Sociodynamics of the UN Sustainable Development Goals

Modeling Societies in the Era of Sustainable Development

Objective of Proposed Research

The objective of this research is to create a dynamic modeling framework for understanding the large transitional sociodynamic processes that would arise in the event of implementing UN Sustainable Development Goals (SDGs) while staying on track with climate change mitigation efforts to limit the warming of the planet to 2 degrees by the end of the century. As the SDGs are spanning across all aspects of life, from poverty to peace to energy, it is crucial that we analyze and quantify the potential of societies of achieving these 17 goals in parallel and what are the positive (or negative) implications of it on the global and national economies, industries, energy and security, as well as migration, conflict and well-being and happiness

Proposed Research Plan

In order fulfill the stated objective, my aim is to create a hybrid system-dynamics and agent-based dynamic network model that can simulate altruistic or utilitarian individual social decisions, as well as the resulting emergence of complex societal preferences. Creating a seperate network configuration for each of the SDGs will open the windows of opportunity to investigate cross-goal dynamics under different societal behaviors. I intend use a net-energy approach rooted in biophysical economics, using the energy intensity of services as the key driver metric.

The underlying theme of all 17 SDGs is energy and equity – the epitomial definitions of William Forster Lloyd's famous *tragedy of the commons*. At COP21, global leaders and scientists made it clear that with every passing day there is a more urgent need for the world to transition away from carbon-intensive fuels in order to avoid catastrophic climate change. Without doubt, a collaboration of countries of unprecedented scale is necessary alongside massive societal behaviour change – but the consensus is that this is primarily an energy-related challenge, balancing two partially contradictory objectives: substituting fossil fuels fast enough to stave-off the worst consequences of climate change while maintaining a sufficient net energy flow to support the world's economy and population. The global energy system is the most interconnected societal infrastructure: planning a complete redesign of such a system with implications on global and local economy, climate, food production, conflicts and many other aspects of modern life is mainly not a technical but a systemic challenge.

In recent decades in science we have witnessed a tremendous boom in the engineering, medical and computer sciences. However, social sciences were a bit lacking behind – mostly because of the cumbersome social data-collection necessities. All of this is about to change – fast! Complex systems modelling techniques (statistical physics, non-linear dynamics, ecological economics) were developed by the postbellum science wave, but were mostly dormant until recently, fostered by the boom in computing power. The exponential increase in data availability and information visualization put some other fields in the spotlight as well, starting with the early 90s: statistical physics and network science – spearheaded by Albert-László Barabási at Northeastern and Harvard Medical School – as well as multi-agent systems and more recently an emerging computerized statistical data mining, analysis and visualization field collectively called data science. Therefore, perhaps for the first time in history we have the theoretical background, the modelling tools – by transferring the lessons from engineering – as well as the data – big – to foster understanding and perhaps create higher confidence dynamic forecasts of behavior of complex systems. And what could be more complex than society and social systems in a stasis of sustainable development?

Expected Results and Impacts

The expected results of this research are country briefings, built around global and country-level simulation data sets describing the social dynamics and potential social and economic development opportunities (or dangers) as advancement is made towards the fulfillment of the SDGs globally, as well in each country – e.g. is there any significant burden to achieving SDG 8 (Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all), if there was significant advancement in SDG 14 (Conserve and sustainably use the oceans, seas and marine resources for sustainable development) or SDG 4 (Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all), say in a small Pacific island nation. We will achieve this through creating a dynamic simulation model that models societies' decisions within the framework of each goal and further investigate the interactions as progress is made on others.

Therefore the main output of this work is handbooks for all countries, tailored to their own geographic and societal characteristics, serving as advice towards implementing and prioritizing SDGs. A general report will also be produced as an interactive, open-sourced website with a data visualization, where anyone can simulate scenarios of their own.

In terms of implementation timeline, I envisioned this project as lasting 24 for months and I would be spending the first 6 months by data mining and particularizing datasets to countries (an objective greatly facilitated by already existing work that I have delivered for my PhD dissertation), spend the next 9 months with developing the model and analyzing the results, while the last 9 months would be used for hashing out the results and presenting it at international forums or conferences, as well as to produce scholarly publications and the country recommendations.

Present Research Related to Research Proposal

I believe that I bring a unique set of skills to this project and HKS, an interdisciplinary research spanning over all aspects of data science (mining, analysis and visualization) and complex systems modeling (system dynamics, agent-based, game-theory, network science, social media analysis). Having deployed two major works in complex system modeling (the global aviation system for my Master's degree and the global energy system for my PhD) and having vast experience with social data mining (lead of data blog with more than a 1000 followers), I have not only developed a critical systems thinking mindset, but also a hands-on problem-solving capacity for complex problems.

Furthermore, having spent my past 5 years in Masdar City, Abu Dhabi, envisioned as a global leader in sustainability and home to the International Renewable Energy Agency (IRENA) and in Cambridge at MIT, I had constant exposure to international policy, high-level decision making and I was in the center of the climate-sustainability-renewable energy discussion. Having seen Professor Jeffrey Sachs present the SDGs last October at the MIT SOLVE Conference live, strengthened my lifelong motivation and dedication to continue working in this field.

Denes Csala

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