# SHORT TERM SCIENTIFIC MISSION (STSM) – SCIENTIFIC REPORT

**The STSM applicant submits this report for approval to the STSM coordinator**

**Action number:** **CA15210 (European Network for Collaboration on Kidney Exchange Programmes)**
**STSM title:** **Research visit Romania - Hungary**
**STSM start and end date:** **04/04/2018 to 11/04/2018**
**Grantee name:** **Radu-Ștefan Mincu**

## PURPOSE OF THE STSM/

As described in the research plan, from the Romanian side the visit involved myself as PhD student in the Computer Science Department at the University of Bucharest and my PhD advisor Alex Popa. Péter Biró was our host, and we had discussions with him and his colleagues at the Hungarian Academy of Science, Corvinus University and also at ELTE University. The two main goals of the visit are knowledge exchange and the initiation of joint researches.

## DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

We had very fruitful discussions on optimisation in kidney exchange problems, and implementation of international kidney exchange programmes. We describe the main topics for discussions below.

**Practical application:** The hosts explained the details of some European KEPs and the plan for the Hungarian one, the medical, organisational, and optimisation aspects, including the international collaborations between Spain, Portugal and Italy, and the Austro-Czech programme.

**Modelling international exchanges:** We discussed some previous scientific approaches, e.g. [Carvalho, M., Lodi, A., Pedroso, J. P., and Viana, A. (2017). Nash equilibria in the two-player kidney exchange game. Mathematical Programming, 161(1-2), 389-417.] and a more general framework for optimisation. We specified the possible goals and restrictions that an international programme may have, which can vary across countries in a cooperation. This feature makes the problem especially challenging, as the combination of existing solution techniques for the national programmes (IP models) is not straightforward.

**Simulations:** We discussed the possibility of testing the combined IPs with simulations.

**DESCRIPTION OF THE MAIN RESULTS OBTAINED**

**Modelling international exchanges:** First, we discussed the main characteristics on an international exchange programme, in term of their goals and constraints that can vary across countries in a joint scheme. We also discussed some known IPs (e.g. the position-indexed cycle formulation by Dickerson et al., and the TSP-based formulation by Ashlagi et al.) and their possible usage for optimisation in international kidney exchange programmes. In particular, we discussed the Austro-Czech joint programme, where the Czech organisers allow long non-simultaneous chains, whilst the Austrian only conduct short simultaneous ones. For this particular application we developed a simple edge-formulation IP.

**Simulations:** We conducted initial tests using a kidney exchange simulation for a simple two-country setting.

**FUTURE COLLABORATIONS (if applicable)**

**Modelling international exchanges:** We continue developing a general optimisation model for international kidney exchanges based on IP techniques. We will also discuss the details of existing European collaborations (AU-CZ, ES-PT-IT, Scandiatransplant) and try to formulate suitable IP models for their solutions.

**Simulations:** We will conduct simulations for general models on randomly generated data and we will also test the particular cases of existing joint programmes in Europe, possibly with real data, if available.

**Dissemination of results:** We will write a scientific paper, present it at an OR/CS conference and write also a journal version.