

The Sustainability Institutionalization Framework Guide

➤ Institutionalizing the EOP Framework



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1. INTRODUCTION: SETTING THE CONTEXT & SHARING OUR VISION

[Villanova University's Sustainable Engineering program](#) simply defines sustainability as “Enough, For All, Forever.”¹ This definition, borrowed from Charles Hopkins, employs a very holistic approach by including economic, social and environmental factors as well as considerations for technological impacts and geopolitical context both now and in the future. The Lemelson Foundation also approaches sustainability with a similar holistic perspective, as further explained in [their definition](#) by Eric Lemelson.

Sustainability is no longer a peripheral concern but a defining imperative of our time. Engineering schools, as incubators of future innovators and leaders, hold a unique responsibility to institutionalize sustainability within their curricula, practices, and cultures. However, achieving this institutionalization requires more than surface-level integration or isolated initiatives; it demands transformative change. Institutionalization, as we define it, goes beyond adopting sustainability as a topic of study or action—it involves a profound rethinking of an institution's purposes, policies, programs, and societal relationships in response to sustainability challenges and opportunities. This framework provides a roadmap for higher education engineering schools to embark on or advance along this path of transformative change.

Our framework is designed with inclusivity and adaptability at its core. Whether your institution is just beginning to explore the relevance of sustainability or is already deeply engaged in sustainability efforts, the tools and guidance we offer are tailored to meet you where you are. By addressing the unique needs and barriers faced by institutions at varying stages of this journey, the framework ensures that sustainability's institutionalization is not a one-size-fits-all process but a context-sensitive evolution that aligns with your institution's identity and aspirations.

Success, as we envision it, is defined by the path of least resistance toward embedding sustainability into the DNA of an engineering school. This includes equipping stakeholders—professors, administrators, deans, students, and beyond—with the understanding and resources necessary to navigate the complexities of institutionalization. Our approach addresses key roadblocks and common concerns, such as inertia, lack of resources, competing priorities, and resistance to change. By offering tools to analyze and overcome these challenges, the framework empowers stakeholders to act as agents of transformative change within their institutions.

Institutionalization is not merely an internal process; it also redefines how a university relates to external societal actors. Engineering schools must engage in dialogue and partnership with industries, communities, and governments, leveraging their expertise to co-create solutions for a sustainable future. Our framework highlights strategies to foster these collaborations, demonstrating how sustainability can serve as a bridge between academia and society, amplifying the impact of higher education on global challenges.

Through this framework, we aim to inspire and guide institutions to achieve meaningful, lasting change. Sustainability's institutionalization is not a destination but a dynamic, ongoing process that requires commitment, creativity, and collaboration. Regardless of where your institution stands today, this framework will help you chart a course toward a sustainable tomorrow.

2. ADVANCING THE ENGINEERING FOR ONE PLANET FRAMEWORK: PAST TO PRESENT

In partnership with The Lemelson Foundation, Villanova University has been actively working towards the advancement and institutionalization of the Engineering for One Planet ([EOP](#)²) [Framework](#)³. The goal of EOP is “to transform engineering education so all engineers are equipped with foundational skills, knowledge, and understanding to protect and improve our planet and our lives.” Engineering for One Planet provides free, open-source tools and [resources](#), like companion teaching guides, to aid in the implementation of the EOP Framework and accelerate curricular changes across all engineering disciplines. [The EOP Framework](#) is a “foundational tool to accelerate curricular change and offers a vetted menu of learning outcomes for integrating economic, social, and environmental sustainability and related professional skills, such as teamwork, communications, and critical thinking, into any engineering disciplines.”

To support the widespread acceptance and integration of [the EOP Framework](#) into engineering institutions across the country, Villanova developed and tested faculty development workshops in various formats, including online, asynchronous, and in-person modalities. These workshops provide tactical and strategic methods to deeply transform engineering education by embedding sustainability concepts into the core of engineering curricula.

As part of the preparation for these workshops and the Sustainability Institutionalization Framework (SIF), Villanova University, supported by The Lemelson Foundation and holding true to various EOP written resources, conducted an extensive literature review on modalities and institutionalization and interviewed various stakeholders to understand their journeys toward institutionalization. Our literature and interview research sought to answer three main questions - 1) What were the steps/process for institutionalizing curricular changes? 2) Who were the key stakeholders involved in the institutionalization journey? 3) What resources are needed to successfully institutionalize sustainability and the EOP Framework across their institutions and curricula?

The findings from these efforts have informed our approach and enriched the institutionalization framework with insights from diverse experiences and practices. It was found that what defines the successful institutionalization of a curricular framework is unique to the institution. It is evident from the literature that successful institutionalization of an educational concept, such as sustainability and the EOP Framework, requires a clear definition of the concept. This can be particularly challenging for sustainability as there are different definitions and perceptions of what sustainability is. Borrowing from strategic planning practices, having a diverse set of stakeholders [administrators (e.g., deans and chairpeople), facilitators (faculty), recipients (students), and support staff] from the outset of institutionalization to co-create the goals and definitions minimizes resistance and enables acceptance. From this point, the change management approach that is taken (e.g., accommodative change or transformative change) must be well explained to the stakeholders such that they can participate in the horizontal and vertical assessment of the curricular change. The costs and time required for this will vary based on the scope of change management that is undertaken. Ultimately, institutionalization can be a year-to-even decade-long process. Existing required assessment techniques, such as ABET student outcomes, can provide a mechanism to test the level of institutionalization. Ultimately, the more the faculty and staff

embody the culture of the curricular change, the more naturally and expansively they can facilitate the institutionalization of a curricular framework.

After our literature review and interviews with previous EOP workshop faculty participants, an advisory committee for institutionalization was formed to help shape the Sustainability Institutionalization Framework. Recognizing the importance of including diversity of thought and experiences, the advisory members represent a range of schools that serve a diverse population (minority serving, geographically, public and private, large and small) and includes members from larger engineering disciplines such as chemical, civil, computer, electrical, environmental, and mechanical engineering who can provide perspectives on potential scalability and impact. Seeking further diversity and long-term impact, the advisory board also includes engineering student and industry partner representation. Candidates we recruited from both The Lemelson Foundation's and Villanova College of Engineering network and were selected based on their teaching and administrative experience, experience working with the EOP Framework, and prior experience with curricular or change management. During committee meetings, a draft framework was presented, and committee members posed strategic questions and shared their feedback regarding areas for improvement and gaps, elements to continue to be included and how this model could be helpful for institutions. Based on their feedback, the SIF was updated to keep in mind the needs of a variety of institutions with differing existing levels of EOP institutionalization and this guide document was formed as the final deliverable for this research work. The project team began with an institutionalization framework of tools aligned with a design thinking process and ended with self-assessment tool for change management and sustainability institutionalization.

The Sustainability Institutionalization Framework seeks to engage academic institutions nationwide to explore successful modalities and models for EOP Framework implementation. It is designed to equip faculty and administration with the resources and strategies necessary to provide engineering students with the understanding, fundamental skills, and knowledge required to approach every engineering solution with a sustainability mindset. By examining the impact of different modalities and identifying the resources—including funding, personnel, and cultural buy-in—needed to set the EOP Framework at the center of not only engineering curricula but also the institution itself, the framework offers tailored guidance for institutions to select pathways that best fit their unique contexts.

Grounded in pedagogy and inquiry, the Sustainability Institutionalization Framework includes concrete steps to explore diverse content delivery modalities and develop a scalable model for the institutionalization of the EOP Framework. This approach ensures that engineering schools can effectively prepare students to become leaders in sustainability, fostering a new generation of engineers who are equipped to address the pressing challenges of our time. At the same time, the approach transforms the written and verbal communication of the college of engineering, the rules, policies, systems, and processes in support of sustainability, relationships between stakeholders, and resource allocation in support of sustainability initiatives.

3. AN OVERVIEW OF OUR PHASED CHANGE MANAGEMENT APPROACH

Drawing from design thinking and change management practices, the Sustainability Institutionalization Framework employs a five-phase approach that emphasizes iterative processes. Figure 1 outlines these phases, with subsequent sections detailing key activities, goals, and tools for each phase.

Preparation: Before beginning, identify a small team to champion the initial institutionalization assessment that will be able to lead the process and engage with stakeholders throughout the assessment. This “institutionalization team” should consist of pairs or triads for accountability and support; for example triads consisting of a faculty member, college administrator/leader and student or faculty member, student and industry partner.

The 5 Phases: Start in the identify phase with understanding the institution’s current state both internally and externally. In this stage, engage all stakeholders to gather information about their priorities and perceived impact of integrating the EOP Framework. Stakeholders will also evaluate how well sustainability is currently integrated across the nine maturity dimensions explained further in Section 3.1. In the define phase, the team will expand information gathering by leading stakeholders through a visioning exercise to imagine the institution’s desired future state. Creating a shared vision with stakeholders and will also help define significant challenge and opportunity areas within a broader context. Spending more time in these information gathering and assessment stages sets up institutionalization teams for success in the subsequent stages. Recognizing the time and resource constraints, the ideate phase can be more effectively performed as a small institutionalization team first and then bring in key stakeholder representatives to provide additional feedback on brainstormed ideas. After effectively co-creating in the ideate phase, teams can pilot options in the test phase and iterate based on feedback to refine solutions. In the adoption and mobilization phase, teams will conduct after-action reviews of the pilots and select refined solutions with key stakeholders to implement in the next institutionalization cycle.

PRO TIP: In line with the design thinking process, this approach centers on including all stakeholders to create meaningful outcomes. It is imperative that the institutionalization team include stakeholder representatives and engage them in feedback loops throughout the process. Lead with empathy while conducting stakeholder interviews in the identify and design phases as well as while seeking feedback from stakeholders during the ideate, pilot and adoption phases. This iteration leverages the collective power of perspectives to enhance innovation and foster institutional buy-in.

Institutionalization Framework - Phases

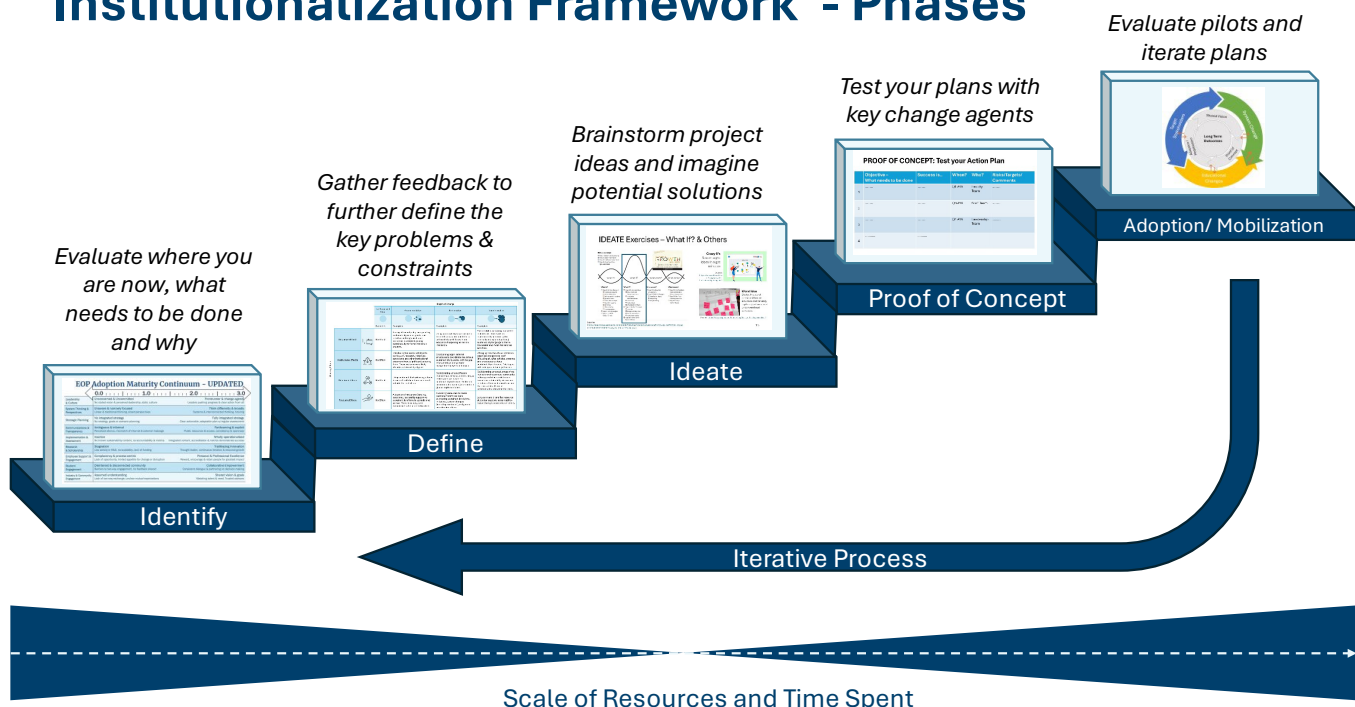


Figure 1. Sustainability Institutionalization Framework Overview - Key Phases

3.1. PHASE 1 – IDENTIFY YOUR CURRENT STATE

The IDENTIFY phase is focused on assessing your institution’s current state of sustainability maturity and EOP Framework understanding as well as current adoption across your institution. Evaluating where your institution currently ranks along the EOP Adoption Maturity Continuum helps your team to better understand your current strengths and areas of opportunity as well as understand some of the “why” behind current institutional practices.

Key activities in the IDENTIFY Phase include:

- **Evaluate Current State:** Institutionalization team first assesses where the institution currently stands in terms of EOP adoption and sustainability maturity and identify areas that require change and improvement.
- **Gather Information & Feedback:** Collect input from stakeholders to understand key problems and constraints and use this feedback to define specific issues that need addressing.

The objective of this initial stage in the phased institutionalization process is to assess your institution’s baseline readiness for EOP adoption within your engineering curriculum and the integration of sustainability practices across your institution. This baseline assessment will inform your setting of strategic goals and enable the monitoring of your progress in subsequent stages.

EOP Adoption Maturity Continuum

The following EOP Adoption Maturity Continuum model was modified for higher education institutions and the EOP Framework from Villanova's SEED program which developed a model for corporate partners in the executive education program as a thought exercise for participants to self-assess their company's sustainability maturity. SEED faculty and staff crafted the original Sustainability Maturity Continuum based on their sustainability industry experience and other sustainability maturity models available, such as the [ESG Navigator](#) tool.

The nine institutionalization dimensions represent the institutional elements needed for adopting the EOP Framework and integrating sustainability within higher education institutions. Guiding questions for each dimension will help the institutionalization team understand key characteristics and gather information to formulate a maturity ranking. As depicted in Figure 2, each dimension is rated on a scale from 0.0 to 3.0, with 3.0 representing the most aspirational goal. This flexible ranking system accommodates changes over time as EOP adoption and sustainability practices evolve. The double-headed arrow on the continuum indicates that institutions can progress or regress in their maturity based on their implementation practices and engagement with the EOP Framework.

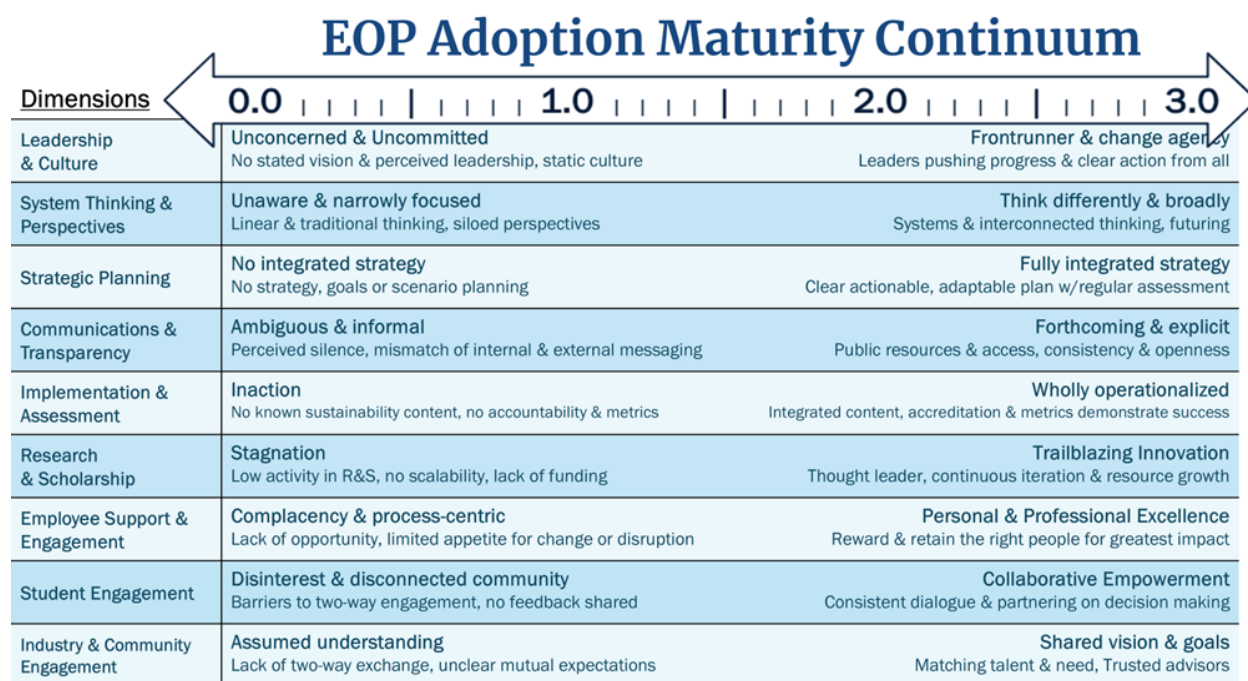


Figure 2: EOP Adoption Maturity Continuum - Dimensions and their Guidrails

EOP Adoption Maturity Dimensions Guiding Questions

The following questions for each dimension were designed with this guiding question in mind: “If you were going to be successful in this dimension, what information would you need to know?”

Institutionalization teams are encouraged to expand on these questions to suit their specific context, using the following list as a foundational starting point.

Leadership & Culture Questions

- Is there a shared vision of our key mission and values among leadership and all internal and external stakeholders?
- How do sustainability-related initiatives align with our strategic goals and accreditation requirements? Is there a shared agreement among stakeholders on this alignment?
- Who are the key change agents across our organization and how do we engage with them?
- How is a culture where sustainability is a shared value among all stakeholders supported?
- How do we secure buy-in from leadership and key stakeholders?
- Are there policies we need to create or revise to support sustainability in curricula, operations, and research?
- What are our strategies to address changes in leadership (i.e. dean) and other personnel?

Systems Thinking & Perspectives Questions

- Does our institution employ both macro and micro lenses during strategic planning and decision making?
- Are all stakeholders able to freely express their perspectives and share differing insights respectfully?
- Do decision makers recognize the interconnectedness of their proposed actions and consider possible implications?
- What is important to our stakeholders?
- How do we conduct scenario planning and how do we think about the future?
- How do we view the future and envision how institutionalize of the EOP framework will continue beyond the initial rollout?

Strategic Planning Questions

- How do we set goals and targets to integrate the EOP Framework across our engineering curricula? How do sustainability principles align with our institution's strategic goals and mission?
- Who needs to be involved in this process and to what extent (faculty, administration, students, external partners)?
- How do we identify and mitigate our risks as well as leverage our opportunities?
- How do we classify and allocate resources (funding, personnel, infrastructure, technology, etc.) to support initiatives?
- What are the estimated costs associated with implementation?
- What incentives do we need to drive the adoption of the EOP Framework?

- What plans are in place for when key contributors leave or can no longer drive institutionalization of the EOP Framework?
- How will we grow adoption beyond a pilot phase?

Communications & Transparency Questions

- What methods are used to communicate key messages to both internal and external stakeholders?
- What messaging strategies resonate with stakeholders who are skeptical of new initiatives?
- How do we clearly communicate the purpose and objectives of EOP integration to all stakeholders?
- How do we ensure all stakeholders are aware of and involved in initiatives? What methods (e.g., newsletters, webinars, workshops) will be most effective for outreach?
- What is the mechanism for collection of stakeholder feedback and subsequent iterative improvements?
- How do we report on project progress and achievements to internal and external stakeholders?
- How do we ensure transparency in decision-making processes related to the EOP Framework implementation?

Implementation & Assessment Questions

- What insights can be gained from previous successful initiatives at our institution? How do we conduct after-action reviews?
- Who should be on the assessment team to evaluate progress and successful implementation?
- What are our metrics of success/needed for accreditation?
- What are the key performance indicators that will drive our operationalization of the EOP Framework and provide structure for assessment? How will we communicate about our progress using these metrics?
- How we will hold champions and participants accountable?
- How frequently should we evaluate performance and make adjustments? Do we have a regular strategic evaluation cycle?
- How do we benchmark against peers or industry standards?
- How do we measure student learning outcomes related to sustainability? How are other student outcomes currently assessed?
- What are the long-term benefits of adopting the EOP Framework for our institution's reputation and rankings?

Research & Scholarship Questions

- What are the strengths of our current research portfolio? What can we leverage to build a future portfolio connected to sustainability?
- How does the EOP Framework support faculty research on sustainability?
- What are the funding or collaboration opportunities?

- How can we adapt our strategy and goals to advancements in AI and sustainability technologies?
- How do we incorporate changes in sustainability practices or technologies as trends evolve over time?
- What are our plans to continue to scale and resource research opportunities that make an impact?

Employee Support & Engagement Questions

- What are the performance requirements for faculty and staff?
- What development opportunities are available for all employees?
- What teaching resources are available to help teach sustainability topics effectively?
- How will EOP adoption impact workloads, and are there incentives for participation? What support would be provided during implementation (time, funding, etc)?
- How will incorporating sustainability into teaching or research be recognized in tenure or promotion decisions?
- What tools or mechanisms to foster interdisciplinary teaching or research collaborations exist?
- How are teams and departments structured? How should we organize our project teams?
- Who should be engaged in this project work and how are decisions made?
- How will work flow between roles? What are the key roles?
- How can we support advocates for sustainability initiatives within our college or university?

Student Engagement Questions

- How can students contribute to shaping and advancing the integration of the EOP Framework?
- What are the mechanisms for collecting student feedback and suggestions? How are these ideas incorporated into our project plan and work?
- What are the leadership/decision making opportunities for students in these efforts?
- How will implementation impact student learning (e.g. additional costs, course outcomes, etc)?
- What are the opportunities for hands-on or project-based learning in sustainability?
- How does this initiative prepare students for jobs or further educational programs focused on sustainability?

Industry & Community Engagement Questions

- What is important to external stakeholders? How are we matching our talent with their needs?
- What role can alumni, donors, and corporate sponsors play in adopting the EOP Framework at our institution? How can we gather their feedback and include their input?
- How can we engage external partners (e.g., industry, alumni, local government) to support this effort? What are the benefits/costs to external stakeholders?
- How can we foster trusted external collaborators and advisors?

After answering as many questions as possible as a team in the first stage, ask each team member to independently rank each dimension as a representative stakeholder. Then, average these rankings to get an overall institutional ranking on the Sustainability 0.0 – 3.0 scale. Next, have all team members share their overall institutional rankings, as well as their highest and lowest ranked dimensions. Look for patterns in the rankings and dimensions across the team. The highest ranked dimensions represent institutional strengths that should be leveraged for further implementation of the EOP Framework. The lowest ranked dimensions highlight areas of opportunity to pilot initiatives and strengthen support for EOP adoption. Complete this ranking exercise with as many stakeholders as possible to provide the institutionalization team with a holistic understanding of the institution's current maturity level.

PRO TIP: By leveraging the systems thinking foundation of the EOP Framework and Design Thinking process, and considering multiple perspectives, you can achieve a more comprehensive and nuanced understanding of complex issues, leading to stronger and more effective solutions. Therefore, this process should also involve various institutional stakeholders, ideally in smaller focus groups (10 – 25 people), to better understand their perspectives on relevant questions and the institution's current state. Below are examples of key stakeholders to include.

Examples of Key Stakeholder Groups to Engage in the Assessment Process

- Board of Trustees
- Administration
 - University President and Senior Leadership
 - Deans and Department Heads
 - Facilities Management
 - Administrative staff (from HR to IT)
- Faculty
 - Engineering-Faculty
 - Non-Engineering Faculty supplying interdisciplinary support
- Students
 - Student Organizations
 - General Student Body
- Alumni & Donors
- Industry Partners
- Research Partners
- Government and Regulatory Bodies
 - Accreditation Bodies
- Local Community
 - Community Leaders and Organizations (especially those advocating for local sustainability)
 - Residents and nearby businesses

EOP Adoption Maturity Continuum

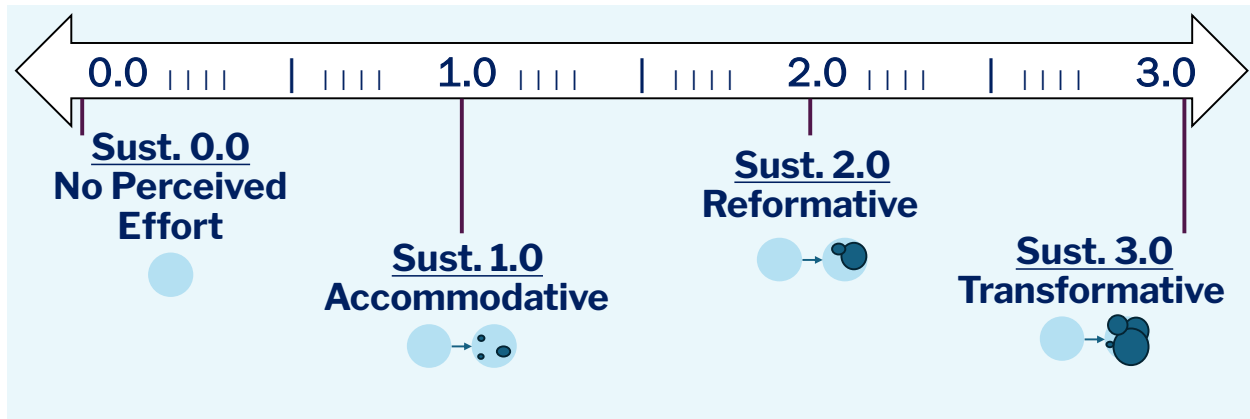


Figure 3. EOP Adoption Maturity Continuum - Sustainability 0.0 to 3.0 Rankings

As shown in *Figure 3*, the Maturity Continuum ranks overall institutional maturity from Sustainability 0.0 – 3.0 along the double-angled range with the following maturity status markers. Each level requires increasing levels of commitment, resources, and strategic integration as was adapted from the depth of change matrix by Cuesta-Claros, et al., shared in Section 3.2:

- **Sustainability 0.0 = No Perceived Effort:** At this ranking status, no efforts to integrate sustainability or the EOP Framework are perceived by any stakeholders at the institution. At this level, institutions are just discovering the EOP Framework and still determining its potential impacts at their institution.
- **Sustainability 1.0 = Accommodative status:** At this ranking status, there are sporadic efforts being made across these institutions and only in a few dimensions of the continuum. Institutions at this level are implementing fundamental sustainability practices that go slightly beyond legal requirements and are engaging limited stakeholders on integration of the EOP Framework.
- **Sustainability 2.0 = Reformative status:** At this ranking status, there are focused efforts being made across these institutions and several of the dimensions along the continuum are supported by various stakeholders and measurable actions. At this level, institutions are actively seeking out and implementing sustainability initiatives that significantly exceed regulatory requirements and embedding EOP learning outcomes and principles into the core curricular strategy and institutional operations.
- **Sustainability 3.0 = Transformative status:** At this ranking status, there are innovative efforts being made across these institutions along all of the dimensions continuum that are supported by almost all stakeholders and several active resources. At this level, institutions are leading the way in EOP adoption and setting new standards for higher education best practices.

3.2. PHASE 2 – DEFINE YOUR FUTURE STATE

During the DEFINE phase, the institutionalization team will co-create a desired future vision of EOP adoption and sustainability maturity at your institution. Similar to the current state ranking in Phase 1, use the guiding questions to help you and your stakeholder focus groups rank where you want your institution to be in the future along the continuum, starting with a 5-year timeframe. During this phase, you will spend additional time interviewing and gathering feedback from stakeholders to craft your future vision.

Building on the information gathered from the guiding questions in Phase 1 for each maturity dimension, Phase 2 involves crafting a future vision of optimal institutionalization. Consider the challenges and opportunities to create this future state, taking into account your institution's potential risks and capacity for change. This will further inform your desired future state and how your institution will be affected by its steering effects. By defining key problems and constraints in this phase, you can determine the change initiatives needed to achieve your desired future vision of EOP adoption.

Key activities in the DEFINE Phase include:

- **Co-create Future Vision & Determine Desired Outcomes:** Collaborate with stakeholders to develop a shared vision of EOP adoption and desired sustainability maturity.
- **Identify Key Constraints and Opportunities:** Consider the challenges and opportunities to achieve the future state, taking into account risks and capacity for change.
- **Rank Vulnerability:** Understand potential risks and rank your institution's vulnerability to each to establish bounds and understand steering effects impacts on change.

These activities help set the foundation for strategic planning and implementation in subsequent phases.

***PRO TIP:** When working with stakeholder focus groups, try completing both Phase 1 and Phase 2 concurrently to minimize engagement time. Still start with understanding and evaluating the current state then move on to craft a shared vision of your institution's desired future state and rank your future state maturity. This will help you more easily measure progress and gauge successful change initiatives. In the Appendix, there is an example of the self-assessment exercises that the project team and stakeholder focus groups may undergo for both Phase 1 & Phase 2.*

Identify & Rank Risks to Resilience

Below is a list of potential risks to your organization's resilience. Ask your team and stakeholder groups to identify perceived risks and their potential impact, then rank your institution's vulnerability to each to establish bounds on your constraint matrix. Use the list below as a starting place to help stakeholders generate a list specific to your institutional context – size, geography, regional norms, institutional resources, etc.

- **Leadership Changes:** Shifts in leadership, especially at the top (e.g., president, dean, board members), often bring new visions and policies that may not align with established institutional values and practices. This can disrupt continuity and make it harder for previous norms to persist.
- **Funding Reductions:** Budget cuts, often due to decreased enrollment, state funding cuts, or economic downturns, can lead to prioritizing cost-saving over quality or tradition. Key programs and staff may be reduced or eliminated, undermining institutional practices and stability.
- **Changes in Student Demographics:** A significant shift in the makeup of the student body (e.g., more non-traditional students, international students, or online learners) can necessitate different support services, teaching styles, and policies that may clash with established institutional norms.
- **Rapid Policy Shifts:** Introducing new policies quickly, particularly when not aligned with faculty and staff input, can lead to resistance or lack of adherence, weakening institutionalization. This is especially true if new policies feel imposed rather than developed collaboratively.
- **Technological Changes:** Higher education institutions increasingly rely on technology for education delivery, administrative processes, and student services. A shift toward online learning, for instance, may risk diluting traditional in-person values and practices, impacting community building and student engagement.
- **Market Pressures and Competition:** As higher education institutions face increased competition from other educational providers, they may prioritize marketable skills and trendy programs over established academic disciplines and values, challenging traditional academic rigor and focus.
- **Changes in Accreditation or Regulatory Requirements:** Accreditation requirements sometimes shift, forcing universities to make changes that may disrupt long-standing practices and structures to maintain compliance, which can hinder established programs and values.

Steering Effects

When setting your future state boundaries, consider both the interrelatedness and the interdependent nature of steering effects and the depth of change within an institution. Steering effects refer to the mechanisms that guide an institution's actions toward sustainability, including policies, funding, leadership, and cultural norms. They shape decision-making through incentives, regulations, and governance structures. Depth of change describes how deeply sustainability is embedded within an institution, ranging from surface-level adjustments (e.g., isolated green initiatives) to transformative shifts (e.g., sustainability integrated into core strategy and values). These concepts are interdependent—strong steering effects drive deeper change, while meaningful change reinforces steering mechanisms, ensuring long-term sustainability integration. Understanding the steering effects present at your organization will allow to better understand which initiatives will have the greatest impact on creating your desired future state.

- *Discursive effects* include references to sustainability topics in written or verbal communication. These effects, seen in internal and external communications and strategic documents, capture the extent to which an institution talks about and communicates sustainability visions, goals, and initiatives. Discursive effects also capture whether the sustainability topics/initiatives caused shifts in institutional narratives^{4,5}
- *Institutional effects* are changes in the rules, policies, systems, and processes in support of sustainability⁵
- *Relational effects* refer to relational changes between stakeholders, such as new, sometimes interdisciplinary, collaborations to further sustainability initiatives or deliberate communication among stakeholders around implementation^{4,5}
- *Resource effects* cover shifts in resource allocation in support of sustainability initiatives.⁵ Resources may include funding, personnel, or leadership support.⁴

Figure 4 illustrates these steering effects and depths of change as a framework to determine the overall impact of sustainability implementation. Figure 4 was adapted from a framework investigating adoption and engagement with the Sustainable Development Goals (SDGs) from Cuesta-Claros et al, 2023.⁴ Ranking your steering effects across different depths of change in the matrix will show your organization's capacity for change. This information will guide you in the next phase, where you'll brainstorm potential initiatives to reach your desired future state.

After creating a shared vision of your future state with all stakeholders, within reasonable constraints, you can set future goals and prioritize the top three areas to focus on for your initiative's proposal in Phase 3.

		Depth of Change			
		No Perceived Effort	Accommodative	Reformative	Transformative
					
		Examples	Examples	Examples	Examples
Steering Effects	Discursive Effects 	No Effect	Among other subjects, incorporating sustainability visions, goals, and initiatives into organizational narratives. Sporadically using sustainability to frame institution projects.	Using sustainability as an umbrella term to frame action and to tell a coherent story of the work and education happening across an institution.	Sustainability becoming part of the institution's identity which inconsistently communicated internally and externally. Using sustainability language to frame discussion and most institutional activities.
	Institutional Effects 	No Effect	Introducing the sustainability into curriculum, research, initiatives, operations, and other institutional systems without significantly altering them. These systems were likely already sustainability-aligned.	Establishing organizational structures to coordinate the various sustainability systems with the goal of preventing siloing and/or competition between initiatives.	Changing how the whole institution organizes and governs itself (including all rules policies, systems, and processes) to place sustainability at its core. This begins with a deep questioning of norms.
	Relational Effects 	No Effect	Using sustainability topics as guidance for one-off collaborations inside and outside the institution.	Collaborating across different institutional, campus, community, or industry groups based on sustainability initiatives. Deliberate communication among stakeholders guides implementation.	Collaborating across all areas of the institution with campus, community, industry, and other social actors based on sustainability visions and initiatives. These collaborations and their established lines of communication become the norm.
	Resource Effects 	No Effect	Allocation of resources (funding, personnel, leadership support) to sustainability efforts is sporadic and ad-hoc. There is no long-term commitment of resource allocation.	Allocating resources to create permanent staff positions supporting sustainability visions, initiatives, system changes (including curricular), and general coordination efforts.	Long-term and diversified resource allocation supports sustainability-based changes across the university.

Figure 4. Steering Effects vs Depth of Change Matrix, adapted from Cuesta-Claros et al., 2023

PHASE 3 – BRAINSTORM PLANS TO ADVANCE YOUR GOALS

The IDEATE phase involves brainstorming project ideas and imagining potential solutions to address future states goals. At the beginning of this phase, institutionalization teams should ensure that all members have a shared understanding of the top priorities and constraints. A designated leader will then facilitate a brainstorming session to explore solutions. The goal is to explore various approaches and possibilities that can effectively tackle the key issues defined in the previous phases.

***PRO TIP:** For ease of time and resources, keep brainstorming sessions contained within the institutionalization team and then re-engage stakeholders in the next phase when prototyping and testing initiatives.*

Key activities in the Ideate Phase include:

- **Brainstorming Sessions:** Conducting collaborative sessions to generate a wide range of ideas.
- **Creative Thinking:** Encouraging team members to think outside the box and propose novel solutions.
- **Solution Exploration:** Evaluating different approaches and imagining how they can be implemented.

This phase is crucial for developing a pool of potential initiatives that can be tested and refined in subsequent phases. It sets the foundation for creating impactful and sustainable solutions for the institution.

***PRO TIP:** Your institution may already have established processes or facilities for brainstorming and innovation. To enhance creative thinking, consider using design thinking exercises. For example, try the 'Crazy 8's' exercise, where participants sketch eight ideas in eight minutes, or the 'Worst Idea' exercise, where participants deliberately devise the worst possible ideas or solutions to explore extreme or unconventional techniques. Imagine the "What If" possibilities to generate both aspirational and realistically impactful alternatives.*

3.3. PHASE 4 – PILOT INITIATIVES AND MONITOR PROGRESS

The PILOT phase is crucial for testing your action plan and demonstrating the effectiveness of educational and sustainability transformation approaches and tools. This phase involves piloting the proposed solutions with key change agents to evaluate their feasibility and impact. The goal is to document successful strategies and refine them for broader implementation.

Key Activities in the Pilot Phase include:

- **Develop & Test Action Plans:** Create detailed project plans for scaling up successful solutions and identify necessary resources, timelines, and responsibilities, etc. Implement the proposed solutions on a small scale to assess their effectiveness.
- **Demonstrate and Document Success:**
 - Collect data and feedback from participants to evaluate the outcomes. Showcase successful transformation approaches and document the processes, outcomes, and lessons learned to build a knowledge base.
- **Re-evaluate Goal and Required Resources:**
 - Assess the availability and allocation of resources required for broader implementation and ensure that the necessary support and infrastructure are in place.

Aligning with change management and project management best practices, institutionalization teams should clearly explain objectives in project action plans and ensure all stakeholders understand the goals as well as their expected responsibilities and roles. Re-engaging key change agents from Phase 1 and 2 stakeholder groups to lead or evaluate key elements of pilot project efforts, strengthens buy-in and support for future implementation and increases credibility. Additionally, the more diversity, in terms of discipline, functional role, experience-level, leadership position, etc., of involved stakeholders in pilot programs, the more valuable insights and feedback received, leveraging the collective expertise and understanding of the institution across all stakeholders.

Lastly, institutions should leverage existing change management or regular assessment processes, allowing piloting and evaluation to occur concurrently. This approach can potentially reduce the need for additional support resources and personnel for these test projects. For example, several institutions have sample templates for project objectives, roles, timelines, responsibilities, outcomes, etc. Utilize these existing resources that stakeholders are familiar to ease barriers to support.

***PRO TIP:** Remember the iterative nature of this process, especially during the pilot phase! Implement iterative feedback loops to continuously refine and improve solutions based on real-time feedback. Encourage open communication and collaboration among team members. As initial findings are gathered during testing, institutionalization teams should be prepared to adapt and pivot project direction based on these learnings. Iteration is a crucial part of the learning and change management process.*

3.4. PHASE 5 – ASSESS YOUR SUCCESS: ADOPTION & MOBILIZATION OF EOP FRAMEWORK

In the ASSESS phase, institutionalization teams undertake a comprehensive after-action evaluation of their pilot projects to determine if overarching institutionalization goals were advanced and if specific project objectives were achieved. This phase is crucial to address two fundamental questions:

1. Did we impact our long-term EOP adoption outcomes and sustainability curricula goals?
2. How are we creating the system changes we desire to integrate EOP framework and sustainability practices across our institution?

Key Activities for the Assess Phase include:

- **Conduct After-Action Evaluations:** Review and analyze the outcomes of pilot projects and determine if institutionalization goals and project objectives were met.
- **Engage Stakeholders:** Connect and debrief with all target stakeholder groups, including academic leadership, faculty, students, industry, non-profits, funders, and government agencies. Ensure their involvement and support for educational transformation at scale and evaluate the effectiveness of future stakeholder mobilization and adoption.
- **Assess Systems Change:** Evaluate how the desired systems changes are being created to integrate the EOP Framework into engineering curricula.

Referring to the Theory of Change model developed by The Lemelson Foundation (Lemelson) to articulate required system change strategies, target stakeholders and long-term outcomes for effective adoption of the EOP Framework, teams should also consider the following elements:

- **Creation of a Shared Vision** - Did we articulate a common agenda that demonstrates relevance and aligns with stakeholder priorities? Do all stakeholders understand sustainability principles enough to know how to implement them across curricula?
- **Adoption/Mobilization of EOP Framework** - Have we galvanized stakeholders and resources to support educational transformation at scale? Have we connected with all target stakeholders groups? How were they involved?
- **Impact to Lemelson's Systems Change Outcomes:**
 - All engineers are equipped with fundamental tenets of sustainability (we are including the STEEP framing – Social, Technological, Environmental, Economic, Political)
 - Sustainability becomes the norm in engineering institutions, education and professions.
 - Engineering professionals integrate sustainability in practice.

***PRO-TIP:** Be sure to document the results of the after-action review and share with stakeholders involved in the process. This enables the institutionalization team to disseminate key learnings to teams leading subsequent cycles and apply critical success factors.*

Figure 5 below is Villanova's adaptation of EOP's Theory of Change diagram to reflect the more circular and iterative process of sustainability institutionalization process, with the ultimate focus being on impacting long-term goals and outcomes established by Lemelson. This diagram helps to visualize the potential impacts target stakeholders, other systemic and educational changes can have on creating the shared vision, pilot programming and adoption strategies needed to impact Lemelson's long-term outcomes.

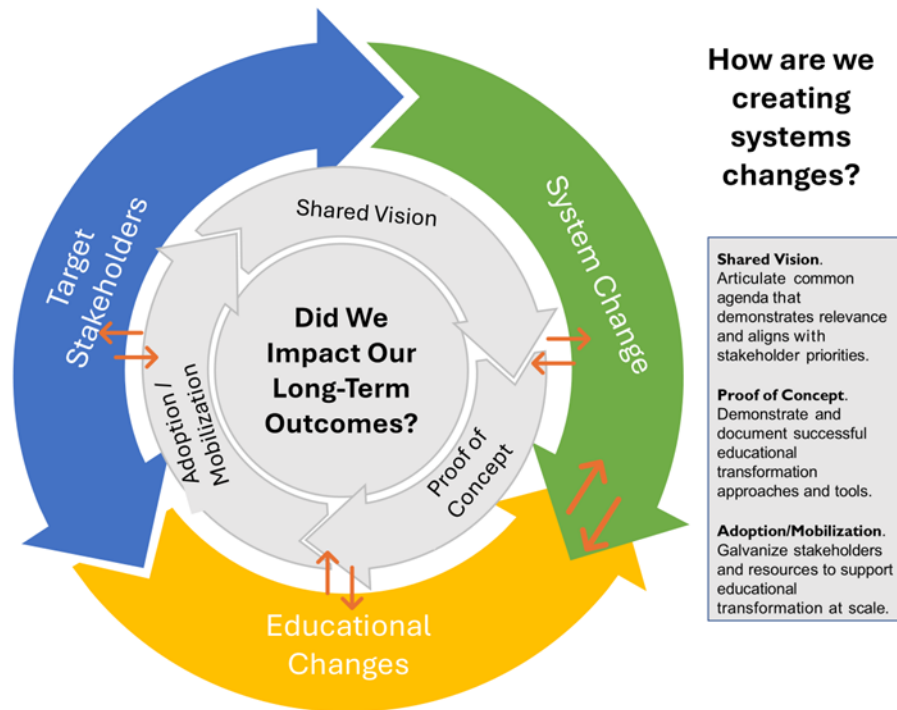


Figure 5: Circular Theory of Change

Created by Villanova University based on EOPs Theory of Change

4. CONCLUSION – KEY TAKEAWAYS & NEXT STEPS

As highlighted throughout this guide, the Sustainability Institutionalization Framework team at Villanova has recognized the power of collaboration in developing this guide. We appreciate the dedication of our core development team and advisory board in crafting this initial draft for institutionalizing the EOP Framework. Aligning with The Lemelson Foundation’s overarching goal “to advance systemic change in engineering education to equip engineers to protect and improve our planet and lives,” we hope this guide assists institutional champions in driving systemic changes to advance sustainability and EOP Framework adoption.

We recommend conducting this phased evaluation every 4-6 years, aligning with ABET assessment and tenure ranking processes. However, we acknowledge that the duration of the process will depend on factors such as institution size, stakeholder involvement, evaluation robustness, selected pilot projects, and available resources.

Looking ahead, the project team aims to test the guide's implementation at various institutions and host the guide, along with potential case studies, on a shared platform. Testing at diverse institutions will also help refine detailed assessment criteria, such as creating matrices for each dimension at the 1.0, 2.0, and 3.0 EOP Adoption maturity levels, aiding institutional partners in effectively ranking their current and future states.

A critical success factor for ongoing learning and development is the public sharing of best practices and success stories to support other institutions in integrating the EOP framework and improving system change outcomes. A thoughtful next step would be to make this guide a living document, allowing institutions to share their “pro-tips” and best practices for EOP framework adoption. Identifying the optimal platform and dissemination mechanisms for this information remains a challenge.

We extend our gratitude to The Lemelson Foundation for their continued support and advocacy for this work and look forward to engaging with the EOP community to ensure every engineer is a sustainable engineer.

5. REFERENCES

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6. APPENDIX

A. Examples of dimensional activities in Institutions that are between Accommodative and Reformative Levels of Maturity in EOP adoption/sustainability

Accommodative (1.0) – Reformative (2.0) Dimensions of Sustainability

