SKOPJE BICYCLE INTER-MODALITY SIMULATOR – E-INVOLVEMENT THROUGH SIMULATION AND TICKETING

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ABSTRACT
For successful crafting political decisions it would be reasonable to verify them theoretically through modelling of potential effect. Therefore, the set of adequate models must be designed demonstrating reaction on policy maker activities. Also is necessary to understand the reaction of potential audience and the new policy accepted by citizens.
The article dealt with simulation and ticketing use in policy decision making based on Skopje Bicycle Inter-modality Simulation case.

Keywords: simulation, e-involvement, ticketing, agent-based models

1. INTRODUCTION

Despite of it that many well established policy decision making methodologies exist IT has not played a significant role in most of these efforts until now (Osimo et. al. 2010). This is especially true for urban policies, which are important on a worldwide scale since the majority of the world´s population is living in urban areas. In Europe currently more than 79 % of the population is urbanized and it is expected that it will further increase and reach 85 % by 2030. It means the vast majority of the population in Europe is affected by urban policies in their daily lives.

The Major Cities of Europe Association (MCE) has conducted a study on the "Citizen Web Empowerment in a network of European Municipalities: "value for citizens" in Web 2.0 projects" (Buccoliero and Bellio 2010). It studies the growing demand of citizen empowerment and benchmarks the degree of citizen empowerment across the network of European municipalities in four areas e-information, Web 2.0, e-consultation and e-decision. The major outcome is that e-information (74 of 100) is sufficiently addressed, while Web 2.0 (23.2 of 100), e-consultation (32 of 100) and e-decision (8.3 of 100) are not developed yet. It means there is a huge demand in Europe to benefit from this hidden potential, which has not been exploited yet.

For successful introduction of political decisions those must be verified by modelling of potential effect. Second, it must be checked would be the new policy accepted by citizens.

Therefore, at least the social networks must be monitored. And, third, audience must be informed in time about activities expected to make up the citizens for policy introduction. Cohen (Cohen 2012) provides at least eleven tips for crafting a policy, but mentioned tasks are important part of them.

Typical sample of putting into practice of the ideas mentioned above is Skopje Bicycle Inter-modality Simulator.

2. SKOPJE BICYCLE INTER-MODALITY SIMULATOR

Skopje Bicycle Inter-modality Simulator (Ginters et. al. 2014) is created to find useable solution for bicycle station and track building location in the City of Skopje (see Figure 1).

To encourage the intermodal transport, the citizens are also involved in the collection of ideas on how bicycle inter-modality can be fostered. The citizen participation is supported including the use of a simulation tool and ticketing. Public simulation is accessible at http://prod.fupol.lv:8080/skopjebicycle.

2.1. Simulation model

The relevant elements of the Skopje Bicycle Inter-Modality model (Buil, Piera and Gusev 2014; Buil and Piera et.al. 2014) are the profiles of the people, the stations along the city, the tracks between stations, and the bicycle users. Following subsections present the data tables with all the necessary columns to correctly define these elements.

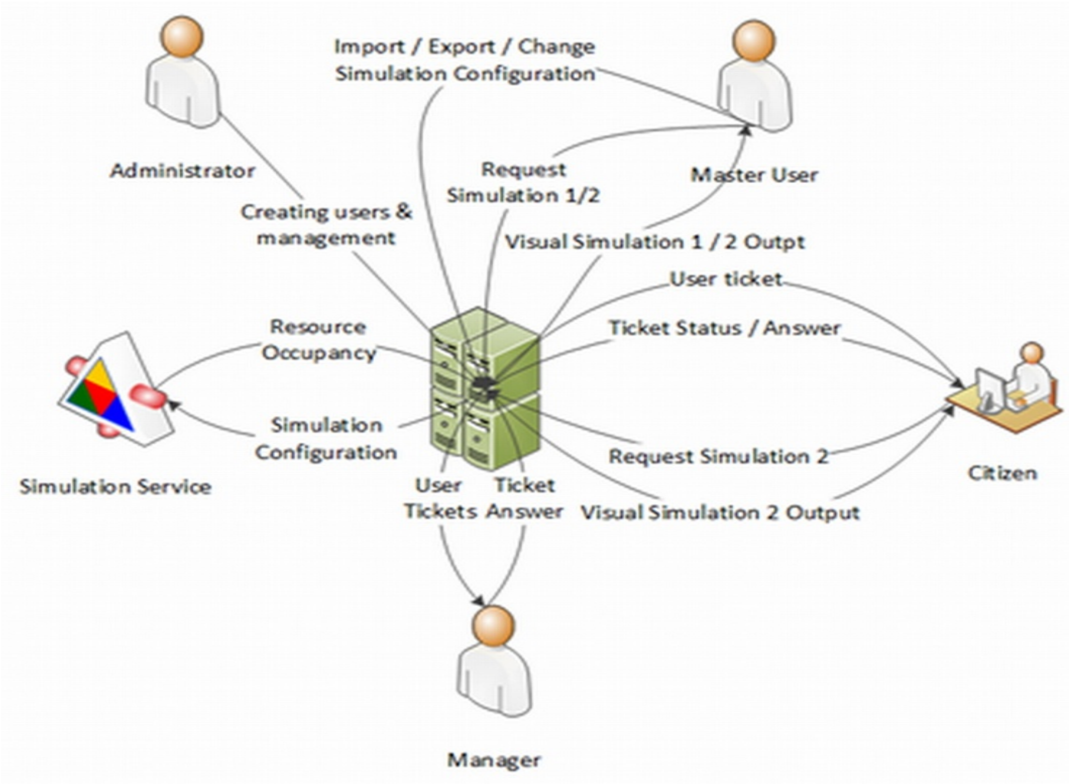

Figure 1: Functional Diagram of Skopje Bicycle Inter-modality Simulator

The Bicycle Inter-modality input has seven tables, and they are named:

- Municipalities;
- Stations;
- Tracks;
- Profiles;
- UsersData1;
- UsersData2;
- Weather Conditions.

The agents defined for the multi-agent systems (MAS) model are:

- Station;
- Track;
- User
- Observer.

Each agent has its attributes and methods.

The attributes defined to describe a station are the followings:

- id: it is the identifier of the station;
- description: name or small description of the station;
- code: it is the area code of the station;
- latitude: latitude of the station;
- logitude: longitude of the station;
- bikepath: indicates if there is a bike starting, ending or going through this station;
- bus, train and point: different variables indicating if the station is a bus station and/or a train station and/or a point of interest;
- rentingStatus: it indicates the status of the renting station (Existing, planned, possible, notPossible);
- capacityRenting: if it is a renting station, it indicates its capacity; parkingStatus: it indicates the status of the parking (Existing, planned, possible, notPossible);
- capacityPrivate: if it is a parking, it indicates its capacity;
- occupancyRenting: number of renting bikes in the station;
- occupancyParking: number of private bikes in the station;
- occupancyExtra: number of private bikes parked outside station due to the lack of parking slots;
- municipality: municipality it belongs;
- oSatisfaction: satisfaction of persons living around this station. Summation of the satisfactions of each one;
- bikeUsers: number of possible users around.

There are not relevant methods; therefore, just attributes are listed:

- Origin: the origin of the track;

- Destination: the end of the track;
- length: length of the track;
- occupancy: the amount of people in the track;
- bikePathStatus: it indicates if the bike path exists in the track, if it is planned, if it is possible or if it is not;
- bikePathQuality: it indicates the status of the track. 0 means it is not built, 1 means it is a bike path in perfect conditions, and any value in between indicate the level of conditioning.

This agent represents the users of bikes. The considered attributes for User are:

- id: it is the agent id, automatically generated;
- groupID: it is the group Id taken from the input tables;
- profile: indicates the type of user;
- description: indicates an area or neighbourhood, or indicates that it has an exact location for the house;
- age: it indicates the age of the agent;
- destination: it indicates the Municipality destination (code);
- destinationID: it indicates the exact ID of the destination station;
- originID: it indicates the exact ID of the origin station;
- tripStations: set of ordered stations from origin to destination;
- duration: duration of the trip between stations;
- startTime: time to start the first trip (going to destination);
- backTime: time to start the second trip (going back to origin);
- durationTotal: duration of the trip;
- distance: length of the trip;
- personality: level of personality of the agent;
- satisfaction: level of satisfaction about the bicycle infrastructure;
- tripStatus: variable in which the status of the tracks are added in order to generate a global status;
- trackID: id of the performed trip;
- stationID: the station where the user is parking or taking a bike;
- pDay: day parameter to determine if the bike is used;
- WEcomp: parameter to determine if the pDay value for weekend is complementary or not, which means that bike must be used one of the two days;
- weVisit: indicates if a complementary weekend, the bike has been already used;
- pMonth: month parameter to determine if the bike is used;
- pWeather: weather parameter to determine it user uses the bike;
- park: indicates if the user bike is parked in a bike parking slot.

The profiles will be useful to generate the correct amount of agents. They indicate a population percentage depending on the type and the age. Transport means indicates the percentage of times the profiles use bus, car, taxi, foot or motorbike.

There relevant methods for the agent User are:

- nextDay: it calculates the next day that the user takes the bike and schedule next scheduleDayDecision, or schedule the day calculation (same method) for the next week if scheduleDayDecision is not randomly scheduled at any day of this week;
- nextTrip: scheduling the next trip of the user;
- parameterMonthWeather: it calculates the decision parameter using the month and weather input parameters;
- scheduleDayDecision: deciding if the user will use the bike depending on the weather parameter and scheduling next use of the bike if the user finally does not use it;
- updateSatisd_endDay: it updates the satisfaction at the end of the trip using tracks and stations status information;
- updateSatisf_location: it updates the agent satisfaction depending on the citizens around the agent origin;
- updateSatisf_Occupancy: it updates the satisfaction depending on the occupancy of the stations;
- updateSatisf_track_by_track: it updates the satisfaction at the end of each track.
- The observer agent, in that case, has been used to manage the data used in the software interface, which can be input and output data. The input attributes are:
- simulationENDtime: simulation time;
- fixweather: indicates if the weather is fixed;
- fixMonth: indicates if the month is fixed;
- tracksFile, userFile, user2File, weatherFile, stationsFile: names of the files used as input data.

The output attributes are:

- numConflicts: number of conflicts during the simulation;
- conflictList: list of conflicts including Station id, user profile and time;
- currentBikeUsersPercentage: percentage of bike users at any time;
- occupancy: structure with the occupancy of the stations and tracks.

Other attributes are:

- distMatrix: matrix of the distances between stations. Used to calculate shortest routes;

- stationIndex: list of stations index used to calculate the shortest route applying the Dijkstra algorithm;
- municipalityStations: ;ist of stations of each municipality. Used in order to generate users origin station;
- cycling_velocity: average cycling velocity. Used to calculate the time of the trips depending on the paths length.

The Observer agent includes methods to initialize the model, the linking methods to reflect the interactions between agents, and other methods.

The relevant methods of the observer are:

- generateStations: it is in charge of generating the stations to consider;
- generateTracks: it is in charge of generating the tracks to consider;
- generateTripStations: it is in charge of calculating the intermediate stations of the trips;
- readUsersData: read the Users data and schedule the first agents generation;
- readWeatherConditions: reading weather conditions from an input file and saving in the weather conditions structure;
- updateRealTime: method used to calculate the real time and update weather conditions, if necessary.

2.2. Simulator Graphic User Interface

Simulator provides three language choices - English (default), Macedonian and Albanian. Each of simulation settings has multiple data sets that contain data about users, stations, tracks and weather. Each registered user can have one or more of three user roles (each role describes different permissions). User roles are - administrator, manager and master. Simulation configuration is section for system high-level administration. It contains such system data as e-mail link for ticket senders, and multiple simulation model settings. Each user can send to administration information about simulation results. Each simulation ticket has multiple informative fields - Status (Sent, when ticket is sent; Open - when ticket is first time opened by Administration; Answered - when ticket has received a reply from Administration; Closed - when sender has closed ticket), Close status (Like - if sender has approved his ticket; Dislike - if sender has disapproved his ticket) and Suggest status (Suggested - if manager has suggested ticket; Rejected - if master has rejected the simulation settings for representing ticket in suggested simulation's visual results block; Approved - if master has approved the settings). Users with master role can access Simulation 1, which is set of multiple simulations that are run for full year. Each of them is run for different simulation configurations. Simulation 2 runs for one week by master and regular users from public side (see Figure 2).

Figure 2: Running Public Simulation View

Each simulation has status, ID that links to simulation visual results, progress percentage, description, chosen simulation settings, bike user percentage and date created.

All simulations have similar visual result page with minor differences between Simulation 1 and Simulation 2. Clicking on each station and track opens its data window, which shows park station status and park station capacity. For tracks there are track quality rate and track status. Results block can be opened by clicking on icon on the results page.

Simulator is created to offer the City of Skopje a possibility to realize a better schedule of track and stations and plan of occupancy. To its citizens it offers the opportunity to simulate the occupancy of the bicycle tracks and stations in Skopje city and suggests new ideas to the administration of City of Skopje. The system helps the Administration of City of Skopje to improve the scheduling and resource planning, initiation and creating new projects involving the bicycle area at Skopje city. Citizens of Skopje can also get involved in decision making process by communication and opinion expression to the authorities throughout the system, making the whole process more transparent and efficient.

In current sample double cycled policy crafting model is realized (see Figure 3).

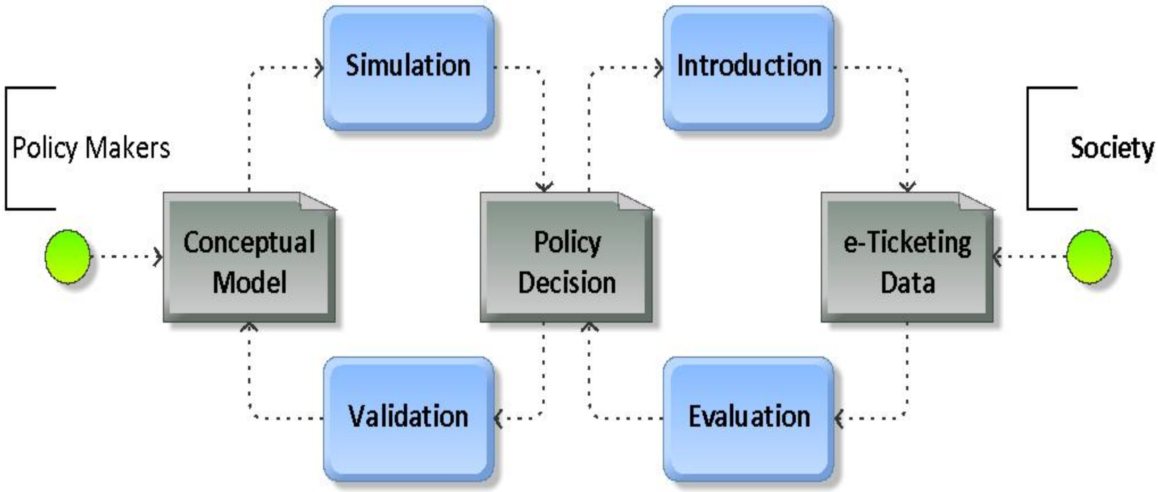

Figure 3: Double Cycled Policy Crafting Model

First Conceptual model is simulated to validate and assess the trend and only after that the policy decision could be introduced. However all the time opinions of the society is monitored through semantic search in social networks and e-ticketing to be sure that forecasts are right and justified.

3. CONCLUSIONS

Before introduction of policy decisions it is reasonable to validate the forecasted results. Also it is recommended to ascertain opinions of the society about potential changes.

Skopje Bicycle Inter-modality Simulator ensures validation of potential activities of Skopje Municipality using multi-agent systems (MAS) simulation in Repast Symphony environment. MAS model is based on statistical data provided by Skopje municipality. However society opinions are collected by ticketing.

Skopje Bicycle Inter-modality Simulator provides possibility for citizens to participate directly in policy planning and crafting. On other hand through the ticketing municipality has the feedback and can be assured about adequacy of their decisions to requirements of the citizens. Inter-modality is actuality of big cities therefore right solution can be interesting for widespread set of policy decision makers.

Further activities of Skopje Bicycle Inter-modality Simulator designing will be related with enhancing and statistical validation of simulation model.

ACKNOWLEDGEMENTS

The article publication is funded by FP7 FUPOL project No. 287119 “Future Policy Modeling”.

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