Governance systems and institutional arrangements for STE resilience
D.s16. Building STE system resilience through Institutions & Governance: Reflections from theory and practice

Informing the governance of STE resilience by integrated and normative perspectives

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Summary
There is a need to approach the concept of resilience from a more integrated as well as normative perspective. It cannot be a purpose in itself and it relates to a variety of phenomena which need to be taken into account explicitly. Resilience cannot be an alternative for a sustainability focus; rather the two concepts represent two mutually complementing perspectives. This paper presents opportunities which the theory of modal aspects (TOMA) offers for developing such integrated and normative perspectives on resilience (innovations) in the context of sustainability ambitions. It demonstrates TOMA's potential to inform model design and selecting indicators for evaluating STE resilience, and to generate rich perspectives on what needs to be considered conceptually and practically in making resilience work for sustainable development.

Keywords
Resilience Capacity; Resilience Thinking; Sustainability; Vulnerability; Multi-Aspectual Analysis

1. Introduction

In this paper, we explore two areas of thinking in relation to resilience: normative perspectives, and integrated perspectives. In combination, we apply this towards a governance perspective on making resilience work for sustainable development (cf Joseph and McGregor, 2020; Marchese et al. 2018). Our exploration is guided by the theory of modal aspects (TOMA) and this paper seeks to examen its usefulness in this context.

Resilience is not a purpose in itself. Related processes of absorption, adaptation, and transformation (Folke et al. 2010; Meuwissen et al. 2019) are meant to serve a purpose, which is often referred to as being able to continue to achieve desired system functions such as stability, security, or sufficiency. This leads to two questions: what type of things can be resilient, and what type of system functions may be served through resilience? We argue that creating a systemic perspective on such typologies would serve resilience innovation and resilience engineering in two ways. First, by providing integrated perspectives on the types of things that can be resilient or lack resilience, and by doing so help to create an overview regarding options for building system resilience. Second, by informing normative perspectives on the types of system functions that may be served through resilience by clarifying which functions are and are not served, as well as related trade-offs (cf. Keessen et al. 2013). For example, building climate resilience through a focus on maintaining certain production levels, may come at the expense of maintaining fair distribution of benefits between different groups in society.

In the following, we briefly introduce TOMA, then illustrate examples of its use in the context of resilience and sustainability concerns (cf. Gillespie-Marthaler et al. 2019), and we close with a reflection on the relevance for considering the relation between institutions and governance arrangements, and STE system resilience.

2. The theory of modal aspects (TOMA)

TOMA is based on a number of premises which are informed by observing patterns in everyday experience. First, it argues that all entities – though in different ways – can be evaluated from the perspective of each of the aspects presented in Figure 1 (Basden, 2019; Brandon and Lombardi, 2010; Wigboldus and Jochemsen, 2020). They are referred to as modal aspects because they relate to a category (modality) which cannot be described by a single word. Second, it argues that distinguishing aspects serves to order our perception of reality and helps to identify ways in which things do or do not make sense (Basden, 2019). Whether formal or informal, all analytical thinking presumes a set of aspects (Basden, 2011). This way of understanding the world is conducive in particular to the various scientific disciplines that tend to take a particular aspect of everyday experience as their focus of study. Third, the 15 aspects follow a particular order that build up gradually from first (quantitative) to last (pistic). Each aspect is distinct from all others, precluding reductionism, yet each aspect coheres with the others in various ways (Basden 2019). Things (entities, processes) function in all aspects simultaneously and no aspect undermines any of the others as they are considered equally important.

Modal aspects	**Related basic questions**	**What resilience innovations may relate to**, e.g. changing ...
Quantitative	How many?	... numbers and amounts
Spatial	Where? How big?	... locations, scales, and patterns of spreading
Kinematic/ kinetic	Is there movement? Where, how fast, in what direction?	... flows and networks
Physical	What substance, what energy levels?	... levels of energy (supply) and non-organic resources
Biotic	What forms of life present?	... thriving?, growth rates, yields, organic resources
Sensitive/ psychic	How perceived?	... feelings, perceptions and observations
Analytical	What distinctions can be made?	... ways of conceptualising
Formative	How can be intervened?	... ways of shaping social and physical reality
Lingual/ symbolic	What are meaningful symbols?	... ways of framing, communication
Social	What social interaction/ communion?	... social relationships, participation
Economic	What are ways of efficient provision?	... way of efficient provisioning; adding value
Aesthetic	What is enjoyed, cherished?	... what is enjoyed, appreciated
Jural	How to give each its/his/her due?	.... regulations, laws and their implementation
Ethical	What is considered to be good?	... sense of responsibility, accountability
Pistic/ fiduciary	What are the beliefs, the values?	... core motivations, paradigms

Figure 1: A brief outline of the fifteen aspects of the theory of modal aspects (adapted from Wigboldus and Jochemsen, 2020)

3. Results

Wigboldus and Jochemsen (2020) discuss a perspective on fifteen aspects of sustainability and how an integral approach to leveraging sustainability transformations (cf. the seventeen Sustainable Development Goals) needs to simultaneously pay attention to each of these aspects of sustainability. Exploring system functions along the lines of the fifteen aspects shows a clear overlap between system function orientation and a sustainability orientation (Figure 2). Thus, it offers a systemic perspective on the connection between resilience (as property) and sustainability (as purpose).

Modal aspects	**Types of (STE) vulnerabilities**	**Types of resilience (capacity)**	**Purpose orientation:** System functions and related sustainability aspirations
Quantitative	Fragile basis for sustaining sufficiency in terms of e.g. financial assets	Ability to maintain/restore needed amounts (e.g. quantitative buffers)	Sufficiency
Spatial	Fragile basis for sustaining needed space, volume, land	Ability to maintain/restore needed space	Proportionality, scalability, land security
Kinematic	Fragile basis for sustaining movements and mobility	Ability to maintain/restore needed movement, mobility	Circularity, mobility, continuity/ constancy, flexibility
Physical	Fragile/sensitive structures, materials, and sources of energy	Ability to acquire, maintain/restore needed energy, materials and structures	Sourceability, availability, accessibility
Biotic	Fragile basis for sustaining life (functions), ecosystems, health	Ability to maintain/restore needed life functions, ecosystem functions/ services	Biodiversity, health (security)
Sensitive	Fragile/sensitive basis for sustaining e.g. mental health	Ability to maintain/restore needed sound perceptions, emotions	Sensibility, security; mental health; proper functioning of senses
Analytical	Fragile basis for obtaining and sustaining knowledge, sense-making and understanding	Ability to maintain/restore needed clarity of understanding	Validity, factuality; clarity of concepts and theories; proper functioning of mind
Formative	Fragile/fractured basis for sustaining production processes; lack of adequate technology	Ability to maintain/restore needed production/ construction supporting factors	Functionality, productivity, utility; adequate, responsible technology
Lingual	Fragile basis for sustaining clear symbols, communication, and interpretation	Ability to maintain/restore needed proper interpretation, and communication quality and channels	Intelligibility, evidentiality; proper interpretation and translation
Social	Fragile/sensitive basis for sustaining social interaction/ relationships; Disfunctioning social structures	Ability to maintain/restore needed social interactions	Inclusiveness, equity, well-functioning of adequate social structures,
Economic	Fragile/sensitive basis for sustaining prudent provisioning	Ability to maintain/restore needed efficient provisioning	Affordability, efficiency, caring and sharing
Aesthetical	Fragile/sensitive basis for sustaining beauty and enjoyment; harmonious development	Ability to maintain/restore needed beauty, enjoyment, recreation	Appeal, beauty, recreation, harmony
Jural/ Juridical	Fragile basis for realising justice, sustaining law and order and/or regulatory frameworks	Ability to maintain/restore needed law and order; community acceptance of proper functioning judicial system	Legality, legitimacy; Implementation of justice; positive law is serving justice
Ethical	Fragile basis for sustaining norms, accountability, love and solidarity	Ability to maintain/restore needed love, solidarity, accountability; moral capital	Accountability, responsibility, integrity (norms)
Pistic/ fiduciary	Fragile basis for sustaining trust, hope, and commitment to values	Ability to maintain/restore needed fundamental trust and hope	Trustworthiness, providing hope, committed to core values; freedom of conscience

Figure 2: Creating an integrated perspective on vulnerability, resilience and sustainability using TOMA

Applying the philosophy underpinning TOMA implies that resilience of any entity is vested in resilience capacity related to each of the modal aspects. Thus, it may open eyes to opportunities for strengthening resilience in quite other ways than common approaches tend to highlight. Also, it alerts to reductionist perspectives of narrow resilience which is only focusing on resilience in some aspects without paying due attention for resilience in other aspects. Figure 3 illustrates how TOMA can help create a dynamic perspective on the way in which a resilience response to a particular (exposed) vulnerability may address a particular sustainability concern, while putting another sustainability concern at risk. An overview such as this table may help as a reference framework in considering the appropriateness of introducing resilience innovations.

Modal aspects	**Typical (STE) vulnerabilities**	**Related resilience response (innovation)**	**Related sustainability focus**	**Resilient sustainability perspective**
Quantitative	Limited/ vulnerable stocks	Change in terms of quantities (numbers)	Sustaining sufficiency	
Spatial				Sufficiency where?
Kinematic				How regenerative is this sufficiency?
Physical				Sufficiency of what exactly?
Analytical				How sure are we that this is sufficient, and for how long?
Social				Sufficiency of what for who exactly?
Economic				How efficient?
Jural/ Juridical				How legitimate?

Figure 3: Example of considering implications of particular resilience innovations for different system functions and related sustainability concerns

Figure 4 illustrates opportunities for using TOMA to create a dynamic, integral perspective on shocks/stresses resulting from extreme events, and the cascading effects and related multiple resilience needs. For example, COVID-19 began as a biotic shock, but gradually created shocks in all 15 aspects, testing resilience and exposing vulnerabilities in all related domains.

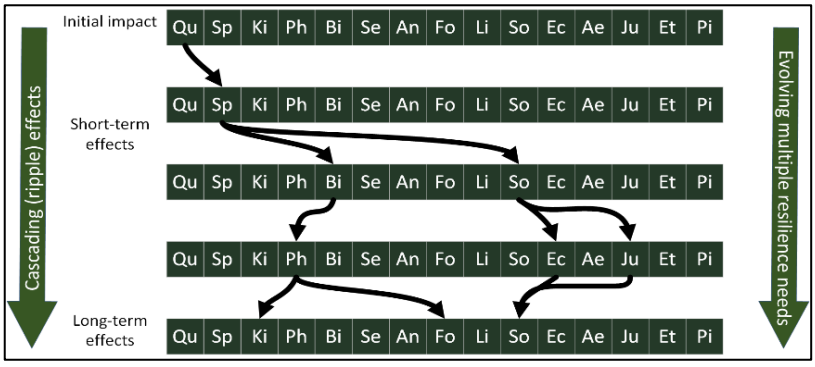

Figure 4: Using TOMA to create unfolding narratives to explore multiple resilience needs in response to extreme events (source: the authors)

In the same way as scientific disciplines take particular aspects as their focus, leading to the need for interdisciplinarity, different institutions and governance arrangements will take particular aspects as their focus. Sustainability concerns, resilience needs, and related trade-offs will need to be considered across different scales, across different spheres of life, and across stakeholder interests. This requires a consistent perspective that can be applied across such different dimensions. TOMA offers opportunities for doing so. Though based on a particular ontology that distinguishes the aspects in all things, it does not have any underlying political orientation, thus enabling the characterization of any such orientation along the lines of the aspects.

4. Discussion

The application of TOMA in the field of resilience thinking illustrates its usefulness in creating systemic perspectives on a variety of ways in which resilience can work for sustainable development. It offers a reference framework for identifying the focus (and what is not part of the focus) of different approaches to resilience engineering. This may also reveal particular underpinning ideological and political orientations (Chandler, 2014; Humbert and Joseph, 2019).

TOMA offers opportunities for systemically and systematically exploring the way in which institutions and governance enable and/or constrain resilience and what this means for needed designs and interventions. It may be used to explore how institutions and governance arrangements 1) *inform* priorities and trade-offs made in relation to system functions, how they 2) *influence* (e.g. contribute to) STE system vulnerability, and how they 3) provide capacities and opportunities which may be *accessed*

to build and sustain STE system resilience (Figure 5). In similar ways it can help to explore implications for resilience response options (e.g. providing new opportunities for adaptation or transformation).
Brandon and Lombardi (2010) used TOMA to systematically and systemically evaluate sustainable development in the built environment. In similar ways, TOMA may be used to evaluate ways in which institutions and governance arrangements shape and/or constrain conditions for STE system resilience.

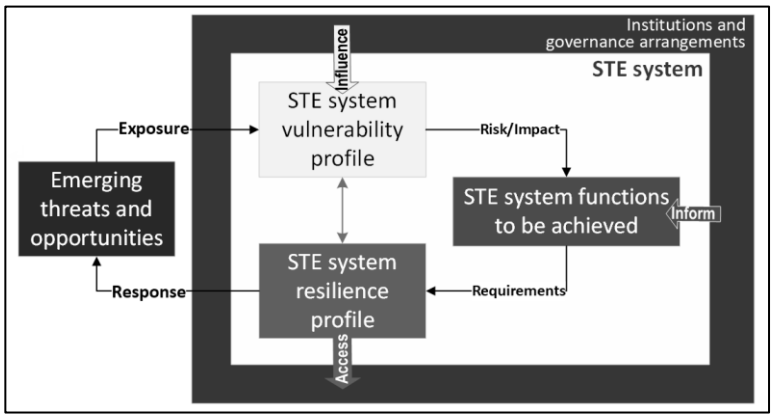

Figure 5: TOMA offers opportunities for systematically unpacking dimensions of STE system resilience (source: the authors)

5. Conclusion

Getting to grips with the concept and practice of resilience requires activating integral perspectives on types of resilience, as well as enabling normative perspectives on what resilience is meant to serve (in terms of system functions and related sustainability concerns). This also applies to creating an appropriate understanding about the way in which institutions and governance arrangements inform, influence, and provide opportunities for STE system resilience. In this paper, we explored opportunities that the theory of modal aspects (TOMA) offers in relation to this. The next step will be to translate this conceptual perspective into practical applications.

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