Systems Approach for Modeling Interactions Among the Sustainable Development Goals Part 1:
Cross-Impact Network Analysis

David Zelinka, Mortenson Center in Engineering for Developing Communities, University of Colorado Boulder, Boulder, USA

Bernard Amadei, Mortenson Center in Engineering for Developing Communities, University of Colorado Boulder, Boulder, USA

ABSTRACT

This article advocates for a systems approach to analyzing the SDGs, categorized as an anthropocentric network. Cross-impact analysis, a semi-qualitative, soft-systems approach is used to explore the connections among the SDGs. This approach can better capture the science underlying the SDGs' interactions in a generic manner compared to existing methods. The suggested approach enables users to: (1) get a better qualitative and quantitative understanding of how the SDGs interact; (2) detect emerging patterns resulting from those interactions; (3) use context-specific information about direct impacts to identify indirect effects; and (4) identify leverage points hidden within the SDGs. The article also discusses how network analysis complements cross-impact analysis as a mathematical approach to understanding patterns of interactions among the SDGs. The term cross-impact network analysis is proposed to describe the synergy between these two analytical methods. This article is the first of two papers systematically analyzing the interactions between the SDGs.

KEYWORDS

Cross-Impact Analysis, Interactions, Network Analysis, Soft System, Sustainable Development Goals, Systems Approach, Systems Thinking

1. INTRODUCTION

1.1. The Sustainable Development Goals

In 2015, the United Nations introduced the Sustainable Development Goals (SDGs) as a new 15-year long road map for worldwide sustainable development (United Nations, 2016). The 17 SDGs listed in Table 1 consist of 169 targets and 230 indicators. As described in the resolution adopted by the General Assembly on 25 September 2015, the aim of the SDG framework is to cultivate and expand humanity's desire to "do good" while also organizing its ability to do so. The SDGs "…seek to build on the [previous] Millennium Development Goals (MDGs) and complete what they did not achieve" (United Nations General Assembly, 2015, p. 1). In launching the SDGs, the General Assembly of the United Nations "recognize[d] that eradicating poverty in all its forms and dimensions (including extreme poverty) is the greatest global challenge and an indispensable requirement for sustainable development" (United Nations General Assembly, 2015, p. 1). To that end, the SDGs represent "a

Table 1. The 17 Sustainable Development Goals (adapted from Global Goals, 2016)

Goal	Title	Description
SDG 01	Poverty	End poverty in all its forms everywhere
SDG 02	Food Security	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
SDG 03	Health	Ensure healthy lives and promote well-being for all at all ages
SDG 04	Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
SDG 05	Gender equality	Achieve gender equality and empower all women and girls
SDG 06	Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all
SDG 07	Energy	Ensure access to affordable, reliable, sustainable, and modern energy for all
SDG 08	Economy	Promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all
SDG 09	Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation
SDG 10	Inequality	Reduce inequality within and among countries
SDG 11	Cities	Make cities and human settlements inclusive, safe, resilient, and sustainable
SDG 12	Consumption	Ensure sustainable consumption and production patterns
SDG 13	Climate	Take urgent action to combat climate change and its impacts
SDG 14	Ocean	Conserve and sustainably use the oceans, seas, and marine resources for sustainable development
SDG 15	Land	Protect, restore, and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
SDG 16	Governance	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable, and inclusive institutions at all levels
SDG 17	Partnerships	Strengthen the means of implementation and revitalize the Global Partnership for Sustainable Development

plan of action for people, planet, and prosperity," which in addition to peace and partnership, define the five "P's" of the mission of the SDGs. To accomplish that mission, there needs to be a "balance [between] the three dimensions of sustainable development: the economic, social, and environmental" (United Nations General Assembly, 2015, p. 3). It must be acknowledged that fulfilling the mission of sustainable development is indeed a daunting task, a truly formidable undertaking, unparalleled in human history.

It should be noted that even though there are many goals and targets, eradicating extreme poverty (SDG 01) is the ultimate goal, but only if it is accomplished in an environmentally benign way. The other goals can be understood as constraints and requirements that the goal of eradicating extreme poverty must also satisfy.

From the inception and ultimately the adoption of the SDGs, there has been an increasing interest in understanding and quantifying their interactions (Costanza et al., 2016). Multiple papers and reports have been produced by various organizations to identify important linkages among the

16 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/article/systems-approach-for-modeling-interactions-among-the-sustainable-development-goals-part-1/216960

Related Content

Theory of Cooperative Coevolution of Genes and Memes
Vladimir Kvasnickaand Jiri Pospichal (2008). *Reflexing Interfaces: The Complex Coevolution of Information Technology Ecosystems (pp. 33-45).*
www.irma-international.org/chapter/theory-cooperative-coevolution-genes-memes1/28370

Networks: Uses and Misuses of an Emergent Paradigm
Alessandro Giuliani (2008). *Reflexing Interfaces: The Complex Coevolution of Information Technology Ecosystems (pp. 174-184).*
www.irma-international.org/chapter/networks-uses-misuses-emergent-paradigm/28378

Design and Analysis of a Novel Hybrid Wireless Mesh Network Routing Protocol
Muddesar Iqbal, Muhammad Shafiq, Jin-Ghoo Choi, Hasina Attaullah, Khawar Akramand Xingheng Wang (2014). *International Journal of Adaptive, Resilient and Autonomic Systems (pp. 20-39).*
www.irma-international.org/article/design-and-analysis-of-a-novel-hybrid-wireless-mesh-network-routing-protocol/118296

Application of Machine Learning Techniques to Predict Software Reliability
Ramakanta Mohanty, V. Raviand M. R. Patra (2012). *Principal Concepts in Applied Evolutionary Computation: Emerging Trends (pp. 237-253).*
www.irma-international.org/chapter/application-machine-learning-techniques-predict/66823

COADA: Leveraging Dynamic Coalition Peer-to-Peer Network for Adaptive Content Download of Cellular Users
Long Vu, Klara Nahrstedt, Rahul Malikand Qiyan Wang (2013). *Innovations and Approaches for Resilient and Adaptive Systems (pp. 238-257).*
www.irma-international.org/chapter/coada-leveraging-dynamic-coalition-peer/68954