FROM SILOS TO SYSTEMS:
DRIVING CHANGE IN UNDERGRADUATE EDUCATION ECOSYSTEMS
Conversation Module 2

Presented by Noah Finkelstein at the meeting of the
Roundtable on Systemic Change in Undergraduate STEM Education
held at the Keck Center in Washington, DC on October 24, 2024

WHO IS THIS MODULE FOR?

This module is written for champions of academic change – both formal institutional leaders and those in other positions who are strengthening and transforming undergraduate STEM education. The module presents the ecosystem approach as a valuable framework for implementing major institutional change. Those interested in practical steps for leaders using this systemic approach should explore Module 5.

WHAT ARE THE KEY IDEAS IN THIS MODULE?

Adopting an ecosystems approach when engaging in transformative change has the potential to cultivate innovation and excellence in education by aligning diverse stakeholders to achieve shared objectives. An ecosystem approach emphasizes that transforming undergraduate STEM education requires reimagining institutions, not as collections of isolated programs and departments, but as interconnected systems (Austin, 2011; Elrod, et al., 2024; Kezar, 2018; Laursen & Austin, 2020; Lee, et al., 2023). From this perspective, institutions are most likely to thrive when faculty, staff, students, and external partners coordinate around shared goals, leveraging their unique roles within a larger, dynamic system. This perspective can empower institutions to align internal systems with external opportunities in ways that create pathways for all students to thrive while preparing them for evolving STEM careers. Embracing an ecosystems mindset can help institutional leaders shift from reactive, piecemeal solutions to proactive, systemic strategies. Furthermore, it can help institutional change leaders avoid a common trap in change initiatives – addressing the symptoms rather than the root causes of an issue. The shift to an ecosystems mindset allows leaders to align their efforts, systemically and strategically, across departments and disciplines, while forging meaningful partnerships with industry, government, and community organizations. The result? A resilient and adaptable education system that advances institutional excellence and opportunities that foster the success of all students.

WHY IS AN ECOSYSTEM APPROACH STRATEGICALLY IMPORTANT?

Higher education institutions are complex ecosystems, where changes in one part—curriculum design, faculty development, student support—ripple through other areas. Interventions that fail to consider these interdependencies often result in unintended consequences or short-lived impacts. Taking an ecosystem approach to change efforts involves identifying the various parts of the organization that relate to a change goal. An ecosystem approach can be particularly useful when a change initiative connects across an array of efforts and people within the system. Challenges such as disparities in student success, changing workforce demands, and limited resources require solutions coordinated across university units and programs. For example, supporting transfer students or veterans returning to school requires attention to admissions and recruitment practices along with systemic efforts in mentorship, teaching, and institutional culture.

An ecosystem approach also recognizes and engages the broad networks within and beyond the institution. Notably, institutions themselves are embedded in larger ecosystems that include regional industries, national funding agencies, professional organizations, and local communities. An effective ecosystems approach facilitates partnerships, aligning with and leveraging external expertise and resources to enhance STEM programs. While consideration of the full system (internal and external) in which an institution is situated is
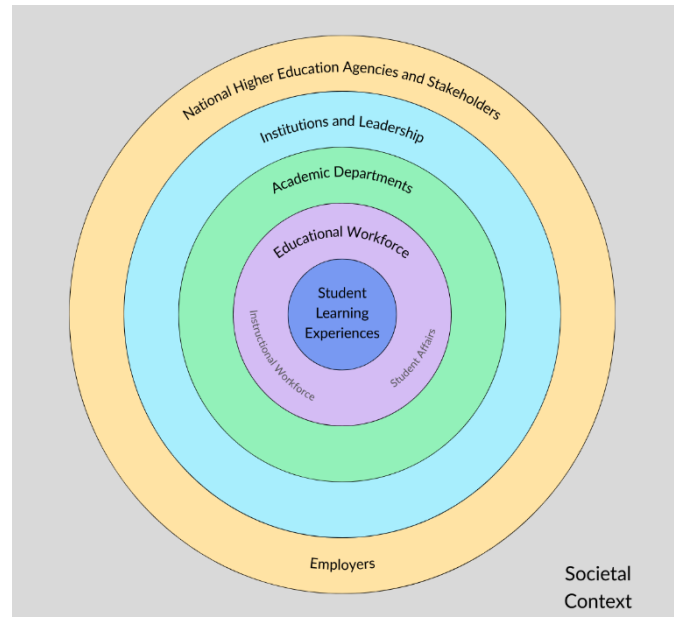
useful, change initiatives often start with attention to the institution's internal system. Change efforts need to consider what is feasible in terms of the time, attention, and energy of institutional members.

KEY STRATEGIES OF AN EFFECTIVE ECOSYSTEM APPROACH FOR CHANGE

The literature on organizational change in education and ecosystems suggests that the following principles (which need not necessarily be applied in the order presented) can be important parts of taking an ecosystem approach to change. For more specific leadership actions to undertake this framing, please see Module 5.

Map the Ecosystem

Mapping helps identify key players, resources, potentially aligned change initiatives, and organizational gaps or shortcomings that may foster or impede systemic change. An ecosystems map around a given challenge or opportunity will identify key components of an institution, capture how they interact, and highlight potentially missing elements needed for effecting sustainable change. In addition to identifying programs, structures, and policies, a mapping exercise will shed light on the essential stakeholders—both actors within a campus who can lead and enact change and those external communities who will be impacted by, support and champion change initiatives.

Components of the STEM Ecosystem that impact and influence student learning experience. Graphic created by National Academies staff.

Analyze the Local Culture and Context

Considering an institution's culture as it relates to STEM education is essential both for discussing and making decisions about relevant change. To promote change we must align—and sometimes work to alter—the implicit and explicit norms, values, beliefs, and practices of our educational institutions and the communities therein. Ultimately, if a change initiative does not align with the cultures in which it is situated, it will not last; as popularized in the management literature, "culture eats strategy for breakfast." We are not suggesting that strategy is unimportant, nor that culture is all that matters, but rather that any change initiative must be seated within and ultimately align with the localized culture. More on academic cultures can be found in Module 3.

Engage Stakeholders in Defining and Reaching Goals

Effective systems change is most likely to occur when there is a shared vision and engagement among all stakeholders, both internal and external to the organization. Efforts to more fully support student learning can benefit from the involvement of various people and units across the institution in addition to faculty members themselves. For example, directors of teaching and learning centers, academic advisors, health center staff, instructional technology experts, and coordinators of graduate teaching assistants are possible collaborators. External partners also can provide critical resources and perspectives that can strengthen undergraduate STEM education. The involvement of external stakeholders, such as industries, government agencies, community organizations, and national initiatives (e.g., National Science Foundation programs) can be especially useful when the change goal is to strengthen the preparation of students for workforce needs. Strategic approaches to engage all stakeholders may involve the creation of teams and partnerships, collective goal setting, data on metrics of success, and regular forms of communication among stakeholders.

Define Priorities to Guide Efforts for Aligning Programs, Processes, and Practices

Along with an identification of the change initiative objectives, an appropriate mapping of an ecosystem, and examination of the local culture, effective change processes involve an alignment and coordination of existing and new programs and practices designed to support student learning (e.g., mentoring programs and advising processes). Most likely, programs will not perfectly align with each other or the goals of an initiative. To that end, an assessment of the degree to which programs and processes (and related change initiatives) can be coordinated may be needed. Some programs may need to be ended, others begun, and yet others expanded, integrated, or modified.

Use Data-Driven Decision-Making

Integrating robust data collection and analysis into change processes can help leaders ensure that reform efforts, informed by an ecosystem analysis, are adaptive and effective. Different data may be necessary at various stages of a change initiative's cycle and might need to be synthesized across different university functions. Data are critical to support continuous improvement of the process, effective communication with the stakeholders, and accountability for the change leaders themselves. Institutions typically have colleagues whose work involves accessing useful data. For example, offices of institutional research are likely to be able to provide the type of data they submit to the Integrated Postsecondary Education Data System (IPEDS), and offices focusing on institutional effectiveness will have data related to accreditation reporting and various other resources that provide broader contextual data about higher education.

Use Frameworks for Fostering Change and Sustainability

Change leaders may find support for their work by reviewing established frameworks like the Collective Impact Model to guide collaboration and measure outcomes (see Module 5 as well as the Supplemental Resource List for all the modules). Such frameworks help institutions set shared goals, align resources, and track progress over time. Frameworks for change help leaders avoid pitfalls of focusing on the tactical at the expense of the strategic, and can identify gaps in approaches that may not be apparent at the outset of a change initiative.

Support and Empower Leaders of Organizational Change Initiatives

Effective leadership is an essential element in driving and sustaining change. Change leaders are critically important in establishing and communicating collective vision, galvanizing the community to engage, aligning the resources and programs needed, managing the change process, celebrating the successes, and addressing the challenges of change. Notably, the various roles of leadership may be addressed by more than a single individual, will not necessarily correspond to a person's title or organizational position, and may be distributed (with effective communication and support) across the members of a group. Aligned with the ecosystem perspective described here, Module 5 provides practical ideas intended to help institutional leaders advance stronger undergraduate STEM education.

HOW DOES A SYSTEMS APPROACH AVOID "CHANGE TRAPS"?

Taking an ecosystem approach to change can help enlist all the components of the system in support of transformative and lasting change. However, when striving to improve undergraduate STEM education, institutional leaders can inadvertently fall into a "change trap" —a cycle of launching isolated initiatives that fail to address systemic challenges (York, 2023). Leaders can avoid these "change traps" by:

- **Focusing on Systems rather than Symptoms**: Be alert to solutions to symptoms target surface-level issues without addressing underlying causes, leading to outcomes that are difficult to sustain.

- **Working across Departments and Programs rather than in Silos**: Avoid having departments or programs operating independently, duplicating efforts or pursuing conflicting goals. Ensure initiatives targeting related education improvements are not developed in isolation and leverage potential alignments appropriately.
- **Considering the Broader Context**: Consider that strategies that succeed elsewhere may falter when applied without consideration of local conditions and institutional culture.

Adopting an ecosystems perspective helps institutions avoid these pitfalls by fostering alignment, collaboration, and context-sensitive innovation. Leaders who embrace this approach design interventions that integrate across systems to create resilient STEM ecosystems that drive innovation, equity, and long-term success.

KEY TAKEAWAYS FOR INSTITUTIONAL CHANGE

1. **Adopt a Systems Approach**: Recognize the institution as a dynamic, interconnected system. Align efforts across stakeholders to achieve shared goals.
2. **Map the system**: Analyze the culture and context, identify key stakeholders, define priorities for change, and find relevant data that help identify opportunities and challenges specific to the context.
3. **Focus on Collaboration and Alignment**: Engage stakeholders and build partnerships—both internal and external—to leverage resources and amplify impact.
4. **Avoid Change Traps**: Stay vigilant about change traps by addressing root causes, breaking down silos, and tailoring solutions to your context.
5. **Take Action**: Empower change leaders and consider using established frameworks for change. Seek alignment in related efforts and foster collaboration in service to the change goal.

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