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Beyond wickedness: an integrative review and conceptual synthesis of policy problem typologies

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Abstract

Complex societal problems (CSPs) such as climate change, pandemics, and polarization are persistent, interdependent, and difficult to define, yet they are often reduced to binary labels like “wicked” or “tame” or high-level typologies that oversimplify their underlying complexity. This paper revisits these typologies and proposes a conceptual framework that treats complexity as a layered structure of interacting dimensions rather than discrete categories. Based on an integrative review of 25 typologies from policy science, systems science, and management, the framework organizes problem complexity into two families: system complexity (structure, dynamics, and scope) and stakeholder divergence (values, knowledge, and power). These dimensions can be visualized through multi-level representations such as radar diagrams that reveal a problem’s complexity profile. The paper outlines three modes of application: problem diagnosis to support sensemaking; frame comparison to monitor (temporal) problem perception differences; and method and governance alignment to connect salient complexity dimensions to appropriate governance instruments and systems methods. This approach reduces risks of misclassification, improves analytical precision, and provides a shared language that supports interdisciplinary collaboration. The framework offers a more nuanced characterization of CSPs and introduces concrete tools for governance and design.

Keywords wicked problems, complex societal problems, policy problems, complexity dimensions, problem conceptualization, integrative literature review

Complex societal problems (CSPs), such as climate change, polarization, and pandemics, are persistent and feature contested goals, incomplete knowledge, and uncertain, path-dependent effects (Ackoff, 1981). Such concerns have been noted for decades, including Özbekhan et al.’s (1970) “problematique,” which framed CSPs as a tightly coupled network of issues rather than isolated policy problems. Recent assessments (World Economic Forum, 2025) show many CSPs—pollution, environmental deterioration, polarization, discrimination, and wealth inequality—remain unresolved or have intensified. To that end, scholars have expressed an urgent need for more effective policy tools that connect analytically precise, usable characterizations to policy design and governance (Alford & Head, 2017; Levin et al., 2012).

To guide more effective navigation of CSPs, scholars have developed typologies (concept classifications) that broadly distinguish structured, tractable problems from complex, resistant ones (Head, 2019; Ison et al., 2015). Structured problems have clear goals, stable causality, and suit rational analysis. By contrast, CSPs exhibit interdependence, uncertainty, and value conflict, which limits the usefulness of linear approaches (Rittel & Webber, 1973). Labels such as “problematique” (Özbekhan et al., 1970), “wicked problems” (Rittel & Webber, 1973), and “ghetto” missions (Nelson, 1974), were originally introduced to capture this second category. Subsequent typologies organized CSPs into finer-grained categories (Jackson & Keys, 1984; Roth and Senge, 1996; van Bueren et al., 2003). High-level typologies offer shared language but have limited analytical depth (Termeer et al., 2019). Recent work in *Policy and Society* advances more detailed representations of CSPs, emphasizing that frameworks with analytical depth can inform governance and design (Alford & Head, 2017; Kirschke et al., 2019; Termeer et al., 2019).

Despite these advances, existing CSP typologies remain fragmented and analytically inconsistent. First, binary typologies (e.g., wicked/tame) can induce either/or sensemaking and obscure complexity (Bannink & Trommel, 2019; Lönngren & van Poeck, 2021) and lists of characteristics lack a coherent relational structure (Alford & Head, 2017). Second, classifications often reduce complexity into tractable subproblems, treating them as independent and encouraging “one-size-fits-all” interventions where situational variation matters (Alford & Head, 2017; Turnbull & Hoppe, 2019). Third, labels like “wicked” can, paradoxically, discourage intervention through paralysis or overestimation (Ison, 2017; Lönngren & van Poeck, 2021). The result is imprecise analysis: many problems are not classified as CSPs even though they display several CSP characteristics (Hoornbeek & Peters, 2017; Peters, 2017; Peters & Tarpey, 2019). Scholars increasingly call for greater analytical precision, yet the literature still lacks a coherent, usable framework that organizes these dimensions for multiple levels of diagnosis and design (Alford & Head, 2017; Head, 2019; Termeer et al., 2019).

This paper responds by synthesizing a hierarchical structure of problem complexity dimensions rather than introducing new labels. The aim is to provide conceptually coherent typologies at multiple levels of abstraction: high-level typologies that support strategic framing and communication, and fine-grained typologies that support analytical work and policy design. The synthesis is based on an integrative review of 25 representative typologies across the policy and systems sciences. Typologies were identified through an initial set of seminal works, expanded through snowball sampling and Scopus search, with inclusion criteria requiring explicit classifications or articulated dimensions of problem complexity. As the goal of an integrative review is synthesis of representative literature rather than exhaustive aggregation (Torraco, 2005), it is appropriate for constructing a novel conceptual framework. The typologies are synthesized through affinity mapping (Holtzblatt & Beyer, 2017), where dimension labels and defining texts are iteratively grouped into thematic clusters. This allows the hierarchy to emerge directly from the data, avoiding forced combinations of disparate frameworks (Alford & Head, 2017). The resulting hierarchy organizes top-level concepts and nested sub-dimensions into coherent conceptual clusters, enabling analysts to construct fine-grained typologies for diagnostic analysis and context-sensitive design.

We conceptualize CSP complexity as a continuum structured into two interacting families: system complexity (structure, dynamics, scope) and stakeholder divergence (values, knowledge, power). The framework can be applied through three distinct decision-support modes: problem diagnosis, frame comparison, and method and governance alignment. Together, they support more precise problem characterization, improve case comparability and reduce ambiguity, offering stakeholders a shared basis for investigation, deliberation, and collaboration on addressing CSPs (Head, 2019; Termeer et al., 2019).

The paper proceeds as follows. We outline the conceptual foundations of CSPs and typologies, then describe the integrative review method. We next present the corpus of typologies and extracted dimensions, introduce the reconceptualized problem complexity structure, and demonstrate its use for high-level and detailed problem typologies. We conclude with implications for research and practice.

Background: the problem landscape

CSPs in a systems perspective

CSPs are situated in multiple interacting systems (e.g., social, ecological, technological), whose elements and feedback evolve over time. A *system* is “an interconnected set of elements that is coherently organized in a way that achieves something” (Meadows, 2008, p. 11). As *complexity* grows, so do variety, nonlinearity, path dependency, emergence, and self-organization, which complicates prediction and control (Jackson, 2019). Within such systems, problems arise when a system fails to achieve its goals. A *problem* can be defined as a gap between a preferred and an existing/expected situation, as experienced by an actor (Dunn, 1981). *Interventions* are changes to the system aimed at bridging this gap (Meadows, 2008).

Problems are also subjective, shaped by observers’ perceptions, values, norms, beliefs, interests, and knowledge. What one person considers a problem, another may consider an opportunity (Ackoff, 1974). This diversity of perspectives is intrinsic to policy contexts and shapes both the boundaries and salience of problems (Bannink & Trommel, 2019).

CSPs resist rational analysis and optimal solutions

Modern CSP concepts were introduced in the early 1970s across policy, planning, and management, to describe persistent social problems that defy rational analysis. In policy and planning, Rittel and Webber (1973) argued that many social policy challenges are “wicked”: they lack definitive formulations or endpoints, resist “correct/false” solution tests, and are interconnected. The Club of Rome’s “problematique” similarly framed global challenges (war, pollution, institutional failure) as a tightly coupled system of problems requiring structured responses to rising complexity and uncertainty (Özbekhan et al., 1970). In management, Ackoff’s “mess” described interrelated problems where solving one can exacerbate another (Ackoff, 1974). Practice-oriented accounts reinforced this: Schön (1983) contrasted the “high, hard ground” (p. 42) of theory with the “swamp” of messy yet important real-life problems; Ravetz (1971) argued that scientific and technical problems are derived from uncertain, real-world “practical problems”; and Heifetz and Laurie (2001) described “adaptive challenges” that lack ready technical answers and demand leadership that mobilizes stakeholders to learn and change.

These traditions converge on common CSP features: interdependence across subsystems and levels; persistent uncertainty about causes and effects; value conflict about ends and means; contested boundaries and framings; and interventions that alter the problem itself. As a result, CSPs exhibit limited tractability for linear, optimization-oriented approaches and require iterative, participatory, and context-sensitive strategies.

Existing CSP typologies and dimensions

To manage diagnostic complexity and guide intervention, scholars have proposed typologies to categorize problems. Early policy and systems typologies used dichotomies such as “tame” versus “wicked” (Rittel & Webber, 1973) or “structured” versus “unstructured” problems (Hoppe, 1989; Rosenhead, 1989). Later typologies contrasted types of complexity Jackson and Keys’ (1984). System of Systems Methodologies distinguished system complexity and participant complexity; Snowden’s (2002). Cynefin framework mapped transitions of problem perceptions between ordered and unordered domains (Roth and Senge, 1996); distinguished dynamic and behavioral complexity, later expanded by Scharmer (2007) with generative complexity; and Pidd (2004) categorized “puzzles,” “problems,” and “messes” based on goals/means alignment.

Later typologies in policy and public administration were finer grained. In the early 2000s, the dimensions of wicked problems were further conceptualized (e.g., Head, 2008; van Bueren et al., 2003). In the 2010s, more granular typologies emerged. Alford and Head (2017) deconstruct wickedness into levels of intractability and stakeholder/institutional divergence. Kirschke et al. (2019) empirically derived five

dimensions in water governance and identified four CSP types (complex systems, uncertainty, tame, wicked). [Turnbull and Hoppe \(2019\)](#) reconceptualized CSPs as political contestation involving uncertainty in discovery and definition. [Bannink and Trommel \(2019\)](#) framed CSPs as governance challenges driven by factual uncertainty and heterogeneous preferences. In science, technology and innovation policy, typologies have been developed for framing mission-oriented policy. Either by differentiating between agreement on problems versus solutions ([Wanzenböck et al., 2020](#)), or by differentiating between the type and scope of desired change—from scientific progress and knowledge development to coordination and behavior change ([Wittmann et al., 2021](#)).

Across these traditions, recurring interpretations of complexity are revealed: complexity arising from systems and complexity arising from stakeholder divergence. Building on these conceptualizations, this study synthesizes their underlying dimensions into a fine-grained, hierarchical structure. In the next section, we explain the review and synthesis approach.

Methods

Approach

We conducted an integrative literature review to achieve a synthesis that advances how CSPs are conceptualized. An integrative review is a type of narrative review which “[r]eviews, critiques, and synthesizes representative literature on a topic in an integrated way such that new frameworks and perspectives on the topic are generated” ([Torraco, 2005](#), p. 1). Unlike systematic reviews, which aim for exhaustive coverage of narrowly defined questions, integrative reviews prioritize conceptual integration and theory-building, making them suitable for topics characterized by diverse contexts and methodological heterogeneity ([Sukhera, 2022](#)). The review focused on conceptual typologies of societal and policy problems across policy science, systems science, management, and science, technology & innovation (STI) studies. This approach enabled us to identify cross-cutting dimensions across disparate typologies and to synthesize them into a coherent hierarchical structure.

CSP typologies are characterized by highly diverse contexts and methodological heterogeneity. They originate from multiple fields such as policy science, systems science, management, and STI studies. They vary in terms of terminology, assumptions, and research traditions. These typologies can span multiple decades, requiring an approach that can combine foundational and contemporary literature into a coherent framework ([Torraco, 2005](#)). Furthermore, they are predominantly qualitative and conceptual ([Siddaway et al., 2019](#)). A systematic review was deemed inappropriate because our goal was not to aggregate empirical findings but to synthesize conceptual insights across disciplines and eras.

Selection and inclusion

We purposively selected an initial corpus of typologies based on their prominence in policy science and related fields, historical significance, and relevance to problem diagnosis and design ([Appendix A](#)). Inclusion criteria required that a typology either (a) proposed an explicit classification of societal or policy problems, or (b) described dimensions of problem complexity.

Selection proceeded in three complementary steps. First, we identified a seed set of 24 seminal typologies widely cited across policy, systems, management and STI studies and frequently used as anchors in reviews and books ([Culmsee & Awati, 2013](#); [Hester & Adams, 2017](#); [Hisschemöller & Hoppe, 1995](#); [Jackson, 2019](#); [Lönngren & van Poeck, 2021](#)). Second, we extended coverage through a targeted Scopus search using the query (*problem* W/2 typolog**) OR (*problem* W/2 dimension?*) OR (*problem* W/2 characteri**) AND (“wicked problem*” OR *problematique** OR “unstructured problem*” OR “ill-structured problem*” OR “adaptive challenge*” OR “practical challenge”), employing proximity operators and wildcards to capture grammatical variation. This search identified two additional typologies that met the inclusion criteria. Third, three further typologies were added through expert-informed identification during the review process ([Roth and Senge, 1996](#); [Scharmer, 2007](#); [Wittmann et al., 2021](#)).

The resulting pool of 29 typologies was then screened against the inclusion criteria, resulting in a final set of 25 typologies included in the synthesis. Specific exclusion grounds per typology are described in the next section.

Analysis and conceptual synthesis

Analysis proceeded in two stages. First, we extracted categories and stated dimensions from each suitable typology. Where dimensions were not explicitly defined, we applied interpretive coding based on textual descriptions and examples. The extraction table captured each dimension label and its defining text. This produced a comprehensive list of 90 complexity dimensions from the final set of 25 typologies, shown in [Appendix B](#).

Second, we synthesized these dimensions using an affinity mapping clustering procedure ([Holtzblatt & Beyer, 2017](#)). One author coded all extracted dimensions and conducted two rounds of clustering, grouping dimensions into hierarchical clusters based on conceptual similarity. After each round, co-authors validated the cluster structures and refined labels until definitions stabilized. Each cluster was named and defined based on its shared concepts. For example, dimensions such as *problem ambiguity*, *problem complexity*, and *problem type* were consolidated into the lower-level construct “problem formulation agreement.” Dimensions that remained too abstract to assign at the lowest level are marked “-” under Level 3 in [Appendix B](#). The resulting hierarchy emerged inductively from cross-typology patterns and forms the basis of the integrated typology mapped against the 25 typologies.

Limitations

Given the integrative and theory-building orientation of the review, the synthesis was purposive rather than exhaustive. As outlined in this section, our aim was to capture the relevant conceptual terrain across major disciplinary traditions rather than enumerating all published problem typologies. Representativeness should therefore be understood as coverage of dominant streams, framings, and conceptual approaches across fields and periods, not as an exhaustive inclusion of every extant typology ([Torraco, 2005](#)).

Our aim is not to catalog every published problem typology, but to synthesize how problems are conceptualized across major disciplinary traditions. In this context, representative refers to coverage of the relevant conceptual terrain across fields and time periods, while remaining non-exhaustive with respect to the full universe of typologies. The resulting corpus therefore represents a broad range of disciplinary perspectives on how societal and policy problems are theorized.

This approach entails acknowledged trade-offs. Some lesser-known or highly specialized typologies may not be included, and the synthesis necessarily involves interpretive judgment in clustering and consolidation. These characteristics are inherent to integrative review designs that prioritize conceptual coverage and theory building. To support rigor and transparency, we applied an explicit search and inclusion protocol, conducted iterative clustering and multi-author validation, and documented all exclusions and their rationale. Specific exclusion grounds are detailed in the following section.

Synthesized structure of problem complexity dimensions

Overview of included typologies

The typologies included in our integrative review span more than five decades (1967–2021) and originate primarily from the policy and systems domains, with overlaps in business, management, and STI policy ([Table 1](#)). Within the policy domain, typologies address governance and policymaking challenges (e.g., [Bannink & Trommel, 2019](#); [Noordegraaf et al., 2019](#); [Peters, 2005](#)), global challenges

Table 1 Distribution of typologies across domains (multiple domains per typology are possible).

Domain	Number of typologies
Policy	11
Systems	9
Operations research & management science	6
Business and management	5
STI	3
Other	3

(Levin et al., 2012; Özbekhan et al., 1970), and STI policy (Nelson, 1974; Wanzenböck et al., 2020; Wittmann et al., 2021). Systems-oriented typologies focus on operations research and management science (Pidd, 2004; Roth and Senge, 1996), systemic organizational challenges (Scharmer, 2007; Snowden, 2002), and problems faced by practitioners and leaders (Heifetz & Laurie, 2001; Ravetz, 1971; Schön, 1983). The full table is provided in Appendix A.

The set of typologies comprises 12 dichotomies, 12 high-level typologies, and seven fine-grained typologies (see Appendix B1). Early typologies were primarily dichotomous, based on implied dimensions rather than explicit criteria, reflecting efforts to challenge problem-solving paradigms (Crowley & Head, 2017).

The first high-level typology was introduced by Jackson and Keys (1984), typically presented as a matrix. Most subsequent frameworks retained this matrix logic, although Snowden's (2002) Cynefin framework emphasized phase shifts rather than fixed categories. Later typologies introduced hybrid labels signaling degrees of complexity, such as "wicked mess" in (Roth and Senge, 1996).

Of the typologies identified, 25 met the criteria and were integrated into the synthesis. Four were excluded, because they did not meet the inclusion criteria for social/policy problem focus, conceptual clarity, or dimensional specificity:

- Simon (1973) focuses on well-structured problems in engineering and design, despite prompting the term "ill-structured problems";
- Heifetz and Laurie's (2001) dichotomy of "adaptive challenges" lacks sufficient conceptualization to identify underlying dimensions;
- Rosenhead (1989) does not introduce a new typology, but applies earlier frameworks already included in this review;
- Crilly (2025) proposes a grouping primarily to demonstrate visualization techniques without sufficient explanation of how dimensions were derived.

Extracted dimensions

From the included typologies, we extracted 90 distinct dimensions (see Appendix B). These were clustered via affinity mapping into a hierarchy of conceptually coherent groups, as described in the Methods section. Stakeholder divergence dominates with 57 out of 90 dimensions, with 36 specifically addressing differences in values and interests (Figure 1). System complexity is significant: Dynamical complexity appears more frequently than structural complexity or system scope, occurring more than twice as often. Figure 1 shows the distribution of dimensions across clusters, and Figure B1 visualizes them in more detail.

Many typologies emphasize a single aspect of complexity, such as either stakeholder divergence or system complexity. For example, stakeholder divergence is central in (Bannink & Trommel, 2019; Noordegraaf et al., 2019; Pidd, 2004; Wittmann et al., 2021), while system complexity is the primary focus in (Ackoff, 1974; Beer, 1967). A limited number integrates both stakeholder divergence and system complexity in a fine-grained manner (Alford & Head, 2017; Kirschke et al., 2019; Nelson, 1974; Peters, 2005; Wanzenböck et al., 2020).

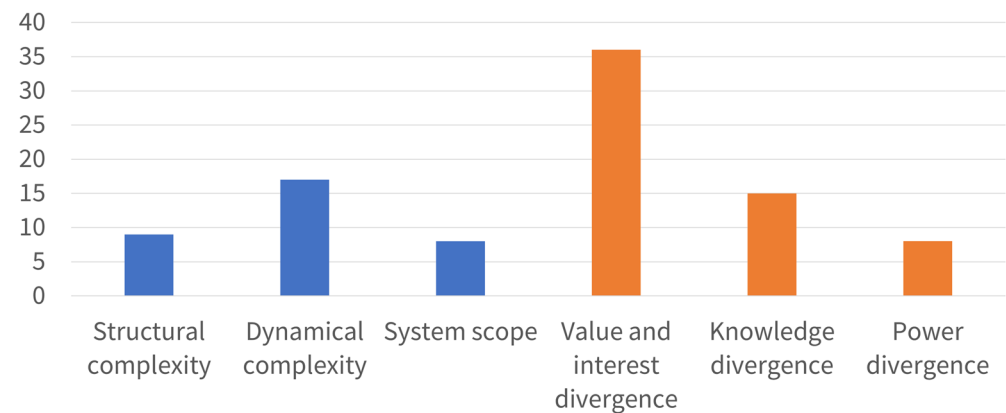


Figure 1 Distribution of problem complexity dimensions per cluster (Source: Authors’ own).

Overall, the corpus reveals substantial variation in how complexity is conceptualized, warranting a structured synthesis that organizes these dimensions into a coherent framework. The next section presents our hierarchical structure which integrates these dimensions into a multi-level model for constructing both high-level and fine-grained typologies.

Hierarchical structure of complexity dimensions

Problem complexity (or “wickedness”) comprises two primary dimensions, system complexity and stakeholder divergence, which can be further divided into subdimensions. The hierarchical structure of these dimensions is visualized in Figure 2 and explained in detail in this section. A comprehensive overview of all dimensions is provided in Appendix C.

System complexity is the extent to which a situation exhibits structural variety (components and inter-connections), dynamic behavior (feedback, nonlinearity, path-dependence, delays), and broad system scope (scale, divisibility). High system complexity involves numerous interacting variables, feedback

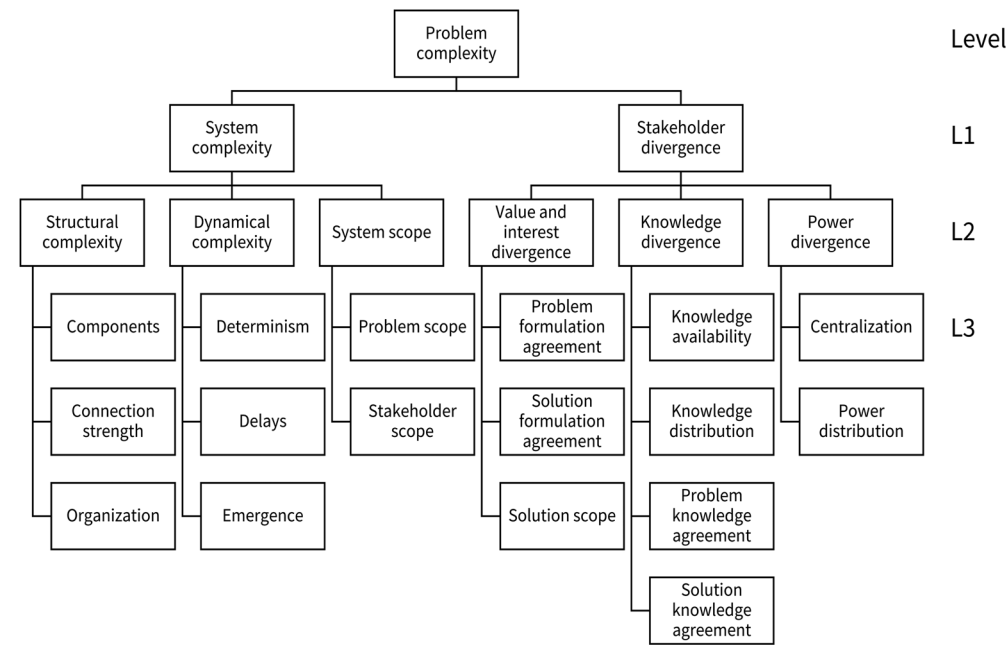


Figure 2 Hierarchy of problem complexity dimensions (Source: Authors’ own).

loops, and emergent properties that make the problem difficult, if not impossible, to fully comprehend or model. For example, the COVID-19 pandemic involved many interacting factors, such as virus transmission rates, healthcare capacity, public health measures, and socio-economic impacts, creating a network of feedback loops and emergent system behaviors.

Stakeholder divergence is the extent to which stakeholders differ in power, values, interests, knowledge, frames, goals, strategies, and norms; and the degree to which this fragments coordination, complicates agreement on problems and solutions, and shapes governance demands. This includes disagreement among stakeholders regarding problem definition, goals, and potential solutions. High stakeholder divergence indicates conflicting values, interests, or perspectives among various stakeholders. For instance, during the COVID-19 pandemic, stakeholders could have conflicting views on prioritizing health, mental health, or the economy (Janssen & van der Voort, 2020).

From the perspective of problem complexity, these two dimensions are interdependent, providing complementary perspectives. Systems with uniform stakeholders will likely experience less divergence in values and interests. Thus, stakeholder divergence can be seen as a subdimension of system complexity, considering social phenomena such as disagreement or power as concrete system components and properties. Conversely, system complexity might be viewed as subjective, where knowledge and beliefs about the system influence how complexity is experienced. Acknowledging this subjective nature of problem typologies (Crilly, 2025), we argue that these dimensions capture key factors of the system. Together, they provide a more comprehensive view of CSP complexity (Alford & Head, 2017; Jackson, 2019). System complexity pertains to what exists in the world and how it is structured—ontology—whereas stakeholder divergence addresses variations in how knowledge is interpreted and what is considered true or significant—epistemology (Rescher, 2020).

System complexity

System complexity refers to the inherent complexity of the system considered. This encompasses both natural systems (e.g., human body, forest, biosphere) and artificial systems (e.g., space shuttle, skyscraper), as well as combinations thereof (e.g., company, canal, stock market, energy grid). Complexities arise from numerous factors, categorized into three main aspects: structural factors, dynamical factors, and scope.

Structural complexity

Structural complexity is the degree to which a system comprises numerous components and strong interconnections, and the extent to which such structure can be organized or decomposed into tractable subproblems. It includes components, connection strength, and organization. *Components* refer to the number and diversity of elements or subsystems that interact within the problem system. Depending on the problem, components can include people, machines, technologies, concepts, etc. The number of components often indicates system complexity, as more components imply more potential interactions (Beer, 1967). For instance, developing a pandemic preparedness strategy is more complex in a country with many different disorganized hospitals and practices than one with a more uniformly organized healthcare landscape, due to the greater diversity and number of interactions.

Connection strength describes the intensity of relationships between these components. Connections between components enable communication, acquaintanceship, and mutual experience (Snowden, 2002). Connection strength influences complexity since systems with weaker connections face more challenges in communication and alignment than strongly connected systems. For example, collaboration between regions with weak connections (e.g., differing health policies and communication channels) is more difficult than between regions with strong connections (e.g., coordinated health measures and shared information systems).

Organization relates to the overall arrangement and hierarchy of system elements and their connections to achieve a specific goal. The organization of components contributes to the complexity of CSPs, as it determines how they interact and influence each other (Wanzenböck et al., 2020). Describing, analyzing, and coordinating a disorganized system is more complex than an organized one (Beer, 1967).

Dynamical complexity

Dynamical complexity is the extent to which a system's behavior changes over time—through delayed feedback, nonlinearity, path-dependence, evolving problem states, and shifting solution validity, and the degree of predictability in such dynamics. It is grouped into determinism, delays, and emergence within the system. *Determinism* refers to the predictability of system behavior and outcomes. A deterministic system has no randomness and is theoretically predictable (Beer, 1967). In CSPs, the level of determinism affects our ability to forecast future system states. Non-determinism introduces uncertainty, making it difficult to anticipate the consequences of interventions or policy changes.

Delays refer to the time and space between cause and effect in a system. CSPs are characterized by large delays between interventions and their effect (Meadows, 2008). For instance, during the COVID-19 pandemic, the impact of newly implemented public health measures on infection rates often became evident only after several weeks.

Emergence refers to unexpected properties or behaviors arising from interactions between system components. The complexity of a system is based on disruptive patterns of innovation and non-linear change. Like determinism, emergence introduces unpredictability and unforeseen consequences, increasing system complexity. For example, in the COVID-19 pandemic, the emergence of new virus strains complicated containment efforts.

System scope

Scope and boundary are the third aspect of system complexity. We distinguish between the problem scope and stakeholder scope. *Problem scope* refers to the breadth and depth of the problem, including discipline, domains, and geography. A broad scope provides a more complete description of a problem but makes defining boundaries for interventions challenging. Moreover, problem scope is not static; problems can metastasize—growing and exacerbating each other (Özbekhan et al., 1970). As a result, a narrow scope can lead to tunnel vision. Problem scope is also a matter of choice, as stakeholders can regard a problem with a certain scope. For instance, a national problem scope may view international dimensions to a problem as external factors.

Stakeholder scope relates to the number and types of stakeholders directly or indirectly affected by a problem. A large stakeholder scope, corresponding to high stakeholder plurality, contributes to system complexity as it leads to complex interactions, including stakeholder divergence.

Stakeholder divergence

Stakeholder divergence refers to the complexity that arises from stakeholders' different interpretations of the system and its desired future states, rooted in their values, beliefs, interests, knowledge, and power. Stakeholders are individuals, groups, organizations, or institutions that can affect as well as be affected by another's policy or policies (Mitroff & Linstone, 1993).

Value and interest divergence

Divergence in stakeholder values and interests is the extent to which stakeholders differ in values, preferences, norms, goals, frames, and strategies; and the degree to which these differences create pluralism, conflict, political distance, contestation, and challenges to agreement on problems and solutions. This divergence is grouped into problem formulation agreement, solution formulation agreement, and solution scope.

Problem formulation agreement refers to the degree of alignment and clarity among stakeholders on what the problem and the desired future are. With CSPs, stakeholders often have different perceptions of what they consider problematic. The lack of a shared perception of the problem situation makes it more complex. For example, during the COVID-19 pandemic, governments, healthcare providers, and citizens often had conflicting views (Janssen & van der Voort, 2020). Initially, governments viewed the pandemic from a medical perspective, while others advocated the socio-economic aspects of the problem. These differing perspectives create complexity in formulating a unified strategy, as desired outcomes and solutions vary among groups (Janssen & van der Voort, 2020).

Solution formulation agreement relates to the degree of alignment and clarity among stakeholders on solutions (or interventions) to address the problem. This also includes agreement on the feasibility and effects of potential solutions, as well as criteria to determine an acceptable solution. CSPs often have many potential solutions (pathways) with uncertain outcomes. In combating pandemics, various stakeholders focus on different solutions. While governments may advocate large-scale vaccination campaigns, businesses might focus on remote work policies. The uncertainty of the feasibility and long-term impacts of these solutions, along with conflicting criteria for acceptable approaches (e.g., economic feasibility versus public health effectiveness), complicates the search for a widely agreed-upon strategy.

Solution scope refers to the range within which stakeholders search and envision solutions. The scope can vary from scientific innovation and technological development to large (system) transformations (Wittmann et al., 2021). Addressing CSPs often requires new knowledge, technology, applications, practices, collaborations, institutions, and larger ambitions, leading to more complex intervention mixes. In a pandemic, stakeholders may focus on smaller-scale solutions, such as enhancing testing capabilities or promoting mask usage, which require fewer changes and emphasize technology adoption. In contrast, larger system transformations, like redesigning the entire healthcare infrastructure, necessitate a broader range of interventions, including new policies, infrastructure investments, technological advancements, stakeholder collaboration, and shifts in public behavior, significantly increasing the complexity of the solution.

Knowledge divergence

Knowledge divergence is the extent to which facts, evidence, and frames are uncertain, incomplete, fragmented, unevenly distributed, or differently interpreted across stakeholders; and the degree to which this affects understanding of problems and solutions. This divergence is grouped into knowledge availability, knowledge distribution, problem recognition, and solution recognition. *Knowledge availability* refers to the amount of knowledge regarding the problem available across the stakeholders. Typically, emerging CSPs are characterized by low knowledge availability. As knowledge accumulates through learning, uncertainty in CSPs can be significantly reduced. For example, during the COVID-19 pandemic, understanding the efficacy of public health measures required time and evidence-based learning (Janssen & van der Voort, 2020).

Knowledge distribution refers to the fragmentation and distribution of knowledge and information regarding the problem (such as causal relationships). If relevant information is highly localized and not shared effectively, stakeholders lack the information to act. For example, in combating pandemics, fragmented knowledge about virus transmission and effective interventions could complicate coordination and implementation of effective solutions. This lack of shared information increases the complexity of addressing the pandemic.

Problem knowledge agreement refers to agreement on the knowledge and information regarding the problem, such as how the problem is caused. Limited agreed-upon knowledge increases uncertainty, contributing to CSP complexity. For instance, stakeholders' disagreement on the cause of virus transmission reduces support and increased uncertainty regarding policy effectiveness. This lack of clarity and agreement complicates addressing the problem.

Solution knowledge agreement refers to agreement on the knowledge and information regarding potential solutions and their feasibility, efficacy, and side-effects. Limited agreed-upon knowledge on solutions and their implementation can cause unintended consequences, increasing the complexity of CSPs. For instance, intervention with limited shared knowledge about the costs, benefits, and potential side effects of lockdowns and vaccination campaigns, could lead to inefficiencies or unforeseen negative impacts, such as economic downturns or public resistance, thereby increasing the complexity of addressing the problem.

Power divergence

Power divergence is the degree to which authority, resources, and decision capacity are dispersed across actors and institutions, and the extent to which fragmentation versus central direction shapes coordination and collective action. This includes the degree of centralization and power distribution among stakeholders.

Centralization refers to the degree of (de)centralization of the power to act on the problem by controlling choices required to intervene. This power is often held to a certain level with central decision-makers such as public authorities, encompassing legitimacy, reputation, resources, enablers, or constraints. Centralization relates to the connection strength between decision-makers and the stakeholders they depend on. For example, during the COVID-19 pandemic, a national government may enforce lockdowns and vaccination mandates through centralized control. However, if a decision-maker possesses significant resources and legitimacy but lacks strong connections with key stakeholders (e.g., local governments or healthcare providers) it may encounter resistance and difficulties in implementing solutions effectively. Combined with poor communication and collaboration, this can hinder progress and increase the complexity of the problem.

Power distribution is the extent to which the power to act on the problem is distributed among stakeholders in the system. If the power, necessary resources, enablers, or constraints are distributed across many different stakeholders, this introduces more complexity and requires more coordination for interventions against CSPs—which can also be a site of power divergence. Moreover, the connection strength between stakeholders plays a key role. For instance, during the COVID-19 pandemic, power was distributed among various stakeholders, including national governments, local authorities, healthcare providers, businesses, and NGOs, each with differing levels of influence over public health measures and economic policies. This fragmented power distribution complicated the implementation of effective solutions due to the need for coordination among these diverse groups. Without clear communication and shared objectives, conflicting interests can lead to delays and inefficiencies in addressing the pandemic.

Illustrative typology constructions

Building on the hierarchy of problem complexity dimensions introduced in the previous section, this framework enables the construction of typologies at varying levels of abstraction, ranging from high-level to fine-grained distinctions.

High-level CSP typology

We obtain a high-level typology by contrasting the high-level dimensions system complexity and stakeholder divergence (Table 2). While these dimensions are continuous (Alford & Head, 2017), the assumption that they are either high or low reveals “ideal types” of problems (Jackson, 2019). We identify these four high-level problem types as tame complexities, complex analytical problems, social dilemmas, and CSPs, and characterize them based on problem complexity dimensions.

Tame complexities are problems with less contestation, fewer unknowns, and fewer competing alternatives, where the system has manageable components, interactions, or clear dynamics. For example, organizing local food delivery services to support vulnerable populations during lockdowns can be considered a well-structured problem, where goals and approach.

Complex analytical problems have less contestation, fewer unknowns, and fewer competing alternatives, but involve systems with many components, connections and interactions, or the dynamics are hard to understand. This requires analysis, modeling, or simulation to reduce uncertainty, although knowledge may be available but not sufficiently widespread. An example is optimizing hospital resource

Table 2 Four high-level “ideal types” of problems.

		Stakeholder divergence	
		Low	High
System complexity	Low	Tame complexities	Social dilemmas
	High	Complex analytical problems	Complex societal problems

allocation to manage COVID-19 patient care, requiring detailed analysis and modeling to ensure efficient use of medical equipment, staff, and facilities.

Social dilemmas involve high contestation and many unknowns, but manageable system components or dynamics, requiring stakeholder management. For instance, implementing remote work policies across various industries during the pandemic. While the technical aspects of remote work were straightforward, managing diverse employee needs and preferences required significant stakeholder engagement.

Complex societal problems involve high contestation, many unknowns, and a system with many components or dynamics are hard to understand, requiring system analysis and stakeholder engagement. An example is developing comprehensive public health strategies to manage the pandemic's impact on mental health, requiring coordination effort across healthcare providers, policymakers, and community organizations to address the multifaceted challenges of mental health during COVID-19.

Towards a fine-grained CSP typology

By contrasting lower-level dimensions, the typology captures multiple aspects of complexity simultaneously, which can be visualized using a radar diagram (Figure 3). This decomposition into subdimensions extends to the lowest level, enabling fine-grained analysis across different complexity profiles. The two illustrative examples show how seemingly similar societal problems can nonetheless exhibit markedly different configurations of high and low system complexity and stakeholder divergence.

These dimensions lend themselves to indicative (proxy) metrics and can be expressed along ordinal or continuous scales, such as 5-point questionnaire scales (Peters & Tarpey, 2019). While suitable metrics are context-dependent, several illustrative measurement approaches can be suggested. Structural dimensions may be approximated by the number and diversity of subsystems involved or by network density measures; connection strength by inter-organizational tie strength or information-sharing frequency; and delays by the time between significant interventions and observable outcome signals. Emergence may be reflected in the rate or diversity of unforeseen side effects or problem re-framings over time. Stakeholder-related dimensions may be approached through inter-rater agreement on problem definitions (knowledge divergence), alignment measures (value and interest divergence), and concentration indices for decision authority (power divergence). These metrics are not intended as fixed operational definitions, but as illustrative interpretations of how the dimensions shown in Figure 3 can be understood and compared across cases.

Discussion

This study advances the characterization of CSPs by proposing a hierarchical framework that distinguishes system complexity and stakeholder divergence, each with nested sub-dimensions. Beyond theoretical refinement, the framework enables diagnostic profiles of complexity, iterative reflection on stakeholder frames, and method selection aligned with salient dimensions and problem context. Moving beyond categorical labels such as wicked/tame, the multi-level hierarchy allows analysts to specify *how* a problem is complex, rather than merely asserting complexity. By disentangling complexity into interpretable dimensions, the framework can be used to clarify which forms of analysis, engagement, and governance are plausibly suited to a given problem configuration, while supporting iteration as conditions change—strengthening analytical and adaptive policy capacities.

Against ongoing debates about the value of CSP concepts—particularly critiques of the “wicked” label—our contribution aligns with calls for greater analytical precision (Termeer et al., 2019). The typology synthesizes perspectives from (STI) policy, systems sciences, and management (Alford & Head, 2017; Bannink & Trommel, 2019; Hoornbeek & Peters, 2017; Özbekhan et al., 1970; Rittel & Webber, 1973; Turnbull & Hoppe, 2019; van Bueren et al., 2003; Wanzenböck et al., 2020; Wittmann et al., 2021) into a cohesive framework, replacing categorical bins with scales that support systematic comparison across cases and over time—thus advancing policy capacity. The typology is theoretically eclectic by design, providing a shared diagnostic vocabulary rather than privileging a single theoretical tradition;

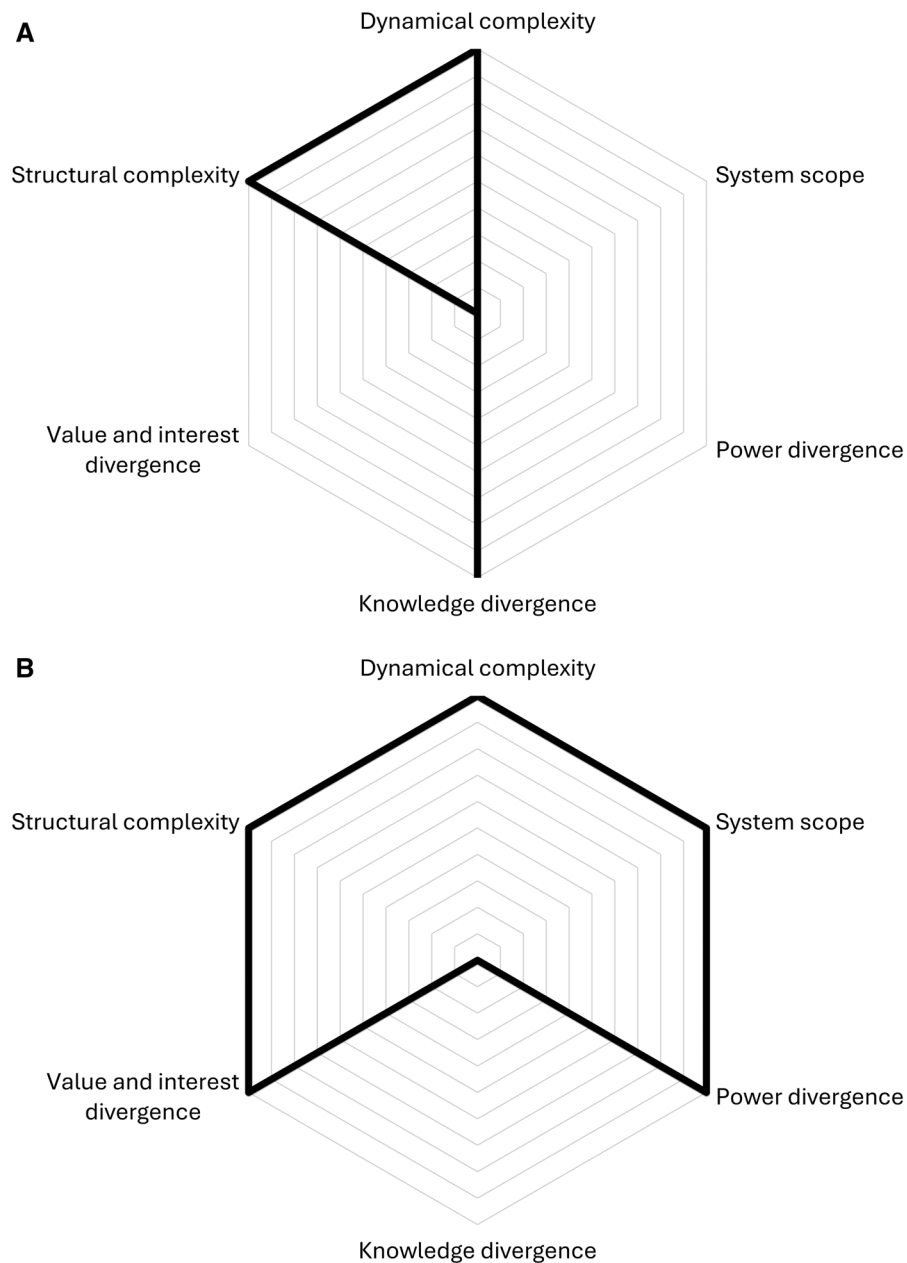


Figure 3 Two complex societal problems with different problem complexity profiles. The upper half consists of system complexity subdimensions, while the lower half represents stakeholder divergence subdimensions. The factors are rated as either low or high but can also be represented on a scale. (A) Highly complex system and low agreement on knowledge; (B) high agreement on knowledge, yet highly complex (Source: Authors' own).

different approaches may thereby foreground particular dimensions, such as dynamical complexity in the systems sciences or value divergence in policy studies.

We also emphasize the importance of typology design. While high-level frameworks offer communicative simplicity, they risk oversimplification by masking important distinctions and by imposing rigid boundaries on fluid situations. For example, structural and dynamical factors both contribute to system complexity, yet such nuance disappears when collapsed into a single categorical label (Crilly, 2025).

Moreover, organizational structure (e.g., highly siloed) may itself amplify problem complexity even when the underlying problem appears relatively simple; both organization and disorganization can contribute to complexity (Meyer, 2025). The hierarchical structure proposed here addresses these risks by retaining top-level coherence while enabling finer distinctions through nested sub-dimensions, as recommended in recent literature (Alford & Head, 2017; Termeer et al., 2019). In practice, such distinctions help decision-makers balance exploration (e.g., experimentation when dynamical interactions dominate) and coordination (e.g., stakeholder alignment when value divergence is high) rather than defaulting to a single response logic.

Strengthening such practice-theory linkages also requires understanding how stakeholders conceptualize CSPs and connect problems to solutions. Objective indicators (e.g., number of system components) and subjective views (e.g., perceived tractability) jointly shape problem classifications and associated responses (Peters, 2017; Peters & Tarpey, 2019). While our contribution is primarily conceptual, the typology illustrates how both objective indicators and subjective perceptions can be accommodated within a coherent diagnostic framework.

Attention to perception is also essential because CSP framing is ambiguous and dynamic. Stakeholders often categorize the same problem differently, and these perceptions shift over time (Snowden, 2002). The Dutch COVID-19 trajectory illustrates this evolution: early phases were dominated by high uncertainty and capacity stress, while later phases involved reduced uncertainty but heightened normative conflict (Janssen & van der Voort, 2020; Rijksoverheid, n.d.). Problems seldom become “tame”; they transform (Özbekhan et al., 1970). The framework therefore supports adaptive adjustments as conditions evolve and is applicable to both relatively settled policy contexts and unsettled (crisis) situations where institutions are challenged (Meyer, 2025). From the perspective of the typology, crises typically involve rapid shifts across complexity profiles rather than convergence toward simplicity.

With such fluidity, where boundaries between categories are porous, rigid application of typologies introduces misclassification risks. A tame-complexities lens may under-scope the problem; a social-dilemmas lens may over-politicize; a complex-analytical lens may over-model; and a CSP lens may induce paralysis (Head, 2022). These pitfalls, noted in Appendix D, highlight the need for iterative assessment, adaptive strategies, and stakeholder dialogue (Jackson, 2019; Midgley, 2000). Our typology helps mitigate these risks by making trade-offs explicit at the dimension level and by encouraging periodic reassessment.

To translate this framework into practice, it can be applied through three complementary modes, each supporting a distinct but related decision function. In problem diagnosis (*diagnostic mode*), analysts use the typology to identify which dimensions contribute most strongly to complexity and to construct a diagnostic profile. This profile supports shared sensemaking by clarifying why a problem is challenging and helps guide intervention strategies, as instruments that poorly fit those complexity features can be disregarded (Crilly, 2025). In frame comparison (*reflective mode*), the typology is applied iteratively or comparatively to surface differences in how stakeholder frame the problem or to track how complexity characteristics shift over time. By explicating changes in system dynamics, knowledge uncertainty, value divergence, or power asymmetries, the framework supports adjustment of engagement and governance strategies. For example, shifting from analytical exploration toward deliberation if normative conflict increases. In method and governance alignment (*selection mode*), diagnostic profiles function as a heuristic decision aid for selecting systems methods and governance instruments aligned with dominant complexity dimensions (Jackson, 2019). System complexity is more closely associated with governance capacity constraints such as analytical limits and coordination demands, whereas stakeholder divergence relates more directly to governance legitimacy (e.g., trust and acceptance). In this sense, the framework also informs deliberation between preparedness-oriented (centralized, ex-ante) approaches and resilience-oriented (decentralized, adaptive) approaches, depending on whether system dynamics or stakeholder divergence dominate. For example, modeling or experimentation is more appropriate when dynamical complexity is high, whereas participatory deliberation is more appropriate when value divergence prevails. In this way, the framework links problem diagnosis to contingent method and instrument choice.

In addition, visualizations can strengthen shared understanding. Radar and profile-based diagrams make complexity visible, with “tamer” problems appearing visually smaller than more complex ones (Crilly, 2025; Kirschke et al., 2019). Such representations help stakeholders identify leverage points, compare cases, and plan interventions more transparently. Different visual forms may vary in how effectively they support shared understanding across audiences and decision contexts.

Several limitations nonetheless remain. First, the framework is intentionally diagnostic and context-agnostic at the level of conceptual dimensions; its strength lies in comparability and integration across cases, while effective application requires context-specific interpretation. For the sake of clarity, we used the COVID-19 as a running example. Other CSPs, such as energy transition or housing affordability, would exhibit different complexity profiles. Second, because the synthesis is representative rather than exhaustive, findings should be treated as conceptual rather than causal claims. The framework requires empirical validation, sensitivity testing with alternative corpora, and replication across policy domains to assess generalizability and practical utility.

Future research should advance this agenda by translating the proposed conceptual typology into empirically grounded diagnostic practice. A first set of priorities concerns *conceptual-empirical translation*, including validation across policy domains and governance levels to assess reliability, interpretability, and practical usefulness of complexity profiles. This includes operationalizing individual dimensions through context-dependent indicators, developed in dialogue with practitioners, and evaluating measurement validity and sensitivity across cases and settings. A second line of inquiry addresses *process dynamics and intervention logic*, examining how different configurations of complexity inform the selection and sequencing of policy instruments and governance approaches, and under which conditions particular strategies perform better. Longitudinal research is especially needed to explore how complexity profiles evolve over problem lifecycles and how such shifts affect timing, path-dependence, and opportunities for adaptive adjustment. A third cluster focuses on *real-world robustness and usability*, including strategies to mitigate misclassification risks (such as procedural safeguards and triangulation) and comparative assessment of visualization formats (e.g., radar diagrams or heatmaps) across audiences and decision contexts—particularly in crises. Collectively, these directions support a transition from conceptual labeling toward more systematic, evidence-informed diagnostic use of complexity profiles in governance and policy design.

Conclusion

This study examines CSPs and introduces a hierarchical framework that synthesizes problem complexity dimensions from 25 influential typologies. By organizing these dimensions as scales across multiple levels of abstraction, the framework clarifies what constitutes complexity and mitigates misclassification risks such as decision paralysis. It also improves analytical precision for both research and practice and links diagnosis to instrument choice, thereby supporting analytical and adaptive policy capacities.

We identify the limits of high-level typologies and show how fine-grained profiles offer richer diagnostics. To support application, we propose three modes of use (diagnostic, reflective, and selection) which align problem diagnosis and governance instruments with the complexity profile of a problem. Combined with profile-based visualizations (e.g., radar diagrams), the framework provides a shared diagnostic language that supports collaboration across disciplines and stakeholder groups, enhances transparency in planning interventions, improves comparability across cases, and facilitates learning within and across organizations.

While dealing with subjectivity and evolving stakeholder perspectives remains challenging, this work opens promising avenues for future research, including integrating stakeholder views, refining dimension-level indicators, validating the framework across domains, and testing visualization formats that improve shared understanding. As a conceptual, integrative synthesis, the study is limited by corpus boundaries and interpretive clustering; future empirical tests and replications using alternative, context-specific corpora are warranted. Ultimately, a fine-grained typology offers a foundation for more robust analysis and actionable strategies, enabling decision-makers to navigate policy complexity with

greater clarity and confidence and providing a coherent basis for ongoing diagnostic practice and a platform for cumulative, policy-relevant research.

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Conflicts of interest

None declared.

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Appendix A Existing CSP typologies and dimensions.

Table A1 Comparison of 29 identified problem complexity typologies in chronological order. A dichotomy has only two categories, a high-level typology has two dimensions; a fine-grained typology has more than two).

Author	Domain	Classification of	Dimensions explicated	Dichotomy	High-level typology	Fine-grained typology
Beer (1967)	Systems, cybernetics	Complex systems	✓		✓	
Özbekhan et al. (1970)	Systems, global issues	Global problems		✓		
Ravetz (1971)	History and philosophy of science	Scientific problems		✓		
Checkland (1972)	Systems, Operations Research/Management Science (OR/MS)	Management problems		✓		
Rittel and Webber (1973)	Policy, planning	Public planning problems		✓		
Simon (1973)	Theoretical problem solving	Design, engineering and planning problems		✓		
Nelson (1974)	Science, Technology & Innovation (STI) studies	Mission-oriented innovation problems		✓		
Ackoff (1974)	Systems, OR/MS	Management problems		✓		
Schön (1983)	Systems, management	Reflective practice problems		✓		
Jackson and Keys (1984)	Systems, OR/MS	Management problems	✓		✓	
Rosenhead (1989)	OR/MS	Ill-structured problems addressed by “problem structuring methods”		✓		
Hoppe (1989)	Policy	Policy problems	✓		✓	
Roth and Senge (1996)	Systems, OR/MS	Organizational decision-making problems	✓		✓	
Heifetz and Laurie (2001)	Business	Leadership decision-making problems		✓		
Snowden (2002)	Management	Complexity in social systems	✓		✓	

(continued)

Table A1 Continued.

Author	Domain	Classification of	Dimensions explicated	Dichotomy	High-level typology	Fine-grained typology
van Bueren et al. (2003)	Policy	Collective action problems	✓			✓
Pidd (2004)	Systems, OR/MS	Complex systems in modeling	✓		✓	
	Policy	Policy problems	✓			✓
Scharmer (2007)	Change management	Complexity	✓		✓	
Levin et al. (2012)	Policy	Policy problems		✓		
Alford and Head (2017); Head (2022)	Policy	Policy problems	✓		✓	✓
Bannink and Trommel (2019)	Policy	Policy problems	✓		✓	
Christensen et al. (2019)	Policy	Policy problems	✓		✓	
Kirschke et al. (2019)	Policy	Policy problems	✓			✓
Noordegraaf et al. (2019)	Policy	Policy problems	✓			✓
Turnbull and Hoppe (2019)	Policy	Policy problems	✓			✓
Wanzenböck et al. (2020)	STI studies	Problem-solution space for mission-oriented policy	✓		✓	
Wittmann et al. (2021)	STI studies	Missions for mission-oriented innovation policy	✓		✓	
Crilly (2025)	Systems, design	Societal problems	✓			✓

Appendix B Mapping of problem complexity dimensions.

We integrated 90 problem complexity dimensions from 25 included problem typologies. The counts per dimension are shown in [Figure B1](#) and the mapping of these dimensions to our own work in [Table B1](#).

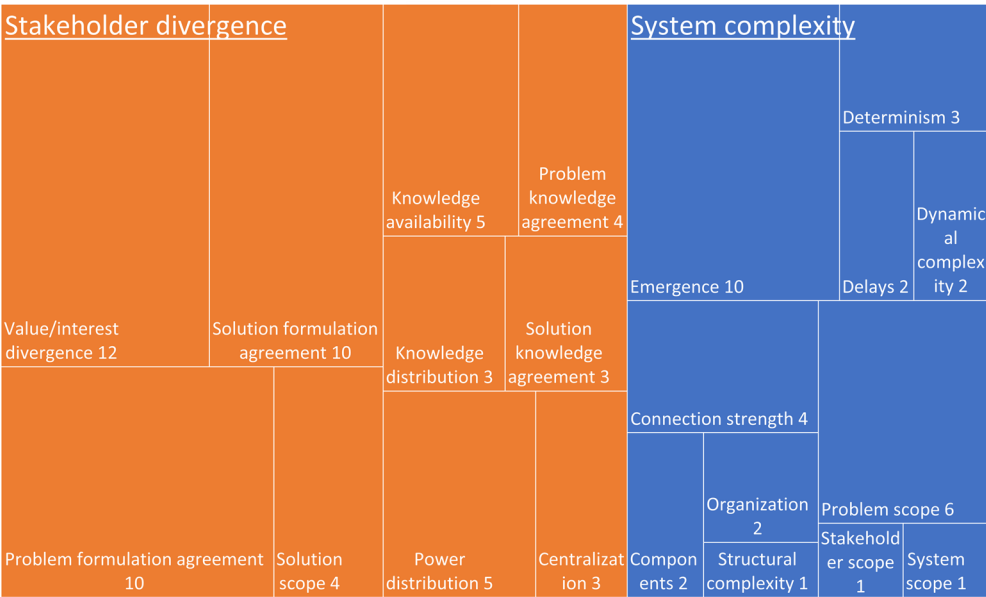


Figure B1 Detailed distribution of problem complexity dimensions per cluster (Source: Authors' own).

Table B1 Mapping of other works' dimensions to our structure of problem complexity dimensions.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Ackoff (1974)	Interconnectedness	The extent to which problems are interrelated and mutually influence each other.	System complexity	Structural complexity	Connection strength
	Decomposability	The extent to which a situation can be effectively broken down into simpler, well-defined subproblems.	System complexity	Structural complexity	Organization
	Solution stability	The extent to which solutions remain valid over time versus being temporary or in flux.	System complexity	Dynamical complexity	Emergence
	Stakeholder diversity	The extent to which diverse stakeholders are required to cooperate to address the problem.	Stakeholder divergence	Power divergence	Power distribution
	Dynamic complexity	The extent to which relationships, priorities, and opportunities change over time.	System complexity	Dynamical complexity	—
Alford and Head (2017); Head (2022)	Stakeholder knowledge	The level of divergence in stakeholder and institutional knowledge (framing differences, knowledge fragmentation).	Stakeholder divergence	Knowledge divergence	Knowledge distribution
	Clarity of the problem	The extent to which the problem is clear versus obscured by hidden or intangible phenomena.	Stakeholder divergence	Knowledge divergence	Problem knowledge agreement
	Clarity of the solution	The extent to which solutions are clear versus requiring iterative discovery across multiple variables.	Stakeholder divergence	Knowledge divergence	Solution knowledge agreement
	Stakeholder power	The level of divergence in stakeholder power, resources, enablers, and constraints.	Stakeholder divergence	Power divergence	Power distribution
	Stakeholder interests or values	The degree of differentiation or conflict between stakeholder interests and values.	Stakeholder divergence	Value and interest divergence	—
	Inherent complexity	The degree to which contradictions, dilemmas, and remedy-caused problems are present for decision-makers.	System complexity	Dynamical complexity	Emergence

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Bannink and Trommel (2019)	Complexity	The extent to which facts about the situation are uncertain or incomplete.	Stakeholder divergence	Knowledge divergence	Knowledge availability
	Conflict	The extent to which preferences or interests among actors are heterogeneous or conflicting.	Stakeholder divergence	Value and interest divergence	—
Beer (1967)	Determinism	The extent to which the system is deterministic (predictable) versus probabilistic (not precisely predictable).	System complexity	Dynamical complexity	Determinism
Checkland (1972)	System complexity	The degree of elaboration and interconnection in the system, from simple to exceedingly complex.	System complexity	Structural complexity	Organization
	Concrete solutions	The extent to which solutions provide final, definitive answers.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Open-endedness	The extent to which inquiry remains never-ending and open to reinterpretation.	System complexity	Dynamical complexity	Emergence
Christensen et al. (2019)	Agreement	The extent to which objectives can be defined and priorities are agreed among stakeholders.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Administrative coordination capacity	The capacity of public administration to get actors to collaborate and cooperate.	Stakeholder divergence	Power divergence	Centralization
Hoppe (1989)	Certainty about relevant knowledge	The extent of certainty concerning knowledge about the situation and how to convert it into a more desirable state.	Stakeholder divergence	Knowledge divergence	Knowledge availability
Jackson (2016); Jackson and Keys (1984)	Consensus on relevant norms and values	The extent to which stakeholders share relevant norms and values.	Stakeholder divergence	Value and interest divergence	—
	Cognitive complexity	The degree of divergence in values and/or interests among those concerned with or affected by the problem.	Stakeholder divergence	Value and interest divergence	—
	Ontological complexity	The degree of complexity in the actual system (components, interactions, adaptability, environmental influence).	System complexity	Structural complexity, Dynamical complexity	—

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Kirschke et al. (2019)	Informational uncertainty	The extent to which information needed for problem-solving is missing or non-manageable.	Stakeholder divergence	Knowledge divergence	Knowledge availability
	Dynamics	The strength of change in variable values over time (ranging from none to linear to exponential).	System complexity	Dynamical complexity	Emergence
	Interconnections	The extent to which variables are interrelated (ranging from none to slight to strong).	System complexity	Structural complexity	Connection strength
	Goals	The extent to which goals are singular versus multiple and prioritized versus non-prioritized.	Stakeholder divergence	Value and interest divergence	—
	Variables	The extent to which the number of factors is low, manageable, or challenging.	System complexity	Structural complexity	Components
Levin et al. (2012)	Degree of central authority	The extent to which strategy can be centrally coordinated and executed with decentralized implementation.	Stakeholder divergence	Power divergence	Centralization
	Degree of urgency	The extent to which time to address the problem is running out or impacts become irreversible.	System complexity	Dynamical complexity	Emergence
	Discounting	The extent to which decisions disregard long-term risks and reflect short-term horizons.	System complexity	System scope	Problem scope
	Emergence	The extent to which the problem emerges from distributed activities without clear boundaries between causes and solutions.	System complexity	Dynamical complexity	Emergence
	Solution criteria	The extent to which criteria exist to determine acceptable solutions (rational or conflict-based).	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
Nelson (1974)	Knowledge focus	The extent to which knowledge can be focused on the search for solutions.	Stakeholder divergence	Value and interest divergence	Solution scope
	Path-dependency	The extent to which historical paths constrain current problem states and options.	System complexity	Dynamical complexity	Emergence
	Problem scope	The extent to which the problem spans system-wide, sectoral, or organizational levels.	System complexity	System scope	Problem scope

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Noordegraaf et al. (2019)	Social pluralism	The extent of multiple interests and values across actors.	Stakeholder divergence	Value and interest divergence	—
	Institutional complexity	The capacity and complexity of interorganizational cooperation and multi-level governance.	Stakeholder divergence	Power divergence	Power distribution
	Scientific insecurity	The extent of fragmentation and gaps in reliable knowledge.	Stakeholder divergence	Knowledge divergence	Knowledge availability, knowledge distribution
Özbekhan et al. (1970)	Metastasis	The extent to which interconnected problems grow dynamically and interactively.	System complexity	Dynamical complexity	Emergence
	Solubility	The extent to which the problem can be solved definitively versus recurring persistently.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Political complexity	The extent of difficulty in negotiating agreements among multiple political interests and actors.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Programmatic complexity (i)	The extent to which citizens understand issues and can intervene effectively in decision-making.	Stakeholder divergence	Knowledge divergence	Knowledge distribution
	Programmatic complexity (ii)	The extent of multiple causation and competing models (and experts).	Stakeholder divergence	Knowledge divergence	Problem knowledge agreement
	Scale	The magnitude of the problem and the range of its effects.	System complexity	System scope	Problem scope
	Divisibility	The extent to which problems entail collective action with diffuse benefits versus appropriable individual benefits.	System complexity	System scope	Problem scope
	Monetarization	The extent to which the problem is phrased in monetary terms or solvable through financial means.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Scope of activity	The extent to which many diverse activities contribute to the problem, affecting feasibility and cost of direct regulation.	System complexity	System scope	Stakeholder scope
	Inter-dependencies	The extent to which problems are confined to a single policy domain versus spanning multiple domains.	System complexity	System scope	Problem scope

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Pidd (2004)	Problem formulation	The extent to which there is clarity and agreement on what needs to be done.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Solution formulation	The extent to which there is clarity and agreement on how the problem should be addressed.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Goal	The extent to which actions serve or achieve human purposes.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Scale	The extent to which large-scale practical problems generate subsidiary technical/scientific problems.	System complexity	System scope	Problem scope
Ravetz (1971)	Purpose conflict	The extent to which agents' private purposes diverge from collectively determined goals.	Stakeholder divergence	Value and interest divergence	—
	Solution availability	The extent to which large-scale practical problems have feasible solutions involving practical projects.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Ineffectiveness of disciplinary knowledge	The extent to which relevant disciplines provide adequate facts versus being immature or ineffective.	Stakeholder divergence	Knowledge divergence	Knowledge availability
	Problem definition clarity	The extent to which the problem can be clearly and definitively formulated.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
Rittel and Webber (1973)	Testability	The extent to which solutions have clear stopping criteria and can be judged by objective truth versus value-laden criteria.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Iterability	The extent to which trial-and-error learning is feasible and mistakes are reversible or tolerable.	System complexity	Dynamical complexity	Emergence
	Interconnectedness	The extent to which the problem is unique yet a symptom of other problems and entangled in larger systems.	System complexity	Structural complexity	Connection strength
	Solution space	The extent to which possible solutions and operations are known and enumerable.	Stakeholder divergence	Value and interest divergence	Solution knowledge agreement
	Problem ambiguity	The extent to which multiple explanations of the problem exist, shaping resolution.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
Roth and Senge (1996)	Behavioral complexity	The extent of diversity in aspirations, mental models, values, and basic assumptions among decision-makers.	Stakeholder divergence	Value and interest divergence	—
	Dynamic complexity	The extent to which cause and effect are distant in time and space.	System complexity	Dynamical complexity	Delays
Scharmer (2007)	Social complexity	The extent to which actors hold different views and interests.	Stakeholder divergence	Value and interest divergence	—
	Dynamic complexity	The extent to which cause and effect are distant in space and time.	System complexity	Dynamical complexity	Delays
Schön (1983)	Emerging complexity	The extent to which disruptive patterns of innovation and change occur.	System complexity	Dynamical complexity	Emergence
	Real-world importance	The extent to which problems are socially significant beyond technical interest.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Solution rigor	The extent to which problems are manageable via formal, research-based technical solutions versus intuition and experiential learning.	Stakeholder divergence	Value and interest divergence	Solution scope
	Problem complexity	The extent to which problem definitions are clear and stable versus uncertain with conflicting interpretations in dynamic contexts.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
Snowden (2002)	Central direction	The extent to which actions are guided by central direction.	Stakeholder divergence	Power divergence	Centralization
	Connection strength	The strength of connections among constituent components.	System complexity	Structural complexity	Connection strength
Turnbull and Hoppe (2019)	System behavior	The extent to which system behavior is ordered (simple/complicated) versus complex/chaotic or disordered.	System complexity	Dynamical complexity	Determinism
	Problem distance	The extent of inherent uncertainties and ambiguities in discovering and defining policy problems.	Stakeholder divergence	Knowledge divergence	Problem knowledge agreement
	Solution distance	The extent to which solutions are partial and contested.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Process distance	The extent to which the policy process is inherently political.	Stakeholder divergence	Value and interest divergence	—
	Political distance	The distance between actors in ideas/values, institutions, and interests, pursued through practices.	Stakeholder divergence	Value and interest divergence	—

(continued)

Table B1 Continued.

Author	Concept	Description	Hierarchical structure of problem complexity dimensions		
			Level 1	Level 2	Level 3
van Bueren et al. (2003)	Institutional uncertainty	The extent of uncertainty arising from highly fragmented decision-making across policy arenas and networks.	Stakeholder divergence	Power divergence	Power distribution
	Strategic uncertainty	The extent to which diverging and conflicting strategies based on differing perceptions cause stagnation or unexpected outcomes.	Stakeholder divergence	Value and interest divergence	—
	Cognitive uncertainty	The extent to which causes and effects are numerous, interrelated, and difficult to identify.	System complexity	Dynamical complexity	Determinism
	Problem uncertainty	The extent of limited knowledge or evidence about risks, cause-consequence relationships, and side-effects of (in)action, including knowledge fragmentation across stakeholders.	Stakeholder divergence	Knowledge divergence	Problem knowledge agreement
Wanzenböck et al. (2020)	Solution uncertainty	The extent of limited knowledge about the availability or feasibility of solutions, with multiple promising options and no clear best choice in time.	Stakeholder divergence	Knowledge divergence	Solution knowledge agreement
	Problem contestation	The extent of normativity, divergent claims and framings, and conflicts of interest related to the policy issue.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Solution contestation	The extent of contestation around solution feasibility and impacts on businesses, users, or society.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Solution complexity	The extent to which novel solutions co-depend on other technologies or require radical changes in social practices and broader system restructuring.	System complexity	System scope	Solution scope
Wittmann et al. (2021)	Problem complexity	The extent to which problems are multi-scalar and multi-dimensional, with unclear responsibilities.	System complexity	Structural complexity	Components
	Type of problem	The extent to which framing ranges from market failure to structural or transformational system failure.	Stakeholder divergence	Value and interest divergence	Problem formulation agreement
	Type of solution	The extent of desired change, from scientific innovation to regulatory/technological change to system transformation and behavioral change.	Stakeholder divergence	Value and interest divergence	Solution scope
	Problem- or goal-orientation	The extent to which a solution is already articulated as a goal versus being problem-oriented.	Stakeholder divergence	Value and interest divergence	Solution formulation agreement
	Demand for governance	The level of demand for governance and coordination of stakeholders.	Stakeholder divergence	Power divergence	Power distribution

Appendix C Dimensions of problem complexity.

The structure is based on the synthesis of problem complexity dimensions in 25 problem typologies, as shown in [Table C1](#). For the mapping of the dimensions in other works to our own typology, see [Table B1](#).

Table C1 Hierarchical structure of CSP dimensions.

Level 1	Level 2	Level 3	Definition
System complexity	Structural complexity	Components	The complexity of problems as determined by the number, scope, and manageability of constituent factors and their institutional characteristics.
		Connection strength	The extent and strength of linkages among variables, problems, and system components, including whether problems are unique or symptoms of larger entanglements.
		Organization	The structural nature of systems and the degree to which problems can be decomposed and described.
		Determinism	The degree to which systems are predictable and ordered versus probabilistic, complex, chaotic, or disordered.
	Dynamical complexity	Delays	How far in space and time causes and effects are separated, complicating observation and intervention.
		Emergence	The dynamic, path-dependent nature of problems and solution, including evolving variables, urgency, innovation patterns, and metastasis.
		Problem scope	The breadth and scale of the problem across systems, sectors, domains, and effects.
	System scope	Stakeholder scope	How many and what kinds of activities/actors contribute to the problem, influencing feasibility and cost of interventions.
		Problem formulation agreement	The shared clarity, criteria, and consensus on how solutions should be defined, evaluated, and justified.
		Solution formulation agreement	The clarity, stability, and shared understanding of the problem's definition, goals, and norms among stakeholders.
Stakeholder divergence	Value and interest divergence	Solution scope	The breadth, rigor, and nature of desired changes, spanning innovation, regulatory shifts, system transformation, and behavioral/practice change.
		Knowledge availability	Whether adequate facts and information exist to understand the situation and act, recognizing uncertainty and immaturity in disciplines.
		Knowledge distribution	How knowledge is fragmented or differently framed among stakeholders and institutions, affecting problem understanding and action.
	Power divergence	Problem recognition	The degree of shared understanding about the problem's causes, evidence, and framing across stakeholders.
		Solution recognition	The extent to which stakeholders share knowledge on solution clarity, feasibility, and enumerability.
		Centralization	The extent to which strategy, coordination, and direction are centralized versus distributed across actors.
	Power divergence	Power distribution	How power, resources, and decision-making capacity are spread across stakeholders and institutions; how fragmentation affects action.

Appendix D Misclassification risks.

Problem classification is inherently subjective, as different stakeholders will have different concepts of complexity and divergence. The implication is that an inconsistent problem perspective poses certain risks. The potential risks of misclassification are shown in [Table D1](#).

Table D1 Risks associated with different views on system complexity and stakeholder divergence.

		Stakeholder divergence	
		Low	High
System complexity	Low	Tame complexities <i>Risk: Underestimating potential challenges</i> • Overlooking hidden system interactions • Overly simplistic solutions • Narrow system scope, missing critical and valuable stakeholder insights • Failure to anticipate emerging stakeholder conflict	Social dilemmas <i>Risk: Focus on the wrong issues</i> • Underestimating the system’s ability to accommodate diverse stakeholder needs • Overreliance on stakeholder management at the expense of social or technological innovations • Stakeholder scope creep reducing effectiveness • Missed opportunities for finding common ground among stakeholders
	High	Complex analytical problems <i>Risk: Overcomplicating solutions</i> • Excessive analysis • Overengineering solutions that may still have unintended consequences • Scope extended beyond manageable limits • Narrow stakeholder scope, overlooking potential stakeholder conflict that arises from complex solutions	Complex societal problems <i>Risk: Paralysis</i> • Overcomplicated problem definition that paralyzes decision-making • Excessive caution and delayed action due to perceived complexity and conflict • Failure to recognize simpler solutions or areas of stakeholder agreement • Scope extended beyond manageable limits • Overallocation of resources to stakeholder management, endless negotiation