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EDITORIAL

Modeling for sustainability: Sustainable Development Goals (SDG) of the United Nations

Benoit Combemale[1] · **Jeff Gray**[2] · **Bernhard Rumpe**[3]

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Our world has pressing problems. We are glad that the United Nations has undertaken the effort to develop a framework for defining the most pressing Sustainable Development Goals (SDGs) and how they should be addressed. Their website (https://sdgs.un.org/goals) summarizes the 17 goals for sustainable development as follows:

This list of SDGs was adopted by all United Nations Member States in 2015. It also embodies an urgent call for action by all countries to help end poverty and other deprivations, improve health and education, reduce inequality, spur economic growth, tackle climate change, and preserve our oceans and forests.

✉ Bernhard Rumpe
bernhard.rumpe@sosym.org

Benoit Combemale
benoit.combemale@sosym.org

Jeff Gray
jeff.gray@sosym.org

1 University of Rennes, Rennes, France

2 University of Alabama, Tuscaloosa, Alabama, USA

3 RWTH Aachen University, Aachen, Germany

When SoSyM was created in 2001, computer science was still mainly engaged with its own foundations. Meanwhile, computer science, software engineering, and modeling communities have matured over the past two decades. Foundations are still not perfect, but our understanding of how to model systems has considerably improved. Of course, we now have many different kinds of explicit models (e.g., UML and SysML), executable models (using mainly programming languages), mathematical models (using mathematics and logic), and also learned models (using neural networks).

It is intriguing to further consider how we can apply our knowledge on modeling to improve the situation summarized in these 17 goals of sustainability, such as:

- Understand the world in a better way,
- Predict the impact of industrial, governmental and societal changes before they are "implemented",
- Identify new technologies, new forms of social, governmental, or industrial interactions,
- Replace unhealthy habits by better ones.

Our forms of explicit modeling and code generation at first seem relatively agnostic to most of these SDGs. However, many forms of research seek to understand the world and also to predict changes and impacts that are based on software that extracts information from the data. Therefore, our forms of modeling can and should play a major role. Actually, it already does, because we can see many scientific papers explicitly using models of various forms, or about code for new digitalization technologies being developed. As computer scientists, we are also aware that many modelers are not using UML/SysML for explicit modeling, but rely on paper-based mathematics and manually designed architectures, and data structures. A sound and robust foundational integration between these different forms of models is still very much needed.

There is also an increasing amount of domain-specific modeling languages (DSLs) that embody domain knowledge as an explicit part of the language. Often, these languages have nothing to do with software, but try to capture real-world phenomena. These forms of languages may be very helpful in capturing the SDGs. However, there is a significant amount of work needed to address these 17 SDGs, which are themselves decomposed into 169 targets that require further decomposition into geographic and regional areas with very specific regional, societal, political, economic and climatic differences. Good models should be able to describe interactions between these targets, should enable understanding of counter effects, should be robust against missing data and individual people or even governments lying about the actual situation.

As an example, consider the daily traffic of workers to their workplace. Digitization allows employees to work at a home office, considerably reducing the CO_2 footprint. As a seriously measurable rebound effect, workers may migrate farther away from a downtown workplace, which increases the CO_2 footprint because of longer travel on days when they visit a physical office. Other consequences include larger homes (to be built and heated), additional road maintenance, larger cars, and less public transport.

Understanding the effects by having appropriate models available for the prediction of the outcomes of governmental and industrial changes on the 17 SDGs above would be beneficial. That is not currently possible, but using good models for this form of prediction is the only way to identify the optimal solutions. Many scientists are focusing in this direction. Our belief is that we should be more effective in developing these kinds of models and integrating them into a larger, well-composed model of the world, with various forms of abstractions and detailed dependencies between them. The modeling community may also help by defining a meta-modeling infrastructure that allows the integration of various kinds of models that may be defined in different technical spaces.

We look forward to seeing more explicit, well-argued, and validated models of the SDGs, their targets, and their interactions. We also expect new (domain-specific) modeling languages for describing SDGs and their interdependencies, but it is really the models and their usability for understanding and healing the world that are of high interest.

To further encourage research on healing the world, we ask authors to identify the specific SDGs that are part of their submission's contribution.

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