

ISD as Reconfiguring Information: A Cybernetic Perspective on How IT Interventions Shape Organizational Behavior

Completed Research Paper

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Abstract

Increasingly, information systems development (ISD) extends beyond delivering information technology (IT) tools deemed satisfactory by a client to a direct commitment to achieving organizational outcome targets. This commitment makes reasoning about the effects of IT on organizational behavior a central concern. However, we have a limited understanding of how ISD efforts can reason ex ante about how IT interventions may shape organizational behavior. We draw on a basic cybernetic understanding of organizations as self-regulating systems whose behavior is shaped by information and feedback. From this perspective, ISD is an exercise in reconfiguring information to shape organizational behavior in desirable directions. On this basis, we distinguish three forms of IT interventions: blind reinforcement of behavior, possibly amplifying undesirable behavior; regulating or enabling behavior; and influencing the reference values for self-regulation, thereby shifting the direction of system behavior. We illustrate these forms through cases from a long-term research program.

Keywords: outcome-orientation, cybernetics, information systems development, feedback

Introduction

Often as part of larger digital transformation efforts, organizations increasingly move beyond developing and implementing IT to support existing practices and known needs to experimenting with using IT to reach transformative organizational outcomes (Vial, 2021). In these contexts, organizational information systems development (ISD) efforts can extend beyond procuring, developing, and delivering IT solutions as deemed acceptable by clients to being directly committed to reaching organizational outcome targets (Li, 2025; Wiener et al., 2019). Examples of such targets are improved resource planning, service delivery, worker satisfaction, or increased sales. These *outcome-oriented* ISD efforts do not only treat IT as tools to be constructed in response to a technical problem or a need articulated by the client, but as interventions into organizational systems, aiming to shape organizational behavior in a desirable direction. They may be organized under a variety of labels, including dual-track agile (Trieflinger et al., 2020), continuous experimentation, BizDev (Antunes & Tate, 2024; Fitzgerald & Stol, 2017), and digital innovation or transformation projects (Barthel & Hess, 2020).

The extended commitment to reaching organizational outcome targets challenges some core assumptions and introduces several new concerns into the ISD process. One interesting set of concerns relates to reasoning about the effects of IT on organizational behavior, and relatedly, how we assess the quality and effectiveness of IT artifacts. In traditional product-oriented ISD, the starting point of the ISD process tends

to be a technical problem or need - such as “we lack a tool to help us with X” - that has been singled out and remains reasonably stable for the duration of the ISD effort. As the process unfolds, the problem is specified in terms of its constituent components, and a solution is developed, and delivered, often through frequent cycles of engagement with client representatives. In this process, the quality and effectiveness of IT is primarily assessed in terms of properties of the artifact itself, such as its usability, security, and efficiency, whether it solves the given problem and need as it is specified, and its “fit” with the current practices and needs of the client and end-users (Burton-Jones & Grange, 2013; Strong & Volkoff, 2010).

In outcome-oriented ISD, as it is directly tied to achieving organizational outcomes, the starting point is not a defined technical problem or need, but an open-ended organizational problem situation, such as poor service delivery or resource management. What is making the situation problematic - i.e., what stands between current behavior and the organizational outcome target - is often a difficult question to answer. Organizational systems tend to be complex and dynamic, where causal dynamics are hard to understand. Problematic behavior is seldom caused by a single malfunctioning part, as is often the case in mechanical systems, but emerges out of the interactions among a vast set of social, technical, political, and juridical aspects (Buchanan, 1992; Rittel & Webber, 1973). As a consequence, immediately observed problems and needs may be symptoms of a deeper problem etiology, and addressing them with new or improved IT tools may yield no or only temporary effect (Li & Thomassen, 2026; Von Hippel & Von Krogh, 2016).

Thus, to be successful in meeting a given organizational outcome target, outcome-oriented ISD efforts must go beyond traditional problem and requirement specification to a broader diagnosis of the organizational problem situation at hand. In this work, reasoning about “what to build” and the relative merit and effectiveness of potential IT interventions must involve developing an understanding of the causal dynamics of an organizational system's behavior, and making judgments about how reconfigurations and additions of IT may alter these dynamics. A constant risk is that the IT-based interventions are designed and developed in ways that fail to target the causal dynamics that matter, and hence, do not lead to any improved or even worse organizational outcomes.

Accordingly, the effectiveness of a given IT intervention in outcome-oriented ISD must be understood, not in representational terms of what the artifact comprises and its fit with existing work practices, but in *performative* terms: as a matter of how the IT shapes organizational behavior.

The ISD literature on the quality and effectiveness of IT artifacts in traditional ISD is very rich - both in design principles and in the process of, e.g., engaging with client representatives and end-users. Meanwhile, on the performative understanding of effectiveness needed to reason about where and how to intervene in outcome-oriented ISD, the literature seems to be largely silent. Beyond the wide range of popular ex post historical accounts of how IT influence larger societal developments (e.g., Harari, 2024; Zuboff, 2018) or the postmortem study of the effects of IT in concrete organizational digitalization efforts in IS implementation studies (Berente et al., 2019), we find limited support in terms of theory and heuristics for how ISD efforts may reason ex ante about the effects of IT interventions on organizational behavior, and how to differentiate between alternative interventions as the ISD effort unfolds.

In this paper, we contribute to our understanding of outcome-oriented ISD and the associated performative notion of IT as organizational interventions by examining the following questions:

1. How can we reason about the effects of IT interventions on organizational behavior in outcome-oriented ISD?
2. On what basis can we differentiate, ex ante, between IT interventions in terms of their potential to shape organizational behavior?

In response, we turn to an intriguing stream of ideas on cybernetics (e.g., Bateson, 1972/2000; Beer, 1972/1995; Wiener, 1950), which suggests that organizations are self-regulating social systems whose behavior is shaped by information and feedback. From this perspective, IT shapes organizational behavior by configuring where, how, when, and what information is generated and fed back within a social system.

The cybernetic perspective helps us make a relevant change of perspective on the effectiveness of IT: from IT as tools or infrastructural components that offer better or worse support for a given human activity and practice, to a performative notion presenting IT as interventions that more or less successfully reconfigure the efficiency, content, and direction of feedback and thereby shape how individuals and organizations behave. This offers an alternative to a dominant view of ISD as designing and developing tools to support

human activities, instead rendering ISD as deliberate and experimental work to reconfigure the flow of information to shape organizational behavior in desirable directions. From this perspective, key ISD activities include identifying the *pathological* feedback (Bateson, 1972/2000) that drives or holds current undesirable behavior in place, and eliminating, weakening, or devising stronger or new feedback loops that seek to counter the undesirable ones to steer organizational behavior in a different direction.

Our basic cybernetic ontology further suggests that feedback can shape system behavior in different ways. On this basis, we distinguish three ways in which IT interventions may shape organizational system behavior: (1) blind reinforcement of behavior, possibly unintentionally amplifying undesirable behavior; (2) regulating or enabling behavior; and (3) influencing the reference values for self-regulation, thereby shifting the direction of system behavior.

We examine the merit of our cybernetic understanding and the three forms of IT interventions through empirical cases from an extensive engaged research program that has been running for more than three decades and spans hundreds of ISD efforts in a wide range of countries in Africa, Asia, and South America.

Conceptual Background

Notions of quality and effectiveness of IT in traditional organizational ISD are largely compatible with what Orlikowski & Iacono (2001) refer to as the “tool” view of digital technology. The aim of the traditional ISD process is to design and develop an “engineered artifact, expected to do what the designers intend it to do” (p. 123). A successful result is a product or a “solution” that supports human activity by addressing a specific technical problem or need as articulated and approved by a client or “user”. An example could be “we lack a tool to support the collection and analysis of data.” The design and development are typically carried out by an internal IT department, an external consultant, or a vendor who specifies the need in greater detail, then designs, develops, and delivers a solution, often through several iterations together with the client.

In this process, notions of IT quality and effectiveness – i.e., what is considered a “good” or the “right” product - are sensibly defined in relation to properties of the product itself (e.g., its internal structure and user interfaces), its immediate use, and alignment with clients and end-users. For instance, design principles for usability, user experience, efficiency, and security are used to make *ex ante* judgments and decisions about the quality of features, and frequent interaction with users helps identify and address issues with use of the tool. Meanwhile, the ultimate measure of “right” typically lies in client acceptance and satisfaction, where a client representative - a “product owner” in agile methodology terms - agrees that the tool satisfies as a solution to the problem or need (Bass, 2015; Maruping & Matook, 2020).

The concerns and practices compatible with this notion of effectiveness are extensively studied by ISD research. For instance, we know much about how client representatives and users are engaged in requirements development in the ISD process (Browne et al., 2018; Maruping & Matook, 2020; Tuunanen et al., 2023). More so, the literature offers detailed and useful notions of IS quality and success that are tied to the nature of the artifact and its relationship to the users and their context. For instance, the seminal “IS success model” of DeLone and McLean (2003) understands “net system benefits” as a function of aspects such as information quality, system quality, and user satisfaction. Meanwhile, streams of literature examines quality and effectiveness in terms of the IT artifacts ‘fit’ with existing user practices, including its deep, mid, and surface level structures (Strong & Volkoff, 2010), or in terms of the degree to which it offers a basis for or ‘affords’ (Strong et al., 2014) *effective use* where users use the tool as intended by the designers (Burton-Jones & Grange, 2013).

The literature thus largely takes what could be described as a *representational* perspective of effectiveness of IT artifacts: It is concerned with what the IT artifact comprises, such as deep, mid, and surface level structures, and how these aspects “fit” with the user's practice of the environment of use it will become part.

From IT tools and products to organizational outcomes

The representational and related ‘tool’ notion of quality and effectiveness of IT works well if the ISD process's primary concern is to deliver a satisfactory product. However, as decades of IS implementation studies and research on benefits realization in ISD have shown, building a product that satisfies a set of requirements and needs far from guarantees any positive higher-level organizational outcomes following implementation in the organization (Baghizadeh et al., 2020; Berente et al., 2019).

Rather, the link between a given IT tool and the organizational effects they are intended to produce is uncertain and often remains unrealized (Li, 2024; Marnewick & Marnewick, 2022; Wiener et al., 2019). Well-documented in the rich IS implementation literature (e.g., Berente et al., 2019; Gasser, 1986; Hanseth et al., 2006), as IT enters the organization, it becomes part of a complex social system in which behavior is shaped by a range of dynamic aspects. In such systems, interventions are often absorbed, counteracted, or redirected in ways that are difficult to anticipate. As a result, even well-designed and well-accepted tools may have little or no effect on the organizational outcomes they were intended to produce.

In response to this issue, several outcome-oriented approaches to ISD have emerged in recent years. In being outcome-oriented, they seek to tie the process of procuring or constructing technical products to the outcomes they intend to help achieve (Barthel & Hess, 2020; Gillespie, 2023). While traditional ISD is primarily accountable for delivering a satisfactory product, outcome-oriented ISD efforts are explicitly accountable to defined organizational targets that go beyond delivering a specific artifact. The process, hence, moves its focus from “outputs” to “outcomes” (Gillespie, 2023).

This shift challenges the IT as “tool” view and the associated notion of effectiveness - it suggests the need for a move from a representational to a performative (Pickering, 2010) notion of IT - from a primary interest in what IT comprises and its “fit” with context, to what behavior it helps produce in the larger system it is to take part in and help improve. To reason about effective IT interventions *ex ante*, we must at least involve (a) understanding why the organizational system is not behaving in line with desired outcomes, and (b) formulating propositions about where and how IT may intervene to shape behavior in a desirable direction.

On these concerns, the ISD literature is largely silent. Also, if we turn to neighbouring fields of organizational and management science, we find surprisingly little support. For instance, the relatively rich change management literature (Kotter, 2012) is primarily concerned with understanding and offering advice on how a given change is to be strategically carried out. It emphasizes involvement, alignment, convincing, and preparing stakeholders, but offers limited guidance on how to reason about what change should be devised in the first place to achieve a given organizational outcome (Stouten et al., 2018). Thus, effectiveness is primarily judged in terms of whether a given change is possible, not in whether it is the right change to reach a given objective.

Beyond the canonical change management literature, there are a few notable examples: with roots in the cybernetic perspective we will present in the next section, certain concepts and perspectives from systems thinking have seen some attention in practice, particularly the “leverage points” of Donella Meadows (2008). The leverage points refer to “places to intervene in a system” with more or less leverage - wield of system behavior, ranging from low to high, and where high levels are related to affecting system goals and the paradigms out of which goals emerge. In Meadows’s context, systems are often ecological or societal, but the framework has been applied in the context of management and organizational change (Murphy & Jones, 2021). However, frameworks such as Meadows’s leverage points remain high-level and have been criticized for a lack of grounding in empirical research. More so, they do not make many explicit connections to the role of IT in change, and we find no examination of their use in the ISD and IS literature in relation to digitalization or ISD efforts.

Lens: The cybernetic organization

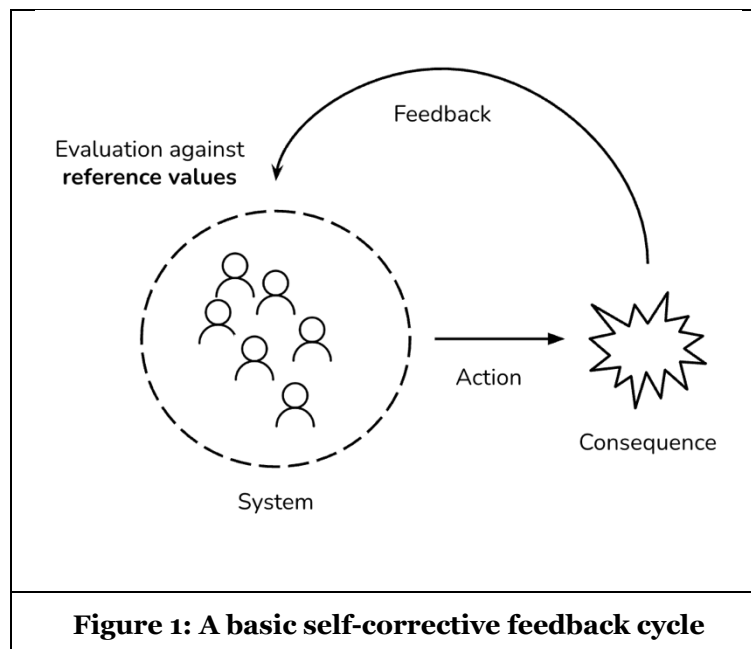
Cybernetics - from greek *kybernētēs* - meaning the art and science of *steering* and first defined by Wiener (1950) as “the scientific study of control and communication in the animal and the machine” jointly emerged from research on control and communication in mechanical systems and in brain science (Pickering, 2010), and quickly gained popularity for understanding basic dynamics of a broad range of systems, including cognitive, biological, ecological, and social (Wiener, 1950; Bateson, 1972/2000).

Cybernetics has a fascinating history and contains many relevant figures, ideas, and elaborate frameworks such as Stafford Beer’s viable systems model or Luhmann’s theory of social systems. We do not adopt any such full framework. Rather, we find it useful to draw up a basic understanding based on some of the core ideas, primarily based on our broader reading of Wiener (1950), Bateson (1972/2000), Beer (1972/1995), and Luhmann (1991/2012). By doing so, we avoid the costs of bringing in unnecessary heavy intellectual and conceptual baggage in formulating our perspective on ISD and the forms of interventions.

Self-correction through feedback

A cybernetic ontology invites us to see organizations as social systems comprising elements or subsystems and the relationships between them. Systems are both recursive and multiplex: both the system elements (departments, projects, individual humans, their brains), and the relationships between them (information - through e.g., language, signs, email, phone) may themselves be systems. Meanwhile, each system or subsystem can be part of many parent systems. E.g., an individual employee can be part of several projects, departments, family systems, professions, sports teams, and so on.

A key insight of cybernetics is that patterns in system behavior emerge through self-regulative feedback cycles relative to some system goal. As a system behaves or acts, it receives information as feedback on its performance from its environment. This feedback is assessed against one or a set of reference values of success, and behavior is adapted accordingly. The self-corrective cycle of action, feedback, and evaluation is illustrated in Figure 1.



A classic example is a heating system with a thermostat. As heat is produced, the thermostat measures the temperature, and when it reaches the defined reference value, say 23 degrees Celsius, it turns off the heater until it receives feedback that the temperature is too low compared to the reference value.

Likewise, drivers of cars, bikes, and employees in an organization alike, as they act, they receive visual, auditory, kinetic, haptic, and other forms of information on the consequences of their action, evaluate if they are satisfactory in terms of a set of reference values, and adjust their behavior accordingly.

While some feedback functions to guide immediate adaptation of behavior, like in the example of the thermostat or when a human is steering a car, social and cognitive systems are also adaptive in that they change their internal structure in response to consistent feedback - i.e., they learn. Here, in Wiener's (1950) words, feedback "is used not only to regulate specific movements, but also whole policies of behavior" (p. 28). Repeated feedback on whether and how an action brings the system closer or further away from the reference values will lead to adaptations in the system structure, e.g., in the brain of a human or the routines and structures of a department, which affects how the same action is carried out in the future.

Social systems are obviously infinitely more complex than mechanical systems or the maneuvering of a car or bicycle. Their behavior is shaped by a virtually infinite number of self-corrective cycles. These form feedback loops that pull or push behavior in different directions. It is thus the sum of a wide range of feedback loops that ultimately determine behavior. Within this collective, individual feedback loops can be

so-called *balancing* by limiting more of the previous action to keep the system stable around the reference value (e.g., turning off the heater as the temperature reach a certain point to keep temperature stable), or they can be *reinforcing* by accelerating more of the previous behavior (e.g., constantly expanding a business if the reference values of our societal system is defined as more and many is better).

Reference values and system pathology

While the reference values of mechanical and artificial human-made systems are typically explicitly defined by an engineer or designer, in social systems the reference values are themselves shaped by feedback (Luhmann, 1991/2012). A useful mental image is that within a given social system, be it a family, set of friends, department, grocery store, café, football team or professional union, through utterances and actions, there is a constant implicit negotiation around notions of high and low status, appropriate and meaningful conduct, what is right or wrong, good or bad, tasteful or tacky, which influence the reference values for self-regulation.

For example, numbers of publications and citations may act as strong reference values within an academic community. These drive behavior in a certain direction compatible with these reference values, while giving less priority to other activities, such as teaching and contributions to practice. These reference values are gradually defined and reproduced by the members of the social system. A new PhD candidate entering an academic community, initially motivated by teaching or to help create meaningful change in a community of practice, may gradually modify and replace these aspirations by being exposed to feedback that mainly attributes honor, admiration, and status to aspects related to quantities around publication and citations.

Thus, a strong driver of behavior in organizations is the reference values to which they, as social systems, self-regulate. The reference values, as defined and shaped through feedback, become the goals to which individuals, projects, departments, and organizations pursue. As social systems are multiplex and recursive, each sub-system is subject to influence from multiple, often divergent reference values. These could be at odds and adhering to them at the same time be impossible, creating what Bateson (1972/2000) calls “double binds” - paradoxical situations where no possible action can satisfy both. A failure of a department or individual to behave according to the desirable goals of a parent organization may arise as reference values tied to other systems or concerns become of higher priority. For instance, corruption may arise as an individual working in a government office prioritizes reference values tied to financial gains or family allegiance above those tied to integrity and public service.

Accordingly, a key insight from the cybernetic understanding of social systems is that undesirable behavior or *system pathologies* (Bateson, 1972/2000) in an organization are often not only tied to a lack of knowledge, tools, methods, or other capacities in how to carry out a desirable activity effectively. Often, they stem from misalignments or discrepancies between the reference values of a system or a set of subsystems and the behavior seen as desirable.

Outcome-oriented ISD as configuring feedback

The cybernetic perspective is useful and relevant to our interest in reasoning *ex ante* about the effect of IT on organizational behavior, as it places information and feedback- and hence, IT and information systems- as a defining factor and the very fundamental structure determining the behavior of social systems. From this perspective, organizations are all about information and communication - and what information is flowing where, how, in what form, and at what amount and frequency.

The perspective positions IT and ISD at the center of organizational design and development as it renders IT not only as tools or infrastructural components that are there to support human activity, but as interventions that can reconfigure both the efficiency, content, and direction of feedback. Doing so may shift aspects related to both the how, what, and why of the behavior of individuals and the organization as a whole. In this context, “effective” IT interventions are those that are able to reconfigure feedback in such a way that behavior changes towards what is desirable.

Likewise, it helps us shift the perspective of ISD from the design and development of tools to deliberate and conscious work to reconfigure the flow of information to shape organizational system behavior in desirable directions. In cybernetic terms, this means making reconfigurations to the feedback loops driving current behavior, aiming to shift which direction dominates. This involves identifying and reconfiguring the

feedback structures that sustain current undesirable organizational behavior - either by weakening pathological loops, reinforcing those that already drive behavior in the desired direction, or introducing new, countervailing feedback. Particularly, the nature of self-regulation and the malleability of reference values point to the importance of understanding the reference values that determine how the system self-regulates, and attempting to reconfigure the feedback determining these reference values in a desirable direction. With these insights, the basic cybernetic model and vocabulary of feedback and reference values hence point directly to some distinct ways IT may be more or less effective in helping “steer” or shape organizational behavior:

- (1) First, with no active consideration of what and how feedback is involved in driving the current undesirable behavior of a system in the ISD process, IT interventions may contribute to a sort of **blind reinforcement of behavior**. This includes unintentionally strengthening the feedback driving the current undesirable behavior and hence worsening the organizational problem aimed to be addressed. Using an example close to home, we could imagine introducing IT that helps make reviewing and editing research articles much faster, e.g., leveraging generative AI. However, speeding up the publication process could contribute to worsening the “publish or perish” or “infodemic” crisis in academia more broadly.
- (2) A second form of IT intervention is those that in various ways help **regulate or enable desirable behavior**. For instance, interventions may seek to constrain undesirable aspects of current behavior by inscribing desirable workflows, mandatory steps, or data points into a software solution. Likewise, interventions may introduce standards, operating procedures, methods, and training that seek to enable new and better forms of behavior. However, the cybernetic perspective suggests that interventions seeking to regulate or enable behavior will have limited effect if the reference values for self-regulation are not aligned with the intended desirable outcome one seeks to achieve. For example, seeking to enforce reporting of data by making a field mandatory in a user interface proves to have limited effect if reporting is perceived as irrelevant given the reference values of the system.
- (3) Therefore, a third form is IT interventions that **influence the reference values for self-regulation**. For instance, IT may help make previously neglected aspects of behavior visible and salient, thereby changing what attracts attention, recognition, and status. Consider, for example, a hospital setting: a digital intervention that makes patient outcomes visible alongside production metrics may gradually shift what is regarded as successful performance, from maximizing activity toward improving health outcomes.

Methods

We examine the forms of IT interventions drawing on empirical episodes from a long-term engaged research program called HISP that has been running for more than three decades and spans ISD efforts in more than 70 countries in Africa, Asia, and South America (Braa et al., 2004). The episodes are drawn from specific research projects organized as qualitative action research or collaborative qualitative case studies, involving close collaboration with local IT and health specialists, NGOs, and health ministries in the respective countries. The HISP began as a research collaboration in post-apartheid South Africa in 1994, with the aim of strengthening district-level health management in a highly fragmented health information system where most information flowed out of the district. Based on the approach and technology developed in South Africa, particularly a software tool for supporting the collection and analysis of health management information called DHIS, the program has since expanded into a global network of ISD experts and researchers. The DHIS software is currently implemented as part of the national infrastructure for health management in around 75 countries, supporting reporting, analysis, and presentation of health management information.

The first author has been part of the research program for about ten years, following and participating in ISD efforts aimed at strengthening health management in several countries in Africa and Asia. The second author has been central to the program since its inception and has participated in and studied a large number of ISD efforts across countries. Our empirical basis thus consists of long-term engagement with the program, including participation in design and implementation activities, project meetings, workshops, training sessions, evaluations, and ongoing discussions with health managers, implementers, and developers.

Data collection

The empirical material used in this paper draws on several sources. First, it draws on fieldnotes and reflections produced during participation in specific ISD projects, including observations from meetings, workshops, implementation activities, and follow-up work. Second, it draws on project documentation, reports, training materials, dashboards, and other artifacts produced as part of the ISD efforts. Third, it draws on informal and formal conversations with actors involved in the projects, including health managers, information officers, developers, implementers, and other members of the HISP network. Finally, it draws on the accumulated experience of the authors and the wider research program, including prior publications and internal reflections on successes, and experienced failures and recurring challenges across contexts.

The cases presented in the paper were selected because they are particularly illustrative of recurring patterns observed across the program. They are not intended as representative cases in a statistical sense, but as theoretically useful empirical episodes that help examine and elaborate the three forms of IT interventions. Some episodes illustrate common and persistent difficulties in turning better information tools into better health management, while others illustrate situations where ISD efforts appeared more successful in shifting how health management was understood and practiced.

Data analysis

Our analysis was abductive, moving back and forth between empirical material and the cybernetic concepts developed in the paper. The initial analytical interest emerged from our long-standing observation that many HISP efforts succeeded in improving the availability, quality, and integration of health information, while struggling to produce meaningful use of this information for local planning and management. Conversely, some efforts appeared to generate more substantial changes in behavior. Engaging with cybernetic literature helped make visible a possible explanation for this difference: that IT interventions vary in the way and degree to which they alter the flow of information. We saw the opportunity to develop a better understanding of these forms, and practical heuristics that could guide ISD efforts as both theoretically interesting and practically useful to our engagement in HISP and ISD more generally.

The idea led us to experiment with capturing conceptually the different ways in which feedback influences social system behavior based on the basic model emerging from our readings of the authors outlined in Section 3. We engaged with the cybernetic literature in tandem with revisiting and writing out empirical episodes from the program by asking what kinds of feedback loops the interventions entered into or helped reconfigure. As we approached the three forms presented in Section 3, we examined in greater detail if and how interventions in a range of cases primarily amplified existing flows of information, regulated or enabled specific ways of acting, or contributed to redefining the reference values through which actors assessed what counted as successful and appropriate behavior. Through this process, the three forms of interventions were gradually refined as analytical distinctions.

The analysis should be understood as theory elaboration rather than hypothesis testing. We use empirical material from HISP to examine whether the cybernetic lens helps make sense of variation in the effects of ISD interventions, and to illustrate how the proposed forms of intervention may be recognized in practice. The aim is not to provide a full causal account of each case, but to develop a conceptual vocabulary for reasoning about IT interventions in outcome-oriented ISD.

Case

We now turn to examine the different forms of interventions as suggested by our cybernetic understanding of IT and organizations. We do so by leaning on some common threads across several projects, while illustrating using specific examples. We begin with some general background on health management as an object of design and development in HISP, before we examine a few examples where interventions have yielded low to moderate effects on organizational behavior, and two that have been particularly successful.

Health management as an object of design and development

Health management is about overseeing and administering health systems, organizations, and programs to ensure the quality of health service delivery. Doing so relies on information regarding resources, performance, and targets. A canonical structure of health management systems in the countries where HISP operates is that data is reported at the level of care - for example, at hospital clinics and health centers - and sent “upwards” through a hierarchy of districts, regions, and the national level. The different levels use the data in planning and management of different aspects. The national level devises general policies, budgets, and plans for overall procurement and distribution of health commodities and so forth, while regions and districts manage more detailed aspects such as allocation of resources across facilities, staffing, service delivery planning, and the monitoring of performance against centrally defined targets. At the level of care, in health centres and in communities, data is used to support actual health services delivery, such as making sure all children are vaccinated and malaria cases diagnosed and treated. While data entry clerks and information officers are responsible for making the necessary data available, responsible staff and managers at district, regional, and national levels are the intended users of this data for decision-making.

The health systems are often organized into several vertical disease- and health services -specific programs, such as tuberculosis, HIV, malaria, and vaccination. Each program typically has its own reporting regime, and a recurrent challenge in many countries relates to the fragmentation of the information system, including duplicate reporting and difficulties in sharing data across programs. These challenges are particularly prevalent at the district level, where managers often are responsible for coordinating across multiple programs, rather than operating within a single program, as is often the case at the national level.

Strengthening health management thus entails improving the decisions being made, the plans devised, and how these are followed up across different levels of the system, as well as across multiple vertical programs.

In many cases, health management systems carry a legacy and role of control, and we will suggest that this is strongly embedded in the dominant reference values of the health management systems. In South Africa, the starting point was a system established during apartheid, in which information flowed out of the district and upwards in the hierarchy. Those who reported the data upwards in the hierarchy, from facilities to districts, and then to provinces, generally did not get feedback on their reporting, unless something was wrong. In many other African and Asian countries, health systems are also shaped by colonial administrative structures with similar control-oriented logics. At the same time, a significant share of funding for health programs comes from international donor agencies, which, for understandable reasons, have strong and legitimate interests in monitoring and controlling the use of the resources they provide. To this end, donors often also introduce parallel reporting systems due to limited trust in national standardized systems, making one clear purpose of the system one of monitoring and reporting of and on resource consumption and performance.

Reinforcing behavior

While the overarching organizational outcome objective is to strengthen health management and service delivery, the ISD projects in HISP typically begin with something far more specific and tangible. In health management systems that have primarily been based on paper, the existing infrastructure is to be digitized. Hence, the problem or need to be “solved” is to develop and configure digital tools to replace paper-based reporting, storage, distribution, analysis, and presentation of health management information.

To this end, the typical process is one of understanding the existing flow of information, the paper forms, and the data elements that are part of this flow. Then, the digital tools are designed to more or less replicate this structure, with the benefits of immediate availability of data, and with new and improved tools for data analysis and presentation. A major benefit and focus of this work is the integration of data and information between different vertical health programs. In many cases, the digitization allows for either integrating data between the different tools of different programs, or uniting several programs within the same tool.

Implicit in these ISD efforts lies the idea that with better tools for collection and analysis, and the improved integration and availability of information that follows, more data-based planning and hence better management decisions can follow. However, this has very often proved not to be the case, and the struggle for strengthening “data use” and health management by increasing the availability of data has proved to be a persistent one across many countries.

Many examples can help illustrate this. In a project in an East African country, a tool intended to help support nurses during consultations with pregnant women was implemented at the regional hospital level. The tool, which would replace a previous paper-based patient record, had a dual purpose - it aimed to offer immediate clinical support to the nurses (e.g., patient journal information) while also gathering aggregate information to be used for higher-level health planning. Hence, the tool would help improve clinical practice while reducing the work associated with reporting. As the tool was implemented for use, from the top, all looked well. Data was flowing in. However, upon examination, the quality and reliability of the data appeared to be poor. Closer inspection revealed that the hospitals had hired temporary staff to take some of the paper-based records each week and enter them into the digital tool, thus satisfying the reporting requirements while sustaining the existing paper-based records. The result was limited support of clinical decisions on the level of care, and low quality of data for health management higher up in the system.

Similar experiences have been observed in many countries. In a project in an Asian country, tools intended to support regional and district-level health management were implemented across hundreds of districts, and health managers were trained. Upon later examination, while reporting persisted, usage of the tool was low, and few of the regional managers had even logged into the tool. When asked why, they justified the lack of use of this tool, which was intended to be central to their work, with the lack of login credentials. In other cases, similar cases, limited use, and workarounds have often been attributed to a lack of training, a lack of necessary functionalities, and poor usability.

In many of these cases, follow-up interventions have been devised and introduced to address these issues. In the Asian country, a feature was developed that made it easier to request a username and password. In other countries, persistent updates to data analysis functionality, for instance, new types of graphs, and capacity building in the use of these capabilities. Other projects have invested significant effort in improving usability and user experience, and introducing ever more sophisticated tools for analysis and presentation of data. In one interesting case, a passionate designer in a project in an East African country resorted to sending graphs on a weekly basis to a regional health manager via email, hoping he would take the bait and find the data useful to their work. Also, projects have attempted to introduce new indicators which are included as part of regional or district-level evaluation of health facilities relating to reporting rate, data quality, and data completeness of reporting.

However, such efforts, despite significant outcome-oriented engagement and personal investment by the ISD teams involved in thinking beyond the mere provision of tools, have still, in many cases, resulted in little use of data and hence marginal improvement of health management.

Regulating for timely reporting and enabling data use

A natural response to the lack of intended effects on health management in many projects has been to try to design and introduce interventions that seek to regulate or enable desirable ways in which management is to be carried out. For instance, standard operating procedures (SOPs) are developed or redefined to emphasize the use of the newly implemented tools, rules are inscribed into the tools by design, and methods and procedures are promoted through capacity building and training. This does indeed affect behavior, but as an interesting example from a project in an East African country illustrates, not necessarily as intended.

In the East African country, following the canonical type of implementation outlined above, the national level grappled with persistent late reporting from the regional and district levels “below.” In turn, this late data hindered important planning activities. The ISD team devised a twofold intervention: first, they configured the tool to prohibit further reporting after the reporting deadline. Second, they introduced “timely reporting” as an indicator subject to presentation and discussion in an annual regional and district evaluation meeting. By doing so, the aim was to *regulate* reporting behavior towards timely reporting.

As a result, timely reporting increased, and for some time, the intervention appeared successful. However, over time, and to the surprise of the ISD team, data quality went down. Upon examination, the districts reacted to the attempt at regulation by completing reporting on time by entering arbitrary data. This fulfilled the reporting requirements as regulated through inscriptions in the software and by the evaluation meeting; yet, it made the data useless for planning purposes. Thus, well-meaning attempts at improving planning capabilities by regulating for timely reporting paradoxically rendered planning impossible.

Similarly, efforts seeking to enable desirable behavior can lead to unintended consequences. In an effort to reduce the reporting burden at the district level in South Africa, new and revised data forms were designed,

and simplified “tick sheets” were suggested to replace the previous forms, which were full of abbreviations and codes representing all activities carried out. While the old forms could not be digitally represented, the new tick sheets were constructed for that purpose and to enable calculation of key indicators. However, the new forms, which were thought of as an improvement in usability by the ISD team and hence intended to enable improved reporting and hence data quality, were not accepted by the health workers as they felt they did not represent the amount of work they carried out. While the old forms looked ‘busy’, the new forms looked ‘empty’, indicating ‘not much work’, as they expressed it. For them, the purpose of the reporting system was to document that they did their work and fulfilled their job contract. The labour union at the hospital agreed to this interpretation of the information system as primarily a control mechanism, and the revised tool was not implemented.

Influencing the reference values for self-regulation

From the examples we see above, despite attempts to improve planning through better tools and tighter regulation, or enablement through e.g., capacity building or improved usability and new features, behavior seems repeatedly to stabilize around fulfilling reporting and control requirements rather than using the tools for better health management. This may reflect that the dominant reference values of the system remain tied to upward accountability rather than local decision-making. Thus, regardless of the interventions' good intent and their quality and effectiveness as tools, and the satisfaction of client representatives, the changes they are intended to lead to on an organizational level are counterbalanced as the system finds ways of stabilizing behavior towards success in satisfying control requirements.

Thus, rather than a lack of capacity, usability, or the right features, the lack of results may be a symptom of a system whose reference values relate to satisfying reporting and work requirements rather than using the information for better management. Paradoxically, in many cases, these adaptations may also be what make the larger health system work, where the goal is and should not primarily be to report data or manage for the sake of management, but to offer clinical services. System participants may hence find themselves in a squeeze between reference values tied to clinical work and reporting. When data reporting and expectations of data-based planning and management conflict with other goals, the system self-regulates towards the reference value defined as most meaningful.

We now turn to two interesting examples that have been particularly successful in leading to improvements in health management, and which seem to relate to a shift in the reference values of the system.

South Africa

In our first example, we go back to the initial HISP project in South Africa in the 1990s. The ISD initiative was part of a broader project of decentralization following apartheid. This included a restructuring of the health system into new provinces and the establishment of health districts as a new unit for planning and service delivery. Here, HISP was established as a collaboration between Cape Town universities, health services, public health activists, and two Norwegian PhD students, as part of the ANC Reconstruction and Development Program, at the advent of democracy in South Africa, in 1994. The ANC Health Plan was to build a decentralized health district with integrated health services, whereas before, there were no locally governed districts and health services were fragmented between what were labelled racial groups and the type of health services. In HISP, this translated into working for local control and management of data in districts, and a focus on data use for decision-making at the district level, and improved health services at health program and facility levels.

The new provinces inherited a multitude of data standards and reporting structures from the previous system. Four provinces and ten homelands were consolidated into nine provinces, and fourteen separate health departments inherited from apartheid were restructured into one national and nine provincial departments. At the same time, 686 transitional local councils were created as interim districts. While a national minimum and essential data set was deemed necessary for measuring progress toward equity, provinces had developed different standards, reflecting the fragmentation of the previous system.

Developing a national minimum dataset, therefore, became a key ISD task. This was gradually achieved through a participatory process with district and province health managers and through the principle of a hierarchy of standards, which became a core feature of the DHIS design. This meant that each level was free to maintain its own data elements and indicators, as long as they adhered to those required by the level

above. At the same time, districts were given authority to manage their own data, define new data elements, indicators, and reports, and access and analyze their own data for the first time.

In parallel, emphasis was placed on reducing reporting load and increasing the local usefulness of data. Data elements, indicators, and information outputs were defined collaboratively, and data were made available for local analysis through tools such as pivot tables and predefined indicators. In doing so, data that had primarily flowed upwards for reporting increasingly became available for local use, beginning to shape the reference values from control toward district-level planning and decision-making. For many district-level actors, this represented a fundamentally new situation, captured in the reaction of one data manager: “We are empowered!”

In this way, the intervention not only introduced new tools but reconfigured how information flowed and how feedback was generated and used in the system. Rather than primarily flowing upwards for control and reporting, data increasingly circulated within districts and was used to inform local planning and coordination. This made locally relevant performance visible and actionable, and, combined with an emphasis on the relevance of locally defined indicators, it began to shift what constituted the ‘purpose’ or meaningful and successful behavior in the system from control to local planning and decision-making.

As a result, data that had previously been collected primarily to demonstrate compliance increasingly became used in district-level planning and coordination across programs - for instance, in decisions about how to allocate staff and prioritize services across facilities. The initial HISP initiative in South Africa was thus embedded in a broader political shift toward decentralization and district-based health systems, and the ISD effort worked together with and contributed to these changes in reference values.

COVID-19 Response in Rwanda

Our second example comes from the COVID-19 response in Rwanda, nearly three decades after the South African case. While the South African episode shows how IT interventions may help shape the reference values of a social system, the following episode illustrates how the effectiveness of IT interventions depends on their compatibility with the reference values of the social system they are intended to shape.

As in many countries, despite several years of persistent ISD efforts to better support health management with digital tools, poor and limited use of data remained a general problem across different levels of the health management system. During COVID-19, however, this changed dramatically. The demand for data on, for example, numbers of positive cases and vaccinated individuals increased rapidly, and decisions regarding lockdowns and public health measures were made directly based on such data.

The local HISP ISD team worked closely with the Ministry of Health in what became a very fruitful and effective outcome-oriented collaboration. In the early phases of the pandemic, before vaccines were available, a range of digital interventions were introduced, including screening systems at airports, mobile-based self-registration tools, integration of laboratory testing data, and real-time dashboards for tracking cases and contacts. Systems for payment for these services were developed simultaneously. Existing DHIS2 infrastructure was adapted to support these efforts, allowing data to move quickly across levels of the system, and many apps were developed to support different aspects of the response.

As the response unfolded, integration challenges that had long proven difficult to address under normal circumstances became possible to resolve under the momentum created by the pandemic. One key example was the laboratory system. Turnaround times of up to one week made real-time surveillance impossible, creating a mismatch between the urgent need for timely data and the system’s ability to provide it. In response, the Ministry of Health and HISP initiated a redesign of the lab system, simplifying workflows, introducing Android tablets for end users, installing workstations in the labs, and establishing a public portal for booking tests, payment, and feedback of results - all based on DHIS2.

Building on this infrastructure, when vaccines became available in March 2021, a vaccination register was developed using the same platform. After initial experimentation with a competing system, the Ministry of Health consolidated COVID-19 systems on the DHIS2 platform, citing the need for local control, responsiveness, and integration. A broader ecosystem of applications was then developed, including for contact tracing, travel registration, and test payments.

Vaccination and testing were subsequently organized as high-priority national efforts and were fully digitized. Data on testing and vaccination were made available through public portals with daily updates, and certificates were required for access to travel and public spaces. These public and real-time feedback mechanisms made performance visible and actionable at multiple levels, reinforcing direct accountability for health outcomes. In this context, what counted as success was defined in terms of managing the pandemic - reducing infections, increasing vaccination coverage, and enabling effective response - rather than in terms of reporting completeness, timeliness, or other administrative concerns. The scale and pace of the vaccination campaign - targeting approximately 7.5 million adults and reaching 7 million doses by mid-November 2021, with one million doses administered in the final week alone - illustrate how success was defined in terms of rapid and widespread coverage.

Seen against the earlier examples, it is notable that many of the same kinds of interventions seeking to enable and regulate behavior worked very effectively in reaching the desired outcomes in this context. Here, the shift in reference values that followed the COVID-19 crisis rendered these interventions relevant and meaningful, as they were aligned with what the system was oriented toward achieving. Thus, the pandemic brought about a shift in reference values that made efforts to enable management through information and digital tools effective. Unlike the South African case, where the ISD effort contributed to shifting reference values by reconfiguring feedback, the effectiveness of the interventions here appears to stem from a broader shift in reference values in the context.

Discussion

We set out to examine how ISD efforts might reason about the effects of IT interventions on organizational behavior. In short, our paper addresses this by suggesting that the effectiveness of IT as organizational interventions can be judged performatively by reasoning about how they reconfigure information and feedback, and, in turn, how this feedback influences organizational behavior. Further, we suggest that the different roles feedback plays in shaping system behavior - from blindly reinforcing to regulating and enabling, to influencing the reference values for self-regulation - can act as a heuristic for ex ante reasoning about the relative merit of potential IT interventions. Table 1 summarizes the three forms and examples of each from our empirical episodes.

We now turn to discuss the implications of our analysis for research on and practice of outcome-oriented ISD.

Form	Case example
Blind reinforcement of existing behavior – possibly strengthening current undesirable system behavior	Making more efficient and extensive digital reporting and ranking health facilities on fulfilment of reporting duties possibly reinforcing the perception of a control system.
Regulating or enabling for desirable behavior to emerge	Making reporting of certain data elements mandatory, improving usability of data entry and analysis tools, or providing training in these tools for health workers.
Influencing the reference values for self-regulation	Changing the flow and access of information to the lower levels of the health system alongside local involvement in defining relevant indicators and data sets.
Table 1: Three ways in which IT interventions may shape organizational behavior	

Contributions to ISD research

Albeit increasingly subject to attention in ISD practice (Gillespie, 2023), outcome-oriented ISD has seen relatively little attention in the ISD research literature, particularly compared to other developments in ISD practice, such as those surrounding intra-IT alignment, including DevOps, SecOps, and continuous delivery (Gall & Pigni, 2021; Wiedemann et al., 2020). The extended commitment to organizational outcomes seen in outcome-oriented ISD is highly interesting as it challenges many of the basic assumptions and introduces new concerns into the ISD process. It represents a change in kind, not in degree, as it necessitates a complementary perspective on IT - not just as tools to support human practices and needs, but as something

that helps us understand IT as organizational interventions. This, in turn, necessitates theories, conceptual frameworks, and heuristics that help us make sense of organizational physiology and pathology.

Our paper contributes to our understanding of outcome-oriented ISD by pointing out this necessary distinction and the important consequences it has for our notion of quality and effectiveness of IT artifacts, while suggesting a basic cybernetic ontology as a fruitful candidate for such a performative perspective on IT and the physiology of organizational systems. Importantly, we do not argue for an either-or: in outcome-oriented ISD, IT must be understood as tool and intervention at the same time. The tool perspective, concerned with the anatomy of the software, is necessary for organizing activities relating to the nature of the tool itself and its immediate use. However, when moving to decisions regarding how to use IT to reach a given organizational target, an understanding of the physiology of organizational systems and the role of IT within them is needed.

We have presented a very basic cybernetic notion as a starting point. The cybernetic universe is full of interesting concepts and models that are relevant for taking the idea further. For instance, Luhmann offers an elaborate theory of social systems, including concepts that may be useful to further understand change and design. Also, later works in systems thinking, such as system dynamics - including Donella Meadows and her leverage points - offer interesting further directions. Furthermore, while we suggest cybernetics, there may be other and better candidates. For instance, theories such as affordance theory or institutional theory may also be good candidates for developing useful heuristics. Our paper can be read more broadly as an open invitation for further inquiry into an intriguing but difficult question: how do we best understand the physiology of organizational systems to intervene most intelligibly with IT?

However, to us, cybernetics and possibly also further or adjacent developments in systems theory and thinking seem particularly promising in that they offer well-developed “grand” theories of system behavior, including theories around control and steering, placing ‘information’ at their core. Accordingly, it naturally lends itself to reasoning explicitly on how information and hence also information technology can shape and possibly contribute to steering organizational behavior.

A cybernetic understanding of IT and Organization

By seeking to theorize aspects of outcome-oriented ISD in particular, our paper also makes a contribution to our understanding of IT and organizations more broadly. The tool perspective of IT is one that seems to underlie much of ISD research literature and practice. Our language and intuitions surrounding IT are colored by it: users, use, deployment, product teams, product owners, product backlogs are all part of the typical ISD vocabulary. Tied to this is a notion of quality and effectiveness relating to supportive capacity - i.e., how well IT supports human activity - the “users” - and whether it leads to effective use (Burton-Jones & Grange, 2013). With our cybernetic ontology, we present an alternative perspective that offers a different starting point: a move from whether IT supports human activity to whether it helps influence organizational behavior. This perspective is made possible through a conceptual lens that places information and feedback, rather than human actors, as the main holder of agency. Instead of user needs, preferences, and the nature of “use,” information and feedback becomes the core unit of analysis and object of design and intervention, and ISD becomes a process of inquiring not into user needs and requirements, but into information flows and feedback.

Our paper thus presents a cybernetic perspective as a viable alternative to the tool view, alongside other seminal perspectives in the IS literature, such as infrastructure and sociotechnical systems. While the sociotechnical systems perspective has been seminal and is highly useful in emphasizing and widely establishing the understanding of technology and the social as working in tandem, the notion has a weakness in that it can be interpreted in many ways and possibly give rise to a somewhat dualistic view of the world being made up of clearly distinguishable ‘social’ and ‘technical’ elements or subsystems. Consequently, in ISD, sociotechnical design and development can, for instance, mean that one develops technology with the “socio” in mind, which is quite different from the kind of technology-based socio-development seen in outcome-oriented ISD where technology is not a tool made to fit the social, but treated as interventions intended to influence it. Here, a cybernetic ontology presents a perspective on IT in organizations and social systems where the distinction between technical and social becomes analytically secondary to feedback and information. Rather than the interaction of the social and the technical, it hence places information and feedback as the core unit of analysis - whether social or technical matters less. What matters is the performativity (Pickering, 2010) - i.e., how feedback influences behavior, and from an IS

perspective, how IT influences feedback. Our paper thus contributes with a perspective that moves away from dualist notions of IT, including sociotechnical ones, toward one where all is “social” and the only relevant concern is the nature of the feedback shaping behavior. This perspective can be relevant far beyond ISD, contributing to broader understandings of IT’s influence in organizations and society at large.

Implications for outcome-oriented ISD

Our analysis has several interesting implications for ISD practice. First, our analysis suggests that engaging in outcome-oriented ISD without a performative understanding of IT, and, from our cybernetic lens, the feedback loops at play in the organization can be a game of chance. In the HISP cases, when ISD efforts treat IT as tools to support existing practice, they remain blind to how the information introduced or amplified shapes behavior, only for issues to emerge *ex post*. By chance, an intervention may reinforce desirable patterns, but just as likely, it may amplify undesirable ones by reinforcing pathological feedback. This suggests that outcome-oriented ISD must be explicitly concerned with performativity and, from a cybernetic perspective, feedback and self-regulation. Hence, diagnosis in outcome-oriented ISD must move beyond specifying what to build, toward inquiring into the feedback structures and reference values that currently shape behavior. In this work, important questions include which loops dominate current behavior, which loops regulate and enable it, and, importantly, which loops are involved in defining the reference values for self-regulation. Addressing questions around reference values suggests that it is particularly relevant to inquire into how notions of status, success, and admiration are attributed and signaled within the system. For example, one may approach this by examining the stories being told, the myths, the legends, what is applauded, and what is ridiculed - and reason on whether this aligns with the intended outcome target, and, if not, how IT may contribute to reconfiguring feedback to influence them.

Second, our case illustrates the useful distinction between interventions that regulate or enable behavior and those that target the reference values for self-regulation. Attempts at regulating or enabling behavior toward a desirable direction are, as seen in HISP, perhaps the most common and default way of using IT. “Digital nudging,” inscribing procedures and workflows, and (online) capacity building are all standard tools in the toolkit. Our theory and empirical findings suggest that these have a limited effect as long as reference values drive behavior in a different direction, as the system finds ways of self-regulating “around” the interventions. In contrast, interventions that target feedback involved in defining reference values can help shift the direction of self-regulation such that regulation or enablement becomes unnecessary - or at least more relevant.

Third, interventions do not fall neatly into one form. In practice, they often involve elements of reinforcing, regulating, and shaping reference values at the same time. This makes intervention design less a matter of choosing a type and more a matter of reasoning about degree and likelihood - how different elements interact, and which effects are most likely to dominate. It also suggests that interventions must often target both: improving capacity and methods, while at the same time shifting the reference values that make their use meaningful.

Fourth, as organizational systems are multiplex, it is important to consider what function a given undesirable behavior currently plays in a given situation, and what changing this behavior would imply for that role. As we reflected in the case of health management, the primary objective of the system is to support effective clinical work. The fact that data-based health management is down-prioritized can also be a healthy sign that the system is prioritizing reference values tied to clinical work. Attempts to shift these reference values toward a greater emphasis on health management may, if done poorly, lead to less focus on what most would consider the most important aspect of the system.

Finally, our two transformative examples from South Africa and Rwanda appear in situations where broader shifts were already underway - a heightened focus on outcomes, and perhaps a more general shift in what counts as success and appropriate behavior. The ISD efforts aligned with these emerging reference values. This raises the question of what triggers such shifts, and whether they can be reproduced without the same “wind” of change surrounding the effort. Change management literature often speaks of creating a “sense of urgency” (Kotter, 2012). In line with this, but more specifically, our findings suggest the importance of mobilizing shared reference values around outcomes, making them the criteria by which success is evaluated within the ISD effort itself.

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