

# Models for National Planning

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*Standards for national planning models are changing. The World Bank (WB), UN Development Programme (UNDP), the International Monetary Fund (IMF), and many bi-lateral funders have adopted Comprehensive Development Framework (CDF) and Poverty Reduction Strategy Paper (PRSP). The CDF, PRSP, and the Millennium Development Goals (MDGs) make new demands for transparency, comprehensiveness, and user-friendliness in national models. While the WB's Revised Minimum Standard Model-Extended (RMSM-X) and the IMF's Financial Planning Framework (FPF) model continue to dominate, they are outdated and do not meet the new standards. A review of currently available national planning models was funded by Conservation International and published by the University of Bergen; the review ranks highest a System Dynamics model called Threshold 21 (T21). This paper summarizes the review, presents an overview of the T21 model and some of its recent national applications, and describes emerging partnerships using T21.*

## Introduction

Since the founding of the World Bank and the IMF and in 1948, standards for national planning models have been set by these institutions.<sup>1</sup> The analysis done with the models of the Bank and Fund influence not only the billions invested by these institutions annually, but also trillions more invested by commercial banks and corporations.

The modeling standard of the World Bank, for example, is simply a model capable of producing the so called CAS table, which is a large table found in an appendix of each Country Assistance Strategy (CAS) prepared by the Bank's economists for each country client of the Bank. The CAS is a country specific strategy that is written by Bank staff and must be approved by the Bank's board of Executive Directors before loans can be made to the country. The standards for the CAS were for decades specified in Bank Procedures documents.<sup>2</sup> The one specifically for the CAS is BP 2.11.

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<sup>1</sup> The UN's development activities are not guided by country specific models. Instead, the UN agencies use the UN Development Assistance Framework (UNDAF), which is a large table of historic data and indicators relating to development processes.

<sup>2</sup> See for example, "Country Assistance Strategies", Bank Procedures: The World Bank Operational Manual, BP 2.11, January 1995.

The only model mentioned in BP 2.11 and the only model supported by the Bank for preparing the CAS is the Bank's Revised Minimum Standard Model Extended (RMSM-X).<sup>3</sup> The model is a spreadsheet in several workbooks, which if pasted together would be roughly 10 columns by 5,000 rows. Its only dynamic element is the Harrod-Domar production function<sup>4</sup>, which dates from 1946 (see Figure 1).



## *RMSM-X Production Function*

$$\Delta \text{GDP}_i = \frac{\text{Capital Investment}_{i-1}}{\text{ICOR}}$$

ICOR = Incremental Capital Output Ratio

Figure 1: The Harrod-Domar Production Function used in the World Bank's RMSM-X Model

In first year economics, students are taught that a production function is a function of land (resources), labor (including labor productivity), capital, and technology (see Figure 2).

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<sup>3</sup> Mills, C.A. and Nallari, R, *Analytical Approaches to Stabilization and Adjustment Programs*, Economic Development Institute of the World Bank, EDI Seminar Paper No. 44, 1992.

<sup>4</sup> Domar, Evsey. "Capital Expansion, Rate of Growth, and Employment", *Econometrica*, Vol. 14, (April 1946), pp. 137-47.



## *Basic Production Function*

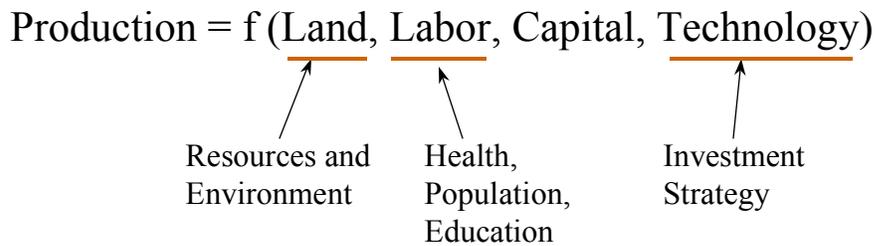


Figure 2: A Basic Production Function From First Year Economics

As shown in Figure 3, the Harrod-Domar production function omits all factors of an elementary production except capital. This means that there is no way to connect to RMSM-X any consideration of health and education on labor productivity, or resources conservation on production, or environmental factors on health and productivity, or population growth on the labor force, or development strategy on technological investment. In effect RMSM-X counts all the costs of education, health, family planning, resource conservation, and pollution control, and none of the benefits.



## RMSM-X Production Function

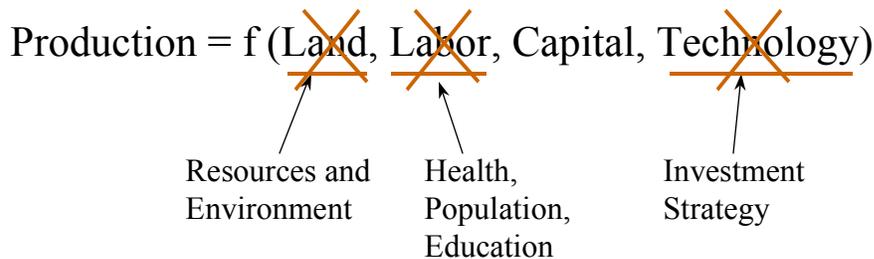


Figure 3: Omissions from the World Bank's RMSM-X Production Function

(The Fund's model is also a spreadsheet (~5,000 cells) called the Financial Planning Framework model.<sup>5</sup> It is simpler than RMSM-X, has no endogenous dynamics, and is entirely exogenously driven.)

RMSM-X and the Harrod-Domar production function have been criticized intensely for decades<sup>6</sup>, but to no avail. Over the years, the criticisms of the Bank and Fund models have become increasingly severe, and even include voices from within the Bank and Fund.<sup>7</sup> While many people now recognized the severe limitations of RMSM-X, it seems that no one at the Bank with a good technical understanding of the problems of RMSM-X feels they have the authority to bring about a change in the model used by the Bank, so RMSM-X continues to be used decade after decade.<sup>8</sup>

<sup>5</sup> See Mills, C.A. and Nallari, R., op sit, p. 71, and R. Barth and W. Hemphill, *Financial Programming and Policy: The Case of Turkey*, (including the spreadsheet on diskette), IMF Institute, ISBN 1-55775-875-1, 2000.

<sup>6</sup> See Mills, C.A. and Nallari, R., op sit, p. 107 and 82 for a lists of criticisms of the Bank's and Fund's models and the Bank's reactions to the criticisms; and J. Ventura, "World Bank Macroeconomic Models," MIT Industrial Liaison Program Report, MIT Department of Economics, December 1995.

<sup>7</sup> A particularly candid and hard-hitting criticism was written and circulated widely by William Easterly before he left the Bank: "The Ghost of Financing Gap: How the Harrod-Domar Growth Model Still Haunts Development Economics" May 1997. A much toned-down version of Easterly's paper under the same title is available on the World Bank web page.

<sup>8</sup> I (GOB) attended a packed, standing-room-only seminar given by William Easterly on his analysis of RMSM-X, "The Ghost of Financing Gap". During the presentation, he strongly made the point that his analysis and criticisms of RMSM-X were not new and had in fact been made by many others at the Bank for decades. Toward the end of the seminar, I asked him: If, as he reports, the severe problems with RMSM-X as a development model have been known for so long, why has the Bank not replaced RMSM-X long ago? He (with others) replied that RMSM-X was so ingrained at the Bank that no one felt they had the authority or power to change the model. After an awkward

## The Comprehensive Development Framework

The situation began to change in 1997 and 1998 when World Bank President James D. Wolfensohn spoke at the Bank's annual meeting about work done by the Bank's Chief Economist Joseph Stiglitz, the Bank's Partnership Strategy, and some external consultations on both. The positive reactions led Mr. Wolfensohn in early 1999 to distribute a proposal for a comprehensive development framework (CDF).<sup>9</sup> This 35 page document opened up a much more comprehensive and holistic view of development than was inherent in the CAS approach. It was based on four principles:

1. *Ownership by the country.* The country, not assistance agencies, determines the goals and the phasing, timing, and sequencing of the country's development programs.
2. *Partnership* with government, civil society, assistance agencies, and the private sector in defining development needs and implementing programs.
3. *A long-term vision* of needs and solutions, built on national consultations, which can engender sustained national support.
4. *Structural and social concerns* treated equally and contemporaneously with macroeconomic and financial concerns.

Operationally, the CDF was implemented by asking all countries to prepare a Poverty Reduction Strategy (PRSP) and asking the UN, bi-laterals, and the Fund to accept the PRSP rather than requiring the country to prepare yet other documents. In the course of defining the PRSP, some of the holistic nature of the CDF was lost, but the CDF principles remain, and as a result, the criteria for defining an acceptable national development model have shifted considerably.

## New Criteria for National Development Models

For a model to support the CDF principles, it is now necessary for the model to meet new standards. The CDF principles and the model standards implies are as follows:

1. *Ownership by the country.*
  - a. National Development Indicators: the capability of the model to calculate and display, for each scenario projected, the country's own national development indicators.
  - b. Poverty analysis: calculate income distributions for all scenarios and to identify how the potential benefit deriving from a particular policy is shared between the different income classes.
  - c. Transparency: clarity and explicitness of the model's structure and assumptions for effective participation in the analysis by civil society and the private sector.
2. *Partnership with all stakeholders in development.*
  - a. Strategy Comparison: easy comparison of alternative strategies and assessment of their feasibility and implementation, both fiscally and institutionally.

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silence, an outraged economist from the Inter-American Development Bank, stood up and said what he had just heard was the most damning indictment of professional economists as a whole that he could imagine. No one responded to him, and after another awkward silence, the conversation went back to methods for calculating regression coefficients.

<sup>9</sup> J. D. Wolfensohn, "A Proposal for a Comprehensive Development Framework (A discussion draft)," Memorandum to the Board, Management, and Staff of the World Bank Group, January 21, 1999.

- b. User-friendliness: an interface that gives access to the main functions of the model rapidly and with simple commands, to clearly display the output, and to help the users in orientating and finding the information they need.
  - c. Flexible outputs: produce structured outputs in standard formats that can facilitate the coordinated participation of development partners.
  - d. Applications: the cost, the time and the effort required per application kept within reason.
3. *A long-term vision built on national consultations.*
  - a. Long-Term Perspective: enables both short-term analyses (1~3 years) and long-term perspectives (up to 30 years) for national policy making.
  - b. Continuous time series output: for effective monitoring and evaluation of the nation's development.
4. *Structural and social concerns treated equally with macroeconomic and financial.*
  - a. Comprehensiveness: capability of representing the socio-economic-environmental system as a whole
  - b. Policy-making Guidance: the extent to which it provides relevant cross-sector policy insights to support long-term development planning.
  - c. Environmental analysis: calculates for all scenarios various indicators that would be useful for an environmental impact assessment.

## **Model Comparison by University of Bergen**

A model comparison has been made by dott. Matteo Pedercini of the University of Bergen<sup>10</sup> evaluating eight models against the criteria listed above. The work was sponsored by Conservation International. The models compared are:

- PoleStar, from the Stockholm Environmental Institute (SEI)
- RMSM-X, from the World Bank
- Population, Development, and Environment (PDE), from the International Institute for Applied Systems Analysis (IIASA)
- Threshold 21 (T21), from Millennium Institute (MI)
- The Road Economic Decision Model (RED) by the World Bank
- Policy Insight, by Regional Economic Model Institute (REMI)
- 1-2-3, by the World Bank
- Integrated Macroeconomic Model for Poverty Analysis (IMMPA), by the World Bank
- Financial Planning Framework (FPF), by the IMF

When evaluated against the criteria listed above, the Threshold 21 (T21) model achieved the highest score.

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<sup>10</sup> M. Pedercini, "An Assessment of Existing Computer-based Models' Potential Contributions to the Development of a Methodology for Comparing the Development Effectiveness of Large-scale Public Investment Programs in Different Locations or Socio-economic Sectors", WPSD No. 2, System Dynamics Group, University of Bergen, 15 June 2002.

## Threshold 21 (T21)

Development work on Threshold 21 began in the late 1970s as a part of *The Global 2000 Report to the President*<sup>11</sup>, which Dr. Barney Directed for President Jimmy Carter. The work continued at Millennium Institute, founded in 1983, with the collection of a library of microcomputer models that could be used to support the various activities of managing the affairs of a country. A book reviewing the best of these models was published.<sup>12</sup> Then an overall design document was prepared by Dr. Barney and Dr. Robert Eberlein of Ventana Systems developed the first version of the model.<sup>13</sup> Dr. Weishuang Qu has developed the model much further since 1995.

From the beginning, the goal of the T21 model has been to develop a practical model that incorporates the full range of issues that are involved in sustainable development of a country. This means that in addition to the economy, the model must include the social dimensions (population, gender, health, education, and income distribution) and environment (resource stocks, depletion, conservation, pollution generation (air and water) and the effects of pollution). The model must also include a rest-of-the-world sector to address natural resource flows (especially water and energy), financial flows, trade, migration, and pollution flows. The model must also address the issues addressed by the RMSM-X model. The general concept is illustrated in Figure 4.



### *The Three Pillars*

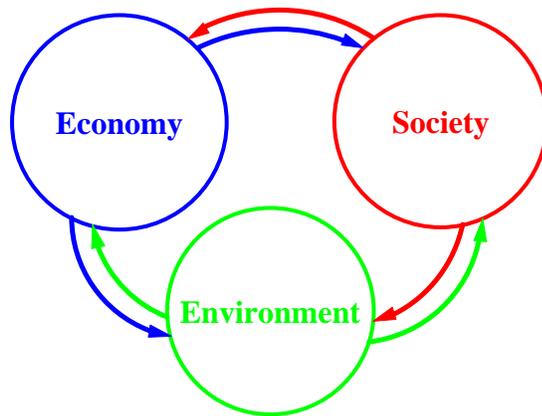


Figure 4: The Overall Concept of the T21 Model

<sup>11</sup> G. O. Barney, Study Director, *The Global 2000 Report to the President*, 3 volumes, Washington: US Government Printing Office, 1980.

<sup>12</sup> G.O. Barney, W. B. Kreutzer, and M. J. Garrett. *Managing a Nation: The Microcomputer Software Catalog*. Westview: Boulder. 1991.

<sup>13</sup> Ventana Systems, Inc. subsequently made a gift of the first version and the copyright to Millennium Institute.

As shown in Figure 4, the three “pillars” of the model—Economy, Society, and Environment—all influence each other.

If we expand the economic pillar, we see the economic sector in somewhat more, but still conceptual, detail.



## *Economy Expanded*

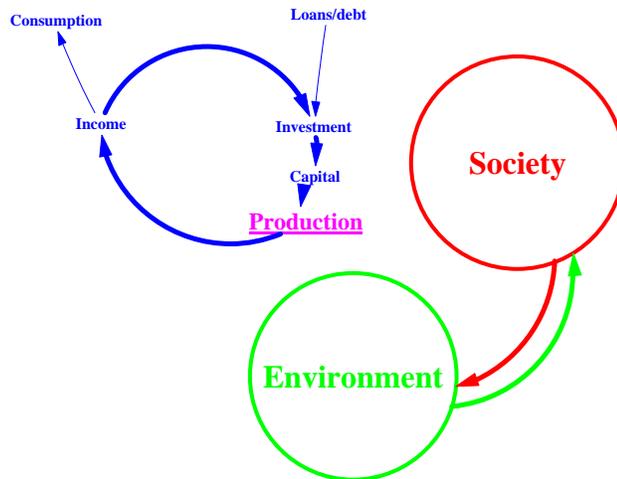


Figure 5: The Economic Pillar of the T21 Model Expanded

As illustrated in Figure 5, Capital (agriculture, industry, and service capital) leads to production and income, some of which is consumed and some invested (along with borrowed funds) to create more capital. This is one of the positive feedback loops that lead to economic growth in the model.

A Social Accounting Matrix is used to assure consistency among the economic sectors.

Other loops from the Society and environment pillars are also important in influencing growth. These loops all connect with and influence production, and as a result, the production function becomes a key and very important part of the model.

The expanded Society pillar is illustrated in Figure 6. Now, it is possible to invest not just in production capital, but also in social capital (hospitals, schools, family planning clinics, etc.) that in turn have an impact on social conditions. The social conditions feed back through the size of the labor pool and the quality of the labor force to influence labor productivity and production. The levels of technology that a country can utilize effectively depends in part on the average educational level of its population.



## *Economy and Society Expanded*

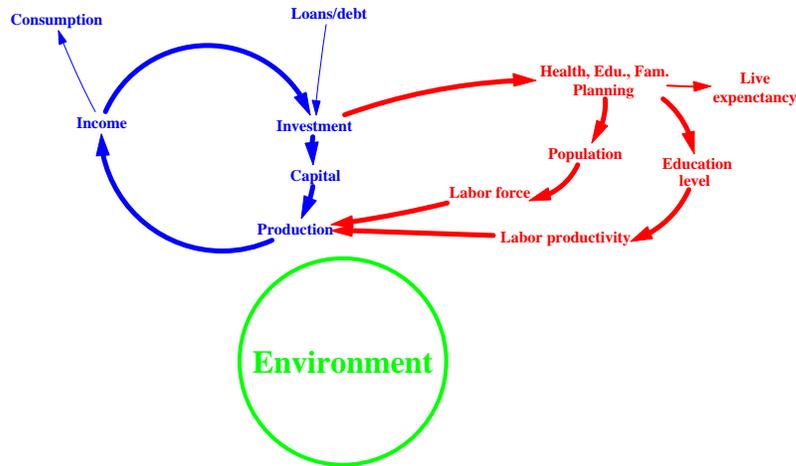


Figure 6: The expanded Society Pillar linked to the Expanded Economic Pillar.

Finally, expanding the environment pillar (see Figure 7) shows how investment can be made in resource conservation and pollution control. The model includes land use, energy, water, air pollution (NO<sub>x</sub>, SO<sub>x</sub>, and greenhouse gasses), and water pollution, although some of these have been omitted from some versions of the model. Resource availability influences production. Production and population (sewage) influence pollution. Pollution influences health. Technology improves labor productivity, but also reduces resources needed for production and reduces the pollution associated with production.



## All Pillars Expanded

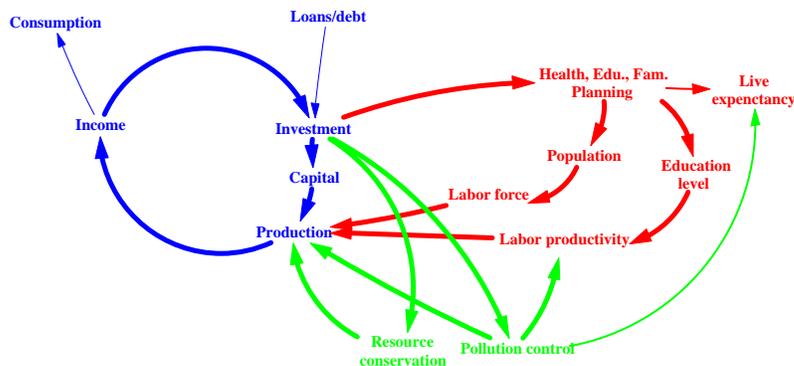


Figure 7: The Three Pillars Expanded and Linked

The previous paragraphs provide just an overview of the model. The full documentation is about 150 pages and a training manual of about 200 pages.

The credibility of the T21 model is growing through an increasing number of applications and through reviews of the model. Custom applications have now been made for: Bangladesh, Benin, Bhutan, China, Ghana, Guyana, Italy, Latvia, Malawi, Somalia, Taiwan, Tunisia, USA, and General Motors.

In addition to the review commissioned by Conservation International (mentioned above), The Carter Center has commissioned a review by a retired World Bank economist and modeler.<sup>14</sup> MI held a three day workshop to consider the improvements that could be made in response to the review. Professor Pal Davidsen, University of Bergen, and Professor Mike Radzicki, Worcester Polytechnic Institute, participated in the Workshop.

In addition to automatically generating the CAS table and a future version of the UNDAF table for each scenario run, the model is also projecting the country's progress toward the Millennium Development Goals sent at the UN Millennium Summit meeting in 2000. T21 is the only model available that projects progress on most of the MDGs.

Currently we are completing applications for Papua (Indonesia) for Conservation International; Mozambique, for The Carter Center, and Cape Verde for the Minister of Finance and Planning with support from the World Bank's PRSP Trust Fund. Next will be a project in Albania for the Carter Center, again with funding from the PRSP Trust Fund.

<sup>14</sup> R.D. Norton, Advisor to the Global Development Initiative. "The T21 Model and National Development Strategies." Atlanta: The Carter Center. November 2002

MI is licensing the T21 model to the University of Bergen for educational purposes. There is also interest at WPI. We plan to write a textbook with the Bergen (and perhaps WPI) faculty based on the T21 model.

Further information on the T21 model can be found on our Web site: [www.threshold21.com](http://www.threshold21.com), and on MI at [www.millenniuminstitute.net](http://www.millenniuminstitute.net).