. Analysis of the completed canvases showed that participants generally demonstrated a correct understanding of each section and block. Their notation styles varied, ranging from full sentences to brief comments and different color schemes, yet this variation is characteristic of canvas-based tools and did not hinder interpretation. Occasional repetitions across blocks reflected participants' reported difficulty in distinguishing closely related concepts. Some participants also used workarounds, such as placing notes between blocks to indicate partially available resources or drafting bullet points before transferring them when working with the online template. These behaviors indicate active engagement with the Canvas and confirm that participants were able to use it meaningfully, even while adapting it to their preferred working styles.

6 Final considerations

This study addressed the challenge of assessing and articulating the value of domain modeling by introducing the Modeling Value Canvas, a systematic and theory-informed approach to support modelers in deciding, planning, justifying, and reflecting on modeling-related projects. We evaluated it against these goals across five case studies, and the results indicate that it was useful in all cases.

Participants' responses indicate that the Canvas effectively supported qualitative value assessments of both modeling solutions (RQ1) and the resources required to deliver them (RQ2). They reported that it helped externalize assumptions, structure complex information, compare alternatives, and reveal interdependencies within the problem space. Their observations suggest that the Canvas makes implicit knowledge explicit, strengthens value-oriented reasoning, and supports clearer and more defensible modeling decisions. The findings also indicate that the Canvas supported the articulation of modeling value in relation to stakeholder goals (RQ3). Participants reported that it encouraged a stakeholder-oriented perspective, strengthening structured reasoning and alignment. In collaborative use, it further facilitated the articulation of ideas and shared understanding among users. Although some participants experienced minor orientation challenges, they used the Canvas correctly and expressed strong intentions to apply and recommend it in future work. Collectively, the findings suggest that the Canvas met its core requirements and provide a basis for future quantitative assessment of the Return on Modeling Effort (RoME).

The analysis also revealed some usability challenges, including initial uncertainty about category distinctions and occasional cognitive overload. Future work may refine user guidance and enhance digital support. It should also assess the effectiveness of Canvas-guided decisions, as implementation outcomes were not assessed in this study. Finally, it would be interesting to explore how the Canvas can evolve and be adapted to contexts beyond modeling.

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