



Soft Systems Methodology (SSM) as an approach to the safety management of nuclear facilities: a case report

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1. Introduction

Building upon the foundations of Soft Systems Methodology (SSM) as laid out by Peter Checkland [1] and echoed in critical literature by Systems Thinking researchers, such as Checkland's contemporaries, influential scholars in the field like Russell L. Ackoff [2], and later contributors to the discourse on SSM such as Gerald Midgley [3], the GASSST - Sociotechnical Systems Safety Analysis Group offers a nuanced perspective that combines theoretical insights with practical experiences. The theoretical underpinnings of SSM, with its emphasis on distinguishing "soft" and "hard" systems and addressing complex, unstructured issues, provide the backdrop for GASSST's exploration of the methodology's application in real-world organizational challenges.

Checkland's conceptual distinction between "soft" and "hard" systems serves as a framework for approaching complex, unstructured issues. SSM, characterized by a participatory approach, becomes a powerful tool in navigating the intricacies of organizational challenges. This methodology actively involves diverse stakeholders, fostering collaboration and inclusivity throughout problem-solving processes. The utilization of key mechanisms such as Rich Picture Development, Root Definition, Conceptual Models, Boundary Critique, and Feasibility and Desirability Assessment guides stakeholders through iterative steps, facilitating the development of shared understanding and comprehensive solutions [4–5].

Rich Picture Development: SSM starts with the creation of a rich picture, which is a visual representation of the problem situation. The Rich Picture captures multiple perspectives, concerns, and issues expressed by the stakeholders. By collaboratively constructing the Rich Picture, stakeholders can identify areas of agreement, divergence, and potential conflicts, fostering a shared understanding of the problem context.

Root Definition: The next step in SSM is to develop a root definition, which is a concise description of the problem situation agreed upon by the stakeholders. This process encourages stakeholders to find common ground and articulate their concerns and aspirations in a mutually comprehensible way. The root definition serves as a foundation for exploring potential solutions that accommodate different concerns.

Conceptual Models and Comparison: SSM utilizes the development of conceptual models to explore and evaluate different solution ideas. Stakeholders contribute their perspectives, insights, and concerns in constructing these models. Through iterative discussions and feedback, the models can be refined to better accommodate various stakeholder concerns. The models also facilitate the comparison and evaluation of different solution options, considering their implications for each stakeholder.

Boundary Critique: SSM encourages stakeholders to challenge and refine the boundaries of the system being analyzed. This involves questioning the scope and assumptions made in defining the problem situation and considering alternative boundaries that may better accommodate different concerns. By engaging in

boundary critique, stakeholders can broaden their perspectives and explore potential accommodations among different actors.

Feasibility and Desirability Assessment: SSM incorporates feasibility and desirability assessments as part of the process. Stakeholders collectively evaluate potential solutions based on their practicality, resource availability, and alignment with stakeholders' values and aspirations. This assessment helps identify solutions that are both feasible and desirable, taking into account the different concerns and interests of the actors involved.

GASSST emphasizes the clarity inherent in Checkland's concepts, recognizing their utility in dissecting multifaceted problems. However, the group also acknowledges the imperative for readers to embrace an interpretive and subjectivist paradigm, as SSM inherently involves the perspectives and interpretations of those engaged in the process. In delving into critical literature, GASSST identifies perceived limitations within SSM. These include concerns about potential self-containment, challenges in addressing power relations and policies comprehensively, and reservations regarding objectivity, rigor, scope, and complexity [6, 7–10].

This study lays the groundwork for a comprehensive exploration of SSM's application in the context of nuclear facility safety. By combining theoretical underpinnings with practical insights, the GASSST group contributes valuable perspectives to the ongoing discourse on SSM's efficacy in addressing complex organizational challenges. The subsequent sections of this study delve into the intricacies of the application process, challenges faced, and the lessons learned, offering a holistic view of the GASSST group's engagement with Soft Systems Methodology.

Furthermore, this study endeavors to provide a bridge between the theoretical richness of SSM, as articulated by Checkland and other scholars, and the real-world application within the complex landscape of nuclear facility safety. SSM's theoretical foundation, rooted in the understanding of systems as human activity systems, aligns with the intricate dynamics inherent in safety management within nuclear institutions. The GASSST group seeks to navigate this convergence by not only drawing from established SSM principles but also by unraveling the practical implications and challenges encountered during their application. As organizations grapple with multifaceted issues influenced by both technical and human factors, the fusion of theory and application becomes paramount in crafting effective methodologies for systemic problem-solving. This study, therefore, serves as a crucial juncture in illuminating the symbiotic relationship between SSM theory and its pragmatic utility in addressing the complex organizational intricacies of nuclear safety.

2. Methodology

The application of Soft Systems Methodology (SSM) by the GASSST - Sociotechnical Systems Safety Analysis Group focused on addressing safety issues related to radioactive waste management within the Nuclear and Energy Research Institute in São Paulo, Brazil (IPEN-CNEN/SP). This six-month project aimed to navigate the complexities of a multifaceted problem involving both technical and human aspects, particularly unauthorized access to controlled areas.

The SSM application involved a structured process, starting with the collection of objective data and followed by in-depth interviews with various stakeholders, including researchers, technicians, administrators, assistants, security personnel, and students. The identified problem necessitated a comprehensive understanding of conflicting perspectives and priorities among these diverse groups. Throughout the application, the GASSST group attempted to create Rich Pictures—a visual representation of the problem—facing challenges in balancing detail and abstraction.

One notable aspect of the project was the impact of the ongoing pandemic, which disrupted the planned SSM study. Despite the challenges, the group observed positive developments, such as increased openness and participativity among the staff. The project concluded with improvements in the identified problem situation, showcasing the potential of SSM to instigate positive changes even before the completion of the intervention.

The GASSST group acknowledges the learning curve associated with the application of SSM and aims to refine its approach in future applications. The experiences documented in this study serve as valuable insights for understanding the practical challenges of applying SSM in real-world, dynamic organizational contexts. The methodology's potential impact on complex organizational challenges, as observed in the nuclear safety domain, underscores the relevance of SSM in facilitating effective problem-solving processes.

Despite the project's limitations and disruptions, the GASSST group emphasizes the importance of continuous learning and adaptation in the application of SSM. The methodology's participatory nature proved beneficial in fostering collaboration and inclusivity, aligning with the principles laid out in the theoretical foundations. The GASSST group looks forward to building on these experiences and further refining its facilitation skills to address future complex organizational challenges using SSM.

3. Results and Discussion

The GASSST team recognized an asymmetry in information sharing, where individuals with less influential roles displayed a willingness to openly discuss problems, attributing their engagement to a sense of being valued for their perspectives. In contrast, senior staff members provided insights that were impersonal and reserved, avoiding direct engagement with core issues. This observation led the team to identify an underlying conflict, subtly masked by political correctness and compounded by communication challenges arising from interpersonal issues within the organization.

A notable revelation occurred during the interview process, as the staff, independently and proactively, initiated interventions to address the identified problem. This unexpected initiative prompted the GASSST team to reassess their approach, realizing that the act of being interviewed seemed to motivate staff members to autonomously address the problematic situation. Interestingly, the solution emerged organically, even before the formal intervention by the Group concluded.

As novice facilitators, GASSST faced multifaceted challenges. The limited familiarity with SSM concepts posed a hurdle in providing effective guidance, risking potential confusion or missed learning opportunities. Managing group dynamics, including conflict resolution and fostering collaboration, proved to be demanding for individuals with limited facilitation experience. Striking the right balance between structure and flexibility emerged as a crucial challenge, with the team grappling to find the optimal equilibrium during workshops. The complexity of the identified problem further tested their ability to comprehend intricate interrelationships, and unforeseen challenges necessitated adaptive thinking and on-the-spot adjustments.

Additionally, seeking mentorship or guidance in a relatively small SSM community in Brazil posed a unique challenge. The scarcity of experienced SSM practitioners limited the opportunities for the GASSST team to learn from established professionals in the field. Despite these challenges, the team expressed a commitment to their growth as an emerging SSM team, emphasizing the importance of acquiring a comprehensive understanding of SSM principles, gaining practical experience, and meticulous preparation before workshops.

In their reflective discussion, GASSST underscored the significance of continuous learning and adaptation

in the application of SSM. Recognizing that each situation presents unique dynamics, the team emphasized the need for a nuanced and context-specific approach in navigating the complexities of organizational challenges. The acknowledgment of the learning curve and the proactive commitment to refinement underscored the team's dedication to enhancing their capabilities in future SSM applications.

4. Conclusions

In future applications of Soft Systems Methodology (SSM), the GASSST team acknowledges challenges in promoting open perspectives within the Rich Picture without causing conflicts, emphasizing the importance of shorter notice in its presentation. The prompt application of SSM is deemed crucial for success, yet the team recognizes the need to avoid excessive focus on details and perfectionism, especially given their collective inexperience. Committed to improving facilitation skills, the team aims to overcome these challenges, aspiring to effectively apply SSM in future problem-solving contexts. The practical insights gained from this study offer valuable lessons, providing guidance for researchers and practitioners seeking to navigate complex problem situations with efficiency and effectiveness using SSM.

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