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Viability of the Sustainable Development Ecosystem

Jay Hays
Independent Researcher, Brisbane, Australia

Hayo Reinders
King Mongkut's University of Technology Thonburi, Thailand

1. INTRODUCTION

Sustainable Development (SD) concerns bearable and sufficient economic and social progress and growth—initiatives and strategies designed to enhance the quality of life of a community's citizens or, at the minimum, stabilizing or securing the current state whilst not overtaxing the environment. SD is founded on key principles of sustainability as well as assumptions about society, economics, and the environment—basically about our nature, existence, and "how things work". As commonly understood, Sustainable Development is development that meets today's demands without compromising the survival of tomorrow (Kates et al., 2016). Thus, Sustainable Development should also be concerned about environmental protection and regeneration, reducing degradation and depletion, finding sustainable alternatives, and restoring what has been spoilt or overexploited. As lofty and "macro" as all this may sound, SD may also be applied at the "micro" level, at the organisational, departmental, or even team level.

At a global level, SD may attempt to address issues of equality, fair distribution, and access, such as championed by the United Nations Global Compact and its 17 sustainable development goals. A prime example is education: a community whose citizens have little chance of becoming educated has slight chance of long-term viability[1] beyond bare subsistence. Individuals lacking skills and knowledge cannot, generally, better their personal circumstances nor can they contribute productively to community welfare.[2] But whilst the ideals and aspirations of SD are laudable, if not presumed necessary, are they really possible?

This article pursues the question: *how viable is Sustainable Development?* The question might be framed alternatively as, "Is Sustainable Development sustainable?" To interrogate and explicate this question, the authors present an ecosystem model of Sustainable Development, with "ecosystem" defined for this purpose as the complex of interdependent animate and inanimate constituents of a given, or "bounded" community and their interaction, which, over time, reveals established patterns (Hays, 2010a; Hays, 2010b). By interdependence we mean continuing relationships of influence amongst elements that might be understood as cycles of cause and effect (or stimulus and response). This applies to the elements within the system (the bounded part) as well as with its external environment.

Organisations and institutions may be thought of as ecosystems as well, bounded entities inextricably tied to various stakeholders, vying for resources, and in malleable and evolving relationships with their environment.[3] To understand an organization as ecosystem is to fathom its richness, complexity, and dynamism—the see it and its relationships as a complete and functioning system. Conceived thusly, an organization is both separate from its environment (bounded), yet inseparable from its larger system and web of relationships (interconnected).

DOI: 10.4018/978-1-7998-3473-1.ch058

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An ecosystem is inextricably tied to its environment, implying a dependency and continuous exchange. Under normal circumstances, all of these mutual influences promote a dynamic balance in the ecosystem. Things stay pretty much as they are unless disrupted by some unexpected, uncommon, or extreme event (Hays, 2013). In fact, and as we will show in portrayal of the SD ecosystem, knowing the elements in the system and the character of their relationships helps us make sense of the system's dynamic behaviour, and is what allows us to predict the system's behaviour under various circumstances. Such is the power of the map: an intervention at a particular point is going to have reasonably predictable outcomes.

We usually think of ecosystems as being impacted by external events, such as a community might be affected by a devastating forest fire. It is also the case, however, that ecosystems may have within them—perhaps unwitting or undetected—the seed, or *potential,* for spontaneous transformation triggered by some random stimulus. This emergent property might be destructive or may confer some attribute that will ensure the system's survival, an adaptive quality or resilience suited to shifts in the environment, for example, a threat or opportunity it presents (Walker et al., 2004).

Building on these ideas of Complex Adaptive Systems and the authors' respective and ongoing collaborative research spanning several years into various aspects of sustainability[4], the authors have developed and present here for the first time a dynamic model of SD as an ecosystem, identifying the key features or variables in the system and their interrelationships. Whilst the approach is novel so far as we know with respect to SD, it is defensible in this case for at least two reasons: such models have been proven to be very instructive in other complex domains[5], and SD generally focuses its attention at the community or regional level—ecosystems[6]. Positive results may be predicted from systemic interventions because understanding of the features and relationships within the ecosystem allows efforts to be applied to the points of greatest leverage, as has been pointed out in numerous studies[7].

One hypothesis arising from this fact is that SD initiatives that address their interventions on the target community or region *as a complex adaptive ecosystem*[8] will be more successful in the long run than initiatives that focus on a particular problem or issue, such as water security or vaccination programs. The same holds true for organisations and institutions, as has been researched with respect to organizational change and development.[9] This is due, in part, to leverage and synergy amongst efforts made possible through *true-to-life* system mapping and deep understanding of behaviour causality, complemented by deliberately disregarding interventions, that well-intentioned providers might be misled to, based on a more superficial and reactive understanding of symptoms and assumed problem causes (Hays, under review).

The case of a sustainable communities project underway in rural Kenya is briefly described in the article as an example of an ecosystems approach to SD. The case qualifies as an ecosystems approach as it involves a multipronged set of interrelated sustainable initiatives addressing a given community as a Complex Adaptive System. Initiative streams cover: power (particularly directed toward lighting and refrigeration); water security; sanitation, hygiene, and medical care; education and skills-building; agriculture and livestock; industry and commerce; and includes a *train-the-trainer* concept that will enable the progress made and lessons learned from the program to extend to neighbouring communities.

The sustainable communities project is also an example of circular economy (Geissdoerfer et al., 2017; Sauvè, 2016) as resource acquisition, production, use, and reuse are contained and exploited, and profit reinvested into and benefitting the sustainable system and its citizens rather than being funneled into the amassing hands of a few or siphoned off to elements outside of the bounded system. Whilst it is too early to claim success, sustainable communities has the hallmarks of a SD program that might succeed—genuinely make a difference at the local and, quite possibly, regional level.

An important feature of the sustainable communities program is its conscious adoption of and adherence to proven principles of sustainability[10] that can be designed into systemic SD solutions. These

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principles and how they apply in the SD ecosystem model are outlined further on in this chapter. As just one example, albeit a prime one, the principle:

Strive to become self-sustaining and self-sufficient (lessen dependence on external support and funding). Build internal capacity through learning.

serves as a reminder that external funding in terms of "charity" (giving a man a fish) is both reinforcing and self-defeating (and the dynamics can be mapped showing the predictable consequences). On the other hand, if the man can become productively educated and acquire useful skills, then he needs no charity and becomes self-sufficient (teaching a man to fish). Of course, it may be the case that an individual (or community) is not immediately or easily converted from a passive, dependent existence to a more proactive, independent, and self-reliant one, a complex phenomenon whose persistent behaviour can also be mapped. Comprising a blend of experience, confidence, knowledge, skill, opportunity, values, expectations, and motives, it is easy to see the scale of impediments to becoming self-sufficient. At the same time, these attributes all need to be addressed in order to achieve sustainable change, and this is an objective of the project in Kenya.

This kind of thinking—attempting to understand dynamic causality in complex behaviour—underpins Causal Loop Diagrams and, indeed, the authors submit, is essential to understanding why some Sustainable Development initiatives succeed and others fail. Our objectives are to increase the success rate.

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2. PRINCIPLES OF AND CRITICAL SUCCESS FACTORS FOR SUSTAINABILITY

In this section we identify five Critical Success Factors (CSFs) over which we have some measure of control and 13 related operating principles (OPs). These CSFs and OPs derive from experience with attempts to implement sustainability programs,[11] and reference to extant literature, including published research on the closely-related phenomenon of organisational transformation.

Critical Success Factors[12]

Leadership

It is practically a given that leadership be included as a CSF for sustainability programs, as it is widely assumed that change cannot happen without strong leadership.[13] But, here, we refer not merely to guidance, support, direction, and inspiration provided by traditional authority figures. We emphasise the leadership inherent or potential in the ecosystem that emerges and is developed through activity, experience, and opportunity. This is not positional leadership, but a distributed, shared, and shifting leadership (Sweeney et al., 2019) that steps up when, where, and how needed. If the system does not have its own inherent or developing leadership, it will fail to thrive.[14] Thus, leadership succession and development are essential for sustainable operations.

Emergence

Emergence is a quality of Complex Adaptive Systems whereby a new feature of the system comes about as a result of interactions amongst the system's elements (Jagustović et al., 2019).[15] There would be

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many interactions in the sustainability ecosystem, with various balancing, propelling, moderating, and reducing influences between and amongst elements. Emergence can be a good thing, and may even be essential to long-term survival. In a human social system, emergence can include most anything, from leadership, through ideas and methods, to relationships—all of which may lead to opportunities. Rules, rigid expectations, or restriction may stifle or repress emergence such as one might see in a resolute bureaucracy. On the other hand, flexibility allows emergence to happen and preparedness enables capitalising upon opportunities (Dahlberg, 2015).

Framework

Despite need for flexibility, a framework within which individuals can work and learn is important. For example, what is important to achieve should be clear, consistent, and consensual. How goals are to be pursued should also be understood and complementary strategies followed. While individuals and groups in an ecosystem may have different goals, approaches, and perspectives allowing for emergence, (if complementary) their unified efforts should be related to sustainability—both achieving and embodying sustainability. This is why we propose operating principles and guidelines rather than stipulations, aiming to instill a set of values and aspirations that provide unifying and beneficent purpose, direction, and ways of being and working.

Culture

By culture, we mean shared values, common interests, and complementary behaviours amongst the group.[16] Common behaviours are the result of and further instill ways of doing, being, and working that come to be expected from members of the group and, presumably, productively serve the group.[17] Here, rules, norms, customs, traditions, language, symbols, and communication patterns all apply (Chen, 2016). To achieve long-term sustainability, a culture of continuous learning and development must be cultivated (Beyerlein et al., 2017). As Hays et al. (revise and resubmit) have stated,

An organisational culture of sustainability engages most members continually and is rewarding to do so. It orients new members and embraces them into the doing and being of sustainability. Obvious facets of such culture-building include the codified vision, values, and priorities for sustainability and Corporate Social Responsibility, with every member … having relevant and respective accountabilities (np).

Relationships

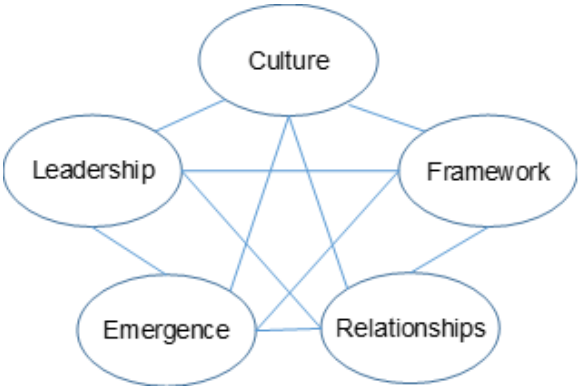
An operational ecological-ecosystem view of the world adheres (and is subject to) the interconnected "web of life" notion (Capra, 1996; Capra, 2007). It is probably the case that little that is complex, enduring, and important can be achieved alone (Solon et al., 2018). There are too many factors impeding progress to get much traction independently. But there is strength in numbers and diversity (Ingegnoli, 2013). Interaction and collaboration with different people and organizations may pose challenges, but confer capabilities and capacities that single-mindedness simply cannot (Hays, under review).

This section presented five Critical Success Factors for viable SD. These are shown in Figure 1 as an interlinked set. The five are not the entire ecosystem, but do collectively comprise a major part, as discussed below. Whilst each factor has its own distinct attributes, they all overlap and interact; they work together to "power" the SD ecosystem. This is the idea of synergy—interaction amongst elements

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Figure 1. Five Critical Success Factors for viable Sustainable Development



in a system produces attributes and outcomes unaccounted by the simple sum of the individual parts (Lee and Green, 2015). Without all of these factors, we suggest, SD will fail in the long run. With them, a robust ecosystem may be possible.

The next section enumerates Operating Principles for viable SD. As space precludes elaboration, we do not explain each principle here; but will incorporate them into the discussion of the viable ecosystem model (Causal Loop Diagram) that follows.

Operating Principles

In addition to the Critical Success Factors identified above, the following operating principles added value in the sustainability projects in which we've been involved or needed in the ongoing work.

Table 1. List of operating principles

■ Find and build champions.	■ Plan for succession and evolution.
■ Find a meaningful job for everyone.	■ Plan and host multiple events and activities.
■ Have and keep to a learning and research agenda.	■ Empower, decentralise, encourage initiative.
■ Permit energies and resources to flow towards and with good ideas.	■ Interact, collaborate, and build partnerships. Promote diversity.
■ Envisage sustainability as a daily discipline and set of practices—develop mastery.	■ Befriend nature and the environment. Act as concerned citizens within the "web of life".
■ Build sustainability into the system: codify, educate, embed, and reward sustainability measures (such as durability, adaptability, sufficiency, efficiency).	■ Operate with integrity and ethics. ■ Always think of the bigger picture and the part that each element plays in it. Act in accord with long-term benefit, rather than short-term ease or gain.

3. CAUSAL LOOP DIAGRAM

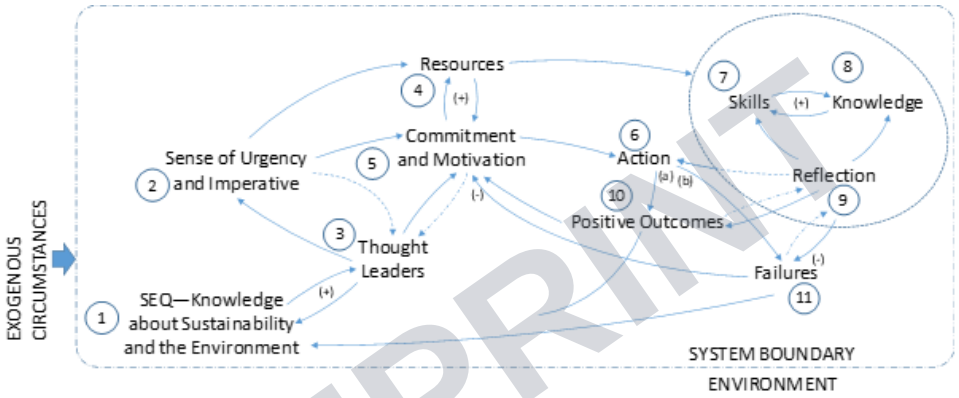
This section presents a basic Causal Loop Diagram (otherwise known as a relationship or influence diagram) of the Viable Sustainable Development Ecosystem. Belying its complexity, the diagram is portrayed to comprise 11 elements, or concepts, each of which is explained in the sequentially-numbered paragraphs below. Relationship diagrams add value to understanding complex system phenomena in

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at least two ways. First is identification and explication of key variables or factors, here referred to as concepts. Second, and more importantly, relationship diagrams trace the direction (if not power) of influence between and amongst system variables.[18] For example, in Figure 2, Commitment and Motivation, Item 5, is shown to be influenced by both Positive Outcomes, Item 10, and Failures, Item 11, albeit in diverging directions. In this case (and as explained below), these affects make sense to the reasoning mind and are clearly established in reinforcement theory.[19] How and why they apply in our model of the viable sustainable development ecosystem is explained below. Beginning to reveal the true complexity of the ecosystem, each concept (items 1-11) is described with respect to the Critical Success Factors and Operating Principles discussed in the previous section.

Figure 2. Basic Causal Loop Diagram of the Viable Sustainable Development Ecosystem



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In general, it does not matter where you start in a Causal Loop Diagram as the elements are all connected in some way, sometimes intricately or subtly, the "web of life" idea. But for practical purposes, you have to begin somewhere. In this case, we have labelled SEQ, Knowledge about Sustainability and the Environment, located in the lower left-hand of the diagram, item 1.

Finally, before beginning our "walk around the map", please remember that this relationship diagram attempts to depict the *viability* of SD. Viability will depend on the virtuous dynamics displayed by the ecosystem, and will be undermined by vicious cycles allowed to enter or permitted to continue operating in it.

1. SEQ—Knowledge about Sustainability and the Environment

To read the relationship diagram, trace the lines of influence connecting elements. Here, you will note that SEQ is connected to Items 2, 3, 4, 10, and 11. The number of connections an element has to other elements indicates its relative importance or prominence in the system. Thus, SEQ is one of the moderately significant elements in our ecosystem, surpassed only by Commitment and Motivation (Item 5), to which we turn shortly.

Implied by SEQ is the collective volume of knowledge, awareness, and appreciation of the members of the ecosystem (community or organization in question) concerning sustainability and the environment—current conditions, understanding of causality, implications for the future, and knowledge with respect to effective strategies and initiatives. This capacity may be developed in a community or orga-

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nization in a variety of ways, including committing to a learning and research agenda, allowing energy and resources to flow where they will have likely constructive impact, sponsoring multiple events and activities, and fostering collaborations, partnerships, and diversity. The main Critical Success Factor, here, is building a culture of sustainability.

For now, we see that the sense of urgency and imperative (to act) (Item 2) is fed by SEQ. As SEQ rises (or diminishes) urgency and imperative will rise or fall correspondingly. This is important as urgency and imperative bear on both Resources (Item 4) and Commitment and Motivation (Item 5), and, possibly, to Thought Leaders (Item 3), as well (suggested by the dotted line-arrow. The model would suggest, as is consistent with experience, that initiatives will not initiate or sustain without Resources and Commitment and Motivation.

Also shown as part of SEQ dynamics is that Thought Leaders (Item 3) positively affect Knowledge about Sustainability (Item 1) and vice versa. As one goes up, so does the other. This is a positively reinforcing loop, presumably a virtuous cycle, if we are interested in the viability of sustainable development. Of course, the opposite is also true, if one goes down, the other will reduce as well. Thought leaders include any individual or organisations that fill positions of influence. They could be scientists, business and government leaders, or influential members of society and media personalities. Obviously, the less ambiguous, debatable, or conflicting their messages, the greater the impact of Thought Leaders.

Continuing, we see that Resources (availability) (Item 4) impacts SEQ. Greater Resources would build increasing SEQ through education, training, and public service communications and information campaigns. Resources include funding, time, and people devoted to sustainability and the environment, including those directed toward Corporate Social Responsibility initiatives.

Finally, we see that Positive Outcomes (Item 10), that is "success stories" from sustainability and environmental initiatives, and "bad news", Failures (Item 11) from efforts both affect SEQ by providing more information about what works and what doesn't, as well as if effort is even worth the investment. This is reinforcement theory at its best. It would be reasonable to assume that the greater the number and kind of Positive Outcomes and the awareness about them would "fuel" the viable sustainable development ecosystem.

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Sense of Urgency and Imperative

Sense of Urgency and Imperative has already been partly discussed in Item 1. Key points are that it is influenced mostly by SEQ (Item 1) and Thought Leaders (Item 3). A building Sense of Urgency and Imperative is driven by threat or fear—dire reports on current conditions or predictions about impending consequence of previous misuse or neglect. Whether or not founded on fact or grounded in reality, perceived threat can drive attention resulting in greater resource allocation (Item 4) and Commitment and Motivation (Item 5) to act, key drivers of mobilisation. Either or both of these effects can lead back to SEQ (Item 1), directly and indirectly, with Thought Leadership (Item 3) also being affected.

Referring to our Operating Principles, those most applicable here are having and keeping to a learning and research agenda, conducting diverse events and activities with a range of stakeholders, encouraging collaborations, partnerships, and diversity, and connecting individuals and units to relevant Thought Leaders. Whilst leadership is key, here, in stimulating a sense of urgency and imperative, a framework for channeling that energy is essential. Also critical is a uniting culture in which members feel shared purpose, commitment, and belief that together they may succeed.

It is important to note that Sense of Urgency and Imperative can diminish in either of two cases, which may or may not be desirable, depending on actual circumstances. In the first case, SEQ is weak, thus

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there will be no sense of urgency and imperative. In the second case, SEQ is strong, but the state of the environment is presumed to be healthy or improving. Thus, there is no need for urgency and imperative. Practitioners should remain aware of the differential effects of SEQ.

Thought Leaders

As discussed above, Thought Leaders (in this instance) are individuals or organisations known as authorities regarding sustainability and the environment whose opinions are sought and influential. Since they can influence and, possibly, inspire others through word and deed, they impact Knowledge about Sustainability and the Environment (Item 1), Sense of Urgency and Imperative (Item 2), and Commitment and Motivation (Item 5). Thought Leaders emerge through the accumulation of relevant knowledge (SEQ (Item 1)) and, though not shown, becoming recognised or being promoted up the ranks in academic, business, and government organizations as with other specialists and experts. Given this, the most applicable Operating Principles include providing meaningful jobs, finding and building champions, instilling succession planning, and developing mastery. Allowing and encouraging relationships is a Critical Success Factor.

Thought Leaders may emerge or be urged into influential platforms given the sway of Urgency and Imperative (Item 2) and / or the stimulus of Commitment and Motivation (Item 5) inherent in the ecosystem, as indicated by the dotted line-arrows.

Resources

Resource availability and distribution in our ecosystem largely come about due to Sense of Urgency (Item 2) and Commitment and Motivation (Item 5), both elements serving as drivers pursuing resources and relinquishing them. This does not indicate where resources come from, but it is essential in a viable model of sustainability that the system, itself, has the capacity and capability of generating and managing its own resources. This assumption also explains the links toward SEQ (Item 1) and to the Skills, Knowledge, Reflection subsystem (Items 7, 8, and 9) in the upper-right hand side of the diagram. Whilst not immediately apparent, we have to assume that knowledge and skill acquired through education and experience will bear on the system's ability to generate resources and effectively mediate how they are used. Thus, meaningful jobs, empowering and decentralising, mastery, and integrity and ethics in conduct of business are all key Operating Principles. What is needed is to develop a culture of self-reliance.

Commitment and Motivation

Commitment and Motivation occupies a central position in our ecosystem, with no fewer than six connections (relationships with other elements). We have explained the influence of Sense of Urgency and Imperative (Item 2), Thought Leaders (Item 3), and Resources (Item 4) already. Another key factor with respect to Resources and its influence on Commitment and Motivation is that commitment and motivation are likely to diminish under conditions of sparse resources: effort may feel unrewarding to individuals, required for sustained endeavor, and chance of success perceived by members as slim, also a factor undermining optimism and determination.

This notwithstanding, when the element of Commitment and Motivation is high, Action (Item 6) is more likely, some of which results in Positive Outcomes (Item 10). As Positive Outcomes increase, Commitment and Motivation is also likely to go up, forming a positively reinforcing loop.

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On the other hand, as Failures (Item 11) increase, Commitment and Motivation is bound to suffer—a negative effect, as indicated by the (-) at the tip of the line-arrow leading from Failures. To stem this affect, supportive leadership is required (not shown in the link), as is learning from failure, also not directly shown, but suggested by the link to the Skills, Knowledge, Reflection subsystem.

Given the nature of and dynamics surrounding Commitment and Motivation, leadership is a Critical Success Factor—keeping individuals inspired, directed toward constructive activity, and rewarded for effort and initiative. An empowering culture of productivity with encouragement to learn from failure is also essential. A framework for action is a third CSF, here, incorporating Operating Principles including ongoing learning and research, allowing energy and resources to flow where they may do the best good and to seed fledgling initiatives, and providing multiple and diverse events and activities that might spawn ideas and give birth to new initiatives.

Action

It could be argued that any action is better than doing nothing. Whilst there is no doubt some truth to that, some actions are better than others, and wisdom may be called for in dictating what course of action to follow or when the chosen course needs to be shifted or halted. Though wisdom does not appear in our model, it is suggested by the link from Reflection (Item 9) to Action, and may be considered an essential quality of our ecosystem leadership CSF, along with the Operating Principles Integrity and Ethics, Big Picture / Greater Good / and Long-Term Thinking, and Befriending Nature and the Environment.

Not just any action, but skillful and appropriate action is also required. In our relationship diagram, this is shown as the function of the Skills, Knowledge, and Reflection subsystem, and funneled largely through Reflection (Item 9). The greater and more effective the Action, the greater the production of Positive Outcomes (Item 10), and the fewer Failures (Item 11).

Not shown, but certainly worth consideration, is that *action reflected upon* will produce learning (Moon, 2013) and contribute to greater Positive Outcomes, so the function and value of Reflection as part of the learning dynamics of our Viable Sustainable Development Ecosystem should not be underestimated.

Skills

There is a wide range of skills required to build and sustain a viable ecosystem. Since, SEQ (Item 1) is concerned with knowledge about sustainability and the environment, we focus here on managerial, technical, and social skills required to solve problems, make decisions and operationalize plans and implement solutions. We also include the skills required for continuous learning, training, professional development, mentoring, and coaching, for these are needed if a system is going to successfully adapt to and evolve within a changing environment. These skills are important to bring into the ecosystem but also to develop amongst existing members, thus one CSF is a culture of learning, along with the particular Operating Principles Learning and Research Agenda, Meaningful Jobs, Succession and Evolution, Empower and Decentralise, and Mastery.

Skills is part of the Skills, Knowledge, Reflection Subsystem, and our maps shows these three elements operating in concert to drive ecosystem learning and performance. Whilst not shown, Reflection (Item 9), itself, is a skill and disposition that can and should be fostered. There may need to be an ecosystem (organizational) framework for reflection and learning and a culture that encourages them.

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Knowledge

This is not so much SEQ (Item 1), but knowledge about the business and its environment—the kinds of things every organization needs to know to continue learning. This is knowledge needed to solve problems and to make informed decisions, and to keep the ecosystem evolving to meet changing conditions. Reflection (Item 9) is shown to feed knowledge in our model, so, again, plays a vital role.

Whilst thorough coverage of organizational knowledge is far beyond the scope of our current discussion, it should be clear that a culture of learning and knowledge is critical to the ecosystem's survival, supported by leadership and frameworks that allow emergence and exploitation of new ways of thinking, new ideas, new relationships, and new ways of working. More than anything, this suggests an organic, flexible, and responsive type of organisation unencumbered by bureaucracy and rigid controls.[20]

Reflection

Reflection and its contribution to learning and effectiveness are extensively covered in the literature, and, as educators, we can hardly conceive of a learning or professional development process or activity that excludes it. In any circumstance, we believe reflection to play an integral role in the learning, adaptation, and evolution of the Viable Sustainable Development Ecosystem. In our map, Reflection is shown to have positive relationships with Skills (Item 7), Knowledge (Item 8), Action (Item 6), Positive Outcomes (Item 10), and, a negative relationship with Failures (Item 11).

Again, Leadership and a Culture that promotes reflection, especially with teammates, colleagues, and partners, will more often than not build learning and resilience and contribute to positive change (Hays and Reinders, 2018). Corresponding Operating Principles include: Building-in Sustainability (in this case, reflective practice), keeping to an evolving Learning and Research Agenda, holding Multiple Events and Activities, Empowering the workforce and Decentralising authority, Mastery, and fostering Collaborations, Partnerships, and Diversity.

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Positive Outcomes

Desired, positive outcomes are rewarding in their attainment, but also important in that achievement provides fuel for continued effort. The gratification feeds Commitment and Motivation (Item 5), contributes to amassing knowledge (SEQ (Item 1)), and provides substance for Reflection (Item 9). Given the power and value of Positive Outcomes, an organization should celebrate wins as much as possible, focusing not solely on the specified outcomes, per se, but also efforts, techniques, and processes that lead to achievement.

Failures

Whilst doubtful that anyone really likes to fail, failure plays a significant role in the Viable Sustainable Development Ecosystem. We see that Action (Item 6) and Reflection (Item 9) flow into Failures, and Failures (Item 11) influence Commitment and Motivation (Item 5) and SEQ (Item 1). As Actions (Item 6) increase, that is, initiatives and responses to environmental threats and measures taken to improve sustainability rise, Failures are likely to increase, as would Positive Outcomes (Item 10), other things being equal. This is merely a matter of numbers. What would reduce Failures, other than chance, would be improving ecosystem knowledge and skill as funneled through Reflection (Item 9). Failures would

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also diminish if Actions (Item 6) were to decrease, but this is probably not desirable. Both action and failures are likely to reduce in environments averse to risk and where failures are punished, though this dynamic is not shown on the map.

Failures can be productive when learning from failure is exploited. This is indicated on our map by the influence line pointing to SEQ—Knowledge about Sustainability and the Environment (Item 1), in a case of "what works and what doesn't". So, we want not to reduce failures, per se, but to reduce unnecessary ones and to optimize *productive failures*[21].

This discussion on failures highlights the importance of allowing them to occur, perhaps even celebrating them, at least those that shed light on problems and their solutions, and reveal assumptions that may be impeding effective solutions. Likewise, it emphasizes the importance of learning in a viable ecosystem. Thus, again we see our Critical Success Factors at work, especially and obviously Leadership, Culture, and Framework. Some of the Operating Principles evident are Building-in Sustainability, Learning and Research, Mastery, Multiple Events and Activities, and Collaborations, Partnerships, and Diversity

In sum, the Causal Loop Diagram of the Viable Sustainable Development Ecosystem identifies elements and their interrelationships considered to be important for understanding the dynamics of SD. It portrays the ecosystem as comprised of various relationships that at least partly explain why a SD program might succeed or fail. To the degree that elements included and the lines and directions of influence amongst them are correct and complete, the CLD can be predictive—what will happen if we increase Thought Leadership (Item 3)? What are the likely consequences of driving Action (Item 6) in the absence of a learning subsystem (Items 7, 8, and 9)?

No map of a complex adaptive ecosystem can be completely accurate. This one is simple, with fewer than a dozen elements. No doubt readers might add or interchange elements or find competing or alternative dynamic relationships. But the CLD offered here provides a glimpse into the phenomenon of SD not previously depicted in this way. Considering the elements and their dynamic relationships as intricately and mutually linked may suggest new possibilities, initiatives, and strategies permitting practitioners and policymakers to better understand impediments, shift emphasis, and gain more value from available resources.

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DIRECTIONS FOR FUTURE RESEARCH

This chapter outlines five Critical Success Factors and a baker's dozen Operating Principles for viable Sustainable Development, and 11 elements comprising the Sustainable Development Ecosystem. Whilst each of these arise from the authors' experience, observations, and insights, the factors, principles, and elements are individually and collectively open to challenge and deserve further investigation. They may be incomplete or insufficiently understood, and based on limited exposure to the breadth and depth of Sustainable Development initiatives worldwide. By nature, Complex Adaptive Systems are difficult to define and the dynamic interdependencies amongst elements may be speculated but hard to prove. This said, we have done the best we can to envisage Sustainable Development as a complex ecosystem and explain the logic of the many and variable relationships amongst its elements.

We trust researchers and practitioners can draw from and build upon our work. How our CSFs, OPs, and the CLD account for successes and failures in past and ongoing Sustainable Development projects would make for interesting and useful studies. Additionally, particular interventions and investigations might consider, for example:

Hayo Reinders (hayoreinders@gmail.com)
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- The merits of conceiving Sustainable Development as an ecosystem, and/or community-as-ecosystem.
- Alternate ecosystem views of Sustainable Development.
- If not ecosystem / Complex Adaptive System conceptualisation, what makes Sustainable Development viable?
- The veracity of the Causal Loop Diagram presented, and its elements and their relationships.
- Applicability of the five Critical Success Factors, and a more-thorough understanding of their character and implications.
- Utility of the Sustainability Operating Principles and their translation in specific contexts and initiatives.
- Our hypothesis that Sustainable Development initiatives will be more successful in the long term to the extent that they deal with problems as Complex Adaptive Systems.
- And, finally, what is the contribution of the Sustainable Development Ecosystem to addressing the UN's Sustainable Development Goals?

SUMMARY AND CONCLUDING REMARKS

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This chapter introduces the idea of SD as an ecosystem and explains how and why it may be fruitful to conceive of SD in this way. The case is made through use of a detailed Causal Loop Diagram (the model or "map" at Figure 2) that provides key features of the SD ecosystem—the main elements and their interdependencies. Critical analysis, discussion of the model, and explanation of the dynamics involved suggest the circumstances under which SD will likely be sustainable and when it will predictably fail. Armed with such knowledge, policymakers and practitioners can make more informed decisions about where to intervene in a *community-as-ecosystem* (Murphy, 2018), that is, how best to invest the limited resources available.

Working with the Causal Loop Diagram and moving toward the idea of a Viable Sustainable Development Ecosystem, the authors came to what—in retrospect—might be an obvious observation. To be sustainable, Sustainable Development must be wise, for all that implies.

A wise system exhibits numerous virtues, but fundamentally is concerned with greater good and long-term flourishing, forsaking short-term ease or gains, knowing and honouring itself and its interdependence with nature and its environment, and consciously learning to be increasingly effective and resilient (Hays, 2010a; Hays, 2010b). This, it seems to us, is the challenge and solution for SD. What are the principles of sustainability that will guide us toward a healthy future, including both internal operations and interactions with our environment? How can we best build in sustainability to SD initiatives and programs? What essential conditions must we create to be sustainable? What are the attributes of mastery in sustainability, and how do we best develop them?

We cannot provide a complete answer, yet, and, possibly, never will be able to. But our explication of the Viable Sustainable Development Ecosystem does reveal Critical Success Factors and Operating Principles that give clues as to what we can do. The most conspicuous CSFs are leadership, culture, framework, and relationships, but emergence should not be overlooked. Emergence may provide the greatest possibilities for a viable SD ecosystem, given healthy and supportive leadership, culture, and framework for operating. One example would be what positive learning can come from failures.

We also identified and provided examples of sustainable Operating Principles. Those most often apparent are learning and research; building sustainability in to all operations and facets of the business; providing many and diverse opportunities for ideas to emerge, including promoting interactions,

Hayo Reinders (hayoreinders@gmail.com)
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collaborations, and partnerships of all kinds; and fostering flexible and organic structures and ways of working wherein individuals feel unimpeded by hierarchy or bureaucracy.

Our wise SD ecosystem is comprised of people who individually aspire to mastery—they demonstrate unwavering discipline in thought and deed, ever vigilant to what opportunities exist in themselves and in their communities to become more sustainable and focussed on making those improvements. They are courageous and driven to act, but always address the first question: is this the right and best thing to do for all stakeholders all things considered? As masters, they do not lord over anyone, but are always willing to step up to calls for leadership, taking a stand on issues that matter, speaking for those whose voices have been unheard, and reminding us all of the vital commitments we have made (or must make) to create a sustainable world for all inhabitants.

If the understandings arising from the Critical Success Factors and Operating Principles we have identified and the concepts and dynamic relationships we have elucidated here are incorporated into the planning, implementation, and evaluation of SD initiatives, they are surely to be at least more sustainable than would otherwise be the case.

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KEY TERMS AND DEFINITIONS

Complex Adaptive System: A system—such as a community or organization—having many elements that continually interact and influence one another in complex and, sometimes, unfathomable ways. Though striving for stability and security, the interactions produce behavior and structure not before seen (emergence and self-organisation).

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Critical Success Factors: CSFs are factors or conditions that must be present in order for an initiative to succeed or a given process or desired condition to sustain. For example, sustainability implies that a system must have within it the capacity to generate its own resources (rather than be wholly dependent on external sources).

Ecosystem: A bounded system of living and interdependent entities in dynamic interaction with their environment, influencing and being influenced by their environment. Here, a socioecological system such as a community or organization.

Relationship Diagram: Otherwise known as Causal Loop or Influence Diagrams, these are "maps" or depictions of the salient elements in a Complex Adaptive System or ecosystem, and their relationships to one another shown as lines (directions) of influence.

Sustainability: Thriving into the future. Necessary for survival, sustainability implies cautious use of resources, including curtailing waste and other threats to the environment, production that does not exceed what can be replenished, and cultivation of products, services and lifestyles that enrich rather than exploit.

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ENDNOTES

1 Viability is a key concept in the real world and in this article, as indicated by the title. For us, viability has to do with capability to survive or, better, to thrive *independently*, that is, without undue and continuing external support—to succeed on its own. A viable proposal or intervention would be practical, realistic, achievable, and suited for purpose given existing circumstances, and robust and resilient in the face of challenging conditions. In many ways, viable means sustainable. To be viable, then, Sustainable Development must be able to be implemented or operationalised in such a way that its purpose is met—it achieves what it intends to—and continues to succeed into the future.

2 As with viability, community is also an integral concept here. We are using community to designate a particular locality within which people live and interact, a social system comprising all of the things people need to survive, as well as resources they may share or compete for. It is likely that people living in a designated locality have common interests, values, culture, and so on, but increasingly the population will be diverse. No doubt, however, they would be united in desire to survive, if not flourish, though may have vastly different understandings of how that might be attained and sustained. For our purposes and with respect to Sustainable Development, inhabitants of a given community would need to establish mutually productive and beneficial behaviours for an ambitious SD intervention to succeed. This implies that a critical mass of a community's members needs to embrace and live by the objectives of a given development or other change project for it to be achieved. For all this means, it is probably the case that a Sustainable Development project of any scope may have to concern itself with *community* development addressed through concerted communication, education, and culture change initiatives.

3 Chang and Tan (2013), Diment et al., (2011), and Stanczyk (2017).

4 These include Alshuaibi …; Pereseina …; Hays … Reinders …

5 See, for example, Nguyen et al., (2015); Rusoja et al., (2018); Sturmberg et al., (2012).

6 Tulane's manual on change-making provides an informative and complementary perspective on communities as ecosystems (Murphy, 2018).

7 Including those cited previous herein, especially Hays (2010b).

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[8] The term "complex adaptive ecosystem" is seldom found in the literature, perhaps because ecosystem generally implies complex adaptive system. One source using the term as we do here is Perfetto et al. (2016).

[9] Hazy and Silberstang (2009) and Matthews and Thomas (2007).

[10] See Hays et al., (revision requested).

[11] Our CSFs and Operating Principles are adaptions and revisions of and additions to our previous and ongoing research, as found in Hays and Reinders (2020) and Hays, et al., (2020).

[12] Our notion of Critical Success Factors (CSFs) comes from the world of organisational change, though could be applied to any large task or project. CSFs are factors and conditions that must be in place to some palpable measure for a project to succeed. More on and examples of CSFs may be found in Akkermans and Helden (2002), Disterheft et al., (2015), and Rockart (1986). A typical example from the organisational change literature is King and Burgess (2006).

[13] See, as examples, Ganz (2010) or Kotter (2012).

[14] See Adner (2017), Dedehayir (2018), and Kramer and Pfitzer (2016) for various perspectives on ecosystem leadership. Hays (under review) explores the dynamics of leadership as an ecological system in his article on leadership in and for a changing world.

[15] See Messier et al., (2015) or Roundy et al., (2018) for more on emergence.

[16] See McLean's (2017) dissertation on corporate DNA as very relevant background on our concept of culture as applied to sustainability.

[17] behaviours and the beliefs, assumptions, biases, motives than underlie it may serve to perpetuate things as they are but may not necessarily be beneficial in the long run. This is important aspect of our model.

[18] The "how" and "why" of the indicated influence—not easily depicted—is the most important aspect in creating (and reading) the map, with the particulars of "how" and "why" often based on assumptions, beliefs, speculations, biases, and limited observations, experiences, and evidence. Thus, while CLDs can be incredibly powerful, the grounds on which relationships are based need always objective analysis and critical reasoning.

[19] See, for example, Bouton (2007) or Steers et al. 2004)

[20] See Alavi et al. (2014) and Karp (2006) for background on organic structures and processes.

[21] See either Giloth, and Austin (2010) or Sastry and Penn (2014) for more on productive failures.

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