Observing Across Systems: Systemic Observational Capacity for DSM-Based Complexity Management

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1 Introduction and DSM-Based Research Problem

Dependency and Structure Modeling (DSM) provides powerful means of representing elements, interfaces and dependencies within complex systems, making structural patterns explicit for analysis and decision-making (Eppinger and Browning, 2012; Lindemann et al., 2009). Yet representation begins with observation: a relationship can enter a model only after it becomes recognisable as potentially relevant from a situated position within the system. This raises a complementary complexity-management question: how does an observer's position influence which relationships become salient, which remain peripheral, and how connections across systems are interpreted?

Observation is treated here as situated rather than neutral. Organisational actors encounter complexity through different responsibilities, professional languages, relationships, constraints and temporal horizons. Boundary-spanning research has long shown that some roles connect otherwise separated domains (Aldrich and Herker, 1977), while later work demonstrates that occupying such a role does not itself guarantee boundary-spanning competence (Levina and Vaast, 2005). We therefore distinguish observational position, relational access and observational capacity. A transversal position may create distinctive access across strategic, operational, disciplinary or institutional boundaries, but access alone does not ensure that the relationships made available by that position are recognised or connected.

This paper asks: RQ1 — How does observational position influence the capacity to recognise relationships across complex organisational systems, particularly in DSM-based complexity management? We propose that the relevance of integrative observational positions lies less in providing a more complete or superior view of the system than in creating conditions for movement across multiple partial views. The core proposition is simple: position provides access; access creates possibilities for observation; neither guarantees systemic observational capacity.

2 From DSM Viewpoints to Systemic Observational Capacity

Complexity and systems literatures already caution against treating any representation as complete. Boundaries are necessary for knowledge but also limit it (Cilliers, 2005). Organisational sensemaking emphasises the situated interpretation of cues (Weick, 1995), the attention-based view shows that organisational structures shape what decision-makers attend to (Ocasio, 1997), and temporal work demonstrates that actors continually reconstruct relations among past, present and future (Kaplan and Orlikowski, 2013). The contribution proposed here is therefore not the claim that observers are situated, that attention is selective or that multiple perspectives exist. It concerns what happens between access to multiple representations or viewpoints and the capacity to observe systemically across them.

We define systemic observational capacity as the ability to move reflexively between partial observational positions, relate what becomes visible from each, notice tensions, absences and discontinuities between perspectives, and revise interpretations as contexts, relationships and consequences evolve. It is not equivalent to accumulating more information or constructing a total representation. Rather, it concerns movement across functional, disciplinary, hierarchical, institutional and temporal boundaries without mistaking any partial view for the whole.

For DSM-based work, this construct complements rather than replaces structural and computational representation. A matrix or multidomain model can make dependencies explicit, but the selection, interpretation and continued reconsideration of those dependencies remain linked to the positions and capacities of the people using the representation. Systemic observational capacity therefore focuses on the transition from having access to multiple models, matrices or viewpoints to being able to question and connect across them.

Figure 1 summarizes this transition from partial positions and relational access to DSM viewpoints and systemic observational capacity

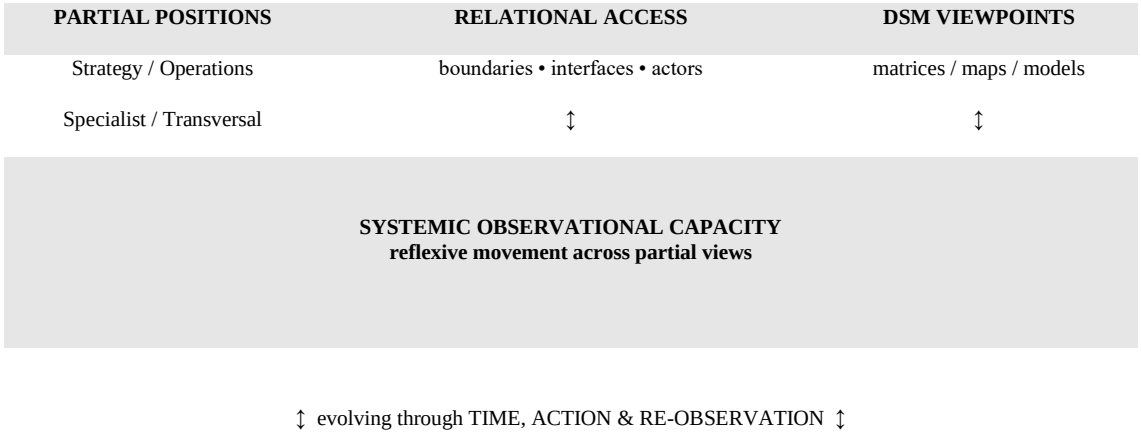

Figure 1. Conceptual relationship between partial observational positions, relational access, DSM viewpoints and systemic observational capacity. The lower field indicates recursive reconfiguration through time, action and re-observation.

3 Development, Human–AI Mediation and Research Agenda

If systemic observational capacity is distinct from positional access, a subsequent question is whether it can be deliberately developed. Experience may broaden relational exposure while also reinforcing established interpretative patterns. We therefore propose RQ2: Can systemic observational capacity be deliberately cultivated? Future empirical work should examine practices that strengthen reflexivity, diversify attention and support movement across organisational boundaries, scales and temporal horizons. ECAT — Embodied Creativity Across Time — is introduced only as an emerging architecture for investigating these relational, reflexive, temporal and embodied dynamics, not as a validated method.

Human–AI collaboration extends the same problem. AI can broaden the observational field by detecting patterns and connecting domains, but greater visibility does not necessarily produce better systemic observation. Automation and augmentation are interdependent rather than simple alternatives (Raisch and Krakowski, 2021); technological mediation may also privilege what is easier to represent or reinforce existing interpretative frames. This motivates RQ3: How might human–AI collaboration expand or constrain systemic observational capacity in DSM-based complexity management? Rather than treating AI solely as an analytical tool, we propose examining the human–AI observational relationship: what becomes observable, questioned and actionable through their interaction that might not emerge in the same way from either independently.

The paper therefore proposes a focused contribution to DSM-based complexity management. Systemic observational capacity names the under-examined transition between access to multiple representations and effective observation across them. Future comparative studies across advisory, managerial, design, project and boundary-spanning roles could distinguish effects of organisational position from individual capacity; longitudinal studies could examine how this capacity develops; and DSM-based studies involving AI could investigate when technological mediation expands or constrains observational diversity. Managing complexity requires attention not only to the relationships represented within a system, but also to the positions and capacities through which those relationships become observable.

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