

# **Learning Economics with Dynamic Modeling. A Norwegian-Ukrainian Collaboration Project**

**Iaroslava Stelmashenko<sup>1</sup>, Iryna Lukianenko<sup>1</sup>, I. David Wheat<sup>2</sup>**

<sup>1</sup> Department of Finance, National University of Kyiv-Mohyla Academy, Kyiv, Ukraine; 2 Scovorody Str., 04655, Kyiv, Ukraine; E-Mails: luk@ukma.kiev.ua (Iryna Lukianenko), stelmashenkos@gmail.com (Iaroslava Stelmashenko); tel: +38 0444256042;

<sup>2</sup> System Dynamics Group, University of Bergen, Norway, Fosswinckels Gate 5, N-5007 Bergen, Norway; E-Mail: david.wheat@uib.no (David I Wheat); tel: +47 40348911;

## **Abstract**

*In 2012, after a few years of informal collaboration, the System Dynamics Group at Norway's University of Bergen and the Finance Department at Ukraine's National University of Kyiv-Mohyla Academy launched an international project designed to build dynamic modeling capacity at the Ukrainian university. Called "Learning Economics with Dynamic Modeling", the project has been funded in three phases by Norway's Center for International Cooperation in Education. Built around a strategy of "train the trainers", the project has enabled 16 students and 3 professors from Kyiv to learn system dynamics modeling methods in Bergen and return to Kyiv to train their colleagues. A bachelor-level course System Dynamics Methods in Finance was started in 2014 and system dynamics has also been incorporated in several existing courses. A distance learning link has been built between Bergen and Kyiv, and when the first system dynamics online course begins in September 2015 that will make the partnership even more sustainable in the years ahead. This paper aims to describe the development of relationship between two universities and how the project has contributed to system dynamics capacity building in Ukraine.*

**Keywords:** capacity building, distance learning, international collaboration, *MacroLab*, modeling, system dynamics

## **Introduction**

The relationship between the University of Bergen (UiB) in Norway and the National University of Kyiv-Mohyla Academy (NaUKMA) in Ukraine began in 2008, when NaUKMA professor Iryna Lukianenko visited Bergen and met with UiB professor David Wheat to discuss *MacroLab* (Wheat, 2007a), Wheat's interactive model of the U.S. economy, which he uses to teach an online macroeconomics course to students in the United States (IThink issue, 2013). Later, a formal memorandum was signed between the two universities for the purpose of facilitating collaboration in research and education, and Lukianenko and Wheat began exchanging information about their respective approaches to

economic modeling and economics education (Lukianenko, 2011, 2012a/b/c, 2013; Wheat, 2007a/b, 2009a/b, 2010). In 2012, the Eurasia Programme run by The Norwegian Centre for International Cooperation in Education (SIU) provided funding for phase I of a project called “Learning Economics with Dynamic Modeling.”

A goal of the Eurasia Programme is to contribute to internationalization of higher education by encouraging cooperation between universities in Norway and in Eurasia, including Ukraine. Strategic priorities include projects focusing on curriculum development, introduction of new teaching methods or materials, quality assurance mechanisms and university management (SIU, 2012). The main goal of our “Learning Economics with Dynamic Modeling” project has been to integrate system dynamics (SD) modeling as an educational and research tool in the economics curriculum at NaUKMA. In 2013 and 2014, SIU provided additional funding assistance for phases II and III of the project, which is now entering its fourth year.

The purpose of the paper is to describe the development of cooperation between two universities, the positive effects it brought to NaUKMA curriculum and development of systems thinking in Ukrainian scientific world, provide a reminder of the benefits of collaboration generally and international collaboration specifically, encourage the discussion of general issues of curriculum design, and start a conversation with anyone who might be interested in collaboration on similar projects.

## Train the Trainers

During phases I and II (2012-2014), the project funded semester-long visits by 12 NaUKMA students and 3 professors to study SD three foundation courses traditionally offered by the System Dynamics Group at UiB plus economics applications in three specially designed courses. The three foundation courses are part of the curriculum of the International Master Program in System Dynamics at UiB.

The first course, *Principles of Dynamic Social Systems*, is taught by Erling Moxnes and gives an introduction to the SD method. The second course, *Model-based Analysis and Policy Design* taught by the founder of the program Pal Davidsen, enables students to extend their knowledge about the SD method, with particular emphasis on model-based problem identification and analysis as well as hypothesis formulation and analysis for policy design. The third course, *System Dynamics Modeling Process* taught by David Wheat, is a project-based course devoted to developing skills needed to build explanatory models of dynamic problems that emerge from real-world complex social and economic systems (Davidsen et al., 2014).

Particularly important was a special fourth course specifically devoted for the Ukrainian students. Generically named *Special Topics in System Dynamics*, it became "macroeconomic dynamics" for us. Designed and conducted by David Wheat, the course was dedicated to developing Ukrainian version of his *MacroLab* (Wheat, 2007a), an SD-based macroeconomic model of the U.S. economy. Each year during the project, this course gave each NaUKMA cohort the opportunity to contribute to the development of *MacroLab Ukraine*, using particular characteristics of the Ukrainian economy. Most recently, in the third phase of the project (early 2015), four NaUKMA PhD students got a chance to come to Bergen to develop skills in model-based policy design and implementation through taking system dynamics-based course *Policy Design and Implementation* and apply those skills to their individual PhD thesis. In addition to learning the methods of dynamic modeling, all participants developed and practiced their presentation and instructional skills, so they could be effective trainers themselves when they return to Kyiv and engage their colleagues in the system dynamics approach to modeling in economics and finance.

## SD Capacity Building at NaUKMA

Many benefits have resulted from the UiB & NaUKMA international collaboration, but the most important are the structural changes made inside the Finance Department at NaUKMA; namely, the integration of system dynamics modeling in the economics and finance curriculum at NaUKMA.

Before the start of dynamic modeling collaboration project, the most widely used modeling tool at the Finance Department at NaUKMA was econometrics. System dynamics is fundamentally different from the econometric method. The difference lays primarily in the fact that while the system dynamics approach seeks to understand how an economic system generates its behavior endogenously, due to its structure. The econometric method calculates the behavior based on comprehensive data analysis. Meanwhile, the radical difference in approaches does not mean that one approach is necessarily better than another. Instead, the relative value of the two approaches depends on the purpose of the modeling task. Both methods are important to study because the truly professional economist, whether in government policy circles, business or academia, is the one who is equipped with integrated methodology and ready to tackle any kind of economic problem by building a corresponding specific model and developing effective policies for regulation and control.

Unfortunately, at the present time, Ukraine as a state is unable to ensure the constant professional growth of its citizens through investing in innovative educational programs due to the ongoing international economic and political/military crises. That is another reason why international cooperation between the University of Bergen and the University of Kyiv-Mohyla Academy has been so important. Thanks to it, graduate students and young professors, who will be part of Ukraine's future professional elite, have gained access to innovative modeling methods developed within international scientific community and develop a systems understanding of the modern economic world.

*Capacity building with workshops and lectures at NaUKMA.* This part of the project was launched by UiB-trained NaUKMA students and professors - they became the trainers of their colleagues in Kyiv. That was followed by workshops and guest lectures in Kyiv by UiB professor Wheat. Project funds were also used to acquire *iThink* software, computer equipment, and many SD textbooks - all necessary resources during the project and beyond. In addition to Wheat's workshops and lectures, the NaUKMA-led activities included three modeling workshops, two PhD colloquium lectures, and nine system dynamics-focused lectures in existing courses in 2013 and 2014. Moreover, while at UiB, three NaUKMA professors delivered lectures to about 50 international students in the system dynamics master's degree program.

*First System Dynamics Course at NaUKMA.* A major milestone was reached during the fall semester of 2014, when a new system dynamics course for undergraduate students titled *System Dynamics Methods in Finance* was offered at NaUKMA for the first time. The course was designed and conducted by Oleksandr Faryna, a UiB-trained NaUKMA PhD student. The aim of the course is to develop theoretical knowledge and practical skills for using modern simulation modeling methods to analyze complex interrelations elements of the dynamics of economic and financial systems. The course develops students' ability to identify, formulate and solve dynamic problems at micro and macro level; to get practical skills of illustrating the structural representation of relationships between elements of systems at the project, enterprises, regions, countries and the world level by using *iThink* software (Faryna, 2014a). When the course was first offered, 28 students - 11 males and 17 females - enrolled and successfully completed it as a part of their Bachelor in Finance degree at NaUKMA. *System Dynamics Methods in Finance* course can be also considered as a starting point for the development of future System Dynamics Master Program at NaUKMA.

*MacroLab Ukraine*. Over the past three years, a key product of the project has been the development of a Ukrainian version of Wheat's *MacroLab*. Now fully operational macroeconomic model, *MacroLab Ukraine* includes the major components of a macroeconomic system, with submodels for labor, capital, production, income distribution, consumption, government taxation and spending, banking and monetary system, pricing, and an international sector that includes imports, exports, capital flows, and exchange rates. The next step is disaggregating the production sector into industry-specific sub-models that utilize data developed for static input-output models in dynamic endogenous processes. Dynamic economic models of this type help both teachers and students move away from static charts and see the behavior of the dynamic complex systems in action. *MacroLab Ukraine* will be used for both teaching and research to help NaUKMA PhD students and staff researchers to make improvements, test policies, and identify options for innovative policy design and decision making within the Ukrainian Government.

*System Dynamics in the Curriculum*. UiB-trained NaUKMA professors and PhD student-lecturers have already begun to incorporate SD in their courses. For example, finance and accounting professor Sergiy Ivakhnenkov is using Wheat's "Telecom" case study as part of the "business processes modeling and reengineering" module of his graduate-level course in *Financial Controlling* (Ivakhnenkov, 2014a). Ivakhnenkov also developed four dynamic models of business income statements and cash flow statements that provide materials for his *Financial IFRS-based Financial Accounting & Financial Reporting* course (Ivakhnenkov, 2014b).

Banking professor Olena Primerova is using models of the banking system, credit markets, and government debt in her graduate-level course in *Marketing of Financial Services* (Primerova, 2014a) and her bachelor-level *Finance* course (Primerova, 2014b). She is also conducting SD-based research on the stability of the Ukrainian banking system. Primerova reports that SD in the classroom helps students understand the relationship of various elements of financial systems, their relationship and interaction.

Furthermore, PhD student-lecturers have created special case studies for their courses. For example, such topics as "modeling managerial accounting elements using system dynamics" and "using system dynamics models in managerial decision support systems" were added to the curriculum of the bachelor level course *Corporate Finance* (Lytvyn, 2013a). "Modeling financial flows in insurance company activities with application of system dynamics" is a part of working plan for *Insurance Services* course (Lytvyn, 2013b). And a version of *MacroLab Ukraine* is a teaching tool in the *International Finance* course (Faryna, 2014b) to explain the causal relationships between a national economy and the international economy. The exchange rate submodel is used to explain exchange rate formation on the interbank foreign currency market and show the effect of different monetary and exchange rate policies of central bank. Other participants of the project also conducted workshops and colloquiums of smaller scale to introduce dynamic modeling method to NaUKMA students at different levels.

*On-line training that links UiB and NaUKMA*. From the beginning of the project, attention was given to sustaining the collaboration between our two universities when, inevitably, external funding would end. Online distance learning has been the cornerstone of the sustainability strategy, and it emerged from Wheat's fifteen years of using *MacroLab* to teach online SD-based economics courses to students in the United States (IThink issue, 2013).

Electronic online interaction actually became essential even before the online courses were designed. Due to the military conflict in Ukraine, some of the 2014 travel to Kyiv was cancelled. Therefore, important project planning meetings were held electronically instead of in-person. That accelerated the efforts to develop a reliable online platform for international course delivery and international meetings. Bergen-trained NaUKMA PhD student Iaroslava Stelmashenko took the lead in coordinating the development and

integration of various tools to enhance online distance learning, including those already in place (e.g., *iThink* simulation software and NaUKMA's *Moodle* online-learning platform) and new technologies (e.g., software provided by Turning Technologies, Citrix, and SoftChalk). Professor David Wheat is currently developing the first online course in economic dynamics, and it will be ready for NaUKMA students in September 2015.

## Dissemination of the Project Achievements

The project team has been very productive scientifically, as well as pedagogically. In December 2012, the first cohort of NaUKMA students in Bergen and the project coordinators, Wheat and Lukianenko, made presentations at an international conference "From Individual Choices to National Strategies of International Cooperation in Education" at the University of Stavanger in Norway (Lukianenko&Wheat, 2012; Faryna et al., 2012).

In 2013, professor Wheat presented the achievements, lessons learned, and value of the project at the "Developments in Economics Education" conference in the United Kingdom (Lukianenko&Wheat, 2013). In 2014, Faryna and Wheat developed a system dynamics model of the monetary sector of the Ukrainian economy and prepared a paper that Faryna delivered at the international conference of the System Dynamics Society in the Netherlands (Faryna, 2014c). During phase III in 2015, six members of the project team are participating in the international System Dynamics Conference in the United States, and this is just one of three jointly-authored papers.

A jointly-authored system dynamics training manual was published in Ukrainian and distributed during the fall semester of 2014 (Wheat et al., 2013). Other completed publications with a system dynamics component include four master theses, sixteen scientific reports, and one scientific journal paper. In addition, four system dynamics-based PhD theses are in progress and will emerge from NaUKMA over the next 1-3 years. Our project was also highlighted in a recent journal article, "Systems Education at Bergen" (Davidsen et al., 2014).

Meanwhile, the dissemination has not been limited to academic settings only, in part because the project team has developed *MacroLab Ukraine*. During August and September of 2014, NaUKMA team members took part in high-level meetings to develop the 2015-2020 economic strategy for the Ukrainian Government. During the meetings, two of the UiB-trained NaUKMA PhD students presented the *MacroLab Ukraine* model as a methodological framework for testing policy options established by working groups and forecasting the future development of core economic indicators. During November 2014, three members of the project team briefed the Prime Minister of Norway during her visit to Ukraine, thereby illustrating the international cooperation in education that exists between Norway and Ukraine.

An overview of the overall project, including interviews with students, is provided in a 5-minute video available online [here](#).

## Going Forward

Collaboration with the UiB System Dynamics Group has been a valuable opportunity for Ukrainian students and professors seeking to extend their modeling capacity. Only through such projects can Ukraine enter the international scientific world, ensure professional development of Ukrainian lecturers and academics, stimulate common international publications, receive groundbreaking technologies and new equipment and, as a result, create innovative educational and active scientific environment in the country. We

hope this project is only a beginning of a long-term cooperation between our two universities and the broader international system dynamics community.

Our future plans include:

1. Development of graduate-level courses in addition to the already introduced bachelor course in the Department of Finance to teach advanced SD modeling skills for research.
2. Development of joint courses and teaching materials for the distance learning platform: SD-based economics courses, online research seminars, etc.
3. Joint PhD and master's degree programs in system dynamics between National University of Kyiv-Mohyla Academy and University of Bergen.
4. Development of the Foundation of the International Center of Excellence in System Dynamics and Applied Econometric Researches at NaUKMA that would allow:
  - 4.1. Creation of an innovative educational and scientific platform that will further integrate complementary features of system dynamics, econometrics, economics, and finance,
  - 4.2. Support and provide fundamental and applied socio-economic research on multidisciplinary policy issues such as economic development, macroeconomic stability and security, the competitiveness of the Ukrainian economy, innovations among business entities, and labor market concerns like unemployment, poverty, and migration.
  - 4.3. Consulting and training of staff, employees, enterprises, and individuals with intensive classes on modern research methods, models and practical implementations.

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