POLITECNICO DI TORINO

Honors thesis

MASTER DEGREE

ARCHITECTURE CONSTRUCTION CITY

Abstract

Behavioural Retrofit scenarios towards Post-Carbon City

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December 2016

"Transition" is characterizing the recent years, in economic, political, energy etc. aspects. It simply means a passage from a condition, mostly harmful, malaise or crisis, to a situation promising as “optimal”. Taking a cue from the current environmental issues and from my interest in energy consumption in architecture, this thesis was born aiming at calculating the probability that an individual has to change his behaviour, toward sustainable and aware lifestyles, considering the impact of some socio-economic variables.

The climate change issue is still important although has been over a century from the 1896 when the Nobel laureate Svante Arrhenius has understood the relationship between the carbon dioxide production of fossil fuels and the temperature increase. Today, the problem of global warming, born due to the intensification of human activities, is actually a priority. It is, in fact, a crucial theme in many academic and political debates. As an example, the COP21 has highlighted that the temperature increase over 2°C, compared to pre-industrial era, will cause irreversible damage to the entire Earth-system. Thus, the main goal is to store the “carbon budget” (the amount of CO_2 that it is possible to burn to avoid this increase) and to “decarbonize” the built environment (transforming the energy system). For these reasons, the utmost purpose of this research is to analyse the rising concept of “Post-Carbon City” (probably a future strategy to face, for example, the problem of population growth and, consequently, the increase of services and GHG emissions) up to the definition of the role of building occupants, both at macro-scale (city and society) and at micro-scale (building).

Many authors have shown how energy consumption depends not only on the building design but, especially, on occupant behaviour. In fact, contrary to common thought, the Post-Carbon City must to respond not only to bioclimatic principles, to technical and scientific challenges, but to a cultural challenge. It is an issue of citizen education depending, essentially, on the occupant’s role. The citizen, in fact, plays an active role: the devices and data processing provide feedback to the user about the actions being done and he/her will make the right decisions not only in the building but in the building in relation with others.

Assuming that behaviours are not unique but are unpredictable, this research aims to explore the behaviours, attitudes and characteristics of a random group of people in order to identify behavioural retrofit opportunities. In particular, this issue was addressed in a holistic way, basing on environmental psychology and on pro-environmental behaviour studies presented in literature. The main practical application of these researches is the Campbell Paradigm, using an experimental approach. In this thesis, this experimental approach was applied. First, subjective data were collected through a questionnaire, set up on the basis of similar surveys presented in literature. Then, a statistical model of pro-environmental behaviour and of willingness to change was built (defining a calculation method). Finally, the obtained model has been validated through a set of real data.

The collected data were analysed in different ways; the first analysis consists to determine the percentage of persons with a pro-environmental behaviour. This elaboration was carried on through the Campbell Paradigm (in its mathematical application i.e. the Rasch model) and through the analysis of the personal effort (i.e. the individuals’ environmental engagement) and of the behavioural “price” (i.e. the physical, intellectual, cultural, economic etc. costs that are put in place when that behaviour is carried out).

Subsequently, the data were elaborated in order to assess the willingness of individuals to change their behaviour. Finally, the behavioural influencing factors were identified through a generalized linear model, which allowed the calculation of the probability of behavioural retrofit through a logistic regression model.

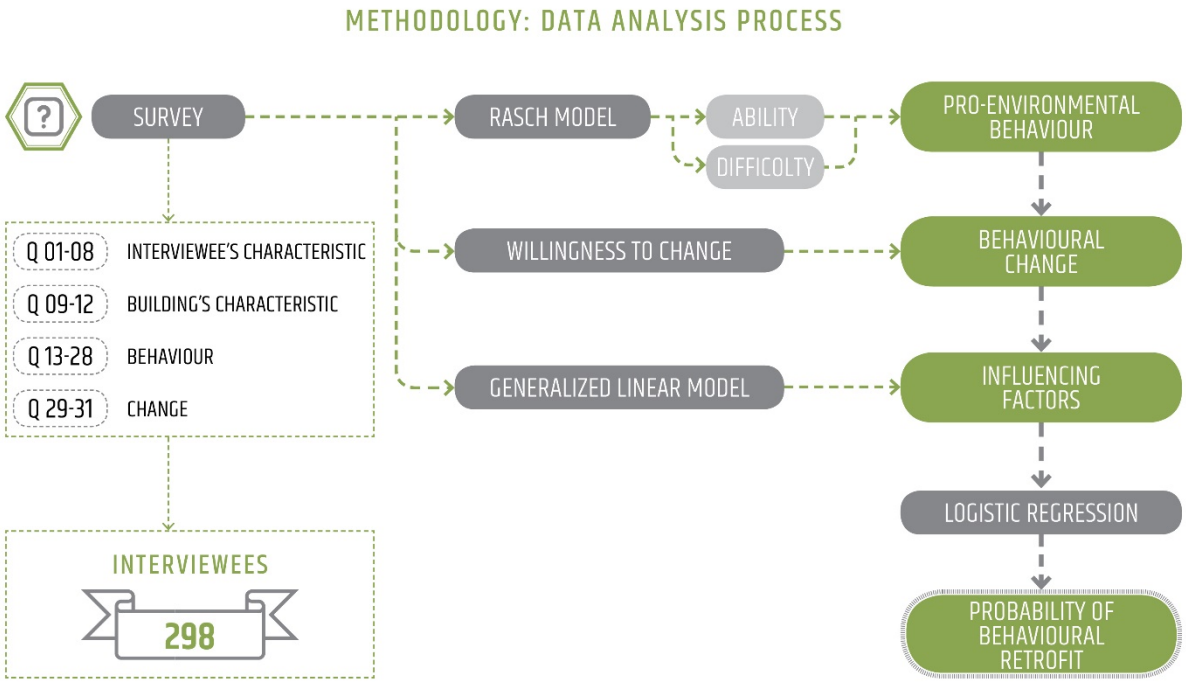

Figure1. Methodological process adopted for the data analysis. The data are obtained by the administration of an online survey.

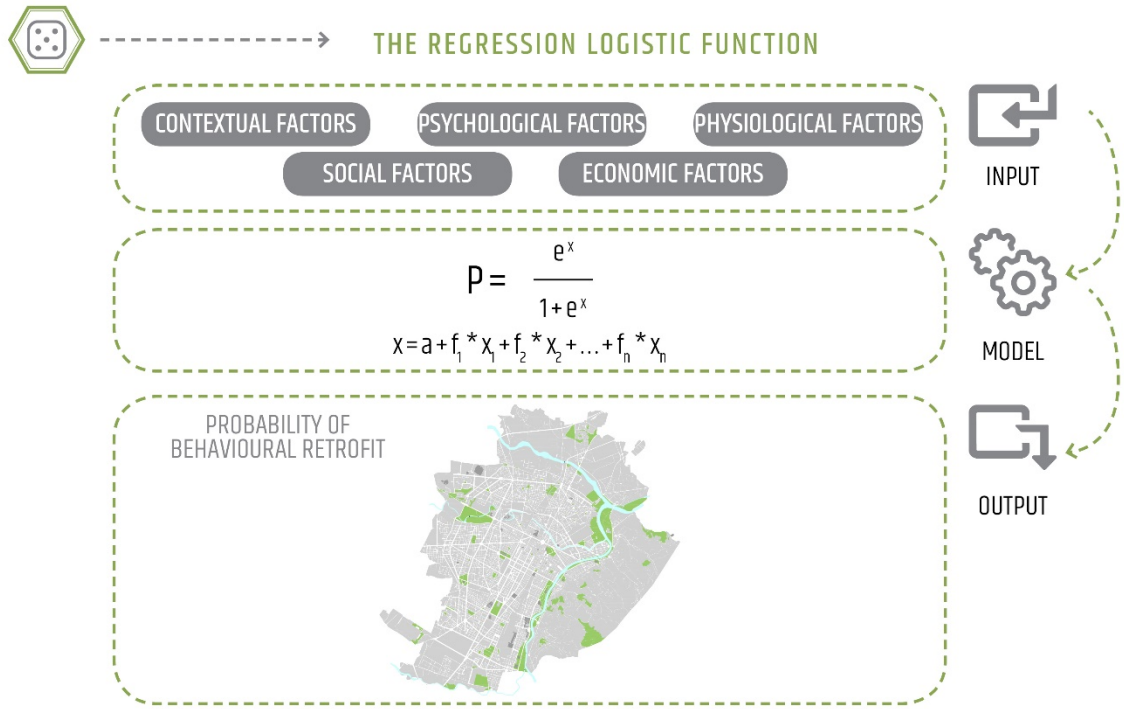

Figure 2. The logistic regression function has allowed to investigate the probability of behavioural retrofit considering as input data different types of influencing factors.

The identified model has been validated on a sample of 200 buildings located in Turin of which combining personal data of occupants and building characteristics (i.e. ISTAT database) with consumer class (a city energy provider database). The validation has allowed to obtain an accuracy rate of about 40%. In conclusion, this methodology have been scaled up expanding to the whole city of Turin, identifying areas where there is a greater probability of behavioural retrofit (green) and areas with a lower probability (grey).

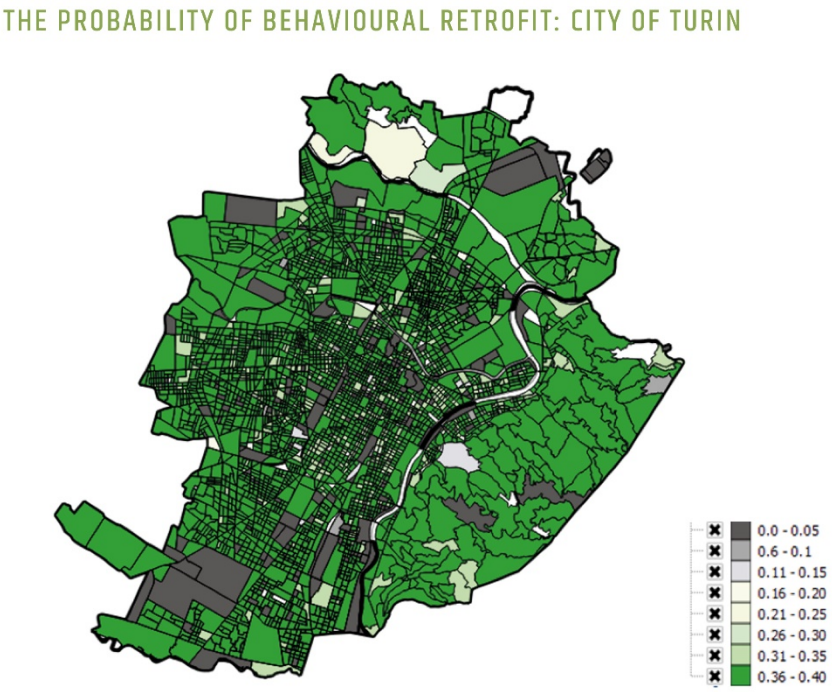

Figure3. The model has been extended to all census sections of the city of Turin: in green the areas with a higher probability of behavioural retrofit, instead, in grey the areas with a lower probability.

The described research shows that socio-economic variables have an important role in achieving more environmental conscious behaviours. The probability of behavioural retrofit could be a key element towards a Post-Carbon perspective. In conclusion, in the future urban planning, the proposed model is able to identify, in an urban scenario, areas where citizens are ready to receive interventions by policy-makers towards sustainability, and areas where it is necessary to educate citizen to environmental values aimed at energy savings before the policy interventions.

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