

# Applying a Framework for Complementarist Intervention Approaches to Service Organizations to Achieve a Sustainable Holistic Management Model

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**Abstract** Organizational management often faces complex problem contexts, requiring intervention for improvement. Many intervention approaches exist to achieve a purpose in real world applications. Each intervention approach was developed with a specific world view (weltanschauung), dictating its methods and purpose. In a complex problem context, a single intervention approach is insufficient to address all challenges faced. Combining multiple intervention approaches, bringing differing perspectives, facilitates holistic action. Several methodologies have been developed to combine multiple perspectives, including soft systems methodology (SSM), total systems intervention (TSI), creative design of methods (CDM), and boundary critique. Each of these methods has strengths and weaknesses. A barrier to their use in organizations is the requirement for systems thinking education. This paper presents a framework for defining and selecting approaches for intervention in complex problem contexts. It also provides a method for utilizing this framework to design holistic and effective interventions. A case study is discussed, where the proposed framework and method are applied to a small non-profit service organization that performs knowledge-based work in a dynamic environment. The proposed framework and application method are presented through (1) description of the need, (2) review of contributing literature, (3) presentation of the framework, (4) description of the method, and (5) illustration in the case study organization. Limitations, future development, and scope of applications of the proposed framework and method are discussed.

**Keywords** Critical systems thinking · System of systems methodologies · Total systems intervention · Creative design of methods · Boundary critique · Complementarist approach

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## Introduction

Systems thinking has become a driver of organizational management. It can be used to gain a holistic perspective of an organization and design appropriate and effective solutions to management challenges (Jackson 2003). Some systems thinking methodologies are primarily theoretical and do not provide much guidance for practitioners. Additionally, those who are not well educated in the field of systems thinking may find its methodologies inaccessible (Jackson 2003). Midgley et al. (1998) discuss a case where systems language created a communication barrier between researchers and organizational management. This presented challenges in comprehension for management and risked creating the impression that researchers were not valuing the perspectives of managers. Systems thinking researchers can benefit organizational managers by designing methods in which systemic practices and concepts are encapsulated. This will allow stakeholders, including managers, to benefit from systemic practices without having education in systems thinking.

Systemic methodologies such as soft systems methodology, total systems intervention, creative design of methods, and boundary critique are concerned with combining multiple world views (*weltanschauungen*). These methodologies can be applied to combine multiple intervention approaches [in this article “intervention approaches” and “methodologies” can be viewed as interchangeable]. Methodologies are initially developed in given problem contexts, with particular *weltanschauungen*, for certain purposes. Methods and outcomes of an intervention approach are inspired by its world view (*weltanschauung*).

A single intervention approach may be insufficient in a complex problem context (Jackson 2001). Organizations often face several management challenges. Individual intervention approaches may address part of the set of management challenges, but multiple approaches may be necessary for holistic action. Deciding which intervention approaches to apply to a given problem context to address the complete set of challenges may be difficult. Furthermore, deciding how to combine multiple intervention approaches effectively complicates the problem. This paper describes the application method of a framework developed by Moore et al. (2015). The proposed framework and method will guide practitioners in holistically selecting and applying multiple intervention approaches to an experienced problem context without an extensive background in systems thinking.

## Operational Definitions

*Weltanschauung* [plural: *weltanschauungen*] A worldview or perspective. A *weltanschauung* guides methods and outcomes of actions.

*CATWOE* An acronym for customer, actor, transformation, *weltanschauung*, owner, environment. This is a tool of Soft Systems Methodology for defining systems of purposeful activity.

*Actor* An individual or party actively pursuing improvement in the problem context. This may include managers, other organizational members, or other stakeholders associated with the organization.

*Environment* When experts in the field of Critical Systems Thinking use the term “environment”, it refers to factors that are not controlled by decision makers of interest. In this research, including the case study presented in this article, the term “environment” refers to the problem context, which includes an organization’s interaction with the world in which it exists.

*Problem Context* Also called problem situation. This is a real world scenario that an actor wishes to improve.

*Intervention* A guided strategy applied in a problem context with a purpose.

*Methodology, Intervention Approach* Two terms used interchangeably in this research. A theory and practice developed for a certain purpose with a particular weltanschauung.

*Pluralism/Methodological Pluralism* Combining multiple whole methodologies, making them agree in their weltanschauungen.

*Complementarist Approach* Combining elements of multiple methodologies, using pieces as needed for intervention.

## Soft Systems Methodology

Soft Systems Methodology (SSM) was developed by Peter Checkland, who noticed that management science at the time was predominately based on ‘hard systems thinking’, structuring real-world scenarios as optimization problems based on goal-seeking. SSM is intended for use in complex scenarios lacking definition in structure and objective, where relationships of stakeholders are highly valued. This made it highly applicable to human activity systems, where people act to contribute to a purpose, such as organizations. In SSM such systems are viewed as loosely structured and dynamic with many perspectives to consider. Relevant perspectives are compared to the real world situation to create action to improve the existing system of interest (Jackson 2003).

SSM consists of seven stages. Stage 1 is simply identification of a situation to improve. Stage 2 involves creating a rich picture of the problem situation. A rich picture is an easily understood, pictorial representation of the system identified in Stage 1. In Stage 3, relevant human activity systems are selected, and root definitions are created for them. Root definitions of systems contain six elements, denoted by the acronym CATWOE: customer, actors, transformation, weltanschauung (world view), owner, and environment. A key element is weltanschauung (W), as each root definition has a different view of the situation of interest. Conceptual models are created for each root definition in Stage 4. A conceptual model consists of about seven activities necessary to achieve the transformation stated in the root definition. At Stage 5, the conceptual models are compared to the rich picture developed in Stage 2. The goal is to identify and discuss various weltanschauungen of the situation under study. In Stage 6, desirable and feasible changes are identified to act on the existing problem situation. Stage 7 is when the changes revealed in Stage 6 are acted upon. The expectation is that, upon acting on the problem situation, the real world will be modified and a new problem situation will emerge. This resets the SSM cycle. In this way, SSM is viewed as a never-ending intervention (Jackson 2003).

This seven stage methodology has led to criticism, stating that SSM leads practitioners systematically more than systemically. There was also criticism that in practice, SSM is disconnected from the norms of organizations. In response to these claims, Checkland developed a modified SSM, which is referred to as the ‘two-strands’ version, which is meant to facilitate constant consideration of cultural issues in the problem context. There are three types of inquiry in the two-strands model: Analyses 1, 2, and 3. Analysis 1 is focused on the action to be taken and the roles of the actors: the client, problem-solver, and problem-owners. Analysis 2 examines roles, norms, and values in the problem situation. Analysis 3 considers the acquisition and use of power. These three Analyses are constantly revisited (Jackson 2003).

SSM and other soft systems approaches have limited applicability. These approaches may be insufficient in cases where stakeholders have significant conflict or unequal influence, known in systems thinking as “coercive” contexts. Organizations may be viewed as coercive contexts, to varying degrees from case to case. Organizations have several stakeholders: customers, shareholders, workers, managers, executives, suppliers, surrounding communities, etc. In most organizations shareholders, managers, and executives have the strongest influence as they control administration and resources of the organization. This case is primarily concerned with small organizations. In the case study, the stakeholders considered are customers, workers, managers, funding agencies, and the host institution.

SSM requires commitment and much participation by practitioners (Jackson 2003). For these reasons, coercive contexts and situations where practitioners are not well informed or not able to commit can be detrimental to the SSM process. Mingers and Taylor (1992) conducted a survey to evaluate practical applications of SSM. They concluded that SSM is applicable in various contexts and can be very successful for its purpose. The main problem is achieving commitment by all actors. Lack of prior use and lack of knowledge are suspected reasons for the difficulty of commitment. Furthermore, weaknesses of SSM have been uncovered. Such weaknesses include difficulty in situations involving clients and its failure to exist in coercive contexts or contexts where strong resistance to change exists.

Some claim that SSM is isolated from other methodologies. Checkland does not discuss SSM in conjunction with other methodologies, nor does he use metaphors that are common in management science and organizational theory. SSM has also been criticised for simply modifying weltanschauungen, without considering the structures and foundations of them (Jackson 2003).

Lane and Oliva (1998) devised a synthesis of SSM and system dynamics (SD). This combination was chosen because of SSM’s weakness in comparing human behaviour in a changing context with behaviour expected based on causal relationships. SD was chosen because its strength aligns with this weakness of SSM. Also, SSM fills a theoretical void in SD, which is the latter’s lack of pluralistic capacity. The authors found promising results, giving credit to the practice of synthesizing multiple methods.

## System of Systems Methodologies

Jackson (2003) developed a framework for defining applied systems thinking strands, called the system of systems methodologies (SOSM). This framework describes problem contexts based on systemic complexity (the vertical axis) and the collaborative relationship between participants (the horizontal axis). Strands of applied systems thinking are defined in terms of problem contexts for which they are applied, based on the complexity and participant relationship.

Systemic complexity ranges from simple to complex. Complexity is driven by quantity of subsystems, and quantity and structure of interactions. Simple systems have few subsystems, and contain few and highly structured interactions. On the other hand, highly complex systems have many subsystems, and contain many loosely structured interactions. Additionally, simple systems are fairly static over time, whereas highly complex systems transform over time according to changes in their own parts and their dynamic environment (Jackson, 2003).

There are three types of participant relationships: unitary, pluralist, and coercive. A unitary relationship exists when participants share values, beliefs, and interests. Participants in a pluralist relationship will share interests, but have differing values and beliefs. Decision making in pluralist contexts depends on disagreement and conflict, leading to constructive debates. Compromise is attainable, even when all participants are active in decision making. Coercive participants will have varying interests and will not share values and beliefs. In coercive contexts, power is exercised to make decisions and compromise does not exist (Jackson 2003).

Jackson (2003) later mapped applied systems thinking approaches on the SOSM. This modified model is valuable to show the assumptions made by systems approaches regarding problem contexts. According to the SOSM, the current research includes all pluralist problem contexts, and complex unitary contexts. Therefore, the systems approaches considered here are primarily soft systems approaches, which are commonly human systems such as organizations, and organizational cybernetics.

## Total Systems Intervention

Critical systems thinking (CST) is a systems thinking approach intended to address complex problems with multiple differing viewpoints. These are the types of problems experienced in many organizations and other human systems. Total systems intervention (TSI) was developed as a methodology for applying CST in scenarios such as organizational management (Jackson 2003).

Methodologies have strengths and weaknesses that can complement each other. They also have differing *weltanschauungen*, providing different perspectives of the problem context. TSI intends to make use of multiple systemic methodologies to address situations where a variety of perspectives are necessary for a holistic view. It aims to guide facilitators and participants to agreement about the major issues faced. Based on this agreement, systems methodologies are selected for intervention, with their strengths and weaknesses considered. The selected methodologies should be used in combination for intervention in corresponding aspects and contexts of organizations. It encourages constant reflection on the methodologies selected, as they may need reconsidering as the situation changes (Jackson 2003).

The TSI methodology has three phases: creativity, choice, and implementation. The creativity phase is intended to reveal the primary concerns, issues, and problems in the situation. It is crucial that several viewpoints are used to achieve the outcome in this stage. The choice phase is when the intervention strategy is developed. Knowledge and information gained in the creativity phase, along with the strengths and weaknesses of methodologies considered, are used to determine a dominant and some dependent methodologies to be used for intervention. The final phase is implementation. At this point, the dominant methodology chosen will be used primarily to address the situation. Benefits offered by other methodologies should always be considered. Actors should repeatedly revisit the three phase cycle of TSI. It is especially important to constantly question the choice of the dominant methodology and adjust this choice if necessary. This will be absolutely necessary if the problem situation changes (Jackson 2003).

One weakness of TSI, as explained by Jackson (2003), is its commitment to methodological pluralism, meaning it requires the use of methodologies as “wholes”. TSI requires

that the dominant methodology be implemented as a whole, possibly blocking out dependent methodologies where the dominant methodology acts.

The usability of TSI has also been critiqued. Lack of instruction for navigating the three phases, especially creativity and choice, has been the source of some criticism. There have also been concerns surrounding the inconsistency of TSI with regards to its acceptance or rejection of alternate approaches. Others have claimed that TSI ignores environmental factors while focusing on considering perspectives of many stakeholders (Jackson 2003).

TSI was developed to facilitate the use of multiple systemic methodologies (i.e., methodologies in the realm of systems thinking) to address complex problem contexts. However, methodologies that are not “systemic”, or in the field of systems thinking, may have much to offer certain problem contexts.

## Creative Design of Methods

Flood and Romm (1995) introduced the concept of “oblique” methods, which is using methods in ways aside from their original intent. This innovative approach was hoped to increase the appeal of methods from which people are deterred due to lack of comprehension or belief of inapplicability. This paved the way for researchers such as Midgley to creatively adopt and combine methods.

Midgley (1997) developed a concept called creative design of methods (CDM) based on the TSI concept that simply choosing a single methodology for intervention may be insufficient in complex problem contexts. As Jackson (2003) explained with regards to TSI, a variety of perspectives are necessary for a holistic view of complex problem situations. Midgley (1997) frames problem situations with a set of systemically interrelated research questions. Each question warrants the use of a different method or partial method. This provided the opportunity to link the “oblique” approach of applying methods with TSI by allowing the use of partial methods, even in contexts for which they were not initially intended.

Midgley et al. (1998) emphasized that CDM synthesizes multiple methodologies to create a single intervention method. It combines methodologies to create a new method that is more valuable than the individual methodologies in the problem context. TSI encourages the use of methodologies in their complete and pure form with dominant and dependent methodologies identified. CDM uses pieces of methodologies as they apply to the problem context to create a custom intervention method.

Generation of a CDM intervention method is driven by a series of systematically interrelated research questions developed based on the desired outcome. Boyd et al. (2007) noted that the purpose of intervention, which drives the research questions, may change as the analysis develops. A methodology to address each of the research questions is chosen. The selected methodologies are synthesized to create an appropriate intervention method. The means of developing these research questions and designing the resulting method is not well defined, but Midgley et al. (1998) stated that intuition and deliberation may be tools used for decision making.

## Boundary Critique

Boundary critique was developed by the work of Ulrich and Midgley, based on previous work by Churchman. It is a discipline of critical systems thinking which explores alternate boundaries of analysis and how adjusting the boundaries affects intervention, while maintaining critical awareness. Critical awareness means constantly considering assumptions and their basis (Midgley et al. 1998).

Churchman (1970) determined that the boundary of a system under analysis is an important consideration. He expresses that boundaries are created, not given. He believes that wider boundaries may deem some improvements insignificant; therefore, he encourages definitions of improvement which contain as much information as possible. Churchman supports widening of boundaries, including several differing perspectives, referred to as ‘rolling out’ the boundaries. Widening of boundaries may affect who is considered a decision maker. He asserts that practitioners should consider the perspectives of the strongest possible enemies. Improvement attempts should only be continued if robust arguments against enemies exist.

Ulrich (1983) created a methodology called critical systems heuristics to appropriately select boundaries using stakeholder collaboration. Ulrich believes that Churchman’s desire to include as much information as possible into improvement definitions is limited by the need for practical solutions. Ulrich maintains that all assumptions should be subject to questioning. To ensure improvements are ethically sound, Ulrich explains that an agreement must be met between the designers and those affected by proposed actions.

Midgley (1992) examined situations where stakeholders disagree about the boundaries of a system. When conflicting boundary definitions exist, one is narrower and one is wider, these are assigned as the primary and secondary boundaries, respectively. The area in between the defined boundaries, included in the secondary boundary but not in the primary boundary, is said to be marginalized. To resolve boundary conflicts, the marginalized area is deemed either sacred or profane. When the marginalized area is profane, the primary boundary is given priority in decision making. This means that the marginalized area and secondary boundary are not considered. When the marginalized area is sacred, everything within the secondary boundary, including the marginalized area, is considered in decision making. However, Midgley emphasized that those making boundary judgements must not neglect what is contained in the marginalized region when a profane status is imposed.

In practice, boundary critique is executed in two phases. Phase 1 is Identifying Problems. In this phase, stakeholders are identified to be interviewed. One technique to develop the richest understanding of the problem context is starting with stakeholders that are easy to identify, then asking them to name others that should be interviewed. This was developed by Midgley and Milne (1995) to ‘roll out’ the boundaries of analysis. After Phase 1, it is beneficial to review the work done to ensure that marginalized entities are not being treated as profane prematurely. To prepare for Phase 2, Designing Improvements, a workshop is held to develop an intervention plan with key stakeholders within the relevant boundary. To guide intervention, stakeholders are encouraged to imagine an ideal scenario, ‘ideal’ meaning ‘best possible’ but reasonable technologically and organizationally. Midgley, Munlo, and Brown (1998) described a case study in which the problem solving team devised a plan to synthesize three methodologies to approach the ideal state.

Boundary critique and CDM were derived from TSI, and have become pivotal tools in TSI practice. Midgley et al. (1998) claimed that CDM is practically necessary in conjunction with TSI. CDM provides more definition in selecting methodologies for

intervention by using research questions to guide the decision. Boyd et al. (2007) recognized that boundary critique is necessary in the early stages of CDM to ensure that the problem situation is fully understood. In this way, boundaries affect which intervention approach to use as CDM uses the understanding of the problem context to select intervention approaches. Some intervention approaches have weltanschauungen that encompass only the organization itself, whereas others include the environment surrounding the organization.

TSI, CDM, and boundary critique have inspired the framework and method proposed here. TSI provided the foundational concept of combining methodologies to match a complex problem context. It outlines a three phase process of understanding the problem context, choosing methodologies to implement, and implementing the methodologies. The proposed method follows the same process. However, TSI requires pluralist implementation of methodologies; CDM allows the use of elements of methodologies to create a new method. The CDM practice of synthesizing methodologies based on a set of research questions about the problem context inspired the situation definition stage of the proposed method. In choosing methodologies, TSI presented the idea to assign dominant and dependent methodologies, ranking them primary, secondary, tertiary, and so on. This is used in the proposed method to design a complementarist approach. Boundary critique is used in implementation to guide the complementarist intervention. The practitioner must consider the boundaries of individual intervention approaches to assign sacred or profane status to the marginalized space when boundaries do not align. This allows dependent approaches to compliment implementation of the dominant approach.

Complementarism is a method of addressing holism using several elements partially. This is a term used by researchers such as Flood and Jackson. This approach allows synthesizing several components without wholly adopting any of them, thus multiple weltanschauungen may be used to address a given problem context (Flood and Jackson 1992).

## Intervention Approach Definition and Application Framework

Moore et al. (2015) have created a framework for intervention approach definition and application. More detail on the development of this framework is available in (Moore et al. 2015). The primary contribution of this framework is prescribing intervention approaches to fit a given problem context. Intervention approaches are mapped on the framework based on the problem contexts they are intended to act in. This is driven by the weltanschauung of an approach.

### Four Definition Categories

The proposed framework defines problem contexts by four categories: Scope, Inspiration, Solution, and Ideal. Each of these categories ranges between two extremes. The categories are described in detail below. Each of the four categories is an axis on the framework, describing a component of the problem context of interest.



## Scope

Scope defines whether the intervention is primarily functional or structural. This axis ranges between the two extremes “organizational operations” and “organizational design”.

## Inspiration

Inspiration expresses what drives the intervention. The extremes of this category are “resource (internally) driven” and “context (environmentally) driven”.

## Solution

Solution describes how the intervention views its objective. One extreme is goal-seeking, striving for “optimal amount of resources”, the other extreme simply settles for “right/adequate amount of resources”.

## Ideal

Ideal explains what an intervention approach values. It ranges from “organizational culture” to “organizational control”.

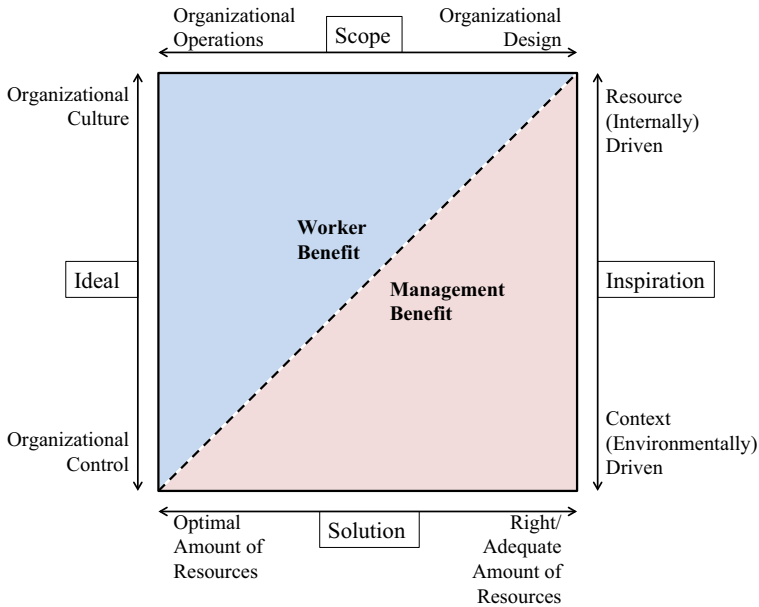
Some intervention approaches may have a strong preference for extremes on the four axes, these approaches will populate the corners of the framework. Other approaches may be somewhat indifferent in the categories, leading them to populate the centre of the framework.

## Beneficiary Line

A diagonal line is drawn across the framework. This line divides the framework based on the primary beneficiary of improvement action in a problem context. The two primary beneficiaries are workers and management. When workers are the primary beneficiaries, organizational operations and culture are likely affected. When management is the primary beneficiary, organizational design and control are likely improved.

As an example, the direct effects of the implementation of the Toyota production system (TPS) may be felt more by employees than by managers. Employees will feel empowered under TPS and they will not be subjected to wasteful efforts. Another example is viable system model (VSM) would yield primarily management benefit. This is because an organization that appropriately adopts VSM will be better controlled and roles will be distributed and clearly defined. Knowledge management (KM) on the other hand, is fairly neutral in terms of its beneficiaries, but possibly slightly favours workers. Workers will be able to access and use knowledge that will benefit them in their responsibilities. This also may reduce the burden on management to train and mentor workers.

The beneficiary regions in the framework are progressive rather than definite. This means that as problem contexts shift away from the dividing diagonal line (toward the upper-left or lower-right), the magnitude of benefit toward one party (workers or management) is stronger.



**Fig. 1** Intervention approach definition and application framework (Moore et al. 2015)

The proposed framework, including the four axes and beneficiary line is provided in Fig. 1.

## Intervention Approach Definition

For the framework to serve its primary purpose, intervention approaches must be defined within it. Each approach will be defined based on the problem context, and associated weltanschauung, it was designed for. These approaches will populate regions within the graph, demonstrating the problem contexts for which they are most suitable for.

## Application Method

### Epistemology Versus Ontology of the Method

Epistemologically, the proposed method follows a similar pluralistic approach to TSI. That is, several intervention approaches are synthesized as wholes to design a single new intervention approach with a unified weltanschauung. In the language of boundary critique, this would require sacred status of the marginal space between the boundaries of the approaches applied. However, as Jackson (2003) has revealed, conflict may exist when pluralism of multiple approaches is desired.

Jackson (2003) explains that an intervention approach is designed with methods to achieve certain outcomes, based on a particular weltanschauung of the problem context experienced. Moore et al. (2015) discuss utilizing elements from multiple intervention approaches to act in an experienced problem context. This perspective realizes that an

intervention approach often has value outside of the *weltanschauung* and problem context for which it was designed. Conceptually, this is similar to SSM. SSM was designed to combine *weltanschauungen* of multiple stakeholders in an organization to create a shared *weltanschauung*, driving desirable and feasible change to the problem context (Checkland 2000; Jackson 2003). The proposed method combines *weltanschauungen* of multiple intervention approaches, rather than stakeholders, to create a unified approach to act in a problem context with the desired *weltanschauung*. This may be necessary when holistic intervention is desired, where no single intervention approach addressed the challenges faced. Several intervention approaches combined may provide the tools necessary to beneficially impact a complex problem context. Although *weltanschauungen* of multiple intervention approaches may not align, elements from each may be extracted to act in the existing problem context.

Ontologically, this is a complementarist method, meaning that a dominant approach is used with others to compliment it. In TSI, this has been suggested as a realistic alternative to pluralism. The dependent approaches complement the dominant approach. The dominant approach may be applied as a whole, but parts of the dependent approaches must be compromised. The marginal space between the boundaries of dominant and dependent approaches must be considered profane. In this way, a dominant approach is selected and beneficial elements from dependent approaches are utilized.

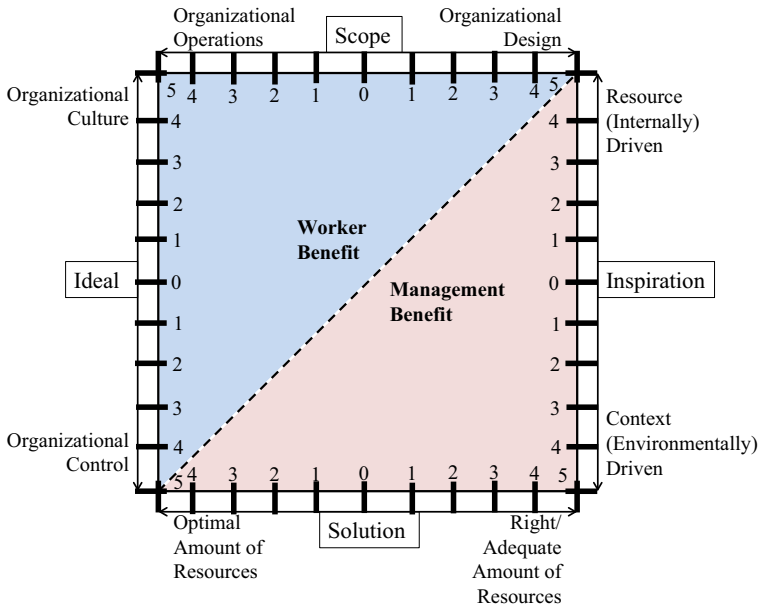
As previously discussed, CDM involves selecting several approaches for intervention based on research questions developed for the intervention purpose. The proposed method provides a structured method for selecting intervention approaches based on the problem context. In this way, the proposed method may aid those who wish to use CDM, which according to Midgley et al. (1998) is necessary for application of TSI.

## Defining a Problem Context

The intervention definition and application model can be used to map intervention approaches and problem contexts. Having already mapped intervention approaches, practitioners can map their experienced problem contexts to determine which approaches coincide with the problem context, thus are applicable. To map a problem context, a practitioner will have to make judgements regarding the problem context.

A practitioner will have to analyse the experienced problem context in each of the four categories previously discussed: Scope, Inspiration, Solution, and Ideal. Each of these categories has a scale ranging between two extremes. To provide the analysis with a numerical basis, two-directional 0–5 scales are displayed on each of the four axes. This is shown on the framework in Fig. 2. Zero is at the centre of each axis, representing a neutral position. Each axis has two 5 values, one for each extreme on a given axis. During the following analysis, each “extreme” of each axis will be assigned a number ranging from 0 to 5, representing how strongly valued the “extreme” is in the problem context. The strongest value for an “extreme” is expressed by assigning a 5. Conversely, assigning a 0 to an “extreme” demonstrates minimal value in the problem context.

A valuation questionnaire is used to capture the value of each “extreme” for each axis. The questionnaire contains a scale for each of the four categories. For each category a numbered scale of 0–5 in two directions is provided. On the scale is a shaded box with a length of five units on the scale. This shaded box represents the area of value on the scale. A practitioner moves the shaded box toward one extreme or the other to demonstrate preference of one over the other, and the strength of that preference. The scale numbers on each edge of the shaded box are the values assigned to the associated extreme. The



**Fig. 2** Intervention approach definition and application framework with axis scales

strongest expression of preference is shown by the box placed all the way to one extreme, thus assigning a value of 5 to one extreme and 0 to the opposite extreme.

Research questions may aid the practitioner in assigning values in each of the four categories. This concept is borrowed from CDM, where research questions are used to establish the purpose of intervention, and thus guiding the selection of intervention approaches. These questions may also add clarity to what each category, and the associated extremes, entails. Research questions for each category are provided below.

**Scope**

- Is the problem context an issue of generating work products (i.e., operations), or is it a consequence of organizational structure (i.e., design)?

This question will help indicate which level of the organization is to be the focus of the intervention. This will also provide insight for which existing intervention approaches should be applied. On one extreme, operational issues may be best addressed with inspiration from Toyota production system. The other extreme, issues of organizational structure or design, may be well served by the viable system model, which provides a framework that can be used for structuring organizations.

**Inspiration**

- Is the problem context primarily concerning organizational resources, or does it involve the external environment (i.e., context)?

Some existing intervention approaches, such as Toyota production system and knowledge management, are primarily concerned with utilization of organizational resources. Other

intervention approaches, such as viable system model, are fundamentally based on proactively adapting to the environment of the system (i.e., organization). This question can help direct actors to use approaches with an internal or external focus.

### Solution

- In the problem context, is it necessary to seek a specific goal (i.e., optimize) with one correct solution, or can it be satisfied with an adequate solution? (An adequate solution implies that there are multiple correct answers or that the goal is not well defined.)

Intervention approaches have multiple methods of solving problems. Toyota production system is an example of an approach with an optimization fixation: There are specific goals and even formulas to arrive at numerical solutions. On the other hand, viable system model simply seeks adequacy, meaning many possible solutions exist; the goal is to find one that works. A good tool to use when answering this question is “Is there a vision of the future (desired state)? Or are actors are hoping to discover or invent the desired state?” If the desired state exists, optimization may be necessary. Otherwise, adequacy may suffice.

### Ideal

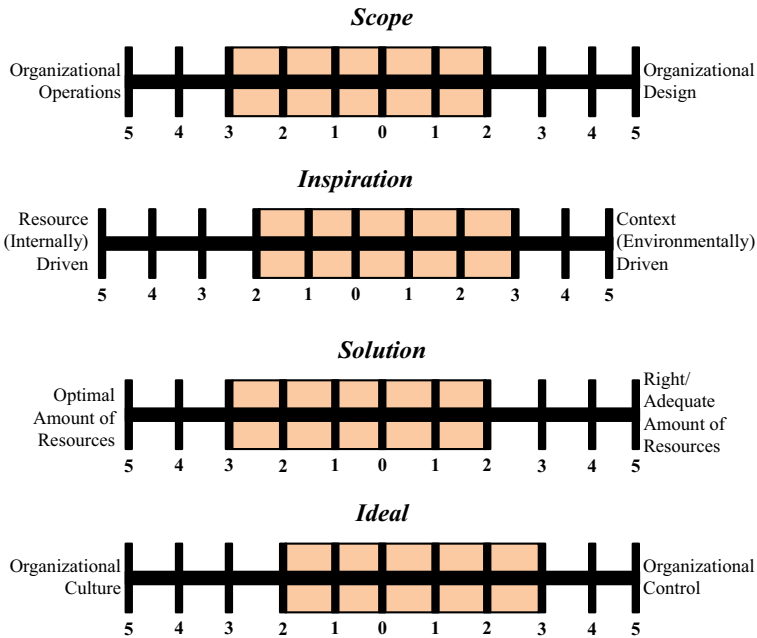
- Will the problem context be most affected by shifts in organizational culture, or modifications in organizational control?

This question requires the actor to discern what form of intervention may be most effective. Changes in culture may be most beneficial when: an organization is small in size, production goals are currently being achieved, or where work ethic or etiquette of the workforce is of concern. Toyota production system and knowledge management are examples of existing intervention approaches that are heavily focused on culture. Improved control will likely be most beneficial in complex problem contexts (based on the size and interaction of units in the organization). In such cases, an intervention approach such as the viable system model may be desired.

The valuation questionnaire is a rich opportunity to include several stakeholders in the proposed method. In light of boundary critique principles, the perspectives of stakeholders should not be treated as profane by only including managers in the valuation process. The valuation process creates the foundation for intervention by generating a formula for combining intervention approaches. As such, a wide breadth of input should be sought to reflect several aspects of the organization. For example, non-managing members of an organization, such as supervisors, have valuable insight gained from experience (Davenport and Prusak 1998; Levy 1965; Nonaka and Takeuchi 1995). Such inclusion benefits the organization by adding value to the intervention process due to the consideration of multiple perspectives, which is necessary for a holistic world view according to CDM (Jackson 2003). Furthermore, this demonstrates to organizational members that they are not operating in a coercive situation.

A model of the valuation questionnaire is provided in Fig. 3. The shaded box positions shown are arbitrary, placed to demonstrate the most neutrality possible in each category.

It should be noted that the questionnaire design forces certain outcomes to occur. Firstly, the sum of the values assigned to each extreme is five for each category. This was a design decision for the preliminary method. It forces equal weighting for each category. More flexibility in rating the four categories for problem contexts and intervention approaches would increase the accuracy and usability of the proposed framework and



**Fig. 3** Valuation questionnaire model

method. In the future, stakeholders may wish to consider some categories more heavily than others. Some categories may not even be relevant to certain problem contexts. Furthermore, intervention approaches do not consider all four categories equally due to their differing weltanschauungen. If a category is not relevant or not desired for the problem context or intervention approach, the length of the shaded box could be expanded, up to ten units. If a category is to be weighted heavily, the length of the shaded box should be reduced, showing more precision in the decision. The challenge this presents is that theoretically, this would result in assigning a negative value to the “extreme” that is less desirable. This is a challenge that will have to be addressed in future expansions on this research. Possible combinations and their associated summations are provided in Table 1.

Another consequence of this design is that the practitioner must express preference for one of the two extremes in each category. This is due to the selection of a maximum value that is an odd number. Even the most neutral result, 2 and 3 or 3 and 2, shows a slight preference for one extreme. This allows practitioners to have dual consideration between extremes if desired, but forces determination of a preference.

**Table 1** Possible values assigned to two extremes on one axis

Extreme 1 value	Extreme 2 value	Value addition
0	5	0 + 5 = 5
1	4	1 + 4 = 5
2	3	2 + 3 = 5
3	2	3 + 2 = 5
4	1	4 + 1 = 5
5	0	5 + 0 = 5

After each “extreme” is assigned a value, the problem context may be defined within the framework. Use of the shaded box with a length of five units ensures that, once mapped on the framework, a problem context will be represented by a four-sided shape with all sides having length of five units.

Creating shapes within the framework is simplified by considering only two “extremes” at a time. To begin, one should pick a corner of the square frame work. Each corner contains two “extremes”. The value for the two extremes in the selected corner should be determined based on the previously established ratings on the questionnaire. The point on the framework where the values of the two “extremes” intersect is plotted. This is one corner of the shape that is being constructed. The process of selecting a corner, determining values for the two “extremes” in that corner, and plotting the resulting point should be repeated for all four corners of the framework.

## Selecting Intervention Approaches

The shape defining the problem context in the framework will intersect at least one shape representing an intervention approach. Whichever intervention approach shape shares the most area with the problem context shape will be chosen as the dominant, or primary, intervention approach.

If the problem context shape intersects multiple intervention approach shapes, dependent approaches may be identified to complement the dominant approach. Having selected the approach with the greatest shared space with the problem context as dominant (primary), the approach with the second largest shared space will be the secondary. The intervention approach shape that shares the third largest space with the problem context shape will be the tertiary approach.

Given the range of values on the framework axes and the forced size of the problem context shapes, at least one intervention approach shape will be intersected. This ensures that at least one intervention approach is identified for any problem context. Although multiple approaches are likely necessary to holistically act in complex problem contexts (Jackson 2003).

The method described so far in this section assumes that the practitioner has not already selected intervention approaches to apply. In this case, the framework will likely be able to prescribe approaches that best match the problem context. However, practitioners may have a predetermined intervention approach, or set of approaches, that are desired. This is true in the case study provided on the following pages. When intervention approaches are already selected, the framework is beneficial to establish the order of dominant and dependent approaches, including assigning dependent approaches as secondary and tertiary. When a problem context is mapped on the framework, it may not intersect at all with a pre-selected intervention approach on the framework. This likely means that the intervention approach was not designed for similar problem contexts similar to the one experienced, but it may still have beneficial elements. It would likely not be beneficial to assign dominant status to an intervention approach that does not overlap the problem context. Instead, the method described above for assigning dominant and dependent approaches should be used, with intervention approaches that do not overlap the problem context given the lowest ranking. The approach that is closest to the problem context should be assigned higher priority compared to one that is farther away.

The proposed method can be viewed as providing support to the three phase process of TSI. As Jackson (2003) has noted, some criticize TSI for lacking structure in its three phases, especially in the creativity and choice phases. The proposed method facilitates the creativity phase as it defines intervention approaches and the problem context on the same framework. Practitioners may discover new and beneficial intervention approaches to apply simply by viewing the framework, which will be populated with existing intervention approaches.

The choice phase of TSI is completed when intervention approaches are assigned priorities based on their position on the framework relative to the problem context. As in TSI, there are two sets of approaches: dominant and dependent. The dominant approach is primary, and dependent approaches are secondary and tertiary.

## Applying Intervention Approaches

The final stage of both TSI and the method proposed here is implementation. The proposed method is similar at this point to the implementation phase of TSI. As Jackson (2003) has suggested, many consider this to be the best-defined phase of TSI.

Consistent with the third phase of TSI, implementation of the proposed method will give highest priority to the dominant approach while utilizing beneficial elements of dependent approaches. When considering an action in the problem context, intervention designers should first consider how the dominant intervention approach views the situation. In this way, the *weltanschauung* of the dominant approach will have the most leverage in the intervention. If the dominant approach does not consider, or is indifferent toward, the action considered, the secondary approach should be consulted for guidance. Furthermore, if the secondary approach is not able to guide intervention, the tertiary approach should be applied. In this way, intervention is driven by the primary approach, while utilizing beneficial elements of the secondary and tertiary approaches.

When seeking guidance from intervention approaches in pairwise fashion, the theories of boundary critique are applicable. To keep the language consistent from the earlier discussion of boundary critique, consider two intervention approaches, primary and secondary, each with its own *weltanschauung*. Each intervention approach has a boundary for its theory, determined by its *weltanschauung*. Since these two approaches do not agree on a single boundary, there is a marginalized space. The marginalized space will, by default, be considered profane. When the primary boundary is not wide enough to serve the desires of the practitioner in the problem context, the boundary must be expanded. This is achieved by deeming the marginalized space sacred, widening the boundary of analysis to that of the secondary approach. This allows the secondary approach to guide actions that exist in the marginalized space. The same holds true when considering the secondary and tertiary approaches, if this is appropriate for the problem context.

It is foreseeable that a practitioner may grant primary status to the closest matching approach, thus marginalising other approaches. This would be considered short-cutting the proposed method, and possibly sacrificing a holistic intervention. The goal is to act in a complementary fashion regarding intervention approaches. It is recognized that certain intervention approaches will match certain problem contexts very closely, based on their respective *weltanschauungen*, but to use only one *weltanschauung* undermines the complexity of real world problem situations. A complementarist approach does not require that



all elements have a shared *weltanschauung*, rather it allows elements derived from several differing *weltanschauungen* to be incorporated.

To ensure a complementarist approach is devised, even when the *weltanschauungen* of an intervention approach and problem context match well, practitioners are encouraged to additionally evaluate non-primary approaches. If elements of the primary intervention approach are adopted for the complementarist approach, a practitioner should consult the dependent (secondary, tertiary, etc.) approaches in an equal manner. The practitioner may find that a contribution cannot be made within the boundary of a dependent approach. But a dependent approach may provide alternate methods or additional insight for the problem context. If a conflict exists between the actions implied by a primary and dependent approach, it is the practitioner's choice for which *weltanschauung* to consider sacred. In general, the *weltanschauung* of the primary approach will likely achieve sacred status in such a case.

As TSI teaches, it is important to remain critical of intervention approaches selected, especially the dominant approach. As action is taken in the real world, the problem context shifts and the proposed analysis method should be reiterated. This is also true if the practitioner desires to act in a new problem context. A different set of intervention approaches may be necessary for a modified or new problem context. Reiteration may allow distilling of the complementarist intervention.

Understanding the limit of repetition of the proposed method is a topic that merits further investigation. As in action research, more repetition may prove to be beneficial as learning takes place. However depending on the nature of changes in the problem context, repetition of the method could be counterproductive. For example, if the method warrants structural organizational change, time should be allowed for the effects to be understood. This resonates with a fundamental concept of systems thinking: There is a delay between changes in the problem context and the effects of the change (Jackson 2003). Large scale organizational changes will result in a transitional period, possibly even giving the impression of chaos, before the system reaches a steady state, hopefully revealing improvement.

As an alternate example, operational changes may result in a shorter delay and require fine tuning of intervention to reach a desired state. Once change is enacted in the problem context, the proposed method can guide actors in modifying intervention or possibly sweeping in new components of intervention.

In any case, an observational period will be necessary after intervention to allow delayed effects to manifest. Further investigation may lead to better definition of guidelines for repeatability of the method and time necessary between iterations.

## Case Study

### Background

The Oregon State University (OSU) Energy Efficiency Center (EEC) is a small, non-profit service organization performing knowledge-based project work in a dynamic environment. The EEC has a multi-faceted mission, benefitting assessed facilities, OSU students, OSU, industrial partners, and the public (OSU Energy Efficiency Center, n.d.). This creates a vast and diverse set of stakeholders. Further definition of this case is provided by Moore et al. (2015).

## Management Challenges

The nature of the EEC and its environment led to several management challenges, including development of a non-central management structure, retention of knowledge in a rapid turnover environment, and meeting diverse stakeholder demands.

### *Management Structure*

The EEC has recently developed a management structure that delegates management roles and tasks to a larger set of individuals, as opposed to the director and operations managers being responsible for all. The organization has already benefitted from this management structure modification, but further consideration would likely be advantageous.

### *Knowledge Utilization*

Analyst-workers at the EEC generally start their tenure with little to no relevant experience aside from university coursework. A crucial function of the EEC is developing the skills of analysts. This increases their value to the organization and later in their careers.

The work performed at the EEC requires specialized knowledge that is developed through experience. Knowledge retention is a challenge at the EEC because of the training and skills required and short employee tenures, averaging about two years.

The EEC uses many electronic resources. These resources are currently spread across several media, some being poorly organized. Distribution, application, and development of knowledge would likely be improved with better organization and definition of electronic resources.

### *Complex Operations and Stakeholder Requirements*

Preparing the primary deliverables of the EEC, assessment reports, is a complex process. It consists of many loosely defined operations that are dependent on each other. An assessment report is the product of a combined effort of several analysts. Constraints exist in terms of quality, completion time, and cost of assessment reports. Furthermore, analysts are constrained in the amount of time available to work on their contributions to the reports. All these factors make report generation a complex operation.

## Selected Intervention Approaches

Based on the previously discussed set of management challenges at the EEC, three intervention approaches have been deemed suitable by Moore et al. (2015). The three approaches to be applied to the EEC are viable system model (VSM), knowledge management (KM), and Toyota production system (TPS), also known as lean manufacturing.

### **Viable System Model**

VSM is a systems thinking methodology developed by Stafford Beer based on organizational cybernetics, which focus on control of, and communication within, organizations. VSM defines what makes an organization viable, meaning capable of existence

independently of other entities in its environment. According to VSM, particular roles and interactions must exist for an organization to remain viable (Beer 1984).

The law of requisite variety is a crucial component of VSM. This theory states that an organization must contain enough variety to address any state of its environment, facing any challenge posed (Beer 1981, 1984). Methods to reduce variety in the world in which an organization exists are divisionalization: separation by factories or products; functionalization: separation by profession or service; and massive delegation: allowing managers to think freely (Beer 1981, p. 230). A decentralized management structure is characterized by managers and other employees having divided control over the use of organizational resources. As such, a non-centralized management structure allows free thinking of organizational members (including non-managers), even in organizational structures separated by division or function (Jones and George 2011).

VSM will be used at the EEC to guide its management structure, including creating non-centralized management.

## Knowledge Management

The EEC performs knowledge-based work (Moore et al. 2015). Therefore knowledge is a crucial resource at the EEC. KM is concerned with maximum utilization of knowledge within and generated by an organization (Davenport and Prusak 1998). It can also be applied to exploit knowledge from an organization's environment (Grant 1996). The KM process consists of effectively: collecting, retaining, distributing, and applying knowledge in an organization. A primary theme of KM is converting tacit knowledge, that which is contained in and individual, to explicit knowledge, which is shared (Nonaka 1991; Nonaka et al. 1996).

Knowledge is developed over time, as an employee gains experience (Davenport and Prusak 1998; Levy 1965; Nonaka and Takeuchi 1995). There is a risk of losing knowledge when employees leave an organization if efforts are not made to retain it (Fong and Kwok 2009). Given that the EEC has rapid employee turnover, there are frequent possibilities of losing knowledge, making knowledge retention efforts crucial.

KM will be used at the EEC to gather, share, and retain knowledge from inside the organization and its environment.

## Toyota Production System

TPS was developed for application in automobile manufacturing, but has more recently been applied to benefit service organizations (Lander and Liker 2007). TPS is a methodology primarily concerned with simultaneous value delivery and cost reduction by seeking to eliminate waste in operations (Monden 1983).

TPS will be beneficial at the EEC to ensure value delivery to stakeholders with minimal waste.

## Framework Application

All three intervention approaches (VSM, KM, and TPS) address part of the set of management challenges faced at the EEC. However, no single approach will address the whole set of challenges. Therefore, a complementarist approach is desired. The proposed

framework is well suited to guide interventions in problem contexts encountered at the EEC. As problem contexts arise, practitioners can use the proposed framework and method to guide intervention actions. In this case VSM, KM, and TPS will be the set of pre-selected intervention approaches; therefore the decision is which is primary, secondary, and tertiary in different contexts.

To prepare for application, the three selected intervention approaches were mapped on the proposed framework. The method used to map the intervention approaches is identical to the method described earlier. The difference was that an intervention approach was being defined, rather than a problem context. The values assigned to all extremes are provided in Table 2.

Definition of VSM, KM, and TPS as regions on the proposed framework is shown in Fig. 4.

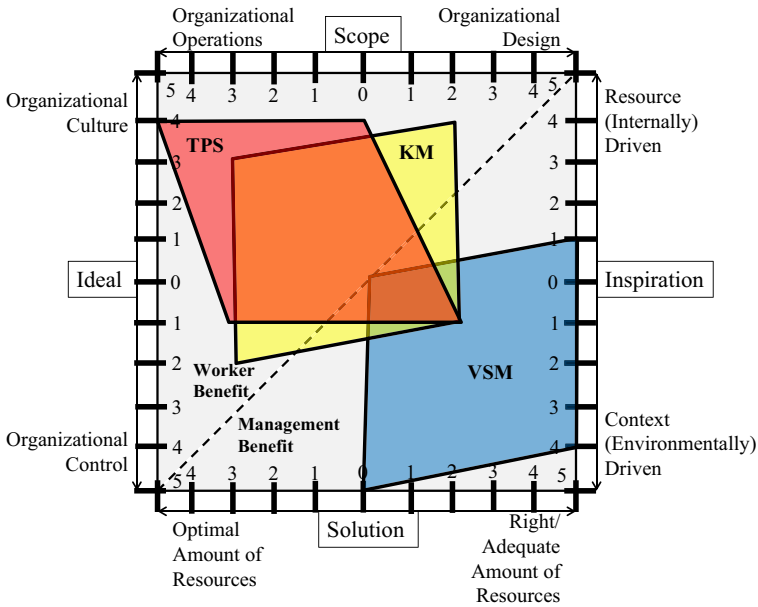
It should be noted that the values presented in Table 2, resulting in the mapping in Fig. 4, were determined based on expert opinion. The authors, being well informed in the three relevant intervention approaches, completed the valuation questionnaire. In the future, more experts should be consulted, including top researchers in the relevant fields, to reach a consensus on the valuation of intervention approaches. If such a consensus were reached, this step in the method could be simplified to only require the practitioner to consult the established values for the relevant approaches.

The next step for the EEC to apply the proposed method is to define a problem context in the framework. Upon framework definition, the three intervention approaches will be assigned priority rankings based on the position of the problem context in the framework. This will assist managers in developing actions in real world scenarios.

As an example, following is a discussion based on the research questions presented earlier. The problem context involves creating a sustainable management structure, where management tasks are delegated from the director and operations managers to capable employees. This must be accomplished given the rapid turnover nature of the organization while adhering to multiple stakeholder interests.

**Table 2** Summary of valuation questionnaire for case study intervention approach definition

	<i>Scope</i>	0	1	2	3	4	5
Organizational Operations		VSM			KM		TPS
Organizational Design		TPS		KM			VSM
	<i>Inspiration</i>						
Resource (Internally) Driven			VSM			KM/TPS	
Context (Environmentally) Driven			KM/TPS			VSM	
	<i>Solution</i>						
Optimal Amount of Resources		VSM			KM/TPS		
Right/ Adequate Amount of Resources				KM/TPS			VSM
	<i>Ideal</i>						
Organizational Culture		VSM			KM	TPS	
Organizational Control			TPS	KM			VSM



**Fig. 4** Intervention approach definition and application framework with VSM, KM, and TPS

**Scope**

- Is the problem context an issue of generating work products (i.e., operations), or is it a consequence of organizational structure (i.e., design)?

Although generating work products is a crucial part of the organization, to meet stakeholder demands and needs, the issue at hand is one of creating a management structure. Therefore, in scope, organizational structure is favoured.

**Inspiration**

- Is the problem context primarily concerning organizational resources, or does it involve the external environment (i.e., context)?

This problem context is characterized by utilizing organizational resources to adapt to the environment. The favour may be slightly on the side of organizational resources as insuring success in delivering work products is a primary focus of the organization. For example, the EEC has devoted itself to deliver useful reports to clients (i.e., high quality with appropriate scope). But the environment is also important as the clients exist in the environment external to the EEC.

**Solution**

- In the problem context, is it necessary to seek a specific goal (i.e., optimize) with one correct solution, or can it be satisfied with an adequate solution?

In this context, an adequate solution is desired. Optimality would be difficult to achieve for the EEC at this point given its scarce operational analytic resources and rapid turnover. Future iterations of this method may focus more on optimality of operations.

**Ideal**

- Will the problem context be most affected by shifts in organizational culture, or modifications in organizational control?

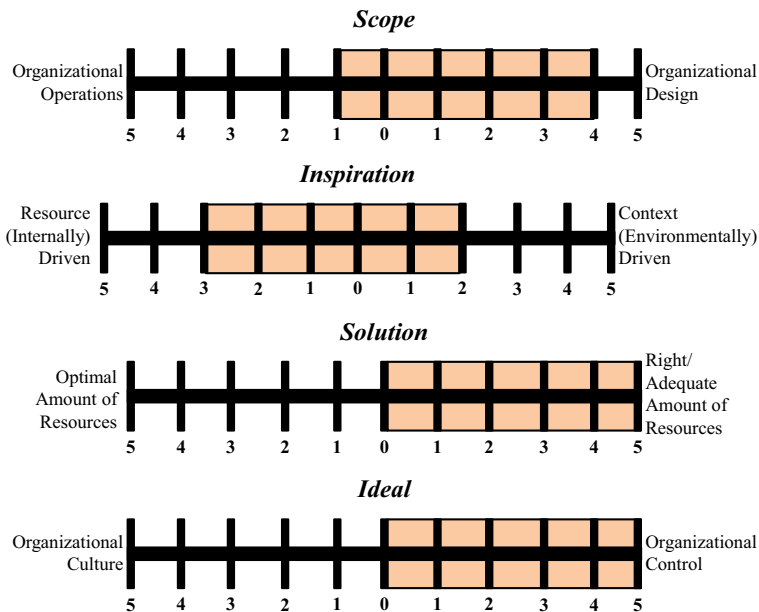
The existing culture at the EEC is very friendly for workers. It is understood that workers, being college students, have obligations aside from EEC work. Additionally, it is a culture that encourages cooperation and has a mission to develop work ethic and analytical skills of workers. The primary concern in this intervention is developing organizational control.

Using the valuation questionnaire, the values shown in Fig. 5 below are achieved given the above analysis.

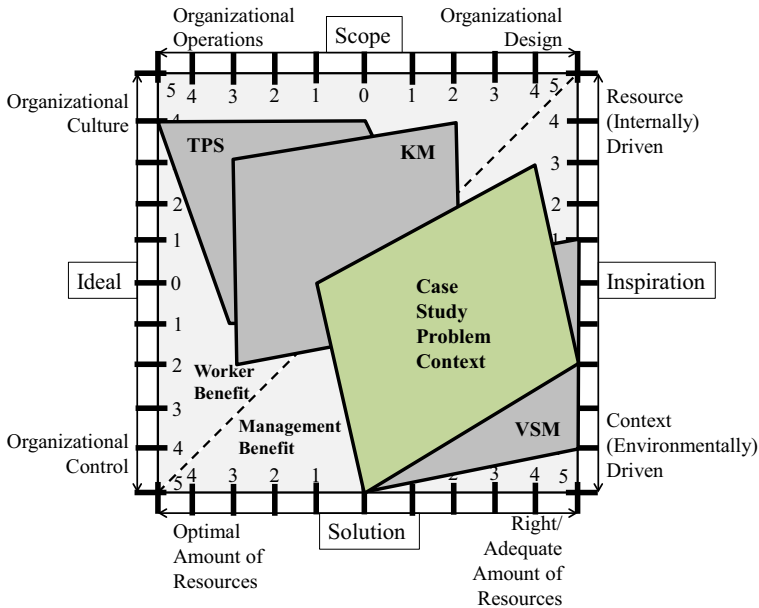
When mapped on the framework model with VSM, KM, and TPS, the problem context is located in the region indicated in Fig. 6 below.

Figure 6 shows a strong overlap of the problem context with VSM. It also has significant overlap with KM, and some overlap with TPS. This shows that VSM should be considered the dominant approach in this problem context, with KM and TPS as dependent approaches. Of the dependent approaches, the framework prescribes KM as the secondary approach and TPS as tertiary. It should be noted that elements of the dependent approaches should be utilized, but VSM will be foremost in intervention.

Figure 7 is a diagram of VSM with indications of how KM and TPS can be used within it.



**Fig. 5** Valuation questionnaire results for case study

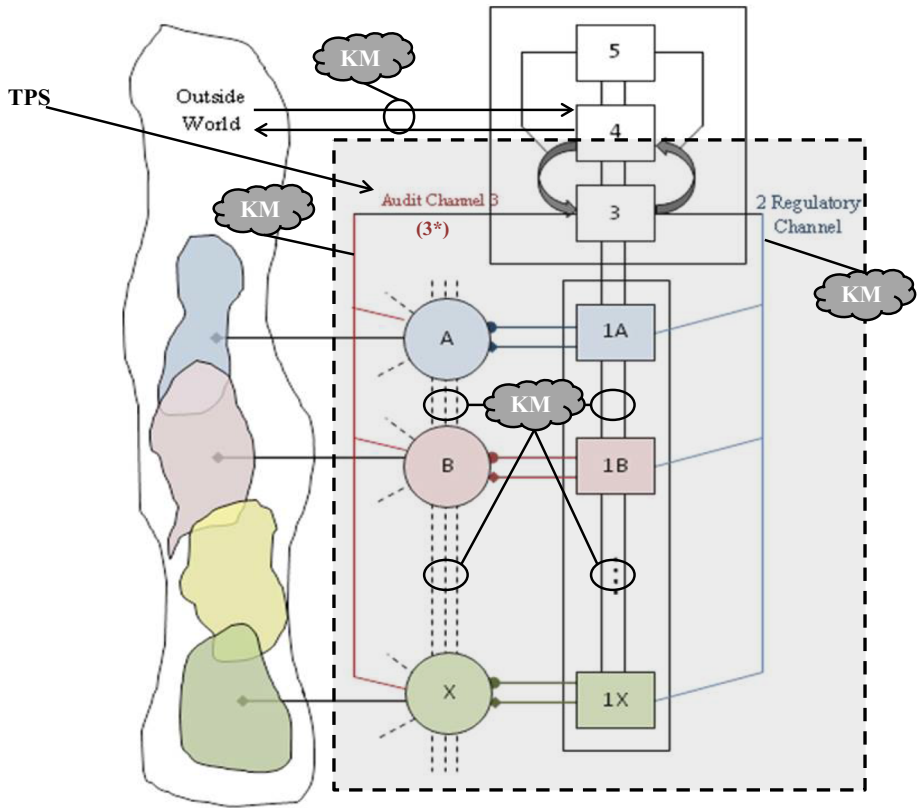


**Fig. 6** Case study problem context mapped on framework with VSM, KM, and TPS

Figure 7 represents a case where VSM is selected as the dominant, or primary, approach. Therefore, KM and TPS are dependent approaches. VSM, being the dominant approach provides the organizational structure. VSM does not define communication channels within the organization or with the environment; it only states that they are vital (Beer 1984). KM can support these communication channels. Additionally, operational elements of the subsystems within VSM are not defined other than descriptions of their roles and interactions. There are no guidelines or tools for these subsystems to effectively operate. TPS can aim in ensuring that these subsystems are achieving their goals efficiently.

The complementarist intervention model described by Fig. 7 would likely represent a case where the problem context is defined in the framework in the lower, right corner, where VSM is most applicable. Such a problem context may be defined by the question: how should the organization be designed to best allocate resources to respond to differing client demands? According to the intervention presented, VSM would be used to ensure that all roles to ensure viability of the organization are functioning. VSM would also guide the organization to ensuring that it contains enough variety to address the needs of clients. TPS would limit the variety to a level that is not excessive or wasteful. A tool of TPS that could be used in the interaction between operational (system 1) elements of the organization and the environment is creating standard work procedures. A standard procedure for every possible situation is not necessary. Only work procedures for relevant environmental situations are needed. KM could be used to collect information from the environment to determine which work procedures are needed to act in the environment. Furthermore, KM would be used to communicate the designed work procedures throughout the organization.

Other concepts of TPS that could be applied in such an intervention are just-in-time and flexible workforce. Just-in-time would guide operational elements in timely delivery of deliverables depending on the time required for each task and the due date. A flexible workforce ensures less dependence on particular workers, allowing resources to be



**Fig. 7** Case study intervention design with VSM as dominant (see discussion on pages 14 and 15 for considering multiple weltanschauungen)

allocated as needed to meet deadlines. KM would help distribute the knowledge about performing certain tasks, including standard work procedures, allowing a more flexible workforce.

Without KM and TPS, VSM may have seemed like an incomplete intervention approach. Synthesizing all three creates a holistic approach to address the set of management challenges at the EEC.

**Limitations**

The proposed framework and method has some limitations. One limitation is that it currently forces shapes constructed on the framework to be four sided figures with side lengths of five units. This was a design choice to keep the preliminary framework and method simple, but in the future it would likely be beneficial to allow more freedom in the shapes of problem context and intervention approach regions on the framework.

Additionally, actors would likely benefit from more definition in selecting values on the valuation questionnaire. The current translation of a real-world problem context into quantities in the questionnaire is subjective.



Definition of problem contexts and intervention approaches are currently based on practitioner judgement, assumedly expert opinion. In this research, a proper test of qualitative and quantitative methods of using the proposed framework was not conducted. The current research included only a preliminary assessment, checking the consistency of intuitive assumptions against the use of the questionnaire. In this assessment, one expert was used for both methods.

As discussed in the Case Study section, definition of intervention approaches in the framework should be established, gaining consensus by several experts. The current research uses the opinion of few experts due to the early stages of developing the proposed method.

An additional method to create a shared view and understanding of problem contexts would be beneficial. Such a method could make use of a methodology such as SSM.

Lastly, additional support in selecting intervention approaches would be useful. Such support may suggest how many intervention approaches should be applied. It would likely also be beneficial to make more quantifiable guidelines for selecting approaches. For example, instead of depending instructions such as “select the approach that overlaps the most”, calculating the area of the shared space would allow actors to objectively make decisions. This would define how to select the dominant approach. The dominant approach would be the approach that has the most shared area with the problem context. Then the secondary approach would have the second most shared area and so on.

## Conclusions and Future Work

Moore et al. (2015) created a framework for defining and selecting intervention approaches. This tool defines problem contexts based on four categories: Scope, Inspiration, Solution, and Ideal, each ranging between two extremes. It also identifies which party benefits most from improving the existing situation: workers or management. Intervention approaches are modelled as regions on the framework, representing the problem context that they were designed for, and thus are strongest in. Practitioners may map their experienced problem context on the framework, which will also be modelled as a region. Overlapping of an intervention approach and a problem context on the framework shows that the intervention approach is well-suited for implementation in the problem context.

This paper presents a method for applying the framework developed by Moore et al. (2015). The proposed method is based on foundations set by TSI, CDM, and boundary critique. The method guides practitioners in translating an experienced problem context into a region on the framework using a valuation questionnaire and numeric axes on the framework. Intervention approaches will be mapped on the framework, filling regions of their own. Practitioners will select intervention approaches to apply to a situation based on proximity of the problem context shape and intervention approach shapes on the framework, with priority given to those that overlap. The dominant intervention approach will be used primarily in implementation, with support of dependent approaches were the dominant approach is not defined.

The proposed framework and method will allow stakeholders to benefit from the use of systems thinking without having a background in it. It will guide actors to select interventions approaches to match their problem contexts and design complementarist approaches. The proposed framework provides an opportunity for a computer application, guiding actors through the method. This would facilitate navigation through the proposed

framework and allow users to quickly evaluate multiple options by modifying inputs. Such a computer application would be merely a decision support tool. It would be comparable to using economic analysis to evaluate options. Outputs would provide the user with valuable information to aid decision making. The burden of decision making ultimately lies on the user.

Future work should address the limitations discussed. The framework should be populated with as many intervention approaches as possible. Currently, only VSM, KM, and TPS are included in the framework as these have been chosen to address the management challenges at the EEC, which may match management challenges at similar organizations (small non-profit, service organizations performing knowledge-based work in a dynamic environment). As opportunities to apply this framework to other types of organizations are explored, more intervention approaches will likely be necessary.

As discussed in the Limitations section, further quantification and definition in selecting dominant and dependent intervention approaches is necessary. The proposed method relies on the actor's interpretation of the shapes representing problem contexts and intervention approaches on the framework. A computer application would likely be very helpful in incorporating such modifications.

The previously mentioned issue of repeatability and time between interventions is an opportunity to expand the proposed method and provide further support to actors.

The proposed framework and method will be applied at the EEC and validated for use in similar organizations, with opportunities for application in other organizations explored. In its current state, the framework and methods are intended only for organizations similar to the EEC. Adaptations and expansions of the framework and methods may be necessary for application to other types of organizations.

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## References

- Beer S (1981) *Brain of the firm: the managerial cybernetics of organization*. J. Wiley, New York
- Beer S (1984) The viable system model: Its provenance, development, methodology and pathology. *J Oper Res Soci* 35(2):7–25
- Boyd A, Geerling T, Gregory WJ, Kagan C, Midgley G, Murray P, Walsh MP (2007) Systemic evaluation: a participative, multi-method approach. *J Oper Res Soc* 58(10):1306–1320
- Checkland P (2000) Soft systems methodology: a thirty year retrospective. *Syst Res Behav Sci* 17:S11–S58
- Churchman CW (1970) Operations research as a profession. *Management Science* 17(2):B-37
- Davenport TH, Prusak L (1998) *Working knowledge: how organizations manage what they know*. Harvard Business Press, Brighton
- Flood RL, Jackson MC (1992) *Creative problem solving: total systems intervention*. Wiley, Hoboken
- Flood RL, Romm NR (1995) Enhancing the process of methodology choice in total systems intervention (TSI) and improving chances of tackling coercion. *Syst Practice* 8(4):377–408
- Fong PS, Kwok CW (2009) Organizational culture and knowledge management success at project and organizational levels in contracting firms. *J Constr Eng Manag* 135(12):1348–1356
- Grant RM (1996) Toward a knowledge-based theory of the firm. *Strateg Manag J* 17(S2):109–122
- Jackson MC (2001) Critical systems thinking and practice. *Eur J Oper Res* 128(2):233–244
- Jackson MC (2003) *Systems thinking: creative holism for managers*. Wiley, Chichester
- Jones GR, George JM (2011) *Contemporary management*, 7th edn. McGraw-Hill Irwin, New York
- Lander E, Liker JK (2007) The Toyota Production System and art: making highly customized and creative products the Toyota way. *Int J Prod Res* 45(16):3681–3698

- Lane DC, Oliva R (1998) The greater whole: towards a synthesis of system dynamics and soft systems methodology. *Eur J Oper Res* 107(1):214–235
- Levy FK (1965) Adaptation in the production process. *Manag Sci* 11(6):B-136
- Midgley G (1992) The sacred and profane in critical systems thinking. *Syst Pract* 5(1):5–16
- Midgley G (1997) Developing the methodology of TSI: from the oblique use of methods to creative design. *Syst Pract* 10(3):305–319
- Midgley G, Milne A (1995) Creating employment opportunities for people with mental health problems: a feasibility study for new initiatives. *J Oper Res Soc* 46(1):35–42
- Midgley G, Munlo I, Brown M (1998) The theory and practice of boundary critique: developing housing services for older people. *J Oper Res Soci* 49(5):467–478
- Mingers J, Taylor S (1992) The use of soft systems methodology in practice. *J Oper Res Soc* 43(4):321–332
- Monden Y (1983) *Toyota production system*. Industrial Engineering and Management Press, Norcross
- Moore B, Calvo-Amodio J, and Junker JF (2015) Synthesizing systemic intervention approaches: combining viable system model, knowledge management, and toyota production system for a sustainable holistic management model. Proceedings from *2015 International Society for the Systems Sciences conference*, Berlin
- Nonaka I (1991) The knowledge-creating company. *Harvard Bus Rev* 69(6):96–104
- Nonaka I, Takeuchi H (1995) *The knowledge-creating company: How Japanese companies create the dynamics of innovation*. Oxford University Press, Oxford
- Nonaka I, Umemoto K, Senoo D (1996) From information processing to knowledge creation: a paradigm shift in business management. *Technol Soc* 18(2):203–218
- OSU Energy Efficiency Center (n.d.). Retrieved from <http://eec.oregonstate.edu/>
- Ulrich W (1983) *Critical heuristics of social planning: a new approach to practical philosophy*. Haupt, Berne