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SySTEM Initiative

Organizational strategic plan

Revision 0.3

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Overview

This document serves as the organizational strategic plan for the Systems, Science, Technology, Engineering, and Mathematics (SySTEM) Initiative. It defines SySTEM's organizational outlook and strategic approach, and further establishes requirements, constraints, and recommendations for evaluating the viability and suitability of current and future SySTEM Initiative actions.

Document information

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1. Introduction

1.1. Document scope

This document serves as the organizational strategic plan for the Systems, Science, Technology, Engineering, and Mathematics (SySTEM) Initiative. It defines SySTEM's mission, vision, long-term goals, and organizational philosophy, and further serves to identify and formally codify functional requirements imposed on future SySTEM actions and activities in order to maintain alignment with the priorities and vision defined herein.

Given this scope of this document, this strategic plan does not seek to address aims which are intermediary, tangential or expected to be either short-term or volatile in nature.

The strategic vision presented in this document represents the core philosophy upon which the SySTEM Initiative is established, and shall remain in effect for the life of the SySTEM Initiative. This document will be considered active until such time as the stated strategic objectives have been satisfactorily achieved, and the SySTEM Initiative is formally concluded.

1.2. Purpose

The intent of this document is to provide a basis for consensus on, and consistent implementation of, long-term SySTEM strategy. This document, in conjunction with the SySTEM charter, shall serve as the first-line basis for determining the suitability of any future organizational efforts, plan(s) of action, partnerships, negotiations, or the like, in that such activities must demonstrate alignment with the strategic plan presented herein and should not at any point contradict, inhibit, or obstruct the achievement of the SySTEM strategic vision.

1.3. Implementation

The contents of this document shall be promulgated by the individuals who comprise the SySTEM organization's leadership. Members, participants, and/or collaborators with the SySTEM Initiative shall also conduct themselves in a manner that aligns with the objectives stated herein.

1.3.1. Accessibility

This document shall be made freely available to members of the public throughout the life of the SySTEM Initiative to serve as a reference for current and future members, participants, and collaborators, in accordance to SySTEM's commitment to equity and transparency.

1.3.2. Interpretation

This document defines requirements, directives, and recommendations for SySTEM strategy. Compliance posture for the items listed in this document is indicated using a class system, as described below:

- Class A: Mandatory requirements, which are non-negotiable and represent essential values or needs of the SySTEM Initiative. These mission-critical requirements are framed using the terms 'shall' or 'must'. Non-compliance with Class A items by SySTEM or agent(s) acting on behalf of SySTEM is not permitted under any circumstances.

- Class B: Directives, which are not imminently integral to core SySTEM values but are instead implemented as non-critical requirements. These items are negotiable as necessary with parties internal or external to SySTEM with sufficient cause. These directives are indicated by the terms 'will', 'should', or 'ought'. Cause for partial compliance or non-compliance with Class B items by SySTEM or agent(s) acting on behalf of SySTEM shall be appropriately documented in all instances.
- Class C: Precatory recommendations, which represent items which are strongly advised. These items should be complied with to the greatest extent possible but are potentially subject to change upon organizational discretion. Recommendations are indicated by the terms 'may' or 'can'. Noncompliance with Class C items by SySTEM or agent(s) acting on behalf of SySTEM shall not require documentation, but may be documented nonetheless for the maintenance of organizational records.

2. Organizational outlook

2.1. Background and mission

The significance of education in science, technology, engineering, arts, and mathematics (STEAM) has been widely recognized on the international stage, both in the academic literature and in public discourse. It has further been well established that a solid and robust level of competency in STEAM skills is necessary to ensure that today's youth are able to successfully operate in the workplace and as global citizens.

SySTEM is founded on the belief that systems thinking (ST) and systems engineering (SE) skills are, by virtue of being interdisciplinary, are also of widespread significance in education and can help students develop competencies that are relevant to individuals inside and outside of the SE practitioner community. To that end, SySTEM shall promote the integration of ST/SE skills into STEAM educational curricula across the globe, at all levels of education (from primary school to post-graduate education/professional development). SySTEM is also committed to helping promote more just, equitable, and transparent approaches to education, and thus also shall support the integration and enhancement of ST/SE into STEAM education in such a manner that helps reduce disparities in educational quality, access, and competency attainment.

2.2. Vision

The SySTEM vision is to improve the quality of STEAM education worldwide, for all students, by changing the way in which educators, administrators, and other relevant stakeholders place value on and leverage ST/SE skills, and by establishing a community to advocate for holistic integration of ST and SE principles and skills (inclusive of the skills represented in the INCOSE Competency Framework) into existing STEAM curricula and programs.

2.3. Core values and philosophy

There are several key values which are intrinsic to the SySTEM mission, and which inform the strategic approaches SySTEM uses in support of its aforementioned mission and vision.

SySTEM therefore declares its commitment to the philosophy and values described in the subsections below.

2.3.1. Accessibility and transparency

SySTEM believes that all individuals should have the right to a quality education which provides them with the knowledge, skills, and competencies needed for success in the modern globalized workforce, regardless of their personal background, geographical location, professional affiliation(s), or field(s) of interest. SySTEM therefore shall be committed to ensuring that its work is accessible, applicable, and implementable by individuals inside and outside the systems engineering community. SySTEM's completed work products shall be rendered accessible to the public at no cost to permit implementation by any and all interested stakeholders, and SySTEM shall not enter into any partnerships or agreements that would impinge upon the accessibility of SySTEM's work (e.g. by placing SySTEM's completed work products behind a paywall).

In support of this greater transparency in education, SySTEM shall make concerted efforts to perform outreach and engage with its stakeholders and solicit their input, and shall engage with individuals inside and outside of the SE community. Input should be solicited on the organizational and grassroots (individual stakeholder) levels.

2.3.2. Inclusivity and accountability

SySTEM is, at least in part, an advocacy organization, and as such shall ensure the representation of the common interests and perspectives of all its stakeholder groups through its participants and community members. SySTEM notes that imbalances and biases in various educational systems currently result in different stakeholder groups with common educational needs being nonetheless disproportionately over- or under-represented in receiving access to SE/ST competency training and quality STEM education, compared to what may be expected from the composition of the general population; SySTEM shall make a concerted effort to combat this issue through its activity by including participants from a wide variety of backgrounds, actively identifying and addressing areas of variability in STEAM educational pathways, and developing products which have relevance to, and can be implemented by, the widest possible set of stakeholders. To this end, SySTEM recognizes that limiting the pool of potential SySTEM participants is only detrimental to the successful achievement of the SySTEM mission. SySTEM shall therefore ensure that any members of the public who are interested in providing input to SySTEM are able to freely do so, regardless of organizational affiliation.

In any instance where the inclusion or exclusion of a party or parties from a SySTEM event, action, or activity is in question, SySTEM and its members shall opt in favor of inclusion unless doing so begets a situation which directly contradicts a Class A requirement stipulated in this document. Additionally, SySTEM shall not enter any partnership, collaboration, or agreement that requires or implies allegiance or to a specific partisan (corporate, governmental, or other) interest that does not align with the values stipulated in this document, or otherwise requires or strongly implies limitations on individual participation in the SySTEM Initiative. This requirement applies to financial sponsorship and funding applications, which sometimes make funding/support conditional on prioritization of the interests of a particular region or stakeholder group above those of other stakeholders or otherwise impose requirements that would indirectly dissuade or limit certain stakeholder groups from joining/participating in

SySTEM. Appropriate discretion should therefore be exercised before SySTEM enters any partnership or agreement.

SySTEM shall also remain accountable to its users, and bears responsibility for ensuring that its efforts result in recommendations and products which can be feasibly implemented by most, if not all, of its stakeholders with the resources and support systems to which those stakeholders have access. Similarly, SySTEM shall not make recommendations which are exclusionary to, or highly impractical for, stakeholders outside of the engineering or STEM sector. While SySTEM should encourage and promote interest in SE, its actions and recommendations should reflect the relevance of SE/ST competencies to non-engineering fields and vice versa. SySTEM shall consequently, in order to provide equal consideration to the interests of stakeholder groups in non-engineering fields, target its efforts on improving educational systems and related infrastructure (e.g.) rather than on changing the behavior of users utilizing those systems[1].

2.3.3. Quality- and action-driven performance

SySTEM is an organization which is evaluated based on its ability to produce viable versions of its end deliverables (elucidated in Section 3.2) within a reasonable time frame. Therefore, SySTEM shall operate in a quality- and action-driven manner, with priority placed on successfully generating viable products and on constantly improving its existing work throughout its lifespan. Thus, if SySTEM is made aware of a fault, error, or other similar quality issue in any of its products that causes SySTEM or its product(s) to violate any of the requirements or end deliverable criteria set forth in this document, the issue shall be classified as an urgent action item and SySTEM shall rectify the issue immediately and completely, or otherwise develop an action plan for closing the issue based on the availability of requisite resources. In the event a quality issue is identified that does not render a product non-viable or otherwise demonstrate discordance with the values and requirements specified in this document, SySTEM may perform a risk assessment as needed and should take steps to address the issue based on its relative priority.

Per the principle of action-driven performance, formal roles within the SySTEM organization shall be assigned based on demonstrated, quality commitment to providing constructive support to the SySTEM mission, as evaluated based on contributions to SySTEM deliverables and auxiliary products, and shall not be pre-emptively assigned.

Per the principle of quality-based performance, SySTEM shall also ensure that its recommendations and products are designed to be of long-term use and sustainable to the greatest extent possible. SySTEM should thus take reasonable steps to ensure that obstacles to implementation are identified and addressed in all of its recommendations, and to minimize the logistical, financial, and resource burdens anticipated to be associated with the implementation

[1] This difference can be exemplified by the distinction between (a) advocating for relevant ST competencies to be included in arts curricula and tailoring the integration of those concepts to the educational context (infrastructure change), and (b) advocating for arts students to take engineering courses to fulfill general education requirements (behavior change).

of such recommendations. SySTEM's efforts shall furthermore be user-focused and maintain alignment with user input.

2.3.4. Integrity and ethical conduct

SySTEM and its members shall abide by existing ethical standards for engineering professional conduct. The INCOSE Code of Ethics[2] is incorporated herein by reference, and shall represent a minimum standard of ethical behavior according to which all SySTEM members shall conduct themselves.

SySTEM also acknowledges that its efforts, if successful, have the capacity to result in substantial changes in the way in which STEAM education is implemented internationally. SySTEM shall therefore abide by the principle of "do no harm" and shall not make recommendations or perform actions which have a high risk of causing or exacerbating disproportional educational outcomes on the basis of protected characteristics, or otherwise negatively impacting performance metrics relevant to the impacted educational system(s). The burden of proof for demonstrating that a given SySTEM recommendation or action is viable, implementable, and positively impactful is placed on the SySTEM Initiative as the organization making the recommendation or proposal for action. SySTEM may prepare impact assessment(s) to support its major proposals, recommendations, or action plans; in such cases, SySTEM shall make the results of such assessments public alongside the associated documentation in accordance with Section 2.3.1 above.

3. Organizational strategy

3.1. Strategic objectives & goals

SySTEM's primary strategic objective is to facilitate achievement of the mission described in Section 2.1, in furtherance of the vision detailed in Section 2.2., through a combination of community engagement/advocacy efforts and the development of implementable recommendations, guidelines, and resources.

SySTEM strives to achieve the following goals in support of that objective:

(1) Introduce disciplines and competencies through early and continuous education;
(2) Set up a steering committee to direct strategies and initiatives with respect to adding value to systems engineering education; and
(3) Foster a community of educators, academics, professionals, and stakeholders in promoting systems competencies.

As reflected by SySTEM's goals, engagement with stakeholders shall be a critical component of SySTEM strategy. Achievement of the above-stated goals shall thus require close interaction and partnerships with individuals across various disciplines, sectors, and geographic regions. The SySTEM member(s) responsible for negotiating such partnerships should have the ability to organize collaborations with groups on an individual (non-organizational level), so long as the partnership benefits the SySTEM mission, is in agreement with the values and requirements

[2] Presently available online at: https://www.incose.org/about-incose/Leadership-Organization/code-of-ethics.

stated in this document, does not involve any financial transactions, and does not fall afoul of any other constraints (e.g. conflict of interest guidelines). The negotiation and formalization of financial agreements or memoranda of understanding/agreement involving SySTEM, should any arise, may require additional approval.

3.2. *Evaluation*

The SySTEM Initiative shall be deemed to have concluded upon successful completion of its end deliverables. SySTEM's end deliverables are as follows:

(1) a framework for integrating systems thinking into STEAM curricula;
(2) a long-term self-sustaining committee for implementing this framework based on community input; and
(3) a template/framework for industry/company engagement in STEAM;
(4) an interdisciplinary community of educators, administrators, academic/industry professionals, and other STEAM stakeholders whose input can be used to support the SySTEM vision.

These "end deliverables" represent the minimum set of completed products required for SySTEM's fundamental mission objectives to be completed, and do not include intermediate products and support architecture which may need to be developed in order to enable SySTEM's activities.

Successful delivery of the aforementioned items will be ascertained based on attainment of the following minimum viability criteria at the time of evaluation:

(1) Completion of a SE/ST-STEAM integration framework that has:
    1. Implementable (i.e. with sufficient detail to be executed by a third party) recommendations for integrating SE/ST into STEAM education;
    2. Basis in community input;
    3. Description(s) of the minimum resources and infrastructure required for implementation of the recommendations;
    4. Recommendations addressing all the core SE competencies in the INCOSE Competency Framework;
    5. Recommendations which span the entire STEAM educational pathway (primary to postgraduate);
    6. Recommendations which can be directly traced to common stakeholder needs identified from SySTEM participant input (i.e., the framework should pass verification testing and be traceable to the requirements imposed on SySTEM in this document);
    7. At least one section with recommendations specifically addressing the inclusion and integration of ST/SE skills in arts and humanities curricula, extending beyond simply mandating the inclusion of science/engineering coursework as a general education requirement;
    8. Commentary addressing recommended practices for implementing the framework in at least three different international regions/educational systems;

9. An impact and risk assessment of the burden and repercussions expected with implementation of the requirements;
10. Appropriate commentary or auxiliary documentation providing the rationale for the recommendations provided, including references to existing studies, analyses, and standards as needed to justify the necessity or utility of such recommendations;
11. Standardized methods for evaluating successful implementation of each recommendation via qualitative and quantitative means;
12. Approval from the academic, industry, and non-SE sectors, with at least three different approving stakeholder organizations representing each sector (i.e. the framework should pass validation testing);
13. A copy posted online for public viewing and use, free of charge.

(2) Establishment of a committee that has:
1. An established chair/committee lead;
2. Appropriate bylaws governing its purpose, conduct, and actions;
3. Membership drawn from existing SySTEM participants with demonstrated commitment to the SySTEM vision;
4. Representatives from both industry and academia;
5. Representatives from at least three different continents;
6. Representatives from outside the engineering community;
7. Has at least five actively participating members, where active participation is defined as attendance of over 75% of group meeting and constructive/non-trivial contributions to group products.

(3) Completion of a framework for industry engagement that has:
1. A checklist of items that companies and organizations can use to evaluate their present alignment with the SySTEM vision and values (e.g. transparency in hiring requirements, formal recognition of education-based equivalencies for experience requirements, etc.), and/or to improve their alignment with SySTEM standards;
2. Classification of items in the checklist based on difficulty of implementation and criticality to achieving alignment with SySTEM's interests;
3. Appropriate commentary or auxiliary documentation providing the rationale for the recommendations provided, including references to existing studies, analyses, and standards as needed to justify the necessity or utility of such recommendations;
4. Alignment with industry stakeholder needs as identified through SySTEM outreach efforts;
5. A copy posted online for public viewing and use, free of charge.

(4) Establishment of an interdisciplinary community that has:
1. A designated, virtual space for collaboration and discussion, which is open to all interested parties and is accessible at no cost to participants;
2. At least one hundred registered members;
3. At least 20% active engagement from its registered members (not inclusive of the committee members described in item 2), where active engagement is

measured as the percentage of registered users who contribute at least one relevant comment/posting per month in the discussion forum;

4. Active engagement from at least 50% of its members who have been participants in the group for more than a month (i.e., the community body should not show significant attrition in participation metrics after signup)
5. Active participants from both industry and academia;
6. Active participants from at least three different continents;
7. Active participants from outside the engineering community;
8. An associated discoverable online page through which members of the public can find and join the community.

Appendix A: Acronyms and abbreviations

The non-standard acronyms and abbreviations which were utilized in this document are defined in the table below. All entries are listed in alphabetical order for convenience.

Acronym/abbreviation	Definition
INCOSE	International Council on Systems Engineering
MOA	memorandum of agreement
MOU	memorandum of understanding
SE	systems engineering
ST	systems thinking
STEAM	science, technology, engineering, and mathematics
STEM	science, technology, engineering, arts, and mathematics
SySTEM	Systems, Science, Technology, Engineering, and Mathematics (Initiative)