

SHORT TERM SCIENTIFIC MISSION (STSM) SCIENTIFIC REPORT

This report is submitted for approval by the STSM applicant to the STSM coordinator

Action number: CA16228 - European Network for Game Theory

STSM title: Open shop scheduling games

STSM start and end date: 27/01/2019 to 09/02/2019

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PURPOSE OF THE STSM:

(max.200 words)

The purpose of this STSM was to begin a new collaboration with Dr. Pedro Calleja from University of Barcelona. The main idea was to analyze open shop scheduling problems from a game theoretical point of view. For unit time open shop scheduling problems, we have studied different rearrangements that have been considered in the literature (see for instance Curiel et al. 1989) and their associated coalitional games. Our aim during the STSM was to analyze the core of coalitional games for unit time open shop scheduling problems since core elements would provide a stable reallocation of the joint cost savings.

DESCRIPTION OF WORK CARRIED OUT DURING THE STSMS

(max.500 words)

During my visit, we have had daily meetings with Dr. Pedro Calleja. First, we define the allocation problem for unit time open shop scheduling problems. We have focused on unit time open shop problems where both the waiting cost and the processing of a job on a machine is unitary. The reason behind our restriction is computational complexity. Finding optimal schedules for open shop situations has been proved to be NP-hard, whereas it has been shown that unit time open shop problems can be efficiently solved. Then, we defined coalitional games associated with unit time open shop scheduling problems. We studied the core of coalitional games since it sheds light on the allocation problem at hand.

I also had a chance to meet with Prof. Marina Núñez. We have discussed the questions that we posed on the transportation game and its extreme core allocations. We have had some preliminary notions and results that we believe will lead to a new fruitful research.

Moreover, on February 6th I presented a work in progress titled 'On the core of many-to-many assignment games' in the Game Theory and Dynamics Seminar organized at the School of Economics, University of Barcelona.

DESCRIPTION OF THE MAIN RESULTS OBTAINED

Since open shop scheduling problems are NP-hard, we restrict our attention to the unit time open shop scheduling problems which can be solved efficiently. Following the most of the literature, we consider different sets of admissible rearrangements for unit time shop scheduling problems with conditions that do not hurt interests of agents outside of a coalition.

Following restrictions imposed, we defined associated coalitional games with a unit open shop scheduling problem with the set of admissible rearrangement. We consider the coalitional game that contains other associated games with different restrictions on rearrangements. In order to study the stable reallocation of the joint cost savings, we introduced a machine based allocation. We showed that it may not be a core element.

Even though a machine based allocation may not be a core element, we defined an allocation rule as the average of the machine based allocations. We proved that this allocation rule assigns a core element. That is to say, we show that unit open shop scheduling games according to an admissible rearrangement have a non-empty core, i.e., stable cost savings exist for these problems.

Following our result, we provide a counterexample to illustrate that further relaxations on the admissible rearrangements leads to games that violate balancedness (non-emptiness of the core).

FUTURE COLLABORATIONS (if applicable)

We will now write a working paper following the results that we obtain. We plan to have a working paper in March 2019. Moreover, we have discussed several new questions on different scheduling problems and we hope to work on the questions that we have posed during my STSM at the University of Barcelona. Also, we agreed to work on questions discussed with Prof. Marina Núñez on the transportation game.

I sincerely thank the COST Action for their support which made this visit possible.