2026 ASEE ANNUAL CONFERENCE June 21–24, 2026 | Charlotte Convention Center, NC

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ASEE AMERICAN SOCIETY FOR ENGINEERING EDUCATION

Paper ID #54039

A community-based model for enhancing engineering practitioners' commitment to sustainability: Insights from initiation processes

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Abstract

Corporate social responsibility (CSR) initiatives in the technology sector employ technology to address sustainability challenges, including reducing resource depletion, minimizing waste, reducing pollution, reusing resources, and, where possible, regenerating resources [1]. Traditional engineering practices have often neglected environmental considerations, focusing primarily on economic efficiency while overlooking opportunities for sustainability. When environmental concerns are addressed, they are typically framed narrowly as cost-reduction opportunities rather than broader sustainability transformations. There is limited research on how engineering practitioners become engaged in designing for sustainability across their processes, products, and services.

Because sustainability involves numerous physical and social processes, there are multiple possible solutions that can motivate an understanding of sustainability impacts [2]. This research will explore the application of engineering leadership practices to motivate engineering practitioners to become intrinsically engaged in seeking sustainability in their designs and to understand why engineers become motivated to pursue a broad definition of sustainability. This paper develops an initial theory to explain how engineers who previously viewed sustainability as a burden have become intrinsically motivated to pursue it in engineering projects.

This research contributes to the field of engineering education by introducing the concept of ecological conversion through initiation within a professional community, using examples from religious conversion. Drawing on sociological research, including Rodney Stark's Network Theory of Conversion (NTOC) [3], this research examines how community-based initiation processes influence professional identity transformation. The community dynamics can be integrated with engineering education frameworks, specifically the engineering for social justice model (E4SJ) by Leydens and Lucena [4] to understand how engineers develop an intrinsic commitment to sustainability. E4SJ is a normative framework to design for social justice that is applied to examine how engineers adopt sustainability values. In this paper, sustainability is defined as integrating environmental stewardship, social justice, and long-term human well-being into engineering design. The E4SJ model takes a broad view of human well-being. This social justice viewpoint largely aligns with the framing of sustainability by the sustainability development goals (SDGs) [5].

This conceptual paper synthesizes both theories from the sociology of religion and engineering education to develop propositions about community-supported professional identity transformation, which will be validated through future empirical research.

Introduction

Many organizations are developing sustainability transformation programs to mitigate negative effects on the environment. Engineers are increasingly contributing to these programs through techniques like "eco-design" [6]. A challenge for engineering leaders is to address how engineers become committed to enterprise transformation efforts that require collective action to achieve sustainability. Sustainability requires discovery and team learning to overcome the design challenges in realizing a product that satisfies stakeholders.

This paper explores personal identity formation among engineers committed to sustainability. Identity is central to how an individual interprets the world around them [7]. Engineers develop this identity through support structures within educational and professional communities [8, 9]. This identity formation is a personal ecological conversion (EC) that involves concern for an individual's impact on the planet's ecosystems [10]. There may be different views on how engineering leaders and engineers understand "design for sustainability" [11]. Engineering leaders can influence their team's thinking to achieve the organization's sustainability values.

Problem

Engineering education and professional practice continue to emphasize technical competence and problem-solving, often at the expense of developing engineers' professional identity and commitment to broader societal concerns such as sustainability. While frameworks such as Engineering for Social Justice (E4SJ) guide integrating these concerns into design, they do not fully explain how engineers become intrinsically motivated to adopt such values. This gap highlights the need to understand sustainability engagement as a process of identity transformation rather than solely a matter of instruction or compliance.

Organizations today are considering sustainability to drive business growth [12]. There is widespread disagreement about what sustainability is and the commitment required for it. It is essential to study the ecological conversion of individuals to achieve unity of action in pursuit of common goals and shared values. However, this desired outcome does not mean that individuals will agree or have the same ideas. Instead, they should bring those perspectives to be integrated into a shared vision.

Similar challenges exist in medical education, where educational programs tend to focus on technical competence rather than fostering professional identity [13]. This skills-focused approach can leave medical practitioners disconnected from their professional values, contributing to burnout and reducing their engagement with best practices [14]. Engineering education faces similar challenges, in which a focus on problem-solving without attention to professional values can lead to what Cech [15] called a "culture of disengagement" from social and ethical values such as sustainability. Contemporary technologies like artificial intelligence present ethical challenges, including the use of natural resources and impact on the climate [16, 17],

highlighting the need for engineers who can critically evaluate the broader impacts of technical decisions [18].

This paper maps the sociological initiation process into a religious community and examines whether any of its steps and practical implementation apply to leading engineers in becoming engaged in design for justice, which also incorporates sustainability concerns. The conversion of individuals presents dynamics that might explain the identity transformation of engineers to become engaged to explore, discover, and further understand sustainability in their designs. It is assumed that belonging to a community (that fosters sustainability as an example) precedes belief, and the structure of social support motivates design for justice. The E4SJ assumes that educators teaching how to apply social justice to the engineering process will examine social structures that affect both developers and users of a product or service, and how communication and concerns can be addressed.

Scope and Assumptions

This paper views ecological conversion through the lens of recruitment theories developed by David Yamane [19, 20], building on Rodney Stark's prior work [3]. Social networks support the convert's growth process. RCIA is just one example of religious community initiation explored to identify key sociological events in adopting a new community, perspectives, and belief structure. The religious contextual beliefs are not transferred to engineering education in using this model. Rather, adoption of the conversion model enables the underlying dynamics of community initiation to be examined. The effectiveness of a phased initiation of concepts such as sustainability, a social justice concern; community sponsorship, and affective commitment should be studied, because this process affects how engineers use value-enhancing design processes (e.g., Value-Sensitive Design (VSD)) [21]. Engineering leadership is applied to instil and achieve an organization’s specific values in corporate sustainability initiatives. This paper seeks to understand how engineers are motivated to become engaged in understanding and considering sustainability in their design processes.

Research Question

The paper includes the following research question: How do community-based initiation processes explain and support engineers' transition from disengagement to intrinsic commitment to sustainability?

Contribution

This introduces a novel theory – Community-Supported Engineering Professional Identity Transformation for Sustainability (CSEPITS) – that integrates Stark’s Network Theory of Conversion with the Engineering for Social Justice (E4SJ) to explain how engineers develop an intrinsic commitment to sustainability. This paper provides an explicit mapping of the network theory of conversion (NTOC) to Leydens and Lucena's Engineering for Social Justice (E4SJ) framework that represents the impact of social initiation into a group that fosters sustainable

development. This paper then provides testable propositions that explains how that initiation process leads to better sustainability outcomes. This research has implications for the actions taken by engineering leadership to realize the shared values (e.g., sustainability values) possessed by a community of practice.

Background

This section provides a background of engineering for justice and how to provide leadership to explore how engineers can take common action to make the world sustainable. This paper draws on phased community initiation processes – studied across religious, military, and professional contexts – as illustrative cases of how structured social support shapes identity transformation. The Network Theory of Conversion (NTOC) [3] provides the theoretical foundation; the Rite of Christian Initiation of Adults (RCIA) process is examined as one documented instance of NTOC in practice [19, 20].

E4SJ Overview

The Engineering for Social Justice (E4SJ) framework by Leydens and Lucena [4] provides six criteria for an engineer to address social justice concerns: (1) listening contextually, (2) identifying structural conditions, (3) working within a political framework to effect change, (4) increasing social justice opportunities using existing resources, (5) reducing risks and harms to one's communities, and (6) enhancing human capabilities. The overarching end goal of E4SJ is to improve human well-being.

The E4SJ framework focused on social justice to engineering by Leydens and Lucena (2018) can be focused on applying the engineering process to achieve sustainability in design solutions. Sustainability considerations can inform the engineering process if practitioners are committed to sustainability. Engineers can either contribute to the health of the environment or harm it. The E4SJ criteria are depicted hierarchically on a conceptual model in Figure 1. These criteria from the E4SJ framework are focus areas that are explored by an engineering class to determine their practical implementation. These criteria are centered on the goal of engineering to improve well-being.

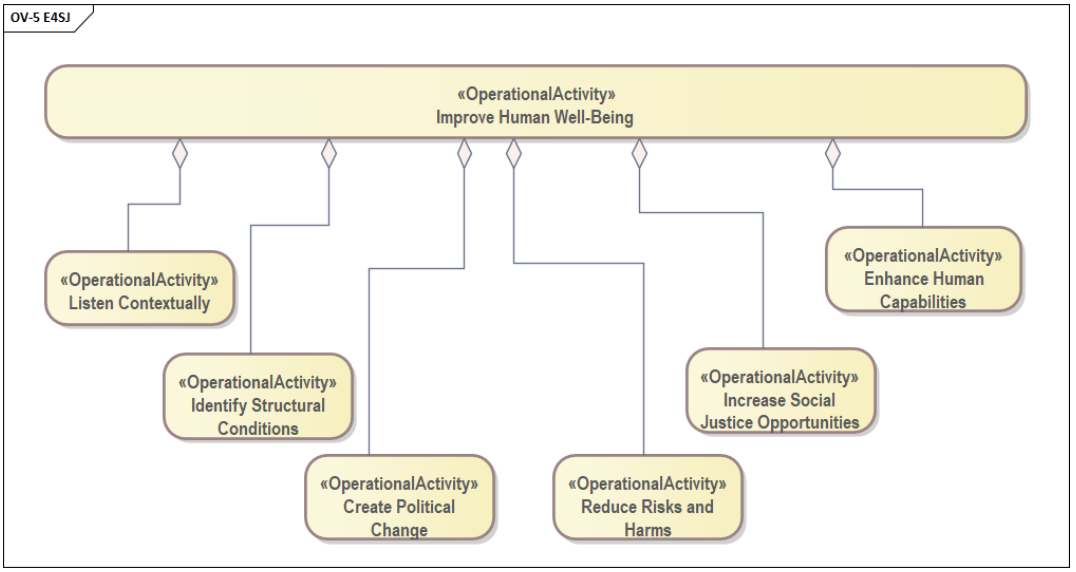

Figure 1. E4SJ Criteria and Objective [4]

Community Initiation Dynamics and NTOC

Stark's Network Theory of Conversion (NTOC) emphasizes local contacts such as family and friends. Affective commitment refers to an individual's attachment to an organization through their personal identity [22]. Individuals satisfy their emotional needs through a sense of belonging [23]. They may not necessarily believe the tenets of their professed religious community [20]. Stark's Network Theory of Conversion argues that conversion is primarily driven by interpersonal relationships and sustained social support, rather than by doctrinal persuasion alone. Stark and Bainbridge [3] suggest that converts seek some benefit from gaining initiation into a community. Affective commitment to a religion offers a payoff according to Stark and Bainbridge [24].

This work draws on the structural dynamics of conversion (e.g., social networks, phased initiation), not theological content. The Rite of Christian Initiation of Adults (RCIA) is one documented instance of these NTOC dynamics in practice illustrating how phased initiation and social support shape commitment within a community. RCIA includes the dimensions of recruitment and the development of relationships between newcomers who become candidates as they pass through the program phases through various social events. Yamane [19] suggested that RCIA initiation can be explained partially by Stark's Network Theory of Conversion (NTOC). Yamane came to believe that the initiation requires the community's social support for newcomers to address their unique situations and concerns. RCIA can be understood as a practical implementation of NTOC, where the network density, mentoring relationships, and rewards are cultivated to support affective commitment.

Terminology Mapping

Religious conversion terminology from the RCIA initiation process is translated into engineering terminology in Table 1 to model the transition from disengagement to engagement to design for sustainability.

Table 1. Application of Religious Initiation Terminology to Engineering Education Equivalent

RCIA / Religious Term	Generalized Initiation Concept	Engineering Equivalent
Inquirer	Newcomer	Exploring Practitioner
Catechumen	Developing Member	Developing Practitioner
Sponsor	Mentor	Mentor / Coach
Mystagogy	New Member	Post-Initiation Support
Ecclesiastical Support	Organizational Support	Communities of Practice
Sacraments	Achievements	Certifications
Conversion	Initiation	Personal Identity Transformation

Research Method

The proposed research method for studying how engineering practitioners become engaged in designing for sustainability is theory synthesis followed by cross-case comparisons to examine the key elements of the combined theory. Theory synthesis reviews and compares multiple theories for two phenomena and integrates them into a larger whole [25]. There can be multiple levels of relationships between core elements of a combined theory – both horizontal (with causal relationships) and vertical (which illustrates containment or inheritance between parent and child elements [26].

This paper sets the groundwork for the combined theory that will be developed from the literature and assessed. Integration of theories can be used to help identify a common foundation and similar concerns [27]. The desired outcome is to develop propositions from the combined theory that explain some phenomena [25]. The combined theory links facts from the constituent theories [28]. The E4SJ and NTOC theories refer to different communities that will be compared in a multiple case cross-comparison study that identifies common elements of E4SJ and NTOC.

Application of Conversion Literature to Identity Transformation

Religious conversion represents a studied form of identity transformation in sociology. Stark's NTOC has been empirically validated across multiple religious

contexts. Professional identity transformation in engineering shares key characteristics with religious conversion: both involve adopting new world views, integrating new values into one's identity, joining communities with shared commitments, and sustaining commitment over time despite external pressures. By examining well-established theories of identity transformation from the sociology of religion, we can identify principles applicable to professional contexts and leverage the existing theoretical frameworks.

Analysis

Community initiation processes – drawing on NTOC and illustrated through cases such as RCIA - provide an analytical lens to explain how engineers come to consider justice values in their designs. A reflective process on interpersonal relationships might lead to insights into how social justice can be supported. Proposition 302 by Stark and Bainbridge [3] suggests that "religious movements must find means to expand the supply of attachments, investments, and pleasures available through membership." It follows that formation of engineering practitioners to an orientation towards sustainability depends on a support structure that builds social connections that enable sustainability values to be explored and understood.

Theory of Conversion for Social Justice in Sustainable Development

A theory of an engineer's personal ecological conversion through community-supported identity transformation captures aspects of social support that influence an engineer's personal environmental conversion. This theory combines aspects of the E4SJ and NTOC frameworks. The themes of the mapping are also expressed in a conceptual diagram and as propositions. The mapping of phased community initiation to engineering education should address what inquiry looks like in the formation of engineers. The E4SJ framework can be augmented to provide pedagogical instantiation of the phased approach to initiation to design for justice or highlight any gaps in technical solutions.

The CSEPITS identity transformation model is expressed in a conceptual diagram depicted Figure 2 that links the two core frameworks (i.e., E4SJ, RCIA/NTOC) to design for sustainability. These two frameworks will have structural and behavioral elements that are related. This integrated model needs to be validated in future work.

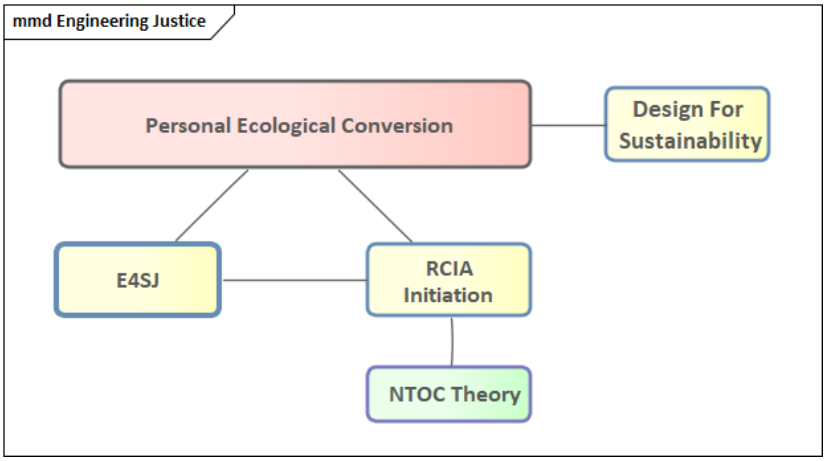

Figure 2. Personal Ecological Conversion to Design for Sustainability Supporting Theories [3, 4, 19]

The CSEPITS framework suggests that engineers become committed to sustainability not through instruction but through community-supported identity transformation, which can be explained using conversion theory and operationalized through engineering education frameworks. The following propositions emerge from the integrated CSEPITS framework and provide a basis for future empirical validation.

Proposition P1: Identity Proposition

Sustainability requires identity change, not just knowledge. Sustainability pursued for compliance may not necessarily achieve its intended effects. Commitment to a program or institution can be related to the social relationships that are fostered as newcomers embrace a professional community.

Proposition P2: Mechanism Proposition.

Engineers embedded in dense professional social networks are more likely to undergo sustainability-related identity transformation than those who are not. The literature on ecological conversion suggests that individuals undergo an identity change, becoming intrinsically committed to considering how their actions impact sustainability [10, 29]. Formation-based approaches to ecological conversion address an engineering practitioner's identity, values, and relationships.

Proposition P3: Process Proposition

Structured initiation through phases, mentorship, and milestones enables identity transformation. Engineers embedded in dense professional support networks are more likely to transition from compliance-based to intrinsic sustainability engagement. Engineering practitioners should continually refine their understanding of how their actions affect others. E4SJ suggests that a set of support structures beyond the classroom is needed to address challenging questions raised by an engineering student [4].

Proposition P4: Motivation Proposition

Belonging precedes belief in sustainability-focused professional communities. When engineering communities explicitly frame sustainability as a valued reward system that people can pursue, engineering members are more likely to form social connections that reinforce justice-oriented design practices. These social connections are central to an integral ecology that values interconnectedness between humans. An integral ecology is one perspective on sustainability; another is the economic view, which is resource-centric and conserves resources.

Preliminary Conceptual Model

Engineers' best designs for sustainability are supported by a process based on formation. Formation must not be coercive if engineers are to become intrinsically motivated to design for justice. The E4SJ process should consider initiation to ensure intrinsic motivation to design for sustainability.

These dynamics are particularly relevant in contemporary engineering contexts such as large-scale system development, digital engineering environments, and AI-enabled systems, where engineers must navigate complex trade-offs between performance, cost, and broader societal impacts.

Figure 3 provides a preliminary conceptual model that illustrates a mapping between converts and engineers, as well as their respective communities, which can be further explored in this research. Social support seems to enhance an engineer's desire to design for sustainability. Understanding and pursuit of sustainability appear to be improved through professional associations that sponsor networking events, such as meetings, where engineers learn about sustainability. Companies that understand the dynamics of the conversion process can draw designers to become engaged in innovating and creatively pursuing corporate sustainability programs.

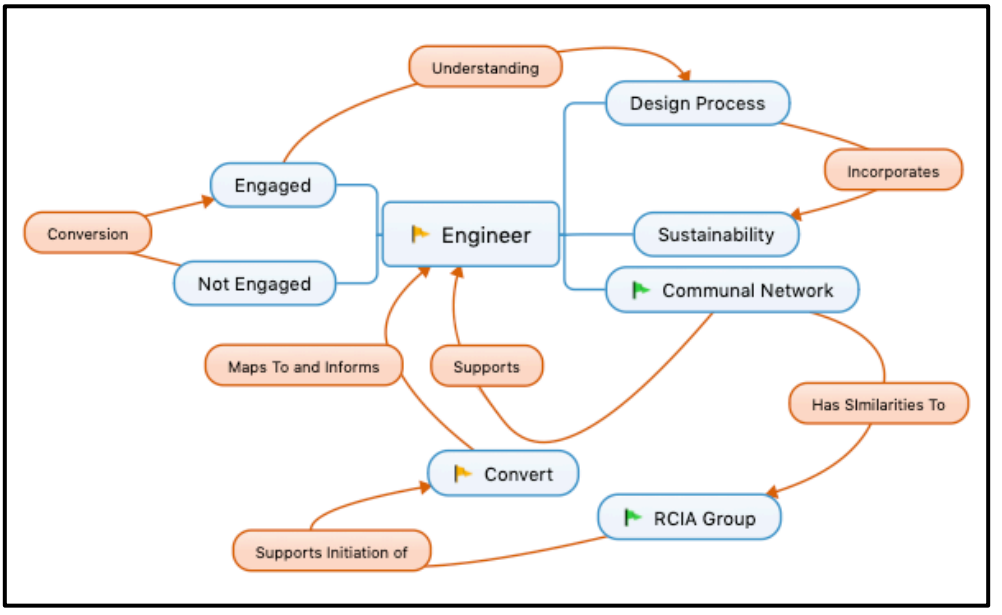

Figure 3. Comparison Between Engineering and Religious Communities and People who Convert.

Mapping Between NTOC and E4SJ

A preliminary mapping between NTOC and E4SJ is proposed. The NTOC element and corresponding E4SJ equivalent with a sustainability implication is presented in Table 2.

Table 2. Mapping between NTOC and E4SJ to Extract Sustainability Transformation Outcomes

NTOC Concept	E4SJ	Sustainability Effect
Forming Social Networks	Listening Contextually	Identifies sustainability views with specific viewpoints
Affective Commitment	Reinforce internalization of social justice values	Challenges engineers to overcome difficulties in achieving engineering and social governance (ESG) goals.
Sponsorship	Build multi-functional teams that define a sustainability project	Establishes a relationship between community mentor and practitioner
Phased Progression	Develops and encourages further understanding of social principles to develop, refine and explain complex sociotechnical problem	Presents sustainability considerations to enable practitioners to explore further barriers to sustainability

Conclusion

This paper suggests that engineering practitioners' engagement with sustainability may be better understood as community-supported professional identity transformation rather than competency development. Engineering education should incorporate structured initiation processes, including mentorship models, community-based learning environments, and phased engagement mechanisms that move beyond instruction toward identity formation. Technical societies like ASEE have communities dedicated to discussing sustainability and addressing sustainable development concerns. This research identified several elements from E4SJ and Stark's NTOC and developed propositions that might lead an engineer to greater affective commitment to design for sustainability. Both models can be leveraged to show how belief from E4SJ inspires human action [3].

Drawing on sociological theories of community initiation and identity formation – studied across religious, medical, military, and other professional contexts –this paper proposes that engineering education, and professional development processes should include a formative process that reshapes the individual's identity, values, and practices. Understanding this process enables engineering leaders to intentionally structure community, mentorship and initiation processes. Mentorship and community support of an engineer's formation to develop sustainability values is essential [30]. Formation is not simply a skills-transfer exercise. However, formation should not be coercive and allow individual engineers and communities of practice to explore sustainability. Engineers have different learning styles and worldviews. The divergent view can identify barriers towards achieving sustainability.

AI Use Statement

Generative AI tools (e.g., ChatGPT and Claude) were used in a limited assistive role for language refinement and structural feedback only. All research ideas, theoretical contributions, interpretations, and conclusions are the sole work and responsibility of the author.

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