



Critical Systems Heuristics: a Systematic Review

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Abstract

Critical systems heuristics (CSH) has been influential in the development of critical systems thinking. However, it is a relatively underutilised method compared with soft systems approaches such as soft systems methodology (SSM) and cognitive mapping. This may be in part due to the complexity of ideas underpinning CSH. Core ideas with which users must feel confident include boundary critique, coercion, emancipation, and “is” vs “ought to be” framings. These ideas were the subject of the early discourse surrounding CSH, which considered the role of boundary critique in systems research, the extent to which CSH could meaningfully address coercion, and the claims of CSH as an emancipatory approach. The purpose of this review is to provide clarity on these key concepts by reflecting on how they have been addressed in the CSH literature to date. We find that CSH has been applied in a range of problem contexts and is most frequently applied to address coercion or power asymmetries. CSH research is frequently associated with advocacy for marginalised groups, and we believe this is a natural extension of the methodological emancipation to which CSH aspires. In providing an overview of the key ideas underpinning CSH, we hope to lower the barrier to application for systems researchers and practitioners.

Keywords Critical systems heuristics · CSH · Boundary critique · Coercion · Action research

Introduction

While soft systems approaches such as soft systems methodology (SSM) and cognitive mapping offer mechanisms for *capturing* different perspectives on complex issues, critical systems thinking emphasises *reflecting* on these systems of thought. Werner Ulrich’s Critical systems heuristics (CSH) has been influential in shaping the critical systems thinking tradition and is a framework that facilitates such reflection (Midgley 1997a; Ulrich and Reynolds 2010). The rationale for the critical approach is that understanding of true reality is limited – we will always fall short, but to remain close we must engage in a process

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of continual reflection on the judgements and assumptions that shape our understanding (Ulrich 2003). Accordingly, Ulrich outlined a framework for learning about problematic situations through critical reflection on our conceptual mental models.

The CSH framework is organised as four boundary categories, each comprised of 3 boundary questions (Table 1). The categories are motivation, control, knowledge, and legitimacy, and their associated boundary questions are designed to uncover what is and what is not relevant to the system of interest. Further, each boundary question may be asked in both the “is” and “ought to be” modes, offering another dimension to the framework as users can explore the system as it is now, and as it would be ideally.

Since its inception, the positioning of CSH research and practice within the systems thinking tradition has been the subject of debate. While Ulrich suggests that his approach ought to fundamentally revise our mode of inquiry in systems research (Ulrich 2003), other authors have suggested that the contributions of CSH – while important in the development of systems thinking – are more circumscribed (Jackson 1985; Ormerod 2004), and regard CSH as a methodology for addressing specifically coercive problem contexts. This debate surrounding suitable application of CSH may have contributed to the relative underutilisation of a method that already contains an array of complex ideas with which users must build familiarity. A Scopus search for “Critical Systems Heuristics” returned a list of 111 documents, 77 of which met the criteria for this review. Similar searches for “Soft Systems Methodology” and “Cognitive Mapping” returned 1,250 and 2,289 documents, respectively. It is of interest to consider why CSH, which formally integrated critical inquiry with the systems thinking tradition (Midgley 1997a), has not been more widely utilised in systems research and practice.

As far as we are aware, there has not yet been a systematic review of CSH research since its development. As a result, we believe that it is important to reflect on CSH research and practice to understand how it has been shaped by early discourse surrounding the framework. This review explores how CSH has been applied, and does so with reference to key CSH terminologies, namely: coercion, emancipation, boundary critique, “is” vs “ought to be”, and specifically considers CSH in an action research context. In exploring the way in which researchers have applied the framework, the review aims to provide clarity around key CSH concepts.

Methodology

Studies for this review were obtained by searching the Scopus database using the search term “Critical Systems Heuristics”. This returned 111 documents, which were filtered to include only peer reviewed articles and reviews, and exclude conference papers and duplicates. The remaining 77 papers were then reviewed, with an aim of understanding how key CSH concepts have been addressed. With this purpose, we have structured the review around important CSH terminologies. By taking this approach, we aim to provide clarity on these key ideas with a view of supporting future CSH research and practice. The review first provides an overview of the problem contexts in which CSH has been applied. We then consider the early discourse surrounding the methodological positioning of CSH in systems research, laying the foundation for the remainder of the review, which is organised into sections on coercion, emancipation, boundary critique, “is” vs “ought to be”, and action research.

Table 1 CSH framework (following Ulrich and Reynolds 2010)

Sources of influence	Boundary questions
Sources of motivation	Beneficiary
	Purpose
	Measure of improvement
Sources of control	Decision maker
	Resources
	Decision environment
Sources of knowledge	Expert
	Expertise
	Guarantor
Sources of legitimacy	Witness
	Emancipation
	Worldview

1. Who ought to be/is the intended beneficiary of the system?
2. What ought to be/is the purpose of the system?
3. What ought to be/is the system's measure of success?
4. Who ought to be/is in control of the conditions of success of the system?
5. What conditions of success ought to be/are under the control of the system?
6. What conditions of success ought to be/are outside the control of the decision maker?
7. Who ought to be/is providing relevant knowledge and skills for the system?
8. What ought to be/are relevant new knowledge and skills for the system?
9. What ought to be/are regarded as assurances of successful implementation?
10. Who ought to be/ is representing the interests of those negatively affected by but not involved with the system?
11. What ought to be/are the opportunities for the interests of those negatively affected to have expression and freedom from the worldview of the system?
12. What space ought to be/is available for reconciling differing worldviews regarding the system among those involved and affected?

Problem Contexts

CSH has been applied in a diverse range of problem contexts, summarised in Table 2. The largest body of CSH research is in education: Goede and Taylor used CSH to support the development of an information systems university module that would leave students better equipped to make the transition into industry (Goede and Taylor 2019; Taylor and Goede 2016); separate studies have applied CSH in interventions designed to improve students'

Table 2 Problem contexts in which CSH has been applied

Problem context	Examples
Agriculture	(Carr and Levindow 2000; Elyasi and Teimoury 2023; Hutcheson et al. 2023; Setianto et al. 2014; Tavella 2016)
Art conservation	(García Celma 2021)
Banking	(Dehghan Nayeri et al. 2020)
Business intelligence systems	(Venter 2019; Venter and Goede 2017, 2018)
Public services	(Flood and Jackson 1991; Johnstone and Tate 2017; Levin et al. 2017; Torun and Torlak 2022)
Child care and protection	(Ariyadasa and McIntyre-Mills 2015; Chowdhury et al. 2023; Fitch 2012)
Co-creative research	(Nicholas et al. 2019)
Environment	(Cleland and Wyborn 2010; Klocker Larsen 2011; Lyons-White et al. 2022)
Energy	(Sianipar et al. 2023; Sunitiyoso et al. 2020)
Community development	(Pinzon-Salcedo and Torres-Cuello 2018; Riswanda, McIntyre-Mills and Corcoran-Nantes 2017; Tirivanhu et al. 2016)
Corporate social responsibility	(Reynolds 2008; Vos 2003; Zlatanović 2015)
Education	(Algraini and McIntyre-Mills 2018; Goede and Taylor 2019; Houston and Foote 2001; Kish et al. 2021; Manduna et al. 2022; Taylor and Goede 2016; van der Linde and Goede 2021)
Enterprise resource planning	(Mirhosseini et al. 2021)
Evaluation	(Gates 2018; Gregory 1997; Tirivanhu 2022)
Health	(Buse 2013; Gadsby et al. 2022; O'Hara and Taylor 2023; Tavella 2023)
Intervention design and evaluation	(Hart and Paucar-Caceres 2014; Midgley 1997b; Ormerod 1997; Parrilla and Neyra Belderrain 2023)
MSEs	(Donaires et al. 2010)
Theoretical contributions and discussion	(Jackson 2001, 2005; Midgley 1997a; Ormerod 2004; Romm 1995; Ulrich 1993, 2001, 2003, 2004, 2012a, b)
Organisational conflict management	(S. A. Raza and Standing 2011)
Performance assessment and auditing	(Irawan and McIntyre-Mills 2016; Mejía et al. 2019)
Quality assurance	(Houston and Paewai 2013; Luckett 2006)
Sustainable development	(Maru and Woodford 2001; Reynolds 2014)
System complexity	(Valentinov 2012)
Technology	(Donaires 2006; Duboc et al. 2020; Loveridge and Saritas 2009; Raza et al. 2019)
Timetabling and planning	(Jeppesen 2011; Leleur 2004; Raza 2021)
Water governance and management	(Simbolon 2017; Wallis et al. 2013)

programming skills (Manduna et al. 2022; van der Linde and Goede 2021); and Algraini and McIntyre-Mills (2018) explored challenges to students' development in Saudi education. Further, Raza (2021) addressed a problem of educational timetabling, and Houston and Paewai (2013), and Luckett (2006) explored the more specific issue of quality assurance in higher education. CSH appears well-aligned to address problems in education as one of the core features of the methodology is the provision of a platform for groups or individuals that may not otherwise have the opportunity to express their views on a situation by which they are directly impacted. The CSH framework can therefore be used to guide students' involvement in the design and improvement of their learning experiences, an opportunity that they may not usually be afforded.

Several studies have applied CSH to explore problems in agriculture. The specific issues investigated relate to GM crops (Carr and Levidow 2000; Tavella 2016), rice supply chain sustainability (Elyasi and Teimoury 2023), agroecological transition (Hutcheson et al. 2023), and Indonesian beef farming (Setianto et al. 2014). Complexity arising from environmental challenges, multiple stakeholders across the supply chain, and technological innovation means such issues in agriculture are challenging to unpack and as such are well suited to exploration with CSH. Other notable areas in which multiple CSH studies have been conducted include health (Buse 2013; Gadsby et al. 2022; O'Hara and Taylor 2023; Tavella 2023), public services (Flood and Jackson 1991; Johnstone and Tate 2017; Levin et al. 2017; Torun and Torlak 2022), intervention design and evaluation (Hart and Paucar-Caceres 2014; Midgley 1997b; Ormerod 1997; Parrilla and Neyra Belderrain 2023), and technology (Donaires 2006; Duboc et al. 2020; Loveridge and Saritas 2009; Raza et al. 2019). Finally, several of the papers reviewed are not practical applications of the framework but contributions to theoretical and methodological discussions about CSH (Jackson 2001, 2005; Midgley 1997a; Ormerod 2004; Romm 1995; Ulrich 1993, 2001, 2003, 2004, 2012a, b).

Methodological Positioning

A key topic of the early discourse surrounding CSH is its methodological positioning. One critique of CSH has been its supposed rejection of methodological pluralism (Midgley 1997a). The case for methodological pluralism in systems research is outlined most notably by Jackson and Keys (1984) in their proposed system of systems methodologies. They make the point that real-world problems can be categorised into different problem types based on the levels of complexity and agreement inherent in the problem situation, and that the type of problem influences the most suitable methodological choice. Mechanistic problems are simpler and may be solved by applying traditional, hard OR methodologies, while systemic problems are more complex and are suitable to more recent systems methodologies, such as system dynamics. The level of agreement in the problem situation also influences methodological choice. Problems in which there is no divergence of opinion on the nature of the problem – two such categories outlined by Jackson and Keys are mechanistic-unitary or systemic-unitary problems – may be more easily modelled and solved. However, many managerial problems are made more complex owing to different perspectives on the nature of the problem. Such problems are pluralist and require “soft” methodologies capable of capturing and addressing different perspectives. Ulrich appears to take issue in general with systems science methodologies, citing their inherent lack of critical reflection.

Policy analysis and program evaluation show an amazing helplessness, if not indifference, with respect to the problem of value judgments. Both pursue the same goal of applying science to public decision making so as to secure improvement, but neither has developed convincing heuristic tools for identifying and rationally unfolding the normative content of any concept of improvement, definition of “the problem”, or solution proposal (Ulrich 1988).

As a result, Ulrich takes the view that the principles of CSH ought to permeate through all systems methodologies applied to social systems, rather than tying the framework to any specific problem type. Critics view this as a harsh assessment of systems science. Jackson (1985) noted that successful interventions do not necessarily require adequate modeling of the “purposeful social systems” with which Ulrich is concerned. We should not lose sight of what is viable and useful in any given problem context.

CSH has not resonated with sufficiently many people to result in an overhaul of systems methodologies (Ormerod 2004). Nevertheless, many systems researchers and practitioners instead turned towards CSH as a means of addressing a specific issue that was inadequately addressed by existing systems methodologies – coercion.

Coercion and Power Asymmetry

Coercion can be defined as the application of force or pressure to groups or individuals so that they engage in behaviours that they either do not want to or are not in their best interests. It is a key issue in situations with power asymmetries between stakeholders and one which CSH aims to address. As such, several studies have applied CSH to problems involving marginalised groups or individuals. Examples include Ariyadasa and McIntyre-Mills’ (2015) examination of the governance determining the experiences of Sri Lankan children in institutional care, Riswanda et al.’s (2017) advocacy for the involvement of individuals adversely impacted by prostitution in Indonesia in policymaking on this issue, and Cleland and Wyborn’s (2010) engagement with a deprived fishing community in the Philippines in exploring coral reef management.

Other soft OR approaches outline mechanisms for capturing different perspectives on management issues, but CSH is unique in that it defines a mechanism for better understanding and addressing power dynamics, and for considering individuals and groups adversely impacted. Tirivanhu et al. (2016) apply CSH because of its ability to address power relations in multi-stakeholder problems, and use it to evaluate a community self-development initiative in Zimbabwe. Kish et al. (2021) chose to explore the Journal of Ecological Economics using CSH, having recognised the power it holds over which research is published and the resulting influence this has on shaping the direction of the field. Moreover, Maru and Woodford (2001) propose that CSH may usefully inform the design of interventions in sustainable development initiatives, despite the asymmetrical relationships present in such problem contexts.

Further CSH applications include the enhancement of teaching programmes (Algraini and McIntyre-Mills 2018; Goede and Taylor 2019; Manduna et al. 2022; Taylor and Goede 2016; van der Linde and Goede 2021), the development of business intelligence systems (Venter 2019; Venter and Goede 2017, 2018), and building understanding in research practice (Nicholas et al. 2019). These problem contexts are not overtly coercive, however, power dynamics, and conflicting understandings and interests do play an influential role: students and teachers have different roles and levels of control in the learning environment;

different stakeholders may have multiple and conflicting requirements of a business intelligence system; researchers and practitioners may understand and interpret differently an emerging area of research. In all such cases, there is the potential for some perspectives to be more dominant at the exclusion of others. CSH provides a platform for different perspectives to be expressed with a view of surfacing adverse impacts on different individuals and groups.

An issue here appears to be in the language that is used. It is easy to understand how the examples of institutional care for children, human rights and prostitution, and coral reef management in deprived communities are inherently coercive problematic situations following our earlier definition. However, following Ulrich's (2003) definition of coercion – "structural conditions that create an asymmetry of discursive chances" – the latter examples of education, business intelligence systems and research development may also be considered coercive. Indeed, any management problem that involves multiple individuals and perspectives has the potential to meet this definition of coercion.

It is clear that in real-world discourses, such conditions of structural inequality are the rule rather than the exception (Ulrich 2003).

Therefore, the potential for asymmetric discursive chances is present in any management problem. By this definition, it does not appear helpful to refer to coercive and non-coercive problems. We might instead think of CSH as a framework for exploring and navigating the coercion inherent in management problems, which may be present in greater or lesser extents. This only requires a slight re-framing of commonly held understandings of why the framework is applied: from this point of view, CSH is not an approach for exploring coercive problems, rather, an approach that, in part, explores the influence of asymmetric power relations in management problems.

Of course, other definitions of coercion exist. Midgley defines it as the "closure of debate" (Midgley 1997a) and highlights valid questions regarding the effectiveness of CSH as an approach for addressing coercive problems following this definition. CSH is incapable of addressing such situations since the methodology is predicated on reflective debate between stakeholders i.e. coercive problems are absent of reflective debate, and without this, CSH is not possible (Midgley 1997a). Midgley therefore advocates for the inclusion of political action and campaigning – change oriented activities - in interventions aimed at emancipatory outcomes.

We believe that a practical take on the extent to which CSH can address coercion is provided by Luckett (2006), who applied CSH to explore perspectives on policies for quality assurance in South African higher education. While this study demonstrated the utility of CSH for aiding policymaking in that the findings influenced the final design of policy instruments, Luckett recognised that CSH was limited by the coercive problem context in which it is applied, and so is cautious about the extent to which issues of power and control are addressed by the framework, citing the dominant influence of a young democracy on policy. Therefore, while CSH may be a useful tool for exploring coercion, this does not mean that it is always effective in transcending power dynamics in the delivery of socially rational outcomes.

While CSH alone may be insufficient in uncovering the cause-and-effect relationships that underpin the influence of coercion in management problems, simply by directly structuring interventions and research around the mapping of control and legitimacy, CSH surpasses soft systems frameworks in its potential to provide insights into coercion. This points towards the integration of CSH and methods that are better suited to uncovering cause-and-effect relationships. An example is provided by Setianto et al.'s (2014)

investigation of smallholder beef farming in Indonesia using a multimethod approach that incorporates SSM, CSH, and causal loop diagrams. CSH was used in addition to SSM specifically to address asymmetric power relations. This was deemed important given the lack of power that farmers have in the Indonesian food system. CSH was applied to build a comprehensive understanding of the problem in the form of a conceptual model, which was followed by causal loop mapping to identify leverage points for change.

There is clearly a question over the extent to which CSH interventions can meaningfully impact change in significantly coercive contexts, such as those dominated by corruption or authoritarianism. Nevertheless, we believe that the first steps in achieving emancipation in such contexts is by striving to illuminate these destructive dynamics. CSH achieves this not only by directly addressing control or power, but also by considering impacts on the “affected”.

Emancipation

Emancipation is associated with liberation and freedom, particularly of marginalised groups or individuals, and research objectives of this kind are evident in CSH research. For example, Ariyadasa and McIntyre-Mills (2015) explore the care system for Sri Lankan children with an emancipatory purpose:

The aim of the research is to advocate for the standard of care the children receive, and the life chances they deserve in order for them to reach their full potential and integrate into their societies when they leave the children’s homes (Ariyadasa and McIntyre-Mills 2015).

Moreover, Hart and Paucar-Caceres (2014), applying CSH to evaluate outcomes of an SSM intervention for a mining case study in Peru, highlight that harder, data-driven research requested by more powerful government and industry stakeholders risks marginalising the perspectives of community groups in future interventions. Additionally, Johnstone and Tate (2017) report on a case study of emergency service provision with historic stakeholder conflict resulting in the marginalisation of frontline workers. Their post hoc analysis demonstrated that CSH can be used for not only the design of IT project governance, but to identify and address entrenched issues within existing governance structures. In each example, CSH is applied with a view of either improving or preventing an undesirable situation for an affected group. This is the emancipatory nature of CSH as outlined by Midgley (1997a): a structured framework for considering the problem of interest from the perspectives of affected groups and individuals. CSH requires those applying the framework to ask specific questions relating to the affected: who represents the interest of individuals or groups negatively affected by the problem; what are the opportunities for expression for the negatively impacted; and what space is available for reconciliation of differing worldviews of individuals or groups affected by the problem (Ulrich and Reynolds 2010)? As such, a key function of CSH is to facilitate deep reflection on a problem through the lens of negatively impacted groups, and so it follows that many applications address issues faced by marginalised groups and communities.

However, such an ideological take on emancipation places additional requirements on researchers (Ulrich 2003), and this is not the definition of the emancipation to which CSH aspires according to Ulrich. He instead describes CSH as a mechanism for achieving “methodological emancipation”.

The “emancipatory interest” in this sense is without regard for persons; its only advocacy is in favour of a situation of undistorted communication in which all concerned parties have as equal a chance of articulating their concerns as possible (Ulrich 2003).

Following this definition, emancipation may be interpreted as the provision of a platform for different voices with different perspectives to be clearly understood. Research may explore the perspectives of marginalised or exploited groups with a view of advocating for their needs and rights, and it is easy to see how such objectives might build from a foundation of methodological emancipation in practical applications. However, it is the concept of methodological emancipation that is central to CSH: the framework is ultimately a mechanism through which different perspectives may be shared and critiqued, irrespective of power and worldview. This opens the door to a much wider range of problem contexts than only those that are overtly coercive.

Boundary Critique

How, though, does CSH address distorted communication beyond soft systems approaches? The key to this is in the practice of boundary critique. Where SSM and cognitive mapping provide mechanisms through which we can capture and explore different perspectives, CSH employs boundary critique, a means of making transparent the assumptions that underpin these perspectives. Formally, boundary critique is defined as:

...a systematic – reflective and discursive – effort of handling boundary judgements critically, whereby “critically” means both “self-critically” questioning one’s *own* claims and “thinking for oneself” before adopting the claims of *others* (Ulrich and Reynolds 2010).

Alternatively stated, in exploring, testing, and expressing our sources of selectivity, CSH aims at equal opportunity for different perspectives to be heard, understood, and evaluated. It follows that such an approach has the potential to enable richer understanding and more transparent dialogue between different stakeholders than would necessarily a soft OR approach. Therefore, no perspective on an issue is readily accepted – they are instead reflected on and questioned so that they may be more comprehensively understood.

Boundary critique is practically implemented through the 12 boundary questions. These boundary questions are structured into a framework that aims to provide transparency about the assumptions that underpin perspective on a problem. The aim is to clearly understand the perspective and why it is held. For example, we are likely to better understand a particular interpretation of the purpose of any given system (boundary question 2) from a particular perspective, if we know who the intended beneficiaries of the system are (boundary question 1) from that same perspective. Summaries of the key points surfaced through application of the CSH framework are frequently presented alongside the boundary questions to which they relate (Gadsby et al. 2022; Kish et al. 2021; Venter and Goede 2017).

This slower, deliberate approach to understanding may be better suited to addressing the additional complexity presented by power asymmetry. For example, Venter and Goede (2018) explored routes to improving business intelligence systems. While they outlined and appreciated the benefits of Checkland’s SSM in designing such an intervention, they concluded that an immediate focus on action may inhibit the formation of effective solutions in problems influenced by coercion. Accordingly, they advocated for approaches based on

CSH owing to its perceived deeper reflection on the social dimension of such problem contexts. Similarly, Torun and Torlak (2022) advocate for CSH as a favourable alternative to SSM in coercive problem situations, owing to SSM's lack of grounding in social theory.

Reynolds (2014) applies CSH to an international development project, selecting the method because of the multistakeholder nature and complexity of the project. Reynolds draws on CSH as a “pro-equity” evaluation tool and posits that its value is not only due to its ability to capture different perspectives on a situation, but that CSH allows for critical reflection on the judgements that underpin these perspectives. Using India's Narmada project as a case study, Reynolds demonstrates the alignment of CSH with a “triple-loop learning” approach, as the boundary questions move beyond understanding what a suitable intervention is and whether this intervention would be the “right” thing to do, and also consider how we know that any given intervention is the right thing to do. Thus, CSH not only considers the ethical dimension of the problem situation, but draws on the wider problem context to understand political influence. This alignment is perhaps most evident in CSH's “legitimacy” dimension, in which participants are encouraged to reflect on the problem from the perspectives of other stakeholders and consider both their adversities and mechanisms through which they can voice issues and receive support.

While coercion and power are key focuses in the majority of CSH studies, some are less concerned with addressing these issues and emphasise more strongly the role of boundary critique in unfolding understanding of a problem. Carr and Levidow (2000) use CSH to consider the risks of GM food production in the UK. They apply CSH to jointly consider the scientific and social implications of GM crops without specific reference to coercion or power structures. Mejia et al. (2019) propose that CSH should be incorporated widely into the guidelines for critical thinking evaluation tests. Currently iPAL assesses individuals' ability to evaluate bias and errors of judgement, evaluate and structure arguments, evaluate the consequences of action, and deliver results. The authors argue that a key omission in this framework is assessment of individuals' abilities to evaluate different perspectives on a problem, which may be facilitated by CSH. Notably, in this context, the authors draw on CSH as a framework for exploring the judgements and underpinning assumptions shaping the understanding of different individuals. While exploring sources of power is a key dimension of CSH, the purpose of integrating CSH is not driven by the authors' desire to specifically explore coercive problems for the achievement of the emancipation of marginalised groups. Rather, integrating the principles of boundary critique into critical thinking is outlined as good practice in general. Mirhosseini et al. (2021) adopted a mixed methods approach in their exploration of enterprise resource planning (ERP) systems. They structured 12 interviews with ERP experts based on CSH to understand the key associated risks, before quantitatively evaluating the significance and frequency of these risks. Again, the focus of this research is not in exploring an explicitly coercive problem or marginalised perspectives. CSH is instead employed to seek comprehensiveness in understanding expert perspectives on ERP.

“Is” vs. “Ought to be”

CSH research to date has highlighted the multi-faceted nature of the framework. In their applications, authors may be more concerned with power or the assumptions that underpin different points of view. An additional application is for ideal mapping – consideration of the system as it “is” compared with how it “ought to be” (Ulrich and Reynolds 2010). This

is a core feature of the CSH methodology, but authors may emphasise it more or less in their approaches. Ideal mapping encourages participants to think about their situation or problem from a best case scenario – if the reality of their situation could be exactly as they like, what would it look like? Participants are then encouraged to think about the situation as it is – by contrasting these two modes, the intervention facilitates a better understanding of the specificities that give rise to the “is” falling short of the “ought to be”.

Wallis et al. (2013) emphasise comparison of the “is” and “ought to be” modes in a water governance case study in Australia. They identified factors driving the success of community-based water management governance policies, as well as barriers to the attainment of more desirable outcomes. In this way, CSH provides an effective framework not only for unpacking complex problems, but also for understanding routes to beneficial change.

Action Research

CSH studies follow a range of methodological designs. Of the 77 reviewed papers, 12 stated that they were following an action research approach (Ariyadasa and McIntyre-Mills 2015; Dehghan Nayeri et al. 2020; Duboc et al. 2020; Goede and Taylor 2019; Kish et al. 2021; Pinzon-Salcedo and Torres-Cuello 2018; Taylor and Goede 2016; Torun and Torlak 2022; van der Linde and Goede 2021; Venter 2019; Venter and Goede 2017, 2018). Action research ultimately aspires to beneficial change in the situation of interest. It is centred on reflection and the participation of those involved. There are therefore synergies between CSH, as a mode of reflective inquiry, and action research designs. By engaging with those involved in a problem, action research aims at deep contextual understanding and evidence-based findings. In emphasising the perspectives of not only the involved, but also the affected, research following a CSH methodology draws on perspectives that may otherwise remain unconsidered, building a more comprehensive understanding of the situation of interest.

The utility of CSH is arguably best exemplified in an action research context, where the success of an intervention is determined by the extent to which it resulted in beneficial change. Pinzon-Salcedo and Torres-Cuello (2018) report perhaps the most impactful application of CSH, in which they use the framework alongside other problem structuring methods in a multi-year social development project in Columbian schools for addressing societal violence. Their designed intervention has impacted more than one million people and has permeated beyond school impact into society more widely. The authors report that their use of CSH enabled them to move beyond understanding what interventions might bring about improvement to the situation, and to also understand the assumptions that underpin these moral judgements – encouraging the questioning of judgements that may be “taken for granted”. They report that fundamental to the success of their approach was participatory reflection in the design of their intervention. The concept of “marginalisation” is addressed in their approach in two ways. Firstly, their participatory approach gave members of a marginalised community a platform to voices their perspectives and contribute to the design of an intervention that was intended to address a problem in which they were the most directly impacted. Secondly, marginalisation may refer to marginalised elements of the of the problem situation (Midgley 1992). CSH boundary questions encourage the challenging of currently held conceptions of a problem situation and may support participants in conceptualising the problem in new but relevant ways. As such, elements that may be critical to the problem and the design of a

successful intervention that have previously been neglected – “marginalised” elements – may be uncovered. Drawing on a wider range of perspectives – particularly those of marginalised individuals or groups – increases the probability of uncovering such marginalised elements in problems where the prevailing narrative is shaped by dominant stakeholders.

Conclusion

CSH has been applied by researchers across a range of problem domains. Most commonly, the approach is chosen because of coercion or asymmetric power structures inherent in the problematic situation. While it was not Ulrich’s intention for CSH to be applied exclusively to address coercion, the framework provides a mechanism for doing so that surpasses soft OR methodologies. This is not only because CSH directly considers the problem through the lenses of control and legitimacy, but also because the practice of boundary critique aims to challenge and comprehensively understand different perspectives, irrespective of the dominance with which they are held. Several authors have discussed the benefits of this slower, deliberate mode of inquiry over a more action oriented SSM approach (Torun and Torlak 2022; Venter and Goede 2018). Moreover, we have attempted to clarify how the practice of boundary critique may lead to methodological emancipation, and distinguished this concept from the ideological emancipation of marginalised groups and individuals sought by many CSH users. While objectives of emancipation of the latter kind is not a requirement of CSH, in many studies they come hand in hand with aims of methodological emancipation, and CSH research frequently advocates for the voices of marginalised groups. CSH has faced criticism over its ability to adequately address coercion but action research in particular demonstrates the beneficial outcomes that the approach can deliver in such problem contexts. The underpinning ideas of CSH are complex, but it is at its core a versatile method for comprehensively understanding different perspectives on issues and why they are held. We hope that this review has helped to unpack key CSH terminology with reference to practical applications, so that more researchers might consider adding the approach to their methodological toolkit.

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References

- Algraini S, McIntyre-Mills J (2018) Human development in Saudi Education: a critical systemic approach. *Systemic Pract Action Res* 31(2):121–157. <https://doi.org/10.1007/s11213-017-9432-9>
- Ariyadasa E, McIntyre-Mills J (2015) A systemic governance approach to an effective re-integration process for the Institutionalized Children in Sri Lanka: application of critical systems Heuristics. *Systemic Pract Action Res* 28(5):429–451. <https://doi.org/10.1007/s11213-014-9338-8>
- Buse C (2013) Intersectoral action for health equity as it relates to climate change in Canada: contributions from critical systems heuristics. *J Eval Clin Pract* 19(6):1095–1100. <https://doi.org/10.1111/jep.12069>
- Carr S, Levidow L (2000) Exploring the links between science, risk, uncertainty, and ethics in regulatory controversies about genetically modified crops. *J Agric Environ Ethics* 12(1):29–39. <https://doi.org/10.1023/A:1009595924500>
- Chowdhury R, Gregory A, Queah M (2023) Creative and flexible deployment of systems methodologies for child rights and child protection through Holistic Flexibility. *Syst Res Behav Sci* 40(4):654–670. <https://doi.org/10.1002/sres.2955>
- Cleland D, Wyborn C (2010) A reflective lens: applying critical systems thinking and visual methods to ecohealth research. *EcoHealth* 7(4):414–424. <https://doi.org/10.1007/s10393-010-0362-6>
- Dehghan Nayeri M, Khazaei M, Alinasab-Imani F (2020) The critical heuristics of Iranian banking credit system: analysis of the antithetical opinions of the beneficiaries. *Systemic Pract Action Res* 33(3):363–392. <https://doi.org/10.1007/s11213-020-09524-x>
- Donaires OS (2006) A critical heuristic approach to the establishment of a software development process. *Systemic Pract Action Res* 19(5):415–428. <https://doi.org/10.1007/s11213-006-9033-5>
- Donaires OS, Pinheiro MG, Cezarino LO, Ostanel LH, Martinelli DP (2010) Systemic model for diagnosis of the micro, small and medium enterprises from two cities from the countryside of the state of São Paulo in Brazil. *Systemic Pract Action Res* 23(3):221–236. <https://doi.org/10.1007/s11213-009-9157-5>
- Duboc L, McCord C, Becker C, Ahmed SI (2020) Critical requirements engineering in practice. *IEEE Softw* 37(1):17–24. <https://doi.org/10.1109/MS.2019.2944784>
- Elyasi A, Teimoury E (2023) Applying critical systems practice meta-methodology to improve sustainability in the rice supply chain of Iran. *Sustain Prod Consum* 35:453–468
- Fitch D (2012) Youth in foster care and social media: a framework for developing privacy guidelines. *J Technol Hum Serv* 30(2):94–108. <https://doi.org/10.1080/15228835.2012.700854>
- Flood RL, Jackson MC (1991) Critical systems heuristics: application of an emancipatory approach for police strategy toward the carrying of offensive weapons. *Syst Pract* 4(4):283–302. <https://doi.org/10.1007/BF01062006>
- Gadsby EW, Wistow G, Billings J (2022) A critical systems evaluation of the introduction of a ‘discharge to assess’ service in Kent. *Crit Soc Policy*. <https://doi.org/10.1177/02610183211065028>
- García Celma M (2021) Supporting decision-making when conserving contemporary art: a model for identification and categorization of stakeholders. *J Am Inst Conserv* 60(2–3):161–174. <https://doi.org/10.1080/01971360.2021.1980695>
- Gates EF (2018) Toward valuing with critical systems Heuristics. *Am J Evaluation* 39(2):201–220. <https://doi.org/10.1177/1098214017703703>
- Goede R, Taylor E (2019) Theory in emancipative action: aligning action research in information systems education with critical social research in information systems. *Systems* 7(3). <https://doi.org/10.3390/systems7030036>
- Gregory A (1997) Evaluation practice and the tricky issue of coercive contexts. *Syst Pract* 10(5):589–609. <https://doi.org/10.1007/BF02557859>
- Hart D, Paucar-Caceres A (2014) Using critical systems heuristics to Guide Second-Order Critique of systemic practice: exploring the Environmental Impact of Mining Operations in Southern Peru. *Syst Res Behav Sci* 31(2):197–214. <https://doi.org/10.1002/sres.2195>
- Houston D, Foote J (2001) Normative implications of assessment and evaluation: a critical view. *Assess Evaluation High Educ* 26(5):403–416. <https://doi.org/10.1080/02602930120081989>
- Houston D, Paewai S (2013) Knowledge, power and meanings shaping quality assurance in higher education: a systemic critique. *Qual High Educ* 19(3):261–282. <https://doi.org/10.1080/13538322.2013.849786>

- Hutcheson M, Morton A, Blair S (2023) Exploring perspectives on Agroecological Transition in Scotland with critical systems Heuristics. *Systemic Pract Action Res*. <https://doi.org/10.1007/s11213-023-09663-x>
- Irawan AB, McIntyre-Mills J (2016) Application of critical systems thinking to performance auditing practice at the Indonesian Supreme Audit Institution: issues and challenges. *Syst Res Behav Sci* 33(1):24–44. <https://doi.org/10.1002/sres.2325>
- Jackson MC (1985) The itinerary of a critical Approach. *J Oper Res Soc* 36(9):878–881. <https://doi.org/10.1057/jors.1985.157>
- Jackson MC (2001) Critical systems thinking and practice. *Eur J Oper Res* 128(2):233–244. [https://doi.org/10.1016/S0377-2217\(00\)00067-9](https://doi.org/10.1016/S0377-2217(00)00067-9)
- Jackson MC (2005) Sexing-up the evidence: a reply to Ormerod and Ulrich. *J Oper Res Soc* 56(4):467–468. <https://doi.org/10.1057/palgrave.jors.2601939>
- Jackson MC, Keys P (1984) Towards a system of systems methodologies. *J Oper Res Soc* 35(6):473–486
- Jeppesen SL (2011) Exploring an explicit use of the Concept of sustainability in Transport Planning. *Systemic Pract Action Res* 24(2):133–146. <https://doi.org/10.1007/s11213-010-9180-6>
- Johnstone D, Tate M (2017) Improving IT project governance: a reflective analysis based on critical systems heuristics. *Australas J Inform Syst* 21. <https://doi.org/10.3127/AJIS.V21I0.1227>
- Kish K, Mallery D, Yahya Haage G, Melgar-Melgar R, Burke M, Orr C, Larson J (2021) Fostering critical pluralism with systems theory, methods, and heuristics. *Ecol Econ* 189:107171. <https://doi.org/10.1016/j.ecolecon.2021.107171>
- Klocker Larsen R (2011) Critical systems thinking for the facilitation of conservation planning in Philippine coastal management. *Syst Res Behav Sci* 28(1):63–76. <https://doi.org/10.1002/sres.1045>
- Leleur S (2004) Scope: an integrated framework for multi-attribute decision making. *Innovation* 17(3):259–270. <https://doi.org/10.1080/1351161042000241171>
- Levin L, Gewirtz S, Cribb A (2017) Shared decision making in Israeli social services: social workers' perspectives on policy making and implementation. *Br J Social Work* 47(2):507–523. <https://doi.org/10.1093/bjsw/bcw024>
- Loveridge D, Saritas O (2009) Reducing the democratic deficit in institutional foresight programmes: a case for critical systems thinking in nanotechnology. *Technol Forecast Soc Chang* 76(9):1208–1221. <https://doi.org/10.1016/j.techfore.2009.07.013>
- Luckett K (2006) An assessment of the application of 'critical systems heuristics' to a policy development process. *Systemic Pract Action Res* 19(6):503–521. <https://doi.org/10.1007/s11213-006-9040-6>
- Lyons-White J, Mikolo Yobo C, Ewers RM, Knight AT (2022) Understanding zero deforestation and the High Carbon Stock Approach in a highly forested tropical country. *Land Use Policy* 112:105770. <https://doi.org/10.1016/j.landusepol.2021.105770>
- Manduna W, Goede R, Drevin L (2022) Incorporating various perspectives in using instant messages in teaching programming: a critical system thinking perspective. *Syst Res Behav Sci* 39(5):947–961
- Maru YT, Woodford K (2001) Enhancing Emancipatory systems methodologies for Sustainable Development. *Systemic Pract Action Res* 14(1):61–77. <https://doi.org/10.1023/A:1009535710891>
- Mejía A, Mariño JP, Molina A (2019) Incorporating perspective analysis into critical thinking performance assessments. *Br J Educ Psychol* 89(3):456–467. <https://doi.org/10.1111/bjep.12297>
- Midgley G (1992) The sacred and profane in critical systems thinking. *Syst Pract* 5:5–16
- Midgley G (1997a) Dealing with Coercion: critical systems heuristics and beyond. *Syst Pract* 10(1):37–57. <https://doi.org/10.1007/BF02557850>
- Midgley G (1997b) Developing the methodology of TSI: from the oblique use of methods to creative design. *Syst Pract* 10(3):305–319. <https://doi.org/10.1007/BF02557900>
- Mirhosseini SS, Ramezani M, Khazaei M, Azar A (2021) Exploring and analysing the risks and challenges of implementing ERP systems: critical system thinking. *Int J Inform Syst Change Manag* 12(3):234–258. <https://doi.org/10.1504/IJISCM.2021.120325>
- Nicholas G, Foote J, Kainz K, Midgley G, Prager K, Zurbriggen C (2019) Towards a heart and soul for co-creative research practice: a systemic approach. *Evid Policy* 15(3):353–370. <https://doi.org/10.1332/174426419X15578220630571>
- O'Hara L, Taylor J (2023) QATCHEPP: a quality assessment tool for critical health promotion practice. *Front Public Health* 11:1121932
- Ormerod RJ (1997) The design of organisational intervention: choosing the approach. *Omega* 25(4):415–435. [https://doi.org/10.1016/S0305-0483\(97\)00006-6](https://doi.org/10.1016/S0305-0483(97)00006-6)
- Ormerod R (2004) A contribution to the discussion of Ulrich's paper. *J Oper Res Soc* 55(11):1236–1238. <https://doi.org/10.1057/palgrave.jors.2601851>
- Parrilla FR, Neyra Belderrain MC (2023) Systemic business intervention to treat complex problems in companies. *Systemic Pract Action Res*. <https://doi.org/10.1007/s11213-023-09662-y>

- Pinzon-Salcedo LA, Torres-Cuello MA (2018) Community operational research: developing a systemic peace education programme involving urban and rural communities in Colombia. *Eur J Oper Res* 268(3):946–959. <https://doi.org/10.1016/j.ejor.2017.11.040>
- Raza SA (2021) A paradigm shift to ethical decision-making—incorporating systemic epistemology into complex socio-technical decision support systems research. *J Decis Syst*. <https://doi.org/10.1080/12460125.2021.2015840>
- Raza SA, Siddiqui AW, Standing C (2019) Exploring systemic problems in IS adoption using critical systems Heuristics. *Systemic Pract Action Res* 32(2):125–153. <https://doi.org/10.1007/s11213-018-9467-6>
- Raza SA, Standing C (2011) A systemic model for managing and evaluating conflicts in Organizational Change. *Systemic Pract Action Res* 24(3):187–210. <https://doi.org/10.1007/s11213-010-9186-0>
- Reynolds M (2008) Getting a grip: critical systems for corporate responsibility. *Syst Res Behav Sci* 25(3):383–395. <https://doi.org/10.1002/sres.901>
- Reynolds M (2014) Equity-focused developmental evaluation using critical systems thinking. *Evaluation* 20(1):75–95. <https://doi.org/10.1177/1356389013516054>
- Riswanda, McIntyre-Mills J, Corcoran-Nantes Y (2017) Prostitution and Human rights in Indonesia: a critical systemic review of policy discourses and scenarios. *Systemic Pract Action Res* 30(3):213–237. <https://doi.org/10.1007/s11213-016-9393-4>
- Romm N (1995) Knowing as intervention: reflections on the application of systems ideas. *Syst Pract* 8(2):137–167. <https://doi.org/10.1007/BF02253410>
- Setianto NA, Cameron D, Gaughan JB (2014) Identifying archetypes of an Enhanced System Dynamics Causal Loop Diagram in Pursuit of Strategies to Improve Smallholder Beef Farming in Java, Indonesia. *Syst Res Behav Sci* 31(5):642–654. <https://doi.org/10.1002/sres.2312>
- Sianipar CP, Chao Y-M, Hoshino S (2023) Multi-actor systems in Water–Energy Nexus: identifying critical stakeholders in Floatovoltaic (floating Photovoltaic) Project. *Water* 15(6):1241
- Simbolon J (2017) Critical systems thinking review on decentralized drinking Water Management in Nauli City, Indonesia. *Syst Res Behav Sci* 34(5):643–653. <https://doi.org/10.1002/sres.2490>
- Sunitiyoso Y, Mahardi JP, Anggoro Y, Wicaksono A (2020) New and renewable energy resources in the Indonesian electricity sector: a systems thinking approach. *Int J Energy Sect Manage* 14(6):1381–1403. <https://doi.org/10.1108/IJESM-11-2019-0019>
- Tavella E (2023) ‘And what did you do about my emotions during Covid-19?’ Making sense of negative emotions at work through institutional logics and Critical Systems Heuristics. *Syst Res Behav Sci* 1–17. <https://doi.org/10.1002/sres.2952>
- Tavella E (2016) How to make Participatory Technology Assessment in agriculture more participatory: the case of genetically modified plants. *Technol Forecast Soc Chang* 103:119–126. <https://doi.org/10.1016/j.techfore.2015.10.015>
- Taylor E, Goede R (2016) Using critical Social Heuristics and Project-based learning to Enhance Data Warehousing Education. *Systemic Pract Action Res* 29(2):97–128. <https://doi.org/10.1007/s11213-015-9357-0>
- Tirivanhu P (2022) Whither made in Africa evaluation: exploring the future trajectory and implications for evaluation practice. *Afr Evaluation J* 10(1):614
- Tirivanhu P, Matondi PB, Sun D (2016) Systemic evaluation of a Comprehensive Community Initiative based on Boundary Critique in Mhakwe Ward in Zimbabwe. *Systemic Pract Action Res* 29(6):541–564. <https://doi.org/10.1007/s11213-016-9377-4>
- Torun Y, Torlak NG (2022) An adaptive use of Soft systems methodology with strategic assumption surfacing and testing, critical systems heuristics and Interactive Planning in a women’s prison. *Syst Res Behav Sci*. <https://doi.org/10.1002/sres.2885>
- Ulrich W (1988) Churchman’s process of unfolding—its significance for policy analysis and evaluation. *Syst Pract* 1(4):415–428. <https://doi.org/10.1007/BF01066583>
- Ulrich W (1993) Some difficulties of ecological thinking, considered from a critical systems perspective: a plea for critical holism. *Syst Pract* 6(6):583–611. <https://doi.org/10.1007/BF01059480>
- Ulrich W (2001) The quest for competence in systemic research and practice. *Syst Res Behav Sci* 18(1):3–28. <https://doi.org/10.1002/sres.366>
- Ulrich W (2003) Beyond methodology choice: critical systems thinking as critically systemic discourse. *J Oper Res Soc* 54(4):325–342. <https://doi.org/10.1057/palgrave.jors.2601518>
- Ulrich W (2004) Reply to the comments of Ormerod: the history of ideas of CST. *J Oper Res Soc* 55(11):1238–1241. <https://doi.org/10.1057/palgrave.jors.2601852>
- Ulrich W, Reynolds M (2010) Critical systems heuristics. In: Reynolds M, Holwell S (eds) *Systems Approaches to Managing Change: A Practical Guide*. Springer, London. https://doi.org/10.1007/978-1-84882-809-4_6

- Ulrich W (2012a) Operational research and critical systems thinking-an integrated perspectivePart 1: or as applied systems thinking. *J Oper Res Soc* 63(9):1228–1247. <https://doi.org/10.1057/jors.2011.141>
- Ulrich W (2012b) Operational research and critical systems thinking-an integrated perspectivePart 2: or as argumentative practice. *J Oper Res Soc* 63(9):1307–1322. <https://doi.org/10.1057/jors.2011.145>
- Valentinov V (2012) System-Environment relations in the theories of Open and Autopoietic systems: implications for critical systems thinking. *Systemic Pract Action Res* 25(6):537–542. <https://doi.org/10.1007/s11213-012-9241-0>
- van der Linde S, Goede R (2021) From Kant's critique of pure reason, to action research in improving the programming skills of students. *Systemic Pract Action Res* 34(4):419–440. <https://doi.org/10.1007/s11213-020-09543-8>
- Venter C (2019) A critical systems Approach to Elicit user-Centric Business Intelligence Business requirements. *Systemic Pract Action Res* 32(5):481–500. <https://doi.org/10.1007/s11213-018-9468-5>
- Venter C, Goede R (2017) The use of critical systems heuristics to surface and reconcile users' conflicting visions for a Business Intelligence System. *Systemic Pract Action Res* 30(4):407–432. <https://doi.org/10.1007/s11213-016-9401-8>
- Venter C, Goede R (2018) A Report and Reflection on an application of critical systems practice to improve a Business Intelligence System's business requirements. *Syst Res Behav Sci* 35(5):548–563. <https://doi.org/10.1002/sres.2565>
- Vos JFJ (2003) Corporate social responsibility and the identification of stakeholders. *Corp Soc Responsib Environ Manag* 10(3):141–152. <https://doi.org/10.1002/csr.39>
- Wallis PJ, Ison RL, Samson K (2013) Identifying the conditions for social learning in water governance in regional Australia. *Land Use Policy* 31:412–421. <https://doi.org/10.1016/j.landusepol.2012.08.003>
- Zlatanović D (2015) A holistic approach to corporate social responsibility as a prerequisite for sustainable development: empirical evidence. *Econ Ann* 60(207):69–94. <https://doi.org/10.2298/EKA1507069Z>

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