Conflicts with Multiple Battlefields with Costs

Many real-life scenarios, such as research and development races, rent-seeking, political campaigning, military budgeting, or lobbying, include interaction between two or more sides deciding to allocate limited or costly resources across multiple fronts. Whether we consider generals deciding on the assignment of their troops across multiple battlefields, political parties deciding on assigning their most popular candidates across different election districts, or security management deciding on placing control points in airports, strategic decision-making of such scenarios is captured by the class of *conflicts with multiple battlefields*. Most of the existing literature imposes the use-it-or-lose-it assumption on budget, where each side is given a fixed number of resources and there are no costs of obtaining or allocating resources, which strongly restricts the possible real-life applications of such models, or can lead to ineffective outcomes, which happens particularly often in the case of public spending. A great example of such inefficiency is the repeating problem of inefficient spending by the Defense Department of the United States at the end of every fiscal year. Consider the following part of a summary of the "Heritage Foundation" article on the inefficiency of military spending in the US:

> *"Attention should be paid to the phenomenon of 'use it or lose it' – how expiring budget authority adversely affects the management of department resources. Congress should change the financial rules that govern the obligation rate of these defense funds, allowing some of these funds to be rolled over to the next fiscal year and accelerating reprogramming and transfers."*

The idea of a money transfer to the next fiscal year is one of many that can be captured by extending the use-it-or-lose-it budget assumption to costs.

This project aims to answer questions arising from extending the use-it-or-lose-it assumption to costs, such as; What strategies should players use in scenarios with costs? How difficult is it to compute these strategies? How does introducing costs affect the efficiency of the outcome of the encounter?

Most results of our project will be formal results on computations and solution properties. We strongly believe that because of many important real-life applications of considered models, the importance of the obtained results will be beyond purely theoretical interest.