Brief for GSDR – 2016 Update

An Interactive Learning Model for Implementing the Sustainable Development Goals

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INTRODUCTION

In September 2015 The Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development were adopted by 193 countries (United Nations, 2016, UNDP, 2016). There are 17 SDGs in all, addressing humanitarian and environmental problems including poverty, education, health, biodiversity, and climate change (United Nations, 2016). Attention now turns to designing and implementing policies to achieve the SDGs by the designated completion year of 2030.

This presents a huge challenge to policy-makers and planners. Many of the SDGs are linked, often in subtle ways. Actions to achieve SDGs in one sector can cause unexpected underachievement or loss of ground in another, both within and between countries (Young et al. 2014). Conversely SDG policy in one sector might cause synergistic gains in another. The SDG policy environment is a complex system characterized by interwoven feedback loops, lengthy time lags between causes and perceived effects, inertias and nonlinearities that are typically underappreciated. Such systems are known to be highly problematic for learning and policy design (Groesser and Schaffernicht, 2008; Sterman, 1994). Also learning through experimentation is essentially impossible due to expense and lengthy time lags. There is clearly a need for a tool to aid learning and policy design focused on SDG attainment.

The Millennium Institute has responded to this need by developing the Integrated Sustainable Development Goal (iSDG) model. The iSDG model is an interactive simulation model designed for policy-makers and planners within governments, international organizations, or any others concerned with finding pathways to the Sustainable Development Goals. The iSDG model is a national scale model with relatively coarse detail resolution and is not intended to replace finer resolution sector-focused models. Rather, the purpose is to help policy-makers and planners make sense of the dynamic complexity they face in their policy environment, and to help them design efficient and realistic pathways to their goals. The iSDG model can be calibrated for any country or region and its respective set of SDGs.

THE iSDG MODEL

The iSDG model builds on the Threshold 21 integrated national planning model that has been used in over 40 countries worldwide. The iSDG model is developed in the Vensim DSS software with user interface developed in Sable software.

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The macro structure of iSDG is comprised of 30 interlinked model sectors distributed across the three primary dimensions of sustainability: society, economy, and environment (Figure 1). The model explicitly accounts for feedback loops running between and within sectors, stocks and flows, nonlinear relationships, and time lags that generate the dynamically complex system behaviors that characterize the challenging planning environment for the Sustainable Development Goals.

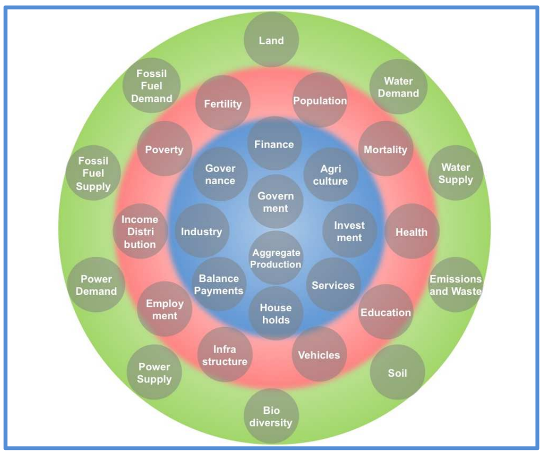

Figure 1. Macro structure of the iSDG model showing the distribution of model sectors within economic (blue), social (red), and environmental (green) dimensions.

The iSDG model can be thought of as a learning support system to aid evidence-based policy design. To further this cause the developers have placed a high premium on transparency and user-friendliness.

Transparency

To promote transparency the model has been thoroughly documented and described. Support materials are available online and include detailed descriptions of each model sector, making use of causal structure diagrams as well as verbal description. For each sector major assumptions, exogenous input variables, and initialization parameters are listed. References supporting the key assumptions are also available. Figure 2 is an example of a sector causal diagram, in this instance of the transportation infrastructure sector, which will be discussed in more detail in a later section of this brief.

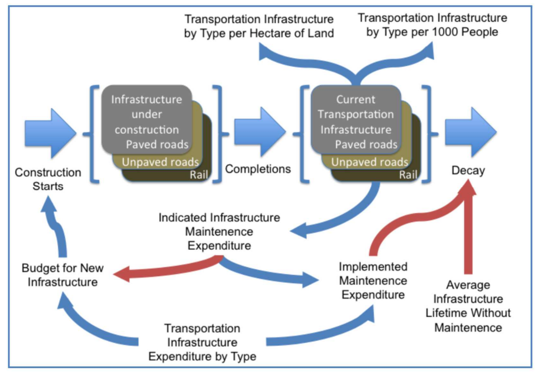

Figure 2. Causal structure of transportation infrastructure sector. The rectangles with rounded corners represent stock variables (accumulations), the thick arrows represent flows that increase or decrease the stocks. The thinner blue and red arrows indicate positive and negative causal linkages respectively.

User-friendliness

The model is accompanied with video and written support materials explaining how to set up and operate the model. Example simulations are performed on video.

The model features an intuitive user interface. The behavior of the system is shown in time series graphs and in numerical tables. Causal diagrams are used to link the behavior to underlying structure. The model simulates almost instantly. The fast simulation makes for a short learning loop, meaning that users receive immediate feedback from simulation experiments. This speeds learning and helps build user intuition.

SIMULATING THE iSDG MODEL

This section introduces the iSDG user interface and gives an example of a simple policy simulation for a low-income eastern African country.

The user interface provides a table of icons for each of the 17 SDGs (Figure 3). Under each icon a red horizontal bar indicates the expected attainment of the SDG by year 2030 if no changes are made in current policies and if no unexpected external shocks occur - ‘business as usual’ conditions. After a simulation is run, a blue horizontal bar appears underneath the business-as-usual bar indicating SGD attainment under the simulated policy or policies. This provides users a quick reference to the state of attainment across all 17 SDGs.

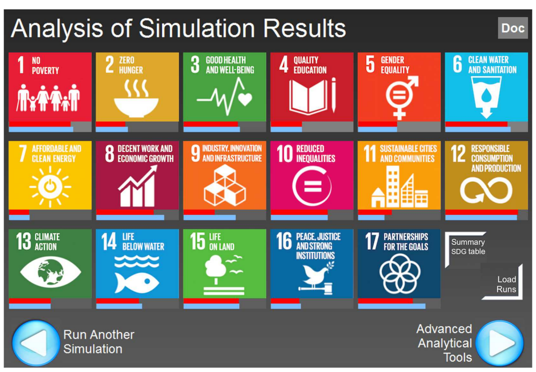

Figure 3. Interactive table of icons representing the 17 SDGs.

Clicking on an icon opens a window in which interventions for a particular SDG can be specified. In the current example SDG 9 (‘Industry, Innovation and Infrastructure’) is selected. In our example, an expenditure rate of 1.5 % of GDP is entered for road infrastructure investment (Figure 4). The sources of expenditures can be specified in a separate window (Figure 5). For this case there are two possible sources of revenue, taxes or foreign grants. Any combination of these two can be specified. In this example we assume 100% funding from foreign grants.

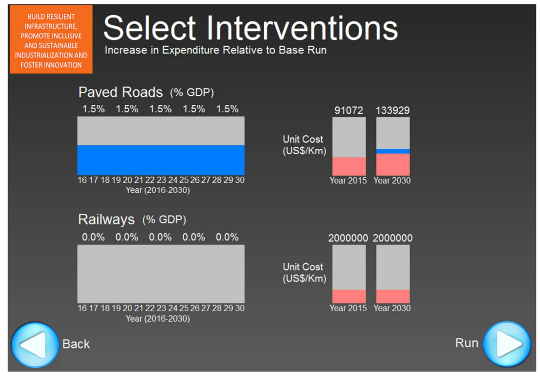

Figure 4. Window for SDG policy intervention.

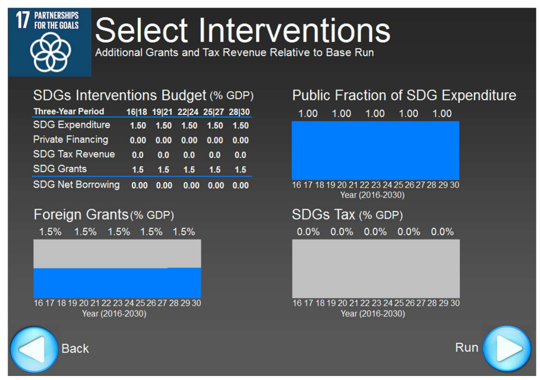

Figure 5. Window for specifying intervention funding sources.

When the simulation is run a diagram showing causes and effects emanating from the selected policy intervention is shown (Figure 6). Clicking on any of the variables in the diagram reveals the trajectory of the variable over the time horizon of the SDGs. This causal diagram helps make the connection between model behavior and structure, an important element of model-based learning.

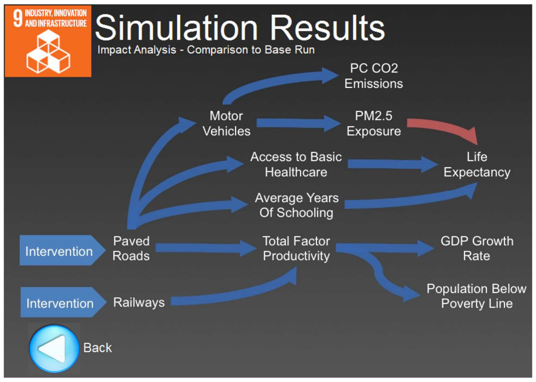

Figure 6. Causal map of transportation infrastructure. Blue arrows indicate positive causal linkages (changes in the variable at the arrow's base tend to cause changes in the same direction in variables at the arrow's point). Red arrows indicate negative causal linkages (changes in the variable at the base cause changes in the opposite direction in the variable at the point).

As shown in Figure 7 the selected policy causes a large increase in transportation infrastructure.

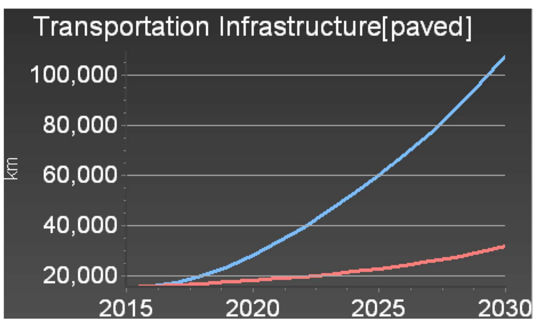

Figure 7. Simulated trajectories of paved roads infrastructure, red curve is business-as-usual, blue curve is the policy response.

Positive influences of infrastructure investment on access to health care, education, total factor productivity and poverty are seen in Figure 8. Improvement in total average years of schooling (Figure 8) only becomes apparent only after year 2025, due to natural time lags associated with increasing the population of more highly educated adults.

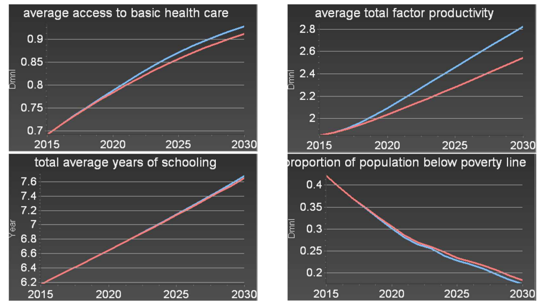

Figure 8. Simulated trajectories of average access to basic health care, total average years of schooling, average total factor productivity, proportion of population below poverty line for business-as-usual (red) and under infrastructure investment policy (blue).

Unfortunately not all influences of road expansion are favorable. As shown in Figure 9, expanded road infrastructure is associated with a greater population of vehicles and consequently greater CO2 emissions. More vehicles, coupled with ongoing population growth in urban centers, causes greater exposure to air pollutants (pm 25 levels). The harmful effect of air pollutants countervails the improvement in access to basic health care, rendering the average life expectancy almost unchanged.

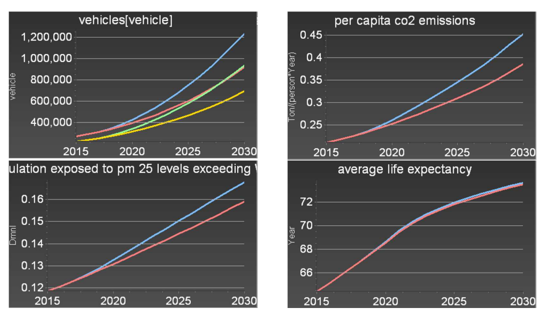

Figure 9. Simulated trajectories for vehicles (commercial and non-commercial, red and yellow for business-as-usual), per capita CO2 emissions, proportion of population exposed to PM 25 levels exceeding WHO recommended limits, and average life expectancy.

CONCLUSION

Because of its integrated and transparent structure, the iSDG model can reveal policy impacts that are unexpected and sometimes undesired - as demonstrated in the simulation described.

Interactive experiments with the iSDG model give planners and policy-makers the opportunity to reduce risks of failure by assessing policy impacts *before* adoption, and provide means to design and test evidence-based policies for greater likelihood of achieving the Sustainable Development Goals.

A demo version of the iSDG model and full supporting documentation is available at www.isdgs.org.

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