Introducing Complex Systems Governance to Practitioners

James C. Pyne, Charles B. Keating, and Polinpapilinho F. Katina

Abstract Complex System Governance (CSG) is an emerging field with the potential to enhance capabilities for the design, execution, and evolution of complex systems. CSG offers a theoretically grounded, model informed, and methodologically driven approach to more effectively deal with complex systems and their problems. However, initial CSG applications have identified multiple impediments to systemic intervention to deploy this new and novel field. In this chapter, we discuss strategies to effectively deploy systemic intervention in support of CSG. Four primary objectives are pursued, including: (1) identification of major forms of systemic intervention for complex systems in general and a corresponding classification schema, (2) presentation of a dynamic and tailored approach (CSG Entry) to improve prospects for introductory systemic intervention for CSG, (3) results from an initial application of CSG Entry in a field setting, and (4) suggestion of lessons learned from initial applications of CSG Entry in relationship to systemic intervention. The chapter concludes with examination of future development directions for systemic intervention to advance CSG performance.

1 Introduction

Landscape of the Modern Complex System Practitioner

Practitioners continue to be besieged with complex systems and their problems that at first glance appear increasingly intractable. This is especially true of organizations. For the purposes of this chapter, we use the term 'enterprise system' to denote an organizational complex system. The shifting landscape of the systems engineering

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practitioner might be characterized by several dominant characteristics. Following previous recitations of this landscape from recent works [4, 10, 11, 15], the following summary is offered with respect to characteristics and their nature for the domain faced by system practitioners dealing with enterprise systems. These include:

1. *Exponential Rise in Complexity*—the availability, magnitude, and accessibility of information are beyond current capabilities to structure, order, and reasonably couple decisions, actions, and consequences. This, coupled with compression of time and the interconnectedness of 'everything,' is challenging our capacity to mount effective responses.
2. *Dominance of Emergence*—the appearance of structures, behaviors, performance, or consequences that cannot be known in advance renders traditional forms of planning innocuous at best, unsuited to current realities, and potentially detrimental. Current methods are failing to provide practitioners with the necessary capabilities to engage highly emergent situations.
3. *Ambiguity in Understanding*—instabilities in understanding, shifting boundary conditions, and unstable structural patterns create a lack of clarity for decisive action.
4. *Uncertainty as a Norm*—the inability to have any measured degree of confidence in how to proceed to produce desired performance is not the exception but rather the stable state of affairs.
5. *Holistic Satisficing Solution Spaces*—the modern problem space is not limited to simple, absolute, or isolated solution forms. The spectra of technology/technical, organizational/managerial, human/social, and political/policy are in play across special, temporal, and social dimensions.
6. *Contextual Dominance*—unique circumstances, factors, patterns, and conditions permeate all systems. They can be both enabling and constraining to decision, action, and interpretation.

Dealing with these characteristics is not insurmountable. However, effectively dealing with them requires a different level of thinking. While these characteristics are certainly not intended to present an 'absolute' depiction of the landscape, they serve as a reminder of the stark reality faced by practitioners. The domain of the enterprise system practitioner appears to be intractable. Complex System Governance (CSG) is an emerging field designed to address this increasingly hostile landscape, which represents a 'new normal' for system practitioners. A snapshot of the realities facing practitioners in this 'new normal' is shown below in Fig. 1.

Three primary conclusions are offered for this set of realities facing practitioners of enterprise systems. First, the nature of this landscape is not likely to improve in the future. More probable is that these elements will escalate in frequency and severity of their impacts. Second, our current approaches to deal with the systems characterized by these conditions are not having the desired impact. This is evidenced by the increasing number of tools, technologies, and approaches attempting to address complex systems without resolution of associated issues. This is not intended to disparage any of those tools, technologies, or approaches, but rather only recognizes

Fig. 1 Five realities for complex system practitioners (adapted from [18])

that the search must continue for more effective approaches. The presented characteristics are representative of a complex system problem domain. Therefore, approaches that are not consistently developed, grounded, or applied in a manner appreciative of 'systems' are not likely to 'match' the complexity demanded by this domain. We now shift to a discussion of intervention to assist enterprise system practitioners in dealing with their new reality from a CSG perspective.

Systemic Intervention

Intervention is certainly not a new concept. Almost every management theory has a related intervention strategy. Facilitators have adapted them to suit their individual practices. At the very essence of intervention is the notion that there is (1) involvement, (2) intention to alter actions/outcomes, and (3) use of some form of leverage (force) to carry out the effort. While this depiction is helpful, systemic intervention has a different connotation. Following [20], we describe systemic intervention as *the purposeful action by an agent, generally human for complex systems, to produce change in a system or situation.* For our perspective of systemic intervention, the following elements are offered [17]:

1. *Purposeful*—engagement in intervention with the intention to achieve some desired aim. The importance of this aspect of systemic intervention is that it requires the outcome (expectations) for the intervention to be specified

(determined) in advance of the intervention. From a systemic perspective, this also must acknowledge that, due to emergence (unpredictable consequences), although there are 'desirable' outcomes, latitude must be given to results and directions not necessarily conforming to desires, design, or intentions for intervention.

2. *Human Agent*—at the center of any systemic intervention are people. The design, execution, and evolution of a systemic intervention are accomplished by people. As such, people become the central driving force behind systemic intervention. So much so that effectiveness in intervention must be a function of those who design, those who conduct, and those who play participatory roles in the intervention effort.
3. *Produce Change*—from a systemic perspective, change in a system may include modifications in structure, behavior, or understanding/interpretation of a system/situation. This point is critically important, since it moves the notion of change beyond the narrow conception of solution as the singular objective for intervention.
4. *Systemic*—this invokes the entirety of the 'systems' perspective for intervention. In contrast to a focus on linear, reduction, or piecemeal inquiry, a systemic orientation to intervention is focused on the nonlinear, holistic, and integrated inquiry into a system.

There are four primary conclusions with respect to the systemic nature of intervention identified for CSG development. First, although the notion of intervention is well known, the nature of 'systemic intervention' introduces a different level of thinking, possibility for different corresponding actions, and can invoke a different level of understanding/interpretation of a situation. Second, systemic intervention does not exist in a binary fashion of 'present' or 'not present.' Rather, it is best to recognize that systemic intervention might be achieved in 'degrees of application.' This opens the possibility of systemic intervention having a spectrum of depth in delivery. Third, the engagement in systemic intervention has real consequences for performance of a given system—introducing an entire spectrum of development possibilities. These developmental 'change' possibilities range across the spectrum of technology, human, social, organizational, managerial, policy, and political dimensions. In addition, although 'everything' cannot change simultaneously for a given system, changes pursued can be assessed for feasibility and their specific fit to the larger landscape of systemic issues identified during intervention inquiry. Each system is unique and must be taken as it is with its own individual culture, peculiar language, available resources, perceived needs, and variety load. Therefore, the associated systemic intervention design, execution, and development expectations must be unique. Fourth, systemic intervention must be engaged by individuals with some level of a 'systems worldview.' In effect, since intervention is undertaken by people, their worldview, and the degree that it is consistent with a systems mindset, will enable or constrain any systemic intervention effort. Thus, while systemic intervention provides an exciting and substantial movement forward for CSG development, it must be engaged with a healthy skepticism.

The focus now shifts to elaboration of the different roles and specific forms of systemic intervention. This elaboration is essential to clearly understand where individuals are placed in a systemic intervention and the particular type (form) being pursued. Both of these aspects require clarity concerning systemic intervention—hopefully at the outset of an initiative.

Observation versus Intervention. As the definition of systemic intervention highlights the characteristic of purposeful action, one may consider what happens when there is inaction and only observing the system. [21] addresses conducting an observation versus conducting an intervention. Midgley defines independent observation as 'observation detached from the values and idiosyncrasies of the observer' [21], p. 9) and suggests that without this independence, an intervention has been conducted. This is not to pass judgment on intervening (or not intervening). In fact, this further highlights a need for a systemic approach to intervention.

In addition to the independence of the observer, the observer's engagement with the system can determine if an intervention is occurring.

Four situations can occur between the observer and the system as follows:

1. Observation performed and *known* by the system results in an intervention as the system has been changed by the knowledge of the observation occurring.
2. Observation performed and *known* by the system does not result in an intervention because the system remains unchanged by the observation occurring.
3. Observation performed and *unknown* by the system results in no intervention because the system is unchanged.
4. No observation—no intervention.

The key takeaway is that there is a distinction between merely observing versus conducting an intervention and that when an intervention occurs, a need for a systemic approach exists.

Roles and Forms of Intervention. In the initiation of intervention, we present four primary forms of intervention and their associated role expectations. It is important to be clear on which of the forms of intervention are being pursued. In addition, each of the different forms requires a specific role to be played by both the interventionist and those enlisting the intervention.

Table 1 summarizes three basic forms of intervention. This is not to say that there might be different configurations or hybrids of the different forms. However, these four basic forms provide an adequate definition of the landscape for intervention.

These three forms of intervention are not intended to define the entire scope of intervention. However, they do provide a survey of the range of intervention possibilities for systems. There are three important conclusions offered with respect to intervention implications. First, there is a range of 'intensity' and corresponding expectations related to the different intervention forms. The simple 'expert advice' intervention is certainly not to the depth or expectations that would be characteristic of the 'participatory' intervention form. Second, there is a range of risk incurred in any intervention. As the intervention moves from 'problem resolution' to 'participatory,' the risk shifts from the interventionist to the client organization. Thus, for

Table 1 Forms and roles for systemic intervention (adapted from [18])

Intervention Form	Nature	Roles	Accountability	Example
Problem Resolution	Engagement for a specific problem to be resolved by the intervention. Expertise is beyond that held by the system in focus	Intervention which brings specific competence not held within the system, or intended to be developed in the future	Risk for proper resolution of a problem is held by the interventionist	Bringing on an expert to solve a specific targeted governance problem in the system (e.g., communications)
Expert Advice	Engagement of an expert for their specific advice concerning a problematic situation	The client system provides data and description of a problematic situation, leaving the interventionist to provide prescriptive advice for resolution	Interventionist has responsibility for the prescription adequacy. Client system holds responsibility for implementation of recommendations	Engaging an expert to make recommendations concerning implementation of a new program (e.g., supply chain logistics)
Participator	Engaging in a shared intervention effort to design, analyze, and improve system to performance	The intervention design, execution, and assessment are shared between interventionist and system actors	The responsibility for conduct and results are shared between all parties in the intervention	Engaging in a comprehensive CSG development effort

holistic intervention, characteristic of the participatory form, there is a sharing of risk for success of the intervention. Third, the ability to make objective determinations with respect to ‘success’ of the intervention endeavor decreases as the form of intervention moves from ‘expert advice’ to ‘participatory’ forms. Fourth, as the depth of intervention increases (from advice to participatory) so too does the risk for failure or falling short of expectations. This is not unexpected, as the nature of problems and their scope, breadth, and depth is increasing with the different intervention forms, with participatory representing the most comprehensive and extreme intervention case. It should be emphasized that the forms of intervention are not binary in nature. Instead, they can exist in different combinations and hybrid forms.

Systemic Intervention for Complex System Governance

CSG is not an easily approachable subject. Instead, it requires commitment to a ‘long view,’ ‘sustainable,’ and ‘integrated’ endeavor. It focuses on the very core of complex system design, execution, development, and maintenance for organizations. However, as with all systemic intervention approaches, it should be met with a healthy skepticism. It would be unrealistic to engage in a comprehensive systemic intervention with little more than a ‘promise’ of effectiveness. Both the practitioners in the complex (enterprise) system as well as the facilitator will be learning throughout the process, but it is especially important for the facilitator to be observant. For the intervention to be successful, the enterprise has to be engaged as it is, not as the facilitator thinks it should be. CSG intervention cannot be a ‘one size fits all’ program. It must be adapted to suit the individual enterprise. Of particular interest in the initial phases of the intervention are the enterprise’s worldview, context, and language. These are not independent attributes. They develop in a system concurrently and are linked. Changes in any one invoke changes in the others. Worldview can be thought of as a system’s outlook or belief about its place in the environment and how it can or should interact with it. Its contexts are factors, conditions, circumstances, and influences, both internal and external to the system, that influence the behavior of the system. Special attention should be given to language. Each complex (enterprise) system has a language that has developed over time in response to its context, environment and the technologies it is involved with. Likewise, CSG has been developed from a systems context in an academic environment and has developed its own specific language. The facilitator must communicate using language readily understandable by the enterprise system practitioners. As the intervention proceeds and the enterprise system practitioners become more familiar with CSG concepts, a common understanding will evolve.

Understanding these provides a foundation for structuring an intervention plan specific to the enterprise. *CSG Entry* (discussed in more detail below) has been developed as a first introduction to CSG to lessen comprehensive engagement hesitation and to provide the facilitator an opportunity to make some initial observations before proceeding with more, in depth, intervention.

Vignette—Worldview, Context, and Language Changes

In an enterprise system, worldview, context, and language are some of the components that make up what some would call its culture. From the early 1970s through the late 1980s, a large governmental utility evolved a specific culture in response to increased regulatory pressure and reinforced by the overall culture of the region that had a large population of active and retired military personnel. This culture influenced how the enterprise system interacted with regulators and other governmental agencies in the region. Although cordial on the surface, the underlying attitudes were adversarial. Indeed, the internal language used to describe the outcome of correspondence and meetings was laced with phrases like ‘we really beat them today’ or ‘we have to fight back against those permit requirements’. The internal departments were effectively siloed and competed for resources with the stronger department heads winning out over the others. Although the enterprise was operating efficiently and was in compliance with all of the regulations, its mission was narrowly defined to meeting regulatory requirements and limiting customer rate increases. Starting in the 1990s and continuing into the new millennium, the culture began to change. The shift coincided with some internal development programs, followed by a change in leadership as older managers began to retire. The enterprise’s governing body specifically chose a top executive with a more expansive worldview. As a result, the language used to discuss relations with other agencies and regulators began to soften as did the walls between the siloed departments. Interactions between the enterprise and others in its environment became less adversarial. This led to new initiatives that were *targeted not only to improve operations related to the enterprise's traditional mission but expand it to improve the regional environment in ways that were not previously considered.*

Intervention Planning and Execution

The intervention requires a rigorous plan. The facilitator must acquire some basic information about the enterprise system in order to develop an intervention plan that is specific to the enterprise considering its context, environment, level of systems thinking, and its current governance condition. The initial phases of the intervention should be designed to introduce the facilitator to the enterprise and for the facilitator to gather the information required for development of a tailored intervention plan that will address specific system weaknesses.

Each enterprise system is unique and will require a strategy tailored to suit its peculiarities. However, there can be a common framework, especially in the early phases of the intervention that can help in developing the structure of the intervention plan and its execution.

Diagnostic Phases of Systemic Intervention

It must be accepted that in the early phases of systemic intervention, the larger portion of the effort will reside with the facilitator. As the intervention progresses, the practitioners will gain insight into systems concepts and methods, in general, and CSG in particular, to be able to accept more of the effort. It must be made clear to the practitioners that the effort they expend is not in addition to their current responsibilities. Instead, governance of the enterprise system is their responsibility. They are already practicing it on a daily basis. The intervention is designed to improve their governance of the enterprise system, especially in its functions.

Early in the diagnostic phase of an intervention it would be beneficial to elicit the system practitioner's concerns about the functioning enterprise system's operation and governance. This can be accomplished utilizing the CSG Entry program methods, discussed below, as well as free form discussions with the system practitioners. It is important to give credence to the concerns that practitioners have. These concerns may be, in reality, symptoms that are the result of deeper systemic problems or pathologies. By first focusing on symptoms brought to light by the practitioners then proceeding to relate those to the deeper systemic issues, the practitioners begin to realize the value of CSG-based methods with respect to enhancing their enterprise system performance.

As the practitioners gain exposure and experience with CSG-based methods, they will be able to take a more active role in the intervention. As their participation increases, the role of the facilitator will begin to decrease as shown in Fig. 2. The result will be that the practitioners will begin to see CSG, its concepts, and methods as not just another 'add on' program but as integral to the functioning of the enterprise system.

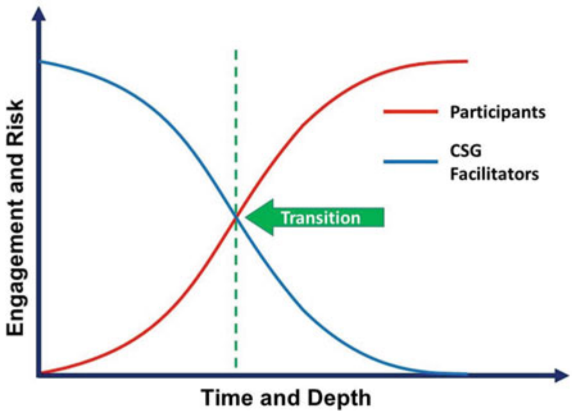


Fig. 2 Relative participatory effort

CSG Entry

The first phase of an enterprise system intervention should consist of an introductory program. CSG Entry has been developed specifically for this purpose. The combination of System Thinking Capacity (ST-Cap), Environmental Complexity Demand (ECD), and Governance System Diagnostic Check (GDC) provides insight and background information for the facilitator and introduces the enterprise system practitioners to systems thinking and CSG concepts. There is a more in-depth examination of CSG Entry later in this chapter.

There is considerable value gained from the CSG Entry alone, so if the enterprise systems practitioners only complete this initial phase, the effort would not have been wasted.

In order to develop a more complete articulation of the enterprise system landscape and its current state of governance, the facilitator and the enterprise system practitioners must investigate deeper. A rigorous system mapping will provide the facilitator and the enterprise system practitioners with insights into the system, how it is designed to function and how its governance functions are integrated.

System Mapping

In many cases, the enterprise structure was developed in a less complex environment and now may need to be updated to suit current complexity, or the structure has been changed on an ad hoc basis to cope using a trial and error-type method not based on a rigorous method but based on some type of systems method. An important part of the systemic intervention is coming to an understanding of the components, relationships, and overall architecture [1] of the enterprise governance system with respect to the metasystem functions as articulated in the CSG reference model [14]. There are many approaches that can be used to perform the system mapping, and the approach should be chosen with respect to what has been discovered about the enterprise system context during the CSG Entry process.

Metasystem Pathology Assessment

The system mapping effort should be followed by an investigation to uncover weaknesses in the governance structure (pathologies) that are inhibiting system performance.

There are currently two possible methods to consider investigating system pathologies. System pathologies are rigorously investigated using the M-path method [9] which is discussed in more detail later in this chapter. The M-Path is a rigorous method that has been fully developed and verified through extensive research. It provides a detailed compilation of the pathologies adversely affecting the nine governance metasystem functions.

Another method for investigating system pathologies has been proposed and utilizes a modified version of failure mode effects and criticality analysis (FMECA) adapted for CSG (FMECA-CSG) and is under development. The five-phase FMECA-CSG approach is being mapped onto corresponding M-Path system pathologies. It will be a less intensive method that can perform an analysis of pathologies similar, although not as in depth or rigorous as M-Path. It may also be used as an initial step to better target the M-Path effort.

CSG Entry, system mapping, and M-Path/FMEC-CSG together comprise a suite of methods that when used at the initial phase of a systemic intervention provide essential information to develop a comprehensive plan to advance the intervention toward the production of favorable results.

In summary, during these initial phases of the intervention, the investigation should concentrate on five aspects of the enterprise system. These include the following:

1. The System Thinking Capacity of the enterprise system.
2. The enterprise system's Environmental Complexity Demand.
3. A diagnostic of the enterprise system's governance (metasystem).
4. A rigorous mapping of the enterprise system and metasystem.
5. An investigation of the enterprise system's pathologies.

2 CSG Entry as an Approach to Begin Systemic Intervention

CSG has not been presented as a 'magic elixir' or 'silver bullet' that can cure all system/organizational ills. CSG development is not a 'sprint,' a 'fad,' 'easy,' or an 'isolated' endeavor. Instead, it requires commitment to a 'long view,' 'sustainable,' and 'integrated' endeavor. It focuses on the very core of complex system design, execution, development, and maintenance for organizations. However, as with all systemic intervention approaches, it should be met with a healthy skepticism. It would be unrealistic to engage in a comprehensive systemic intervention without more than a 'promise' of effectiveness. Thus, *embarking on a comprehensive CSG development effort as a first step is unrealistic.* The associated risks and inherent uncertainties in a comprehensive CSG endeavor are simply too great as a first step.

Therefore, *CSG Entry* has been developed as a first introduction to begin a systemic intervention effort. It represents a 'hands-on' low-risk, efficient, and value-adding introduction to CSG. In a nutshell, CSG has been developed as a systems-based approach that:

1. *Appreciates the 'new normal' for practitioners marked by increasing complexity in their organizations, systems, and environment,*
2. *Offers an alternative perspective and approach to better understand critical system functions directly responsible for performance,*
3. *Is based in the application of fundamental system laws that govern performance of all systems, and*
4. *Enhances capacity to more effectively deal with increasingly complex systems, environments, and problems.*

It is a four-phased *CSG Entry* (Exhibit 2) approach that offers an efficient, convenient, low-risk, and value-added introduction to CSG (Fig. 3).

CSG Entry offers a 'hands-on' first exposure to CSG that is a short-term, efficient, and value-adding endeavor. It can be achieved from start to finish in the four phases with a minimal investment of time and resources spread out over a time period convenient to the enterprise system practitioners. A summary of the four phases of CSG Entry includes the following:

1. *PHASE 1: INVITATION TO CONDUCT CSG ENTRY*—the organization agrees to engage in a CSG Entry effort and is provided a basic overview of the process and expectations. The focal entity (unit, team, organization) is identified, and

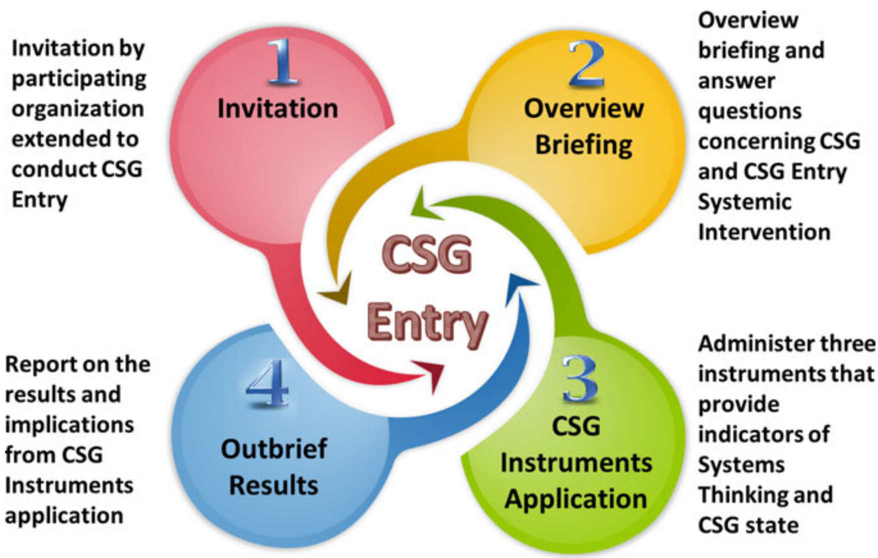


Fig. 3 Four phases for CSG entry (adapted from [18])

prospective participants are selected and a tentative timetable for completion set. This should include a discussion with someone in authority that will act as the sponsor for the intervention to gauge the level of interest and support.

2. *PHASE 2: OVERVIEW BRIEFING*—this briefing is designed to introduce participants to CSG and the *CSG Entry* approach. Questions are answered, expectations are set, and preparations are made to execute *CSG Entry*. In this briefing, the nature of CSG is kept to an overview level, and the emphasis is on instruction and clarification of the three instruments to be completed by the participants. Plan this phase and phase 1 to not only introduce the facilitator to the enterprise but to learn about the enterprise for use in adapting the intervention strategy.
3. *PHASE 3: CSG ENTRY INSTRUMENTS APPLICATION*—this phase is designed around administration of three web-based instruments that provide a set of insights concerning CSG. The total time investment in this phase is approximately 30 min per participant to take the three instruments. The results of these instruments are anonymous, and only aggregate information is compiled. Each instrument provides a snapshot of a different aspect related to CSG for the focal entity (unit, team, organization). In summary, the three instruments are as follows:

    a. ***Systems Thinking Capacity***—examines seven dimensions of systems thinking through a 39-question web-based survey instrument. The instrument determines the relative preference for systems thinking that exist in the participating group. Although each individual has a personal profile for systems thinking preference, only aggregates are collected and reviewed for CSG implications.
    b. ***Environment Complexity Demand***—examines the degree of complexity that exists in the environment of the enterprise system. This is captured by assessment of the seven dimensions of systems thinking in relationship to the environment through a 43-question web-based survey instrument. The aggregate of participant responses is collected and mapped onto the seven dimensions of Systems Thinking Capacity.
    c. ***Governance System Diagnostic Check***—a 45-question web-based survey that guides participants through an examination of CSG function performance to provide a 'snapshot' of performance across the nine essential governance functions. Participant responses are anonymous, and only aggregate data are used for analysis and mapping of the results.

4. *PHASE 4: OUTBRIEF RESULTS*–after completion of the three instruments, results are analyzed and compiled in a technical document provided to help guide interpretation of results. The document is provided in advance of a briefing presentation conducted with participants to explore the interpretations, answer questions, and suggest implications of the results for individuals and the participating entity.

In sum, *CSG Entry* offers an *efficient, low-risk, and value-added* set of activities to introduce CSG. This approach represents a ‘hands-on’ demonstration of the practical utility of CSG for helping to address some of the most vexing problems facing organizations and practitioners responsible for design, execution, and development of complex systems. CSG development, beyond *CSG Entry*, is not easy, fast, or achievable by following a prescriptive recipe. However, the *CSG Entry* approach outlined above offers an important first step for more comprehensive systemic intervention. To be able to move forward to more, in depth, systemic intervention, the practitioners and participants must perceive that systemic intervention will produce something of value for them. *CSG Entry* is the first step in demonstrating systemic intervention value. However, even if nothing is pursued beyond the *CSG Entry* effort, there is still significant value that can accrue.

Results from an Initial Application of CSG Entry

This section presents results from an initial application of the CSG Entry approach. The objective of this entry was to introduce CSG, through hands-on experience in an operational setting. This discussion is limited to what resulted and what was learned from the application. The presentation is broken down to the corresponding phases of CSG Entry (Invitation, Overview Briefing, CSG Instruments Application, and Outbriefing of the Results).

1. *Phase 1: Invitation*—project sponsors were provided a brief overview of CSG and the potential value that CSG might provide to the organization (system in focus). The expectations with respect to resources necessary to engage were explained. The nature of CSG, coupled with the efficient deployment, limited risk, and potential value were considered as sufficiently reasonable by the sponsor to engage in the effort.
2. *Phase 2: Overview Briefing*—the project sponsors selected participants for the CSG Entry effort. These were mainly leaders from the various organizational departments. The selected participants were briefed on the basics of CSG, the approach to CSG Entry, and the specifics of the instruments that would be deployed to provide data for the CSG Exploration. Timeframes were established, all questions answered, and access to the CSG instrumentation was provided.
3. *Phase 3: Instrument Application*—participants completed the three web-based instruments (System Thinking Capacity, Environment Complexity Demand, and 14-Point Governance Check) consistent with the timetable scheduled. Data were collected and prepared for outbriefing of results.
4. *Phase 4: Outbrief Results*—results of the instruments application were prepared in a technical report, and an outbriefing of the results was conducted with the participants. In this particular project, the participants were not provided with the technical report in advance of the outbriefing. For brevity, we include a snapshot of the representations of the results.

The following are the actual results of the CSG Entry effort as presented to the participants during the outbriefing. The presentation includes the numerical results of the instruments as well as definitions of the parameters measured.

The results of each of the three web-based instruments and their implications are shown below. *Care must be taken not to overreach the results and their implications.* Remember, these results stem from three short instruments and represent only a *'snapshot'* of several aspects of the enterprise. As such, it would be shortsighted to attribute 'absolutes' to the results. Rather, they are indicators that suggest potential implications, can focus further explorations/discussions, and suggest development directions for possible consideration to enhance system governance. We now examine each of the instruments and their results.

Systems Thinking Capacity—this instrument examined seven dimensions of systems thinking through a 39-question web-based survey instrument. The instrument determines the relative preference for systems thinking that exist in the participating group. The results of this instrument are provided in Table 2 and Fig. 4. The % spread provides the degree of variability of thinking in the group (max variability is 100%, indicating the group includes thinking along the entire spectrum of the dimension, where 0% would indicate total uniformity of thinking). The Systems Thinking Capacity % provides the degree to which a preference for systems thinking exists in the group as a whole (100% is maximum systems thinking capacity).

Table 2 Definition of systems thinking capacity dimension and variability of responses

Dimension	Definition	% Spread of group members (max spread 100)	Systems thinking capacity % (max 100, more systemic)
Complexity	Comfort with multidimensional problems and limited system understanding	**53**	**30.3**
Independence	Balance between local-level autonomy versus system integration	**42**	**58.2**
Interaction	Interconnectedness in coordination and communication among multiple systems	**42**	**77.3**
Change	Comfort with rapidly shifting systems and situations	**32**	**59.1**
Uncertainty	Acceptance of unpredictable situations with limited control	**45**	**57.6**
Systems Worldview	Understanding system behavior at the whole versus part level	**34**	**47.3**
Flexibility	Accommodation of change or modifications in systems or approach	**18**	**27.3**

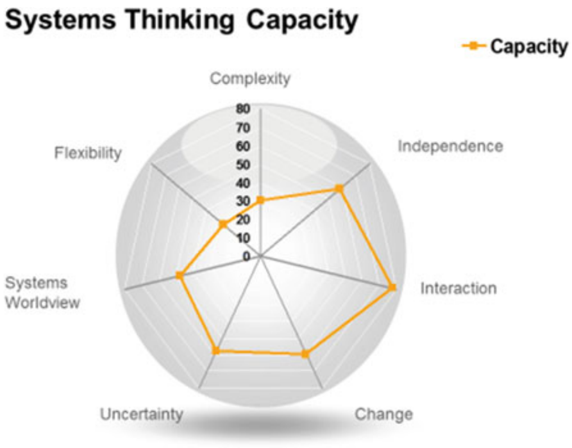
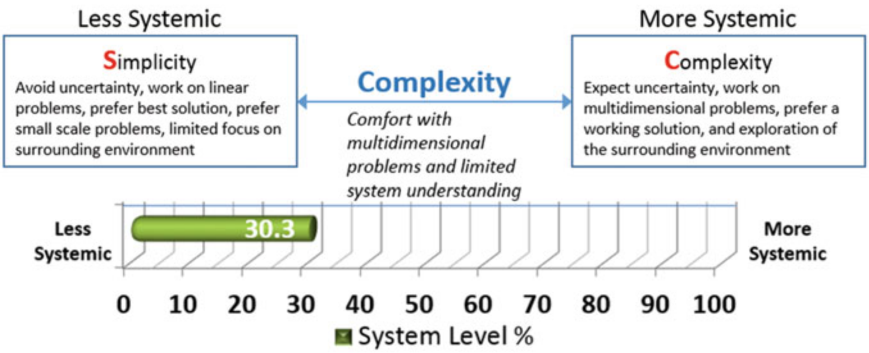
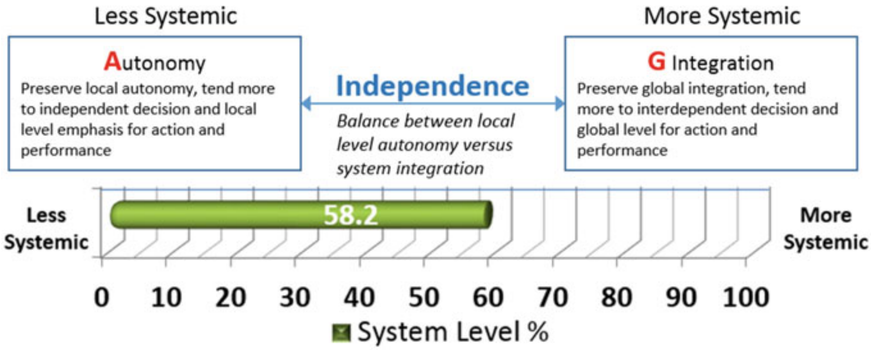
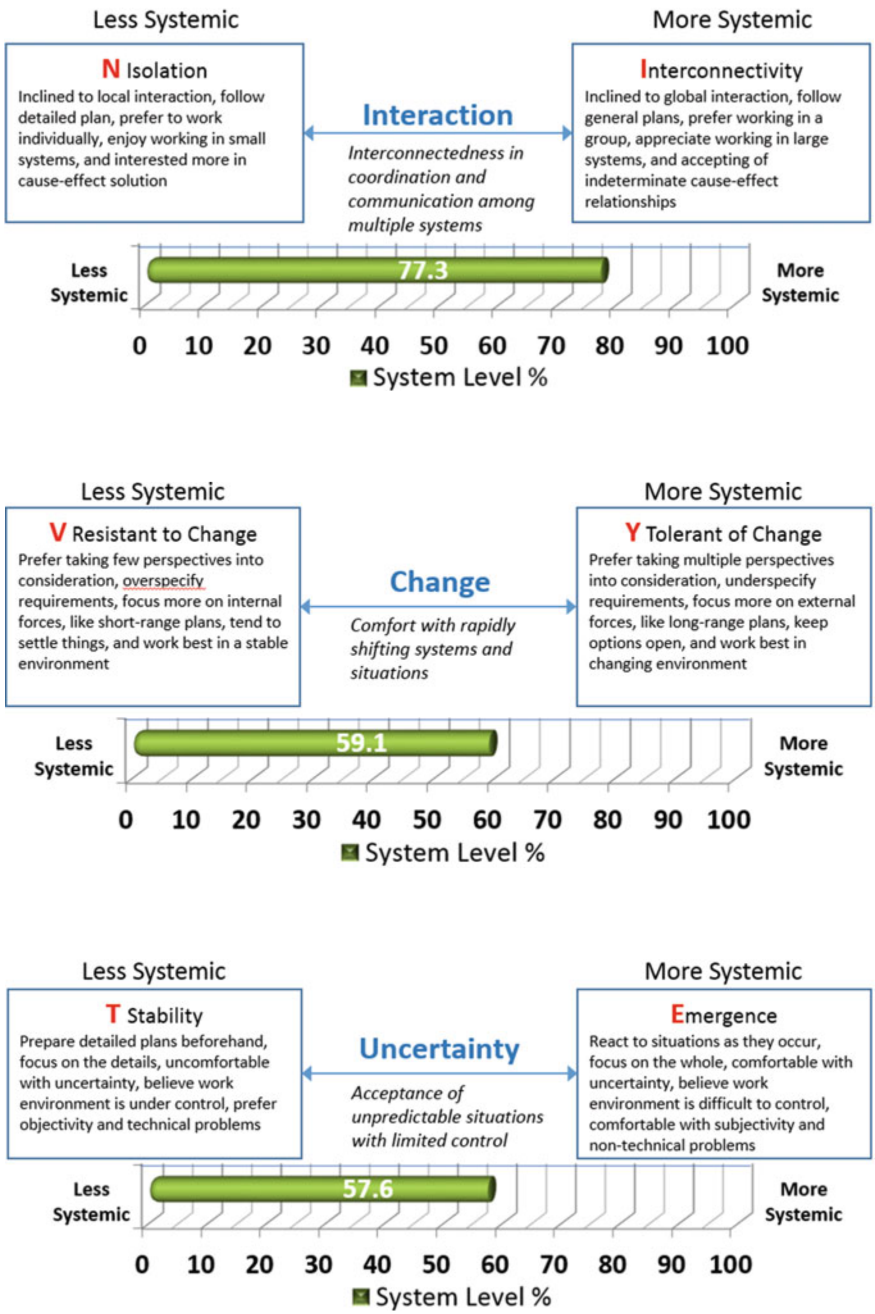


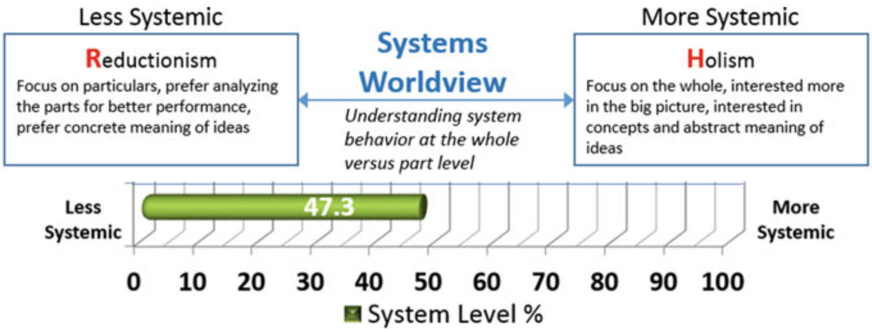
Fig. 4 Systems thinking capacity

The following diagrams break down the definition and results for each of the seven dimensions of Systems Thinking Capacity.






Less Systemic
More Systemic
N Isolation
Inclined to local interaction, follow detailed plan, prefer to work individually, enjoy working in small systems, and interested more in cause-effect solution
Interaction
Interconnectedness in coordination and communication among multiple systems
Interconnectivity
Inclined to global interaction, follow general plans, prefer working in a group, appreciate working in large systems, and accepting of indeterminate cause-effect relationships
Less Systemic
77.3
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %
Less Systemic
More Systemic
V Resistant to Change
Prefer taking few perspectives into consideration, overspecify requirements, focus more on internal forces, like short-range plans, tend to settle things, and work best in a stable environment
Change
Comfort with rapidly shifting systems and situations
Y Tolerant of Change
Prefer taking multiple perspectives into consideration, underspecify requirements, focus more on external forces, like long-range plans, keep options open, and work best in changing environment
Less Systemic
59.1
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %
Less Systemic
More Systemic
T Stability
Prepare detailed plans beforehand, focus on the details, uncomfortable with uncertainty, believe work environment is under control, prefer objectivity and technical problems
Uncertainty
Acceptance of unpredictable situations with limited control
Emergence
React to situations as they occur, focus on the whole, comfortable with uncertainty, believe work environment is difficult to control, comfortable with subjectivity and non-technical problems
Less Systemic
57.6
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %



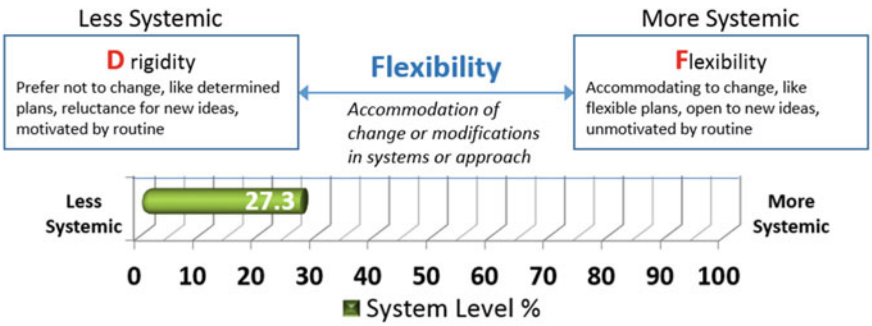


Figure 5 provides a summary overview of the results for the Systems Thinking Capacity identified for the aggregate of the group.

Environment Complexity Demand: This instrument examined the degree of perceived complexity that exists in the environment of the enterprise. This was

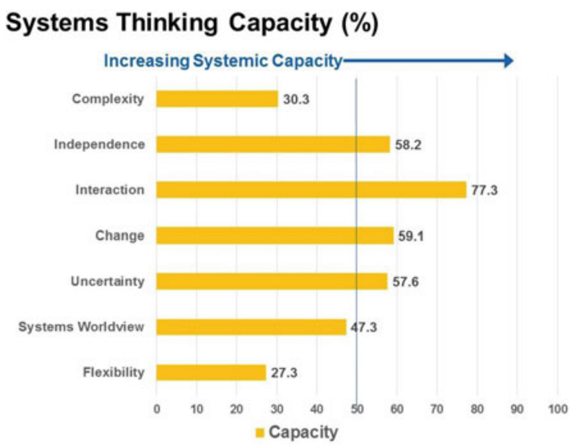


Fig. 5 Systems thinking capacity summary (max 100%, more systemic)

captured by assessment of the seven dimensions of systems thinking in relationship to the environment through a 43-question, web-based survey instrument. The aggregate of participant responses was collected and mapped onto the seven dimensions of Systems Thinking Capacity. Table 3 and Fig. 6 summarize the results with details following in the associated diagrams.

The % spread provides the degree of variability of thinking in the group with respect to the demands of the environment (max variability is 100%, indicating the group has perspectives that span the entire spectrum of the dimension, where 0% would indicate total uniformity of thinking). The Environment Complexity Demand % provides the degree to which the group perceives the complexity in the environment (100% represents a maximum in the complexity which must be responded to by the organization). The results of this instrument are provided in Table 3 and Fig. 7.

The following diagrams break down the definitions and results for each of the seven dimensions of Environment Complexity Demand. Recall that these are parallel to the Systems Thinking Capacity seven dimensions with the focus shifted to the environment.

Table 3 Definition of environment complexity demand dimensions and variability of responses

Dimension	Definition	% spread of group members (max spread 100)	Environment complexity Demand % (max 100, more systemic)
Complexity	Range of multidisciplinary requirements and understanding	**39**	**55.8**
Independence	Balance between local-level autonomy versus system integration	**40**	**45.5**
Interaction	Interconnectedness in coordination and communication among multiple systems	**32**	**54.5**
Change	Rapidly shifting systems and situations	**40**	**54.5**
Uncertainty	*Unpredictable situations with limited control*	**55**	**47.7**
Systems Worldview	*System behavior at the whole versus part level*	**43**	**54.5**
Flexibility	Ease of change or modifications in systems or approach	**42**	**38.2**

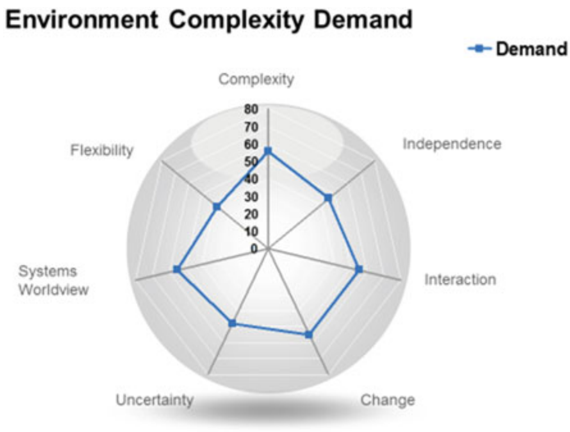


Fig. 6 Environment complexity demand

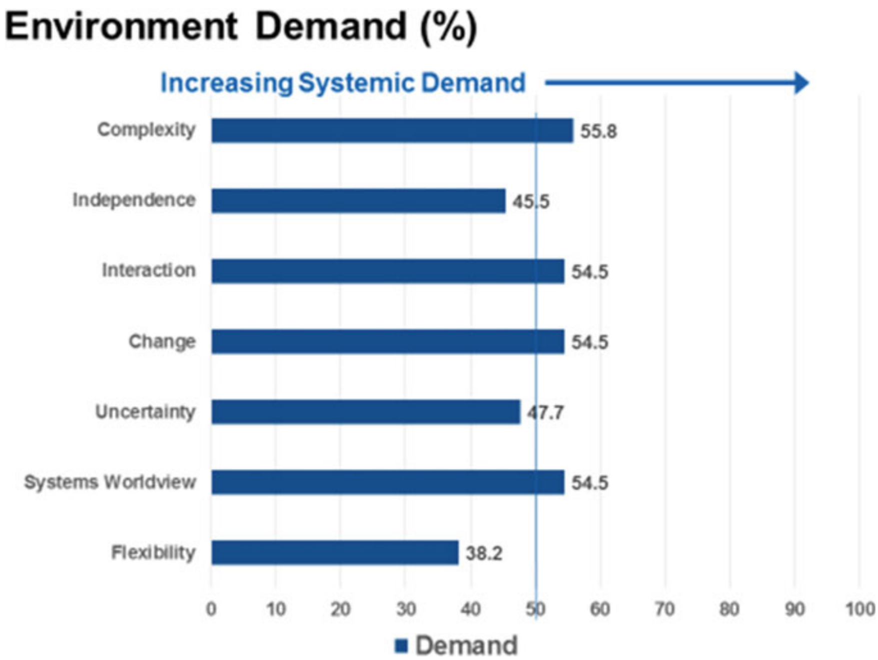
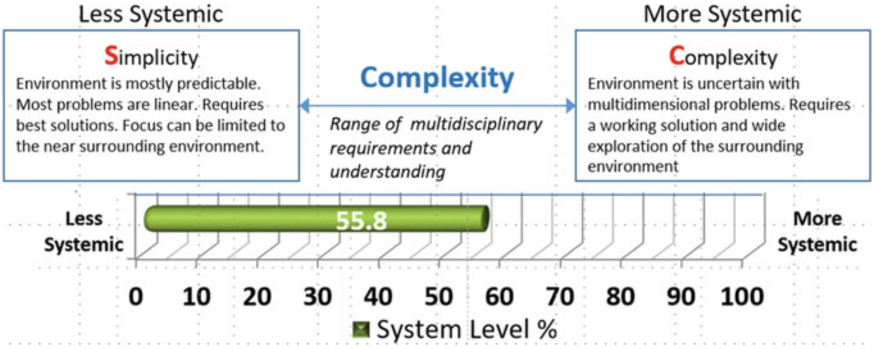
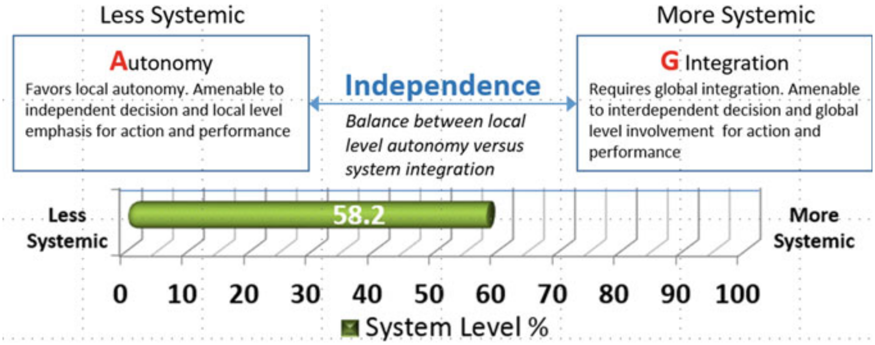
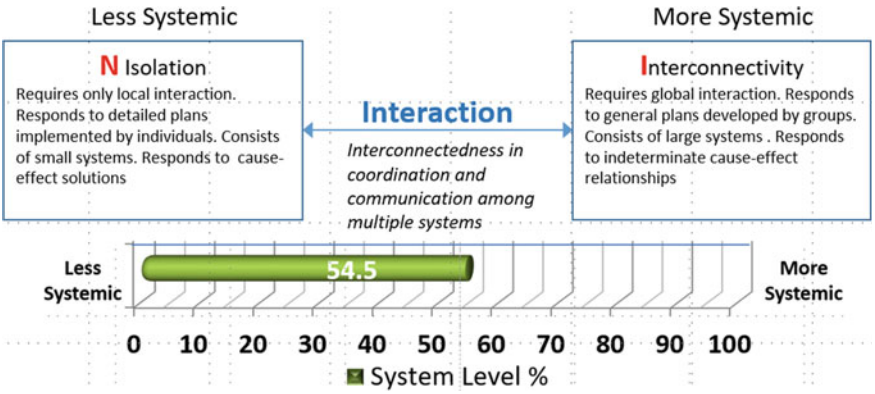
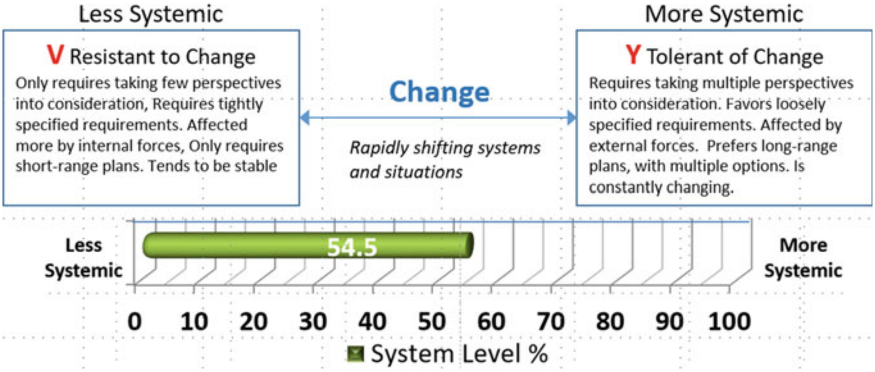


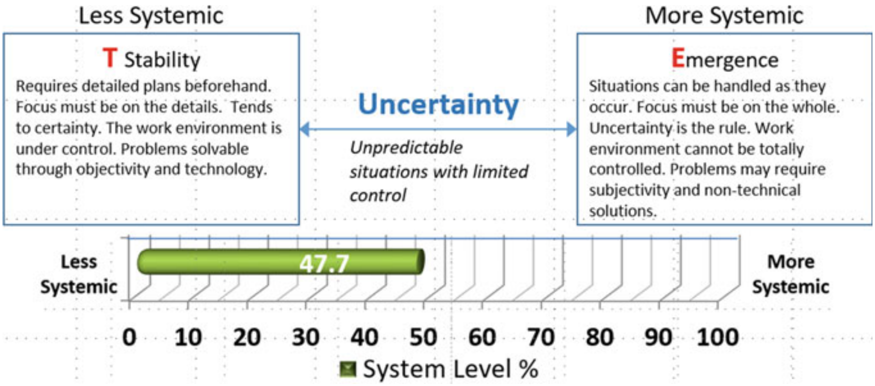
Fig. 7 Environment complexity demand summary (max 100%, more systemic)

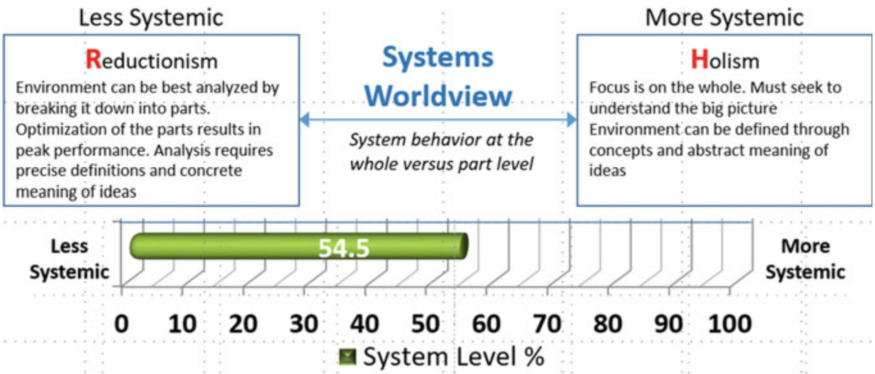

Less Systemic
More Systemic
Simplicity
Environment is mostly predictable. Most problems are linear. Requires best solutions. Focus can be limited to the near surrounding environment.
Complexity
Range of multidisciplinary requirements and understanding
Complexity
Environment is uncertain with multidimensional problems. Requires a working solution and wide exploration of the surrounding environment
Less Systemic
55.8
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %

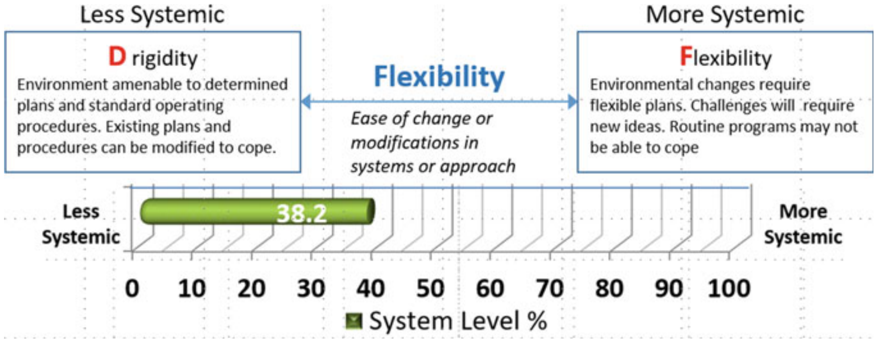

Less Systemic
More Systemic
Autonomy
Favors local autonomy. Amenable to independent decision and local level emphasis for action and performance
Independence
Balance between local level autonomy versus system integration
G Integration
Requires global integration. Amenable to interdependent decision and global level involvement for action and performance
Less Systemic
58.2
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %


Less Systemic
More Systemic
N Isolation
Requires only local interaction. Responds to detailed plans implemented by individuals. Consists of small systems. Responds to cause-effect solutions
Interaction
Interconnectedness in coordination and communication among multiple systems
Interconnectivity
Requires global interaction. Responds to general plans developed by groups. Consists of large systems . Responds to indeterminate cause-effect relationships
Less Systemic
54.5
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %


Less Systemic
More Systemic
V Resistant to Change
Only requires taking few perspectives into consideration, Requires tightly specified requirements. Affected more by internal forces, Only requires short-range plans. Tends to be stable
Change
Rapidly shifting systems and situations
Y Tolerant of Change
Requires taking multiple perspectives into consideration. Favors loosely specified requirements. Affected by external forces. Prefers long-range plans, with multiple options. Is constantly changing.
Less Systemic
54.5
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %


Less Systemic
More Systemic
T Stability
Requires detailed plans beforehand. Focus must be on the details. Tends to certainty. The work environment is under control. Problems solvable through objectivity and technology.
Uncertainty
Unpredictable situations with limited control
Emergence
Situations can be handled as they occur. Focus must be on the whole. Uncertainty is the rule. Work environment cannot be totally controlled. Problems may require subjectivity and non-technical solutions.
Less Systemic
47.7
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %


Less Systemic
More Systemic
Reductionism
Environment can be best analyzed by breaking it down into parts. Optimization of the parts results in peak performance. Analysis requires precise definitions and concrete meaning of ideas
Systems Worldview
System behavior at the whole versus part level
Holism
Focus is on the whole. Must seek to understand the big picture Environment can be defined through concepts and abstract meaning of ideas
Less Systemic
54.5
More Systemic
0 10 20 30 40 50 60 70 80 90 100
System Level %



The combination of System Thinking Capacity and Environment Complexity Demand is instructive in understanding the degree to which the organization views its Systems Thinking Capacity in relation to the complexity demands of the environment it must confront. We have provided two composite diagrams for the Systems Thinking Capacity versus the Environment Complexity Demand. The figures below provide a composite view of System Thinking Capacity available in the enterprise versus that demanded by the environment that must be engaged. Figure 8 suggests that the environment complexity demands more than the enterprise's current systems thinking capacity in the complexity, flexibility, and systems worldview dimensions. For the independence, interaction, change, and uncertainty dimensions, the enterprise's capacity for systems thinking exceeds the complexity demands of the environment. This suggests that there are potential targeted development areas that are in need of having the 'gap' closed between what is demanded from the environment and that which is capable of being delivered by the organization (Fig. 8).

System Governance Check—this instrument was a web-based survey that allowed participants to examine 14 elements of system governance. The results provide a 'snapshot' of several aspects of governance. Participant responses were aggregated

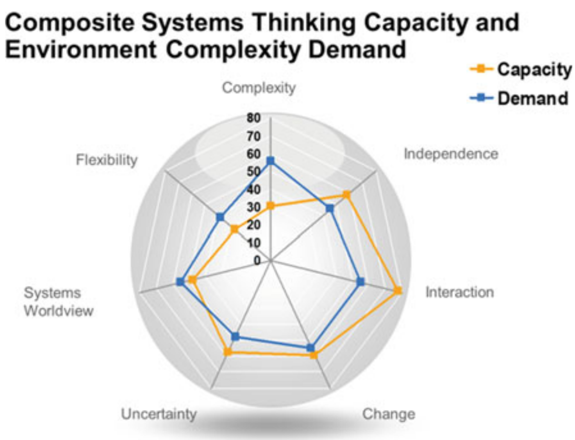


Fig. 8 Composite systems thinking capacity and environment complexity demand summary (max 100%, more systemic)

to provide for the analysis. The results of the 14-Point Governance Check instrument are provided below and detailed in the Table that follows.

Table 4 provides a summary of the raw data numerical results for the governance areas examined in the instrument (Fig. 9).

The results of the 14-Point Governance check suggest that there are developmental areas that might be engaged to enhance system governance. In addition, there was a variability in the range of responses. The governance check is precisely that a check. As such it is a ‘snapshot’ of indicators and cannot be taken as absolute. Instead, it is an invitation to deeper dialog concerning the state and development of system governance.

Implications of the CSG Entry Effort

The CSG Entry was successful in providing a ‘snapshot’ of three distinct aspects of how the organization (system) viewed itself along three dimensions related to CSG (Systems Thinking Capacity, Environment Complexity Demand, Preliminary State of Governance). While we hesitated to draw absolutes concerning the results, we offered three high-level indicators for more critical examination from the initial inspection of results:

1. There were three areas of Systems Thinking Capacity that indicated the organization was not at a level demanded by the environment being faced. These included complexity, systems worldview, and flexibility.
2. As an aggregate, the group had several areas that could be considered good focal candidates to enhance Systems Thinking Capacity. In addition, there were several areas of Systems Thinking Capacity that exceed the environment demand—with the greatest difference being observed in the interaction, independence, and uncertainty dimensions. These offered possible areas to exploit with respect to system governance design, execution, and development.
3. The results of the 14-Point Governance Check indicated that there was sufficient room for development in system governance, as indicated by the mapping of the different governance aspects (e.g., coordination). While the instrument was not offered as an absolute assessment of the state of governance for the organization (system), it provided a basis for further explorations of possibilities for system governance enhancement.

What Was Learned About CSG Entry

In sum, the *CSG Entry* effort provided an *efficient, low-risk, and value-added* set of activities to introduce CSG to a participating organization (system). The ‘hands-on’ effort was intended to provide a ‘snapshot’ of several different aspects of CSG—as examined by the enterprise system practitioners who provide governance for the organization (system). CSG provided a new and novel look into the organization (system) with a different set of lenses and frame of reference, from which different thinking, decision, action, and interpretation development possibilities accrued.

Table 4 Summary results of responses to the 14-point governance check instrument (11 participants—1 less effective, 5 more effective)

Checkpoint	Explanation	1	2	3	4	5	Range	Mean
1. We have a detailed mapping of our environment and governance system that shows how we function to produce value	This mapping is like an owner's manual for your system—it shows the precise detail, like a set of blueprints that maps the environment and shows how system governance (integration, coordination, communications, control) is achieved to produce products and services	**1**	**5**	**4**	**0**	**1**	**5**	**2.5**
2. We actively perform scanning of our environment to identify events, entities, trends, or patterns that impact present system performance and future system development	Environmental scanning is essential to continuously monitor and interpret what goes on external to the system. It identifies, processes, and responds to external events, trends, or factors that can impact system performance and influence future development directions	**1**	**5**	**4**	**1**	**0**	**4**	**2.5**
3. We are well equipped to keep up with external turbulence and speed of change that exist in our environment	If the environment is changing faster than our ability to respond, we will continually feel behind and struggle to keep up. Matching this rate of environmental change is essential to avoid crisis situations and identify implications for future development	**3**	**5**	**1**	**1**	**1**	**5**	**2.3**
4. Our system design is effective in balancing accountability with resources necessary to achieve expected levels of performance	Consistency between resources provided and accountability for expected contributions is a source of stability. Continual shifts in resources, or expectations, can create an imbalance and increase the level of uncertainty and stress in the system	**1**	**7**	**2**	**1**	**0**	**4**	**2.3**

(continued)

Table 4 (continued)

Checkpoint	Explanation	1	2	3	4	5	Range	Mean
5. We routinely communicate the right information, at the right time, and at the right place to support consistent decision and action	Information is the lubricant for effective system decisions. The exponential rise in information makes the purposeful design for communications critical. Effectiveness in communications ensures availability, accuracy, and accessibility in the flow of information to support decision and action	**1**	**5**	**3**	**2**	**0**	**4**	**2.5**
6. We share and maintain our identity such that our uniqueness is clear and we have a common reference point to support consistent decision, action, and interpretation	Sharing a strong sense of system identity (e.g., vision, mission, values, strategic orientation) supports and maintains consistency in decisions, actions, and interpretations	**1**	**2**	**5**	**3**	**0**	**4**	**2.9**
7. Our strategic system performance measures are balanced, monitored, and effectively utilized for system improvement	System measures should be limited in number and balanced between the present and future. They should also monitor performance across a spectrum of technical, social, and policy considerations. System measures should also guide actionable improvement	**1**	**4**	**5**	**1**	**0**	**4**	**2.5**
8. We effectively detect, correct, and learn from our system errors, making system adjustments to preclude recurrence	Systems should not only focus on detecting and correcting compliance errors, but also on addressing deeper underlying system structural issues. Effective systems identify deep structural issues and initiate responsive actions before they become crises	**1**	**5**	**3**	**2**	**0**	**4**	**2.5**

(continued)

While the initial effort for CSG Entry met the original intent, there were several areas that were rethought and adjusted for future CSG Entry. For conciseness, we have provided these lessons in Table 5 for each phase of CSG Entry.

Table 4 (continued)

Checkpoint	Explanation	1	2	3	4	5	Range	Mean
9. Our system design provides the greatest possible degree of flexibility for making local decisions and taking action in response to their circumstances	Over constraining/regulating a system wastes resources and steals initiative from those entities closest to and in the best position to directly address the source of errors plaguing a system. Close proximity to a problem reduces the error propagation and time between source and response	**1**	**4**	**5**	**1**	**0**	**4**	**2.5**
10. We actively pursue rigorous 'self-study' of our system design and execution in pursuit of purposeful system development	Active system 'self-study' is essential to higher-level system development and requires a commitment of time, energy, and resources to follow a rigorous development plan. Potential for system development is dampened without continual examination and questioning	**2**	**4**	**4**	**1**	**0**	**4**	**2.4**
11. There is an appropriate balance between short and long-term focus for our system that continues to evolve with our changing circumstances	Overemphasis on the short term can sacrifice long-term prospects. Overemphasis on the long term can diminish short-term performance. Balance is necessary, can shift over time, and should be a source of continual examination for system development	**1**	**2**	**5**	**3**	**0**	**4**	**2.9**
12. We provide effective coordination between entities in our system such that unnecessary variability is eliminated	Effective interaction between system entities is necessary to reduce conflicts and issues stemming from poorly designed or executed coordination. Coordination helps to ensure that scarce resources are not wasted due to ineffective interrelationships between system entities	**1**	**7**	**3**	**0**	**0**	**3**	**2.2**

(continued)

Table 4 (continued)

Checkpoint	Explanation	1	2	3	4	5	Range	Mean
13. Our system design and execution effectively eliminate operation in 'crisis' or 'reactive' modes	When crisis operation is too frequent, it can indicate potential issues in system design, execution, or both. Constantly being in reaction mode creates unsustainable stresses in the system and individuals who must compensate for this mode of operation	**1**	**5**	**5**	**0**	**0**	**3**	**2.4**
14. We effectively design and account for the wide range of influences on our system (technical, human, social, organizational, managerial, political, policy, cultural, and stakeholder)	System design and execution are dependent on both 'hard' (technical) and 'soft' (sociotechnical) influences. Limited or complete absence of consideration of the spectrum of hard and soft influences risks achievement and maintenance of higher-level system performance	**1**	**3**	**5**	**2**	**0**	**4**	**2.7**

Fig. 9 Mapping of the 14-point governance check (1 less effective, 5 more effective)

The CSG Entry proved to be an effective introduction to CSG and identified several areas for refinement of CSG Entry. In addition, as a result of the initial application, the implications of systemic intervention for CSG have been revised.

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Table 5 Lessons and adjustment to CSG Entry

CSG Entry Phase	Lessons and implications
Phase 1: Invitation	• Initial briefing of sponsors should include more detailed explanation as to what might accrue from the effort. In particular, value offered from the entry effort • Potential utility expectations and paths forward that might be anticipated for the effort need to be emphasized • Relationship establishment to past, present, and future system development activities, concerns, and priorities is an essential conversation to position CSG Entry, distinguish CSG from other approaches, and identity potential further CSG development in relationship to the organization
Phase 2: Overview Briefing	• Greater detail as to the 'fit' of CSG to the 'ongoing' governance activities and initiatives and distinctions of CSG development • Additional details, with simplified explanations, concerning CSG in the overview briefing were identified as an area for future focus • Greater clarity on the utility expectations and what might lie beyond the CSG Entry instruments application as value-adding potential
Phase 3: Instrument Application	• The 14-Point Governance Check, while efficiently executed, was not effectively linked to performance of the nine governance functions—this resulted in a revamping of the governance check (a 45-question web-based instrument directly aligned to CSG functions) for future applications • Establishing the range of variance within the group of participants for Systems Thinking Capacity and Environment Complexity Demand was identified as an important delineation in addition to the aggregate mean scores (was included in the final outbriefing and report)
Phase 4: Outbrief Results	• The technical results were provided concurrent with the outbriefing, with the intent not to have the group 'misconstrue' the results without guidance. In hindsight, prior distribution of the technical results might have sharpened the focus of the discussion • Some rudimentary preparation materials (e.g., short papers, video) to provide greater context for the exploration would have been beneficial • The depth of exploration necessary to properly explore the results for implications lends itself to more of an extended workshop endeavor, rather than a limited technical outbriefing • Closure to the CSG Entry effort would benefit from the examination of potential for further development, based on results and their implications as well as fit to current developmental priorities. As conducted, potential paths forward were not effectively presented or explored

Initial Systemic Intervention Beyond CSG Entry

The System Map

The objective is to map the components or subsystems of the enterprise governance system to each of the nine metasystem functions that they are, or should be, performing. The results of the mapping will probably bear little resemblance to the traditional organizational chart. Articulating the enterprise governance system architecture in terms of CSG gives the enterprise system practitioners a new perspective on their system governance and their enterprise system in general. A graphical representation utilizing images and language commonly used within the enterprise system produces enhanced understanding.

The initial system map will, in all probability, be revised over the course of the intervention as the enterprise system practitioners learn about their system governance and what changes are required to enhance its performance. It may be advantageous to generate several different representations of various types emphasizing different perspectives. However, the representations must relate to the CSG reference model to ensure continuity as the intervention progresses.

Like other forms of enterprise records and drawings, the final versions of the various representations are useful to the enterprise system practitioners beyond the intervention as they adapt the enterprise governance system to changes in the enterprise's context and environment.

Metasystem Pathologies Assessment (M-Path) method

Another investigation that is part of the initial systemic intervention suite is an assessment of the various pathologies (weaknesses) that exist within the enterprise governance system. What follows is an introduction to the M-Path method as developed in a previous chapter. It includes a method with repeatable procedures to support identification of pathologies in a system enterprise. This method extends previous research related to problem formulation [5–8]. For this discussion, a brief recap of CSG concepts is included to ensure understanding. Also, a specific set of pathologies is provided for illustrative purposes. The set of pathologies is drawn from the earlier work of [12] and supplemented by recent research into the emerging field of Complex System Governance [2, 13, 15]. Complex System Governance (CSG) is an emerging field, representing an approach to improve performance through purposeful 'Design, execution, and evolution of the metasystem functions necessary to provide control, communication, coordination, and integration of a complex system' [13]. CSG was developed at the National Centers for System of Systems Engineering and is anchored in the fields of Systems Theory and Management Cybernetics. The CSG reference model was developed to provide a detailed account of 'an organizing construct for the interrelated [nine metasystem] functions necessary to perform CSG' [14]. Table 6 elaborates on the nine interrelated metasystem functions essential to CSG and acting to enable system viability. These functions provide a 'backdrop' against which the pathologies are derived (Katina and Keating 2016). Following the

Table 6 Metasystem functions in the CSG reference model

Metasystem function	Primary role of the function
Metasystem five (M5): Policy and identity	To provide direction, oversight, accountability, and evolution of the system. Focus includes policy, mission, vision, strategic direction, performance, and accountability for the system such that: (1) the system maintains viability, (2) identity is preserved, and (3) the system is effectively projected both internally and externally
Metasystem Five Star (M5*): System context	To monitor the system context (i.e., the circumstances, factors, conditions, or patterns that enable and constrain the system)
Metasystem Five Prime (M5'): Strategic system monitoring	To monitor measures for strategic system performance and identify variance requiring metasystem-level response. Particular emphasis is on variability that may impact future system viability. Maintains system context
Metasystem Four (M4): System development	To provide for the analysis and interpretation of the implications and potential impacts of trends, patterns, and precipitating events in the environment. Develops future scenarios, design alternatives, and future focused planning to position the system for future viability
Metasystem Four Star (M4*): Learning and transformation	To provide for identification and analysis of metasystem design errors (second order learning) and suggest design modifications and transformation planning for the system
Metasystem Four Prime (M4'): Environmental scanning	To provide the design and execution of scanning for the system environment. Focus is on patterns, trends, threats, events, and opportunities for the system.
Metasystem Three (M3): System operations	To maintain operational performance control through the implementation of policy, resource allocation, and design for accountability
Metasystem Three Star (M3*): Operational performance	To monitor measures for operational performance and identify variance in system performance requiring system-level response. Particular emphasis is on variability and performance trends that may impact system viability
Metasystem Two (M2): Information and communications	To enable system stability by designing and implementing architecture for information flow, coordination, transduction, and communications within and between the metasystem, the environment, and the systems being governed

development of the CSG formulation, subsequent research [16] has resulted in development of a three-stage methodology (i.e., initialization, readiness level assessment, and governance development) for implementation to provide structured identification, assessment, and development of CSG. This development methodology relies on effective formulation of the problem domain at the 'front end' of the effort. As part of this formulation, the identification, assessment, and strategizing with respect to pathologies are fundamental.

The focus of this 'front end' initialization stage of the CSG methodology involves establishing the present state of the governance of the complex (enterprise) system through framing and context articulation. Framing involves establishing the nature and structure of the enterprise governance system. The articulation of system context involves identification of circumstances, factors, patterns, or trends that constrain/enable the system [16]. Following [12], an expanded set of pathologies (53 in total) corresponding to the nine metasystem functions for CSG are proposed in Table 7. In effect, these pathologies provide a potential set for purposeful exploration of their existence in any system of interest.

The following conclusions are drawn regarding the set of pathologies identified in Table 7 and their essential role in problem formulation and the initialization stage of the CSG methodology. First, these pathologies are not unique to any one enterprise system. They certainly could be present or absent to some degree for any given system. Instead, this set represents aberrant conditions affecting metasystem functions of complex systems in a generalized form. Therefore, the 53 pathologies in Table 3 are circumstances, conditions, factors, or patterns that can act to limit system performance, or lessen system viability, such that the likelihood of a system achieving performance expectations is reduced. However, the particular form of manifestation of the pathologies will be specific to a particular system. Second, these pathologies do not exist in a binary fashion of 'present' or 'not present.' Rather, it is best to recognize that they may exhibit themselves in 'degrees of existence.' Third, pathologies have real consequences for performance of a given system/organization which can be measured in terms of a 'range of possible effects.' While the range of effects can vary in particular systems, there are always consequences for a given pathology. Fourth, in accordance with previous research, these pathologies should be a subject of exploration during problem formulation, since bringing change to the enterprise governance system is largely dependent on understanding the current state of the system [3, 6, 19]. It is from this perspective that present research articulates the metasystem pathologies (M-Path) method for use in the identification and assessment of the conditions (listed in Table 7) that negatively impact system performance.

Phases of the M-Path Method

The proposed method consists of five phases (identification, analysis, exploration, systemic implementation, and follow-up) as shown in Fig. 10. A detailed account of the five phases is the basis for the remainder of this paper.

Table 7 Metasystem functions and corresponding CSG metasystem pathologies

Metasystem function	Corresponding set of pathologies
Metasystem five (M5): Policy and identity	M5.1. Identity of the system is ambiguous and does not effectively generate consistent system decision, action, and interpretation
	M5.2. System vision, purpose, mission, or values remain unarticulated, or articulated but not embedded in the execution of the system
	M5.3. Balance between short-term operational focus and long-term strategic focus is unexplored
	M5.4. Strategic focus lacks sufficient clarity to direct consistent system development
	M5.5. System identity is not routinely assessed, maintained, or questioned for continuing ability to guide consistency in system decision and action
	M5.6. External system projection is not effectively performed
Metasystem Five Star (M5*): System context	M5*0.1. Incompatible metasystem context constraining system performance
	M5*0.2. Lack of articulation and representation of metasystem context
	M5*0.3. Lack of consideration of context in metasystem decisions and actions
Metasystem Five Prime (M5'): Strategic system monitoring	M5'0.1. Lack of strategic system monitoring
	M5'0.2. Inadequate processing of strategic monitoring results
	M5'0.3. Lack of strategic system performance indicators
Metasystem Four (M4): System development	M4.1. Lack of forums to foster system development and transformation
	M4.2. Inadequate interpretation and processing of results of environmental scanning—non-existent, sporadic, and limited
	M4.3. Ineffective processing and dissemination of environmental scanning results
	M4.4. Long-range strategic development is sacrificed for management of day-to-day operations—limited time devoted to strategic analysis
	M4.5. Strategic planning/thinking focuses on operational-level planning and improvement
Metasystem Four Star (M4*): Learning and transformation	M4*0.1. Limited learning achieved related to environmental shifts

(continued)

Table 7 (continued)

Metasystem function	Corresponding set of pathologies
	M4*0.2. Integrated strategic transformation not conducted, limited, or ineffective
	M4*0.3. Lack of design for system learning—informal, non-existent, or ineffective
	M4*0.4. Absence of system representative models—present and future
Metasystem Four Prime (M4'): Environmental scanning	M4'0.1. Lack of effective scanning mechanisms
	M4'0.2. Inappropriate targeting/undirected environmental scanning
	M4'0.3. Scanning frequency not appropriate for rate of environmental shifts
	M4'0.4. System lacks enough control over the variety generated by the environment
	M4'0.5. Lack of current model of system environment
Metasystem Three (M3): System operations	M3.1. Imbalance between autonomy of productive elements and integration of the whole system
	M3.2. Shifts in resources without corresponding shifts in accountability/shifts in accountability without corresponding shifts in resources
	M3.3. Mismatch between resource and productivity expectations
	M3.4. Lack of clarity for responsibility, expectations, and accountability for performance
	M3.5. Operational planning frequently preempted by emergent crises
	M3.6. Inappropriate balance between short-term operational versus long-term strategic focus
	M3.7. Lack of clarity of operational direction for productive entities (i.e., subsystems)
	M3.8. Difficulty in managing integration of system productive entities (i.e., subsystems)
	M3.9. Slow to anticipate, identify, and respond to environmental shifts
Metasystem Three Star (M3*): Operational performance	M3*0.1. Limited accessibility to data necessary to monitor performance
	M3*0.2. System-level operational performance indicators are absent, limited, or ineffective

(continued)

Table 7 (continued)

Metasystem function	Corresponding set of pathologies
	M3*0.3. Absence of monitoring for system and subsystem-level performance
	M3*0.4. Lack of analysis for performance variability or emergent deviations from expected performance levels—the meaning of deviations
	M3*0.5. Performance auditing is non-existent, limited in nature, or restricted mainly to troubleshooting emergent issues
	M3*0.6. Periodic examination of system performance largely unorganized and informal in nature
	M3*0.7. Limited system learning based on performance assessments
Metasystem Two (M2): Information and communications	M2.1. Unresolved coordination issues within the system
	M2.2. Excess redundancies in the system resulting in inconsistency and inefficient utilization of resources—including information
	M2.3. System integration issues stemming from excessive entity isolation or fragmentation
	M2.4. System conflict stemming from unilateral decisions and actions
	M2.5. Excessive level of emergent crises—associated with information transmission, communication, and coordination within the system
	M2.6. Weak or ineffective communications systems among system entities (i.e., subsystems)
	M2.7. Lack of standardized methods (i.e., procedures, tools, and techniques) for routine system-level activities
	M2.8. Overutilization of standardized methods (i.e., procedures, tools, and techniques) where they should be customized
	M2.9. Overly ad hoc system coordination versus purposeful design
	M2.10. Difficulty in accomplishing cross-system functions requiring integration or standardization
	M2.11. Introduction of uncoordinated system changes resulting in excessive oscillation

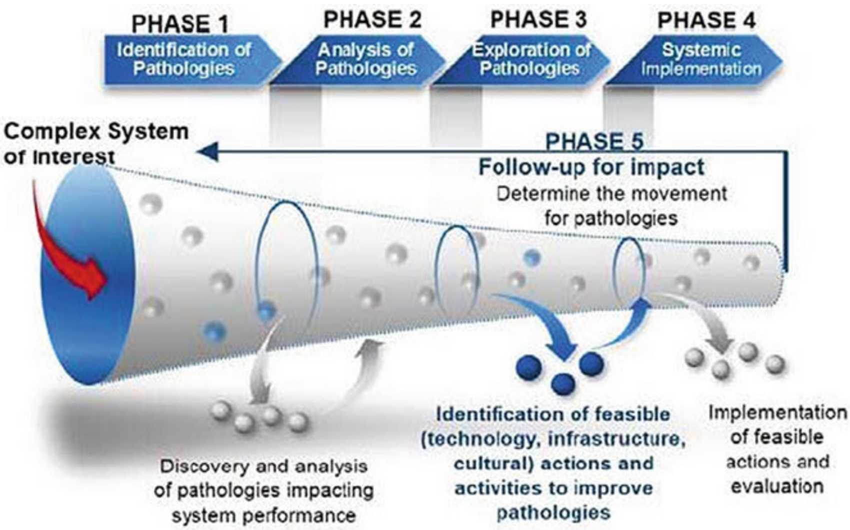

Fig. 10 Five phases of the M-Path method

Phase I: Identification

This phase involves the identification and discovery of the degree to which the 53 pathologies exist for a given situation for a system/organization. This phase produces two essential pieces of information: ***degree of existence*** and the corresponding ***impact*** of each pathology. The degree of existence is the level to which a pathology is deemed to be present—ranging from negligible to extreme and corresponding to numerical values of 1 to 7. Similarly, the measure of impact of a given pathology ranges from 1 to 7 (1 being negligible and 7 being extreme). There are a variety of tools that an analyst can use, including data mining and surveys, to ascertain information regarding the presence of pathologies in a system of interest as well as their impact on system operations. Previous research has used a web-based instrument (e.g., see Katina, 2015b). The associated pathology analysis involves an ordinal process of 'binning' pathologies based on levels of existence and potential impact. Table 8 presents a pathology matrix based on the two levels. The scale for existence is along the horizontal axis. Impact is along the vertical axis of the matrix.

The following caveats apply to Table 8.

- Each pathology must be evaluated for existence and impact on a given system. This produces a total of 53 tables (one for each potential pathology)
- The top-right most cells of the table provide higher numbers (e.g., {7,7})—these correspond to issues that are considered to be of most pressing (highest level of existence and impact)

Table 8 Pathology ordinal matrix

Range of impact associated with pathology, P_C

	Negligible	Very Low	Low	Moderate	High	Very High	Extreme
Extreme	1,7	2,7	3,7	4,7	5,7	6,7	7,7
Very High	1,6	2,6	3,6	4,6	5,6	6,6	7,6
High	1,5	2,5	3,5	4,5	5,5	6,5	7,5
Moderate	1,4	2,4	3,4	4,4	5,4	6,4	7,4
Low	1,3	2,3	3,3	4,3	5,3	6,3	7,3
Very Low	1,2	2,2	3,2	4,2	5,2	6,2	7,2
Negligible	1,1	2,1	3,1	4,1	5,1	6,1	7,1

The degree to which pathology exists in a given system, P_E

- A decision-maker should not ignore pathologies in the top-left and bottom-right cells (e.g., {1,7} and {7,1}) since the very presence of a pathology suggests that system performance is at stake

Phase II: Analysis

The first phase only indicates presence and impact of the 53 metasystem pathologies. The second phase, analysis, involves an examination of nature and implications of the unique 'landscape' of pathologies for the system of interest. Driven by the kind of tools used in data collection of phase I, the analyst collects and synthesizes the data into meaningful information concerning pathologies. This phase provides an initial portrait, in the form of a landscape, of pathologies for the system. This landscape is unique to each system of interest and articulates the degree to which pathologies exist and affect the system.

The following caveats apply to this phase:

- Analysis in this phase includes an enumeration of metasystem pathologies using measures of existence and impact.

- Provides an indication of variability in measures of the degree of pathology existence and impact as suggested by participants. Variability is expected since each participant will not provide identical measures for the entire set of pathologies. Such variability provides insights that might be further examined in Phase III.

Phase III: Exploration

The results of phase II are made available to system participants to provide a guided investigation into the meaning of the identified pathologies as well as their implications for system development. This phase involves a two-way dialog between system participants and the analyst and involves the ***general meaning*** of pathologies and exploration of the ***meaning in context*** for the system of interest. This dialog is instrumental for articulating and/or voicing system of interest development ***implications*** in response to the discovered pathologies. It is during this phase that the existing initiatives (development activities already underway in the organization) are mapped against discovered pathologies. This mapping enables discovery of strengths and weaknesses in system development in relationship to the existing pathologies. The results of this phase include a ***prioritized enumeration*** of pathologies based on ***feasibility***—organizational ability to successfully address pathologies with a reasonable chance of success. The result is a set of ***strategies*** and corresponding ***actions*** designed to impact the identified pathologies.

Phase IV: Systemic Implementation

The purpose of this phase is to ensure that selected responsive strategies are effectively deployed. Activities in this phase are based on what is decided in the previous phase. For example, an activity such as the '*development of effective environmental scanning mechanisms*' could be identified in the previous phase due to existence of metasystem pathology M4*0.1 '*a lack of effective scanning mechanisms*' as identified in Table 7. Identifying this as an issue starts in Phase I. This issue becomes more explicit in Phase II. In Phase III, there is a follow-up to develop new initiatives to address '*a lack of effective scanning mechanisms.*' This is in conjunction with understanding ongoing initiatives, including effectiveness of the existing scanning mechanisms. Once there is agreement on the need to develop effective scanning mechanisms, a strategy to develop such mechanisms must be put in place in Phase IV. This phase is necessary to ensure that something is done in relation to a pathology. A comparative medical analogy is being prescribed medication for an illness and failing to take the medication. In such a case, an identified pathology will not 'disappear' and might even worsen if left without being addressed. In addition, this phase sets a time line for future incremental system evaluation to determine the shifting state of pathologies in response to strategies.

Phase V: Follow-up

This 'final' phase is focused on an examination of the effects of strategic actions undertaken to address pathologies. An established time line can serve as a placeholder for a re-evaluation of the system by fulfilling two primary purposes. First is to measure the effects of the strategies/actions as implemented in Phase IV, and second is the identification of new pathologies. Such efforts serve the role of continuous system development. Continuous system development is essential since an organization in question is operating within a dynamic and most likely turbulent environment. Moreover, the deployed strategies might lose effectiveness over time, new pathologies might emerge, and new technologies might shift the landscape of pathologies. Therefore, navigating through the M-Path method is truly a continuous process with each phase complementing and interrelated to previous phases.

M-Path Method implications

Applying the M-Path method to a system of interest serves to identify, analyze, explore implications, and generate a response to the systemic deficiencies (pathologies) impacting system performance. This method is consistent with [19] supposition that an analyst ought to be in a position to 'identify the problem to be studied and define its scope in such a way that he has some hope of finding an acceptable and implementable solution with the economic, political, technological, and other constraints that exist, including limitations imposed by the policy makers' span of control and the time available for decision' [19], p. 23). The value associated with the proposed M-Path method is summarized as follows:

- Identification and representation of pathologies in a given system of interest,
- Exploration of the nature of pathologies and their implications for improving system performance/viability,
- Determination of feasible actions and initiatives to impact pathologies,
- Purposefully evolving a system based on continuous assessment of development.

The proposed M-Path method echoes Dery [3] in that it does not simply offer a descriptive definition of a situation. The M-Path method does not merely describe pathologies in a situation but also helps in selection of 'certain aspects of reality as being relevant for action in order achieve certain goals' (Dery [3], p. 35). Although the developed method is a guide through problem formulation, it is also focused on generating important subsequent courses of action that are dependent on the results of execution of the M-Path method.

In summary, the M-Path method is a well-developed and rigorous procedure for exploring possible weaknesses in the enterprise governance system. The results from M-Path, presented in various ways including several visual forms currently under development, starkly illuminate weaknesses in the enterprise governance system that impede enterprise system performance.

Exploring Potential for Integration of FMECA into CSG

There is much to be gained from the development and tailoring of FMEA/FMECA to improve capabilities in the developing CSG field. For application of FMEA/FMECA to CSG, we suggest an approach outlined in Fig. 11. The essence of this approach is to move through five primary phases, including: (1) identification of existing and potential CSG failure modes, (2) exploration of contributing factors to the failure mode, (3) attribution of the consequences stemming from the failure modes, (4)

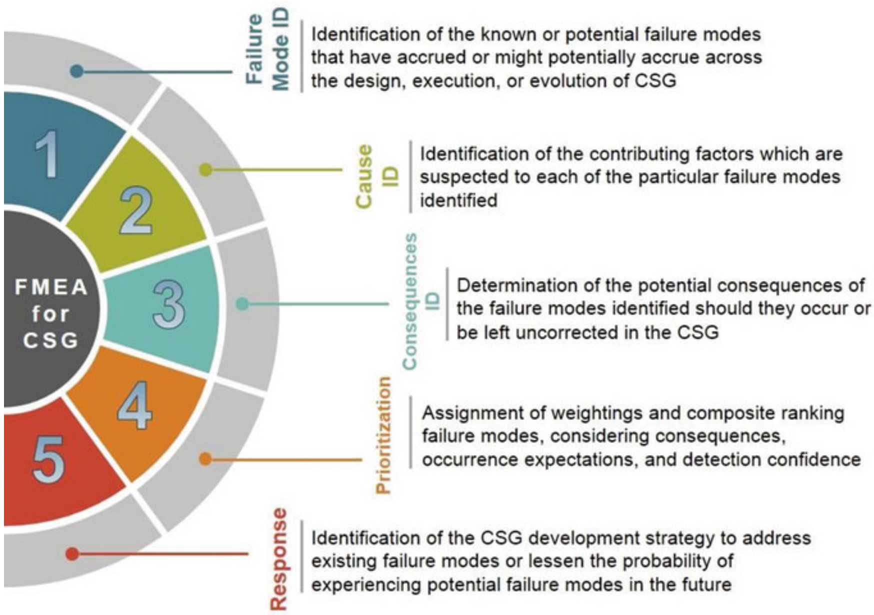

Fig. 11 Five-phased FMECA approach for CSG

prioritization of the failure modes, and (5) response for CSG modification based on results.

To provide this examination, we begin by specifying ten potential failure modes in CSG that are representative of failure across the functions we earlier defined for CSG. These failure modes include (Fig. 11):

- *Information flow does not support consistent decision and action*—this failure mode would be experienced in the Information and Communication function of CSG.
- *Lack of coordination among entities produces uncertainty and incongruence*—this potential failure mode would emanate from the Information and Communication function of CSG.
- *Stable planning and execution surrender to* ad hoc *responses*—this failure mode would be associated with the system development function.
- *Process for examination of performance variance and crises is inconsistent*—the source for this failure mode would be located in the operational performance function of CSG.
- *Future system development is sacrificed for near term operational demands*—this failure mode is more than likely associated with the system development function in CSG.
- *Resolution of issues frequently results in temporary or piecemeal relief*—this failure more is associated with the learning and transformation function of CSG.

- *Monitoring, assessment, and response to environmental shifts are sporadic and* ad hoc—this failure mode is a potential emanation from the environmental scanning function of CSG.
- *Internal system circumstances, factors, and conditions impede performance*—to understand this failure mode, the system context function of the CSG would be the likely source.
- *Measuring and monitoring long-range strategic development lack emphasis*—the operational performance function of CSG is the likely source for this failure mode.
- *Lack of clear focus creates internal inconsistency and external misunderstandings*—the source of this failure mode is likely in the policy and identify function of the CSG.

The set of ten potential failure modes in CSG provides a set to delineate applicability of FMECA for demonstration purposes. However, each system would experience the particular failure modes differently depending on the uniqueness of the system and its context. This is the emphasis of *Phase 1 Failure Mode ID. Phase 2 Cause ID* requires examination of the local context for the contributions to the failure mode in CSG. Likewise, the attribution of *Phase 3 Consequences* requires assessment of the particular impacts the failure mode would produce and should be experienced in the system. Similarly, *Phase 4 Prioritization* represents classification of the highest impact failure modes for the specific system. Finally, *Phase 5 Response* is focused on developing appropriate responses tailored to what is feasible (technologically, contextually, resources, legally, safety) given the particular CSG and the context within which it exists. The result of the FMECA application is concentrated on bringing a higher degree of rigor, critical examination, and assessment to the identification and exploration of potential/existing failures for CSG. The ultimate result would be to make design modifications based on the analysis.

The intersection of CSG and FMECA offers three important contributions to the emerging CSG field. First, FMECA is a disciplined and proven approach to identification of potential failure modes in a system. Since CSG is a systems-based articulation of governance, the rigor imposed in the 'failure modes' thinking of FMECA can prove insightful. Second, FMECA forces the analysis to assign a prioritization to the different failure modes identified. There is not an assumption that 'all' failure modes are congruent in their importance. This can assist in the allocation and targeting of scarce resources to the areas of greatest impact for CSG improvement. Third, the FMECA is ultimately about making improvements in the system, be they at concept/design, (manufacturing) execution, processes, or service provision. Therefore, even with a 'system' as unwieldy as governance, FMECA induces a disciplined consideration across a spectrum of design, execution, and production aspects of the CSG system.

However, there are several challenges that loom for the further development and modification of FMECA for use in the CSG field. Three primary challenges include (1) developing sufficient detail in the identification of governance failure modes such that subsequent analysis can be conducted, (2) the complexity of CSG is such that the interrelationship between failure modes may prove to be an important consideration, requiring an additional element of analysis for the assessment, and (3) the rigorous assignment of the prioritization is essential, while it is doubtful that for governance the Risk Prioritization Number (RPN) as utilized in traditional FMECA could be replicated. Notwithstanding limitations in incorporating FMECA into CSG, there is an opportunity to provide a rigorous approach to establishing prioritization of failure modes for FMECA application in CSG.

There is much left to develop for FMECA application to CSG. However, there are significant contributions that FMECA can provide to help advance the CSG field and to assist practitioners in providing a method to identify and address existing and potential CSG failure modes, such as the representative ten CSG failure modes introduced. Although there is still much to be developed in the application of FMECA to CSG, there is also great promise in extrapolating a proven method into a field in search of more rigorous formulation of methods, tools, and techniques. While beyond the scope of this chapter, future direction for FMECA for CSG will involve a case application to establish the application in a field setting. This emphasis will demonstrate the ability of FMECA to provide a more rigorous analysis of CSG failure across the spectrum of both 'hard' and 'soft' failure modes. This significantly extends the traditionally 'technical' failure orientation of FMECA.

Conclusion: Systemic Intervention Future Development Directions

As an emerging field, there is much that remains unknown about CSG, particularly with respect to systemic intervention to improve CSG. Much of the unknown for CSG stems from the unique demands for intervention in complex systems. CSG is somewhat unique in relationship to other systems-based approaches in three primary ways. First, CSG makes an *explicit* mapping to systems theory [22] as a grounding basis for the field. This is not to suggest that other systems-based approaches are not 'born' out of an underlying systems theory base. However, CSG is explicit in the delineation of the systems theory conceptual basis. Second, engagement in CSG is constrained by the degree of Systems Thinking Capacity of the participating group and the state of system governance that currently exists for the system in focus. Therefore, the directions and engagement will be driven by the individuals and system 'fitness' to participate across a range of CSG development activities. This range of fitness determines the nature, depth, and expectations for the level of CSG system improvement activities that might be effectively engaged. Third, CSG is not equivalent to introduction of a new program or initiative (e.g., lean six sigma, TQM, balanced scorecard, CRM, etc.) that will be engaged 'in addition to' what is already being done by the individuals/organization. Instead, all viable (continuing to exist) systems are already performing the nine CSG metasystem functions, irrespective of intervention. Whether or not these functions are purposefully explored for development, they are, and will continue to be, performed if the system continues to exist. Thus, CSG is not a temporary endeavor that exists beyond the normal scope of system activities/initiatives being engaged by the organization (system).

With respect to systemic intervention, several implications have been identified from experiences with the initial deployment of CSG Entry. These implications include the following:

1. *CSG is not the Entry Point:* As promising as CSG might be for advancing system understanding and performance, it is not the highest priority for those who might be considering engagement. Instead, the priority for enterprise system practitioners is focused on 'their problems.' Thus, first understanding their problems and then drawing the linkage to potential CSG value contributions are essential. Making this connection is critical to draw attention to the possibilities that CSG might bring related to their most vexing issues.
2. *CSG Engagement is not a Binary (all or nothing) Proposition:* Following CSG Entry and the implications that might be suggested from the results, there are many developmental paths that might be pursued. It is incorrect to have CSG postured as an all or nothing alternative. Instead, there are a spectrum of activities (training, development, modeling, etc.) and levels (practitioner, system, enterprise, problem) that might be pursued in the development path to enhance CSG.
3. *CSG is not an 'In Addition To' Endeavor:* Unlike more traditional system interventions that seek to address a new concern by introduction of a totally new initiative (e.g., lean, six sigma, TQM, CRM, etc.), CSG functions are already being performed by a system that is viable (exists). Thus, CSG is focused on understanding and potentially improving that which is already being performed by an enterprise system . Therefore, the language, thinking, and explorations of CSG are applied to existing enterprise system execution of CSG functions which are already being 'tacitly' performed.
4. *CSG Systemic Intervention Time and Risk Should Initially Fall on the Facilitator:* It is unrealistic to expect participants to fully engage a CSG initiative in terms of investment of time and acceptance of 'risk of failure.' Instead, the CSG facilitator should bear the burden of time and risk until the value of investment (time) and utility of CSG engagement combine to produce an acceptable *risk-value-cost* trade-off. In effect, CSG should be conducted in a 'safe to fail' mode.

To elaborate implications for systemic intervention, a systemic intervention framework was developed following initial applications of CSG Entry. This framework, titled the *9R framework for systemic intervention* (Fig. 11), identifies eight areas of concern that practitioners would be advised to consider as they design and execute systemic intervention initiatives for complex systems. This framework has broad implications for systemic intervention beyond CSG.

Each of the framework elements has been identified as having potential impact on systemic interventions undertaken to improve performance of complex systems. Each element provides an area that should be considered when looking to undertake an intervention into a complex system. The following discussion elaborates each of the eight elements targeted to CSG (Fig. 12).

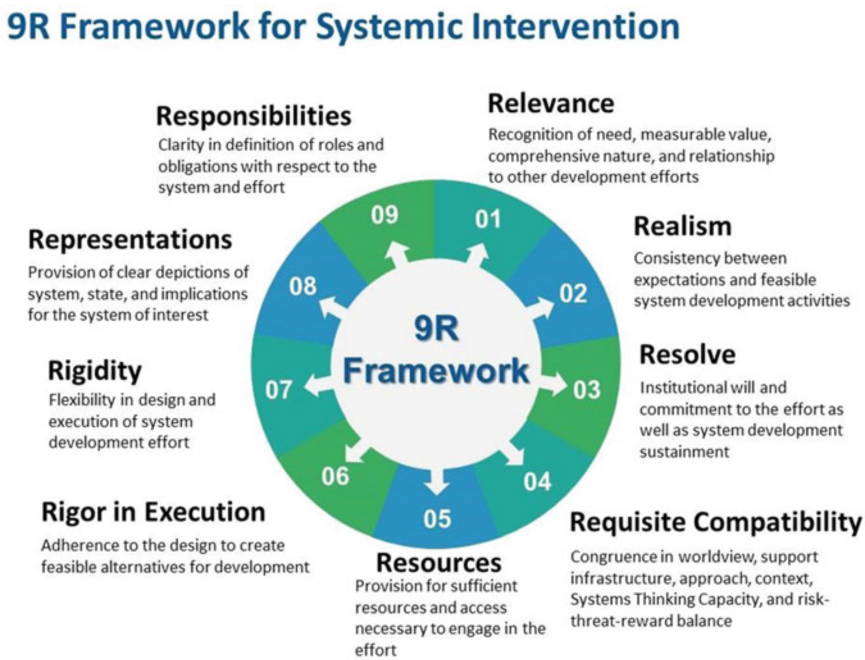

Fig. 12 9R framework for systemic intervention

Relevance: Systemic intervention is undertaken in response to a recognized need or problem situation which is unresolved and persists in a system. However, CSG is not targeted to specific problems, but rather to the 'underlying system' that must address problems. The problems might be perceived as surface manifestations stemming from deficiencies in underlying system functions. While the true value of CSG is in addressing the underlying system deficiencies, value is most recognizable as addressing the surface 'symptomatic' conditions immediately perceived by practitioners. Thus, systemic intervention must focus on: (1) translation of surface problems to the capabilities of CSG to discover the deep seated 'roots' of the problem and offer a different frame of reference for understanding potential alternative paths to resolution, (2) casting CSG in relationship to past, ongoing, and future development initiatives to better position CSG as a 'meta-initiative' that provides an integrating perspective of system development, (3) exploration of systemic intervention as *'enhancing system capabilities'* such that in the future the *'system can solve the problem(s),'* and (4) projection of CSG as system enhancement for functions that the system is already performing, without the benefit of the CSG framing of those functions, and is therefore not 'in addition to' ongoing system work, but rather facilitation of existing work.

Realism: Although CSG holds great promise to identify insights into systemic deficiencies, this identification must be subject to the underlying capability of practitioners and their system to apply those insights to fully engage systemic issues. CSG development is constrained by the level of Systems Thinking Capacity that exists within system participants and the current state of CSG. Thus, expectations for system development must be appropriately metered such that capabilities are commensurate with an appropriate level of improvement activity undertaken for system development. This defines the region of feasible engagement for system development. Knowing issues and having capabilities to address those issues must be congruent. Otherwise, the development is likely to fail and perhaps leaves the system in a worse state than before the systemic intervention was initiated.

Resolve: Commitment of resources (manpower, material, money, methods, minutes, information—M5I) is necessary for engaging in systemic intervention. However, they are not sufficient. Sufficiency is also determined by institutional will and commitment to sustainment of system development following systemic intervention. *Institution will and commitment* are not easily determined or measured. However, the willingness to increase engagement beyond simple resource allocations should be evident and escalated throughout the intervention. Thus, will and commitment should be congruent with increasing recognition of value accrued.

Requisite Compatibility: Systemic intervention for CSG is not necessarily the right approach or fit to every problematic circumstance or every system. The determination of 'fitness' for CSG appropriateness should consider compatibility with system: (1) *predominant worldview* recognized as the prevailing paradigm(s) which drive decision, actions, and interpretations related to system circumstances, (2) *support infrastructures* (e.g., procurement, human resources) that influence, and will be influenced by, system development stemming from intervention discoveries, (3) *contextual factors* (e.g., policy, power, politics, culture, management style) that influence the prospects for conducting systemic intervention and implementing modifications, (4) approach taken to conduct the systemic intervention (e.g., level of participation), and (5) *risk-threat-reward balance* that indicates willingness to engage rigorous self-examination in hopes of finding deeper sources of system development. Lacking these compatibilities, CSG is not likely to produce success. A rigorous analysis of the results following the CSG Entry effort may indicate that continuing to intervene in the enterprise system utilizing CSG will be unlikely to produce positive outcomes.

Resources: Provision for sufficient resources and access necessary to engage in the effort. This must consider the time investment of participants as well as the more mundane aspects related to sufficient levels of funding necessary to engage the desired depth of systemic intervention. Resource allocations should be consistent with expectations of value to be accrued from the effort. Additionally, shifts in resources necessary due to 'discoveries' during systemic intervention activities should be expected, scrutinized, and embraced where appropriate. Incongruence between resource allocation and expectations of value are likely to disappoint the best systemic intervention intentions.

Rigor in Execution: Systemic intervention should have sufficient detail and clarity such that it can be executed with precision. Detailed design related to data collection, analysis, and interpretation should be thorough and explicit such that *what must be done, how it will be done, who will do it, when it will be done, where it will occur, and why it is necessary* are clearly delineated. This does not preclude shifts in design or execution. However, the shifts in approach, execution, and interpretations should be clearly articulated, with the underlying assumptions and supporting logic made explicit and capable of withstanding scrutiny.

Responsibilities: Each systemic intervention is unique in the specific roles that will be played and responsibilities that are allocated to those roles. Responsibilities range across the spectrum of intervention design, execution, and implementation of decisions/actions stemming from systemic intervention activities. Sufficient clarity must exist such that accountability for achievement of different aspects of the systemic intervention can be clearly fixed. This is not to support a punitive dimension for systemic intervention, but rather to ensure that expectations for completion of assignments is unambiguous. Additionally, the pursuit of system changes stemming from a CSG endeavor should have clarity in responsibilities as well.

Rigidity: Systemic intervention follows a particular plan that lays out the design for execution. Although there might be emergent understanding that suggests alteration of the initial design, modifications should be purposeful rather than arbitrary or fickle. Execution of systemic intervention is always dynamic, emergent, and subject to shifts in direction. Reasonable and measured changes in systemic intervention should be expected and embraced, allowing for flexibility in design, execution, expectations, and trajectory of an effort.

Representation: Systemic intervention for CSG is not offered or pursued as yet another approach to improve systems. Instead, CSG and the systemic intervention that it pursues provide a theoretically grounded, application-driven, and practitioner-oriented approach to enhance prospects for better dealing with complex (enterprise) system development. While not presented as a panacea, CSG systemic intervention has shown promise to enhance system development and professional practice by: (1) development of a systems theory-based approach to engaging complex system development, and (2) providing a frame of reference for more rigorous examination of system performance. Future development of CSG and systemic interventions to develop CSG are poised to contribute to development of complex systems in new and novel ways.

Exercises

1. The introduction section of this chapter describes six characteristics of the evolving landscape for the systems engineering practitioner. Think of a complex system in your experience and describe the issues faced by that complex system using those six characteristics.
2. What are some ways that a facilitator of an intervention can identify the level of systemic thinking within an enterprise?
3. For each of the four phases of CSG Entry, please identify reasons why each phase may not be successful and strategies that might increase the probability of success.
4. What does CSG Entry contribute to enabling systemic intervention?
5. How can the 9R framework for systemic intervention be used to address the systemic deficiencies and not just readily recognizable symptoms that may appear on the surface?

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