

# Systems Processes and Pathologies: Creating an Integrated Framework for Systems Science

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**Abstract.** Among the several official projects of the INCOSE Systems Science Working Group, one focuses on integrating the plethora of systems theories, sources, approaches, and tools developed over the past half-century with the purpose of enabling a new and unified *\_science\_* of systems as a fundamental basis for SE. Another seeks to develop a much more SE-usable Systems Pathology also grounded in a *\_science\_* of systems. This paper introduces the wider SE community to the current status of this unique knowledge base produced over the past three years by an INCOSE-ISSS alliance summarizing the current output of 7 Workshops, 12 Papers, >24 Presentations or Webinars, and 5 Reports. It describes the need for integration of systems knowledge by demonstrating the extensive fragmentation of numerous contributing fields. It presents the current 12-step *\_protocol\_* used by the current group to guide its efforts at synthesis across systems domains, disciplines, tools, and scales asking for feedback to improve the approach. It introduces 15 Working Assumptions or Hypotheses that form the foundation for this attempt at unification citing why these could be used as working principles but why it may be undesirable to call them *\_principles\_* as others often do. The paper presents working frameworks for integration and criteria used to judge whether results are a *\_science\_* of systems or not with reminders that these early guidelines are being subjected to constant testing and revision. The paper ends with images of the resulting *\_system\_* of systems processes theory (SoSPT) and its major spin-off, the new top-down Systems Pathology. Fiftyfive key Systems Processes are listed that are dynamically and causally joined by more than 200 Linkage Propositions resulting in a much more detailed general theory of how systems work than previously known. The paper argues these products and the networked community of scholars working on them could prove very useful to future SE design, testing, modeling/simulation, and gradual evolution of better SE understanding of the sustainability, maintenance, and repair of systems of all kinds, far beyond those currently served by SE.

## Biography

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Dr. Len Troncale is Professor Emeritus of Cell and Molecular Biology, and past Chairman of the Biological Sciences Department at California State Polytechnic University. He is also Director of the Institute for Advanced Systems Studies, and Coordinator of its NSF-supported Systems-Integrated-Science General Education Program. He has served as VP and Managing Director of the International Society for General Systems Research (SGSR) for six years, and President of the International Society for the Systems Sciences (ISSS) for the three year cycle. He has served as Visiting Professor at the University of Vienna, Austria, CSU Monterey Bay, and CSU Sonoma and as Research Associate at IIASA (the International Institute for Applied Systems Analysis at Laxenburg, Austria). He was a member of the Board of Directors of IFSR (International Federation for Systems Research) and still serves on the Board of Trustees for ISSS. Currently he has been presenting numerous talks at INCOSE and at Systems Biology conferences and serves as Lead for two official projects of the Systems Science Working Group of INCOSE (the International Council on Systems Engineering). Dr. Troncale has published 87 articles, abstracts, editorials and reports, 18 conference posters, served as Editor on 11 projects, delivered 115 invited and computerized presentations and demonstrations in 23 countries and served as P.I. on 52 grants and contracts for \$5.3M from a variety of federal, state, and private organizations such as the NSF, DOE, ONR, HUD, the HHMI and the Keck Foundation, as well as the CSU System.