

# *Comparing residential development scenarios in Luxembourg regarding their access to amenities*

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## **1. Problem and research questions**

This paper aims to propose and evaluate different scenarios of residential growth in the Grand-duché of Luxembourg. The simulations of residential development are done using the MUP-City platform (Tannier et al, 2012). They are compared to other scenarios, generated within the framework of MOEBIUS project (Gerber et al, 2009), which produces different scenarios of urban growth according to planning policy in force among the country. The comparison is based on two main points: 1) a spatial comparison of the location and patterns of urban extensions; 2) the evaluation of the accessibility of new residential extension to several amenities, which are taken into account in the modeling process (retails and services, green spaces, sports infrastructures...).

## **2. Methodology, research strategy**

The two groups of chosen scenarios have been created by using the same construction process. They all result in the definition of a possible location of future residential developments. The number of housings to build each year is defined according to demographic forecasts (population and households), produced by the national Luxembourgish institute for statistics (STATEC, 2011). The forecasted growth of the number of households is converted into a number of housings to be built, minus the number of vacancies, destructions (quite rare), and changing of status, i.e. from commercial to residential function. This number of housings is then converted into the area to be urbanized by formulating hypotheses on the desired built density and take into account the urban hierarchy. The role of MOEBIUS and MUP-City models is to locate at a very fine-scale, about 20 meters, the total amount of residential extensions for cities.

The scenarios adapted from MOEBIUS project have been developed by combining the value of five criteria: 1) the centrality criteria allows the selection of cells according to typologies of towns based on planning priorities; 2) the density values are used for enhance the process of urbanization in dense areas (above the national average) and limit the effect of sprawling; 3) the accessibility to employment areas by public transports is useful for including zones which are considered as a priority by the government in order to encourage the modal split in the favor of alternatives to the private car (Ministry of Transport, 2008) ; 4) the land-mix criteria

aims to avoid mono-functional spaces, and select areas where it is possible to find a mix of commercial and residential functions ; 5) The compactness criteria takes into account planning zones in which building is allowed, to limit the process of sprawling in natural areas.

Each scenario takes into account different values of these criteria and traduces them into quantitative planning rules according to the current planning documents and strategic orientations.

Other planning scenarios for urban development are simulated with a new version of MUP-City software (Tannier et al 2010, 2012). The simulation method is based on the combination of fractal planning rules and accessibility rules to amenities. Different types of amenities are included in the analysis; the typology is based on the potential frequency of recourse: daily, weekly and monthly or less frequent. All the rules are aggregated through a multi-criteria analysis classically used in decision-making tools, the AHP (Saaty, 1977). The relative importance of each rule varies according to the different planning strategies. New accessibility rules have been added to the initial version of MUP-City in order to deal with planning policies and enhance the realistic aspect of the simulation.

The methodology is interesting in the way that two modelling conceptions are compared. The results of scenarios are evaluated using ex-post accessibility measures to amenities.

### **3. Major finding**

The research aims to confirm or infirm the results already obtained within the framework of fractal modelling of urban growth, especially concerning the accessibility to a range of various amenities (Tannier et al, 2012). The hypothesis is that the accessibility to various amenities is better in case of a fractal residential development than of other types of residential developments (compact, axial...).

### **4. Takeaway**

The assessment of different shapes of residential development by comparing the possible access to amenities is interesting. Nevertheless, this spatial assessment has to be completed by taking into account the functional aspects of daily mobility trips (time constraints of households, congestion of roads...). Hence the next step of the research will be to adapt a traffic model to the case of Luxembourg to measure the impact of different urban growth theories on daily mobility patterns. This additional task should allow understanding more deeply the relationship between the role of residential locations and their environment, i.e. retails and services, urban facilities, green spaces or leisure areas and the quality of life of urban residents.

### **5. Keywords**

Modeling, urban growth, accessibility, amenities

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