

# SDM thesis to focus on the dynamics of seasonal labor migration

By Rafael Maranon, SDM '10

*Editor's note: Rafael Maranon is a telecommunication engineer who has worked on information technology projects for the public and private sector in Spain, and has also served at the United Nations headquarters in New York and at the Spanish consulate in Moscow. In this article, he discusses his SDM master's thesis research, which is designed to improve the management of migration flows in his native Andalusia. (The work is sponsored by the Andalusian Ministry of Economy, Innovation, and Science.) The Pulse will follow up on Maranon's work once his thesis has been published.*

In the last 20 years, Spain has been transformed from a region that emigrants left in search of employment to one

in which immigrants make up 12 percent of the population. The driving forces behind this change have been low birth rates and fast economic growth in the agriculture and tourism industries, prompted by Spain's 1986 entry into the European Union.

In Andalusia, a region in southern Spain, growth in the agricultural sector prompted concerns about a labor shortfall. In accordance with a 1997 state law, local administrators implemented a

successful guest worker program to supply farms with foreign workers by managing migratory flow.

## Circular migration

Agriculture labor migration in Andalusia is mainly seasonal: guest workers travel to the region to work on farms, return to their home countries after the harvest, then come back the following year—the migration flow is circular. To address the labor shortfall, Andalusia fostered a guest worker program that allowed farmers to hire guest employees in their home countries, creating a legal route for migration, and stemming the illegal flow of workers from Africa to Europe.

However, this program now needs to be improved and consolidated. Since the start of the recent global financial crisis, Andalusia's unemployment rate has reached 26.3 percent—and native-born workers are willing to return to agricultural work. This shift in the labor market has led the Spanish government to limit the number of temporary visas it issues, and the local government is experimenting with severe adjustments in the size of the contingent of foreign workers.

Complicating the issue, native-born workers tend to consider farm work difficult and undesirable. They only take these jobs while looking for better paying work in the service sector. While farmers have been pressured to hire locals, many prefer the foreign workforce and do not wish to jeopardize it. Because of all these factors, circular migration continues to be an essential tool, allowing migration flows to be adjusted yearly according to labor market needs.

For my SDM thesis research, supervised by Dr. Ricardo Valerdi, a research associate in the Lean Advancement Initiative and a lecturer in the Engineering Systems Division at MIT, I plan to examine the history of circular migration in the city of Cartaya in Andalusia with the goal of developing a useful case study.

Cartaya, with more than 13 years of experience implementing labor supply management techniques, has become an exemplar in circular migration strategies under the European Union's \$3 million Aeneas project. This innovative program helps to develop and regulate legal migration, which annually benefits more than 300 farmers in Huelva (the province in which Cartaya is located), 33,000 foreign workers, and governments from different countries in Africa.

To date, I have been able to collect a considerable amount of data by working with governmental institutions in Andalusia, including local administrations, labor unions, farmer associations, the Foundation for Foreign Workers, and the University of Huelva. In order to analyze the implications of abrupt changes in the flow of this legal migration during periods of high unemployment, I am creating a model to help characterize the dynamics of managing the labor supply in Andalusia's agricultural sector. Substituting stakeholders' existing mental model for one based on systems dynamics, this research will provide specific recommendations on how to efficiently regulate migration flows under varying labor market conditions.

## System dynamics modeling

In order to develop new conceptual instruments that will be incorporated into the current review of the circular migration program in a time of high unemployment, the



Rafael Maranon, SDM '10, meets with Cartaya Mayor Juan A. Millan, leader of the European Union project in circular migration, after signing a collaboration agreement to model labor migration flows between Africa and Andalusia.

# Thesis targets seasonal labor migration

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question that this research will answer is:

*How do we improve and consolidate the circular migration program to dynamically adapt to the flow of immigrants under varying economic conditions while maximizing value to all stakeholders?*

To address the aforementioned question, further issues will be analyzed, including: why this tool that regulates labor migration flows was created; how it was successfully implemented in Cartaya; finally, how it is currently functioning during a period of high unemployment. Covering one city (Cartaya) and a time period of the past 24 years, this research will formulate a single case study about circular migration.

Among all the tools and methodologies we have been using in our SDM courses, I will approach my research using system dynamics to create the model of this multi-dimensional migration management system. Perspectives from economics, sociology, and public policy will all come into play, making this an ideal case for applying system dynamics. In order to formulate my dynamic hypothesis, I will consider in this model the social integration of guest workers as a key element to explain the benefits of implementing responsible labor supply management practices while having a just-in-time workforce.

In addition, some aspects and logistics of the international relations between Spain and African countries such as visa processing—aspects originally left out of the Cartaya process because of implementation difficulties—will be incorporated in the system dynamics model because the power of this modeling technique. Modeling the factors that made this circular migration program a success over the time, and using feedback loops and “stocks and flows” diagrams, will allow the stakeholders to better understand system constraints and design a robust and sustainable system of circular migration.

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## SDM thesis roundup

This sampling of SDM thesis research illustrates the range of systems questions SDM students tackle. To read these theses in full, contact Lois Slavin, SDM communications director, at [lslavin@mit.edu](mailto:lslavin@mit.edu).

### Andrei Akaikine, SDM '09



**Title: The Impact of Software Design Structure on Product Maintenance Costs and Measurement of Economic Benefits of Product Redesign**

Fixing software bugs can be extremely costly, both in terms of time and money. It has been estimated that for most software products, the cost of maintenance activities exceeds the initial cost of development

and can reach up to 90 percent of total life cycle cost. Yet, most research on software products economics focuses on cost management during the development phase of the software life cycle. This study focuses on software complexity as one of the main drivers of maintenance costs. To measure the complexity of software systems under investigation, Akaikine designed a complexity measure, based on the design structure matrix, suitable for use in the maintenance phase of software lifecycle. He presents an empirical analysis of the effects of software complexity on costs associated with maintenance tasks within a large-scale commercial software product organization. The study found that with reduction of propagation cost from 38 percent to 11 percent, the productivity of engineers working on similar maintenance tasks improved by more than 10 percent.

### Akshat Mathur, SDM '08

**Title: The Evolution of Business Ecosystems:**

**Interspecies Competition in the Steel Industry**



This thesis builds on the work of Theodore F. Piepenbrock, whose 2009 MIT doctoral thesis, “Towards a Theory of Evolution of Business Ecosystems,” proposed that firms in the same industry vary systematically in performance over time as a result of differences in architecture.

Piepenbrock defines architecture in terms of the strength, closeness, and the specific morphology of relationships that exist between the core firm and the four markets that are its key stakeholders—product markets, capital markets, supplier markets, and labor markets. Mathur extends Piepenbrock’s model to examine its validity in commodity industries, specifically the steel industry from the 1860s to the present. He finds the theory is consistently supported by the steel industry data, and he concludes that the evolution of business ecosystems is a reasonably robust theoretical framework.