

Building ontologies from a variety of points of view

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Abstract

Methodologically, we suggest that modelling must start by an enumeration of the actors and institutions implied in the exercise of modelling, both the actors and institutions to be modelled (internal), and the modelling scientists, and possibly the interested decision makers and/or stakeholders (external). The aim of this paper is to illustrate this methodology by making a medium sized model. This proposed model objective is to understand the relationships between residential segregation and school segregation, resulting from the interaction between school supply and students' choices. We will first identify the various so-called actors, their objectives and their resulting point of view on the targeted system. Then we provide a synthesis of these points of view. Finally we will discuss the pros and cons of the proposed methodology with respect to knowledge elicitation potentials.

1. Introduction

In (Aubert & al., 2010), we propose to model the socio-systems using four meta-categories: Actors, Institutions, Territories and Resources. The *Actors* are decision-making entities that can be individual or collective and perform activities (Ferber, 1999, 2007). The *Resources* are the entities used by the actors in their activities, and described relatively to these activities. The *Institutions* are the ontology and norms shared by a group of actors (Ostrom, 1990). The *Territory* is a socially structured area of physical space, which boundary is defined by the scope of activities of both the actors and the institutions. Therefore any actor is situated simultaneously socially within a set of institutions, and spatially within a set of territories. As a methodological consequence, we suggest elsewhere that modelling must start by an enumeration of the actors and institutions implied in the exercise of modelling, because each one generates its own descriptions of the resources and territories. Ultimately, those descriptions are explanatory of the observed behaviours. But we argue further that these actors are not only the ones represented in the model. Then, the users of the model could be viewed as another category of actors (external); these include the modelling scientists, and possibly the interested decision makers and/or stakeholders. Each resulting point of view will be formalized as an ontology (Gruber, 1993; Munn, Smith, 2008) as proposed in (Müller, 2007, Livet & al., 2009) and represented by a UML class diagram (Bommel and Müller, 2007). Finally, we propose to merge these various points of view into a single synthetic model. We argue that this process allows to make explicit and to justify our simplification assumptions.

The aim of this paper is to illustrate this methodology by making a medium sized model. This proposed model objective is to understand the relationships between residential segregation and school segregation, resulting from the interaction between school supply and students' choices. We will first identify the various so-called actors, their objectives and their resulting point of view on the targeted system. Then we provide a synthesis of these points of view. Finally we will discuss the pros and cons of the proposed methodology with respect to knowledge elicitation potentials.

2. The actors

In a first round, different kinds of actors and their points of view on the system have been identified (figure 1): the (external) actors who build, modify and *observe* the model (the thematician: i.e. geographer economist or sociologist), and the (internal / represented) actors who are acting *within* the model. Among these, one can distinguish the spatially and socially localized actors (the student, the school director) and a macro-level institution (the education authority) of which regulations concern the whole system. Only the students and school directors will be simulated in the model (in green in figure 1). The policy maker's point of view will be used in order to define different classes of scenarios. The points of view of the geographer and the economist structure the model, its initialization and its observables.

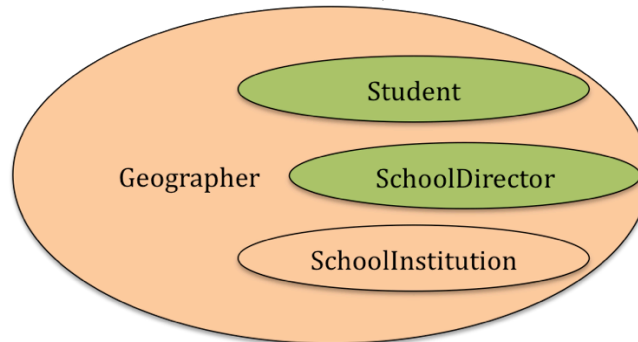


Figure 1: The points of view

The figure 1 illustrates that the points of view of the student, school director and education authority are actually the point of view of the geographer on their points of view. Having their proper points of view would have requested interviews and surveys that have not been made in this project.

2.1 The geographer

The goal of the geographer is to understand the mismatch between residential segregation and school segregation, mismatch which is empirically observed in many cases (Coleman, 1993; François & Poupeau, 2007; Andersson & alii, 2010). The approach will consist in comparing different spatial, institutional and social contexts. In this study the fields are first the Paris area and next a comparative study with the Stockholm area. Its view of a generic situation is described as follows. Metropolitan space is not homogeneous: first, the decreasing population density from centre to periphery impacts on the global level of schooling supply. Second, space is socially divided into sectors, meaning different population base for local schools. Third, this social division of the physical space has existed from long time, and thus affects the quality of the schooling supply: for instance, many of the private schools are concentrated in the old bourgeois neighbourhoods (the so-called “Beaux Quartiers”). Thus, for a home-based student, the schooling supply is not only different, but also more or less heterogeneous, depending on the localisation. Moreover, forms and quantity of available capital as well as schooling rules may vary throughout space. In such context, individual opportunities are rather different, leading the geographer to ask two questions:

- If there is an additional amount of segregation due to the scholar-system dynamics, what are the main causes? (Initial conditions, global rules or individual behaviours?)
- What are the resulting maps? I.e. for a given system (initial situation and rules), what is the resulting segregation at the different scales? Are they huge boundaries or smooth transitions?

The resulting analysis is summarized in the figure 2. The residential space is composed of residential areas where the students are distributed according to their social category status

(upper center of the figure). The school space is essentially a set of spatially situated schools. From a geographer point of view, the school director is characterized by its strategy. The student is characterized by its social status that is a combination of a social category, a cultural capital, a scholar level and an origin.

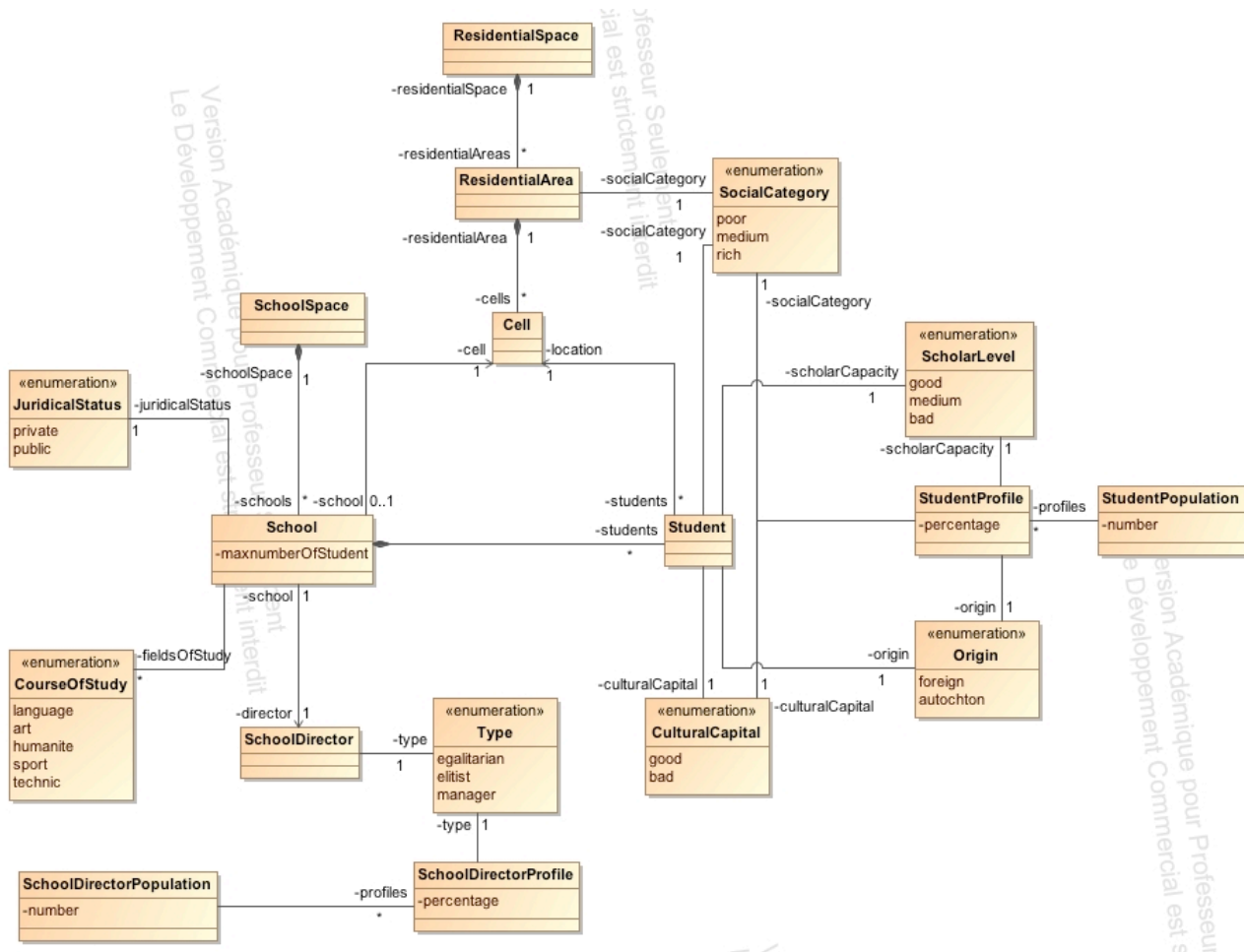


Figure 2: The geographer's model

For exploring the above-mentioned question, the geographer characterizes the population of students by a given percentage of each social status profile and the population of school directors in a similar way according to their strategies. The students are distributed in the residential areas according to their profile and the social category of the residential areas. The social division of the city and the density of population as well as that of schools are given as an initial fixed situation. It corresponds to a stylized city with a radio-concentric organisation of densities and a sectorial organisation of social groups. The school directors are randomly distributed in the schools.

2.2 The economist

The goal of the economist is to evaluate the efficiency of the educational system. What efficiency means may be politically defined through the strategy of a state for its educational system; a general view is that it may be measured through the overall success rate. But, reducing inequality of the educational system is often another shared objective and the problem may be typically a multi-criteria objective where the policy maker typically defines an aggregate objective. Otherwise, the economist's point of view does not differ much from the geographer's one.

2.3 The student

In the model the goal of a student (or rather of its family) is to find a school that fits his desires in an accessible area. Desires and accessibility will depend on its social and spatial position, and accessibility in turn will combine a physical and a cognitive dimension. Two examples can illustrate the different views the students may have on the system. Cultural capital increases knowledge on a greater number of schools as well as the possibility to access private schools, and thus, increases the size of the truly accessible part of the physical space, even if there is an isotropic transport network. Moreover, his or her social class will affect the student's choices. For instance, a student with huge economic capital will tend to prefer schools with so called European course of study, as he (or his family) aims at an international manager job. A typical working-class student, at the contrary, will be more confident by choosing a short-time technical course of study that will give him a job, in a way less desirable but easier to obtain and keep for him. Such a self-limitation of ambition is due to his or her dramatically low level of social capital and the existence of social and spatial discrimination.

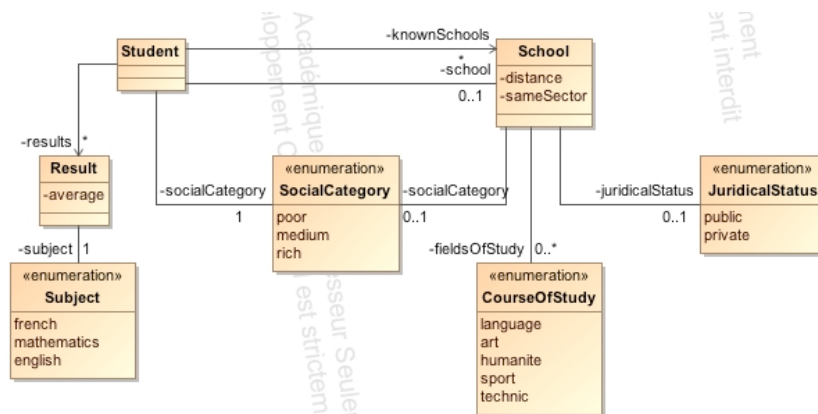


Figure 3: the student's point of view

Figure 3 illustrates how the student sees himself as well as his point of view on the schools he is aware of. In particular the geographer can observe the detailed population of the students in each school while the student only has a rough classification of the social category of the school that may or may not correspond to the reality. In case of sectorisation (see the education authority's point of view) one criterion may be whether the school is or is not in the same sector. Finally, each student knows about a number of schools with more or less information (hence the 0..1 cardinality on some descriptions).

2.4 The school director

In the model the school director is constrained by the higher level policy of the education authority. He can control two kinds of actions. First, he can decide to create or close a specific course of study. Second, he can accept or refuse the application of a student. His decisions will depend on his view on his school and on the student. Without loss of generality we distinguish only three simple strategies: - the "egalitarian" school director aims to ensure social diversity; - the "elitist" school director aims to ensure excellence; - the "manager" school director simply tries to increase the number of students. The directors have two different ways to apply these strategies: on the one hand, they choose the course of studies they want to offer: each course of studies will be attractive for different types of students. On the other hand, the directors may refuse a student who does not fit the school, in particular if the "elitist" strategy is chosen.

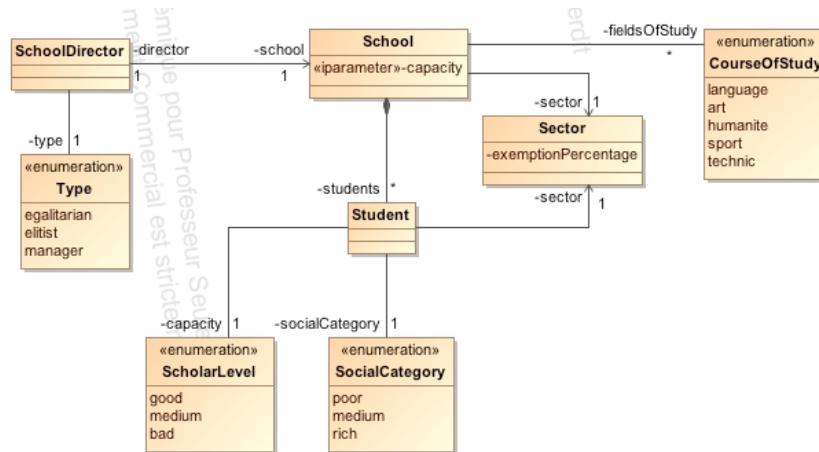


Figure 4: the school director's point of view

Figure 4 illustrates the point of view of the school director (including on himself as usual now). In particular, he sees the capacity of his school when the students don't. Additionally, the decisions of the policy maker is known in terms of the exemption percentage which is allowed for students who are not from the school sector. His decision will also depend on the sectorisation decided by the education authority, and represented here as the sector of both the school and the students.

2.5 The education authority

The education authority defines rules concerning schools size and budget as well as principles for students school allocation. In France, the territory is divided into districts surrounding each school that constrain more or less rigorously the “choice” of the school of the students residing inside the district. In the model, four strategies will be considered: - sectors built up according to a proximity principle; - sectors built up in order to maximize social diversity; - no sectorial constraint for the students but obligation for a school to accept a student who belongs to its sector; - no sectors, no constraints, i.e. a completely liberal system.

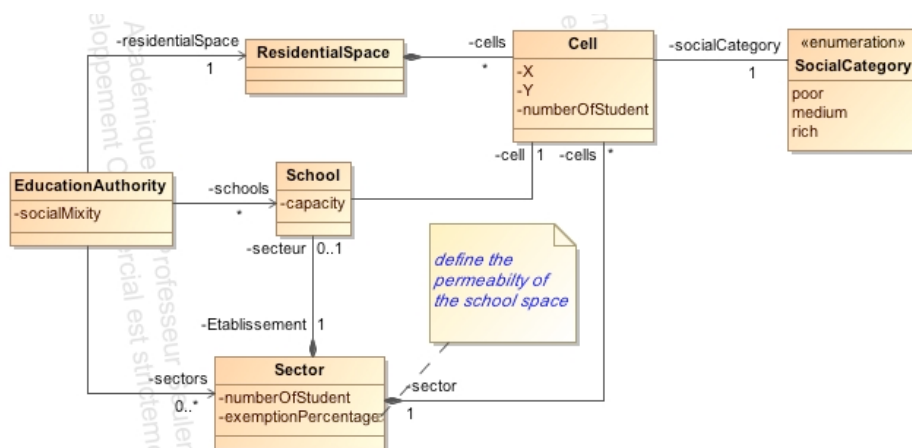


Figure 5: The education authority's point of view

Figure 5 illustrates the point of view of the education authority. Once again the point of view is slightly different from others for structuring its space. First the institution is the only one to see explicitly the cell coordinates (and then the residential space geometry) because it has to specify the sectors geometry. For the institution, a cell only contains the number of students.

In effect, it is not necessary to know each student independently (by the way the number of students by sector derives directly from its cell composition and could be omitted).

3. A synthesis

Combining the different points of view requests a number of choices. Among these choices, the possibility to keep the points of view separate or to combine them in a single category is of the outmost importance. For example, if we consider that, the discrepancy between the actual school features and the student's view of it, it is necessary to understand the targeted phenomenon, they have to be kept separate. Otherwise, one can consider that the school features are just common knowledge and represented only once.

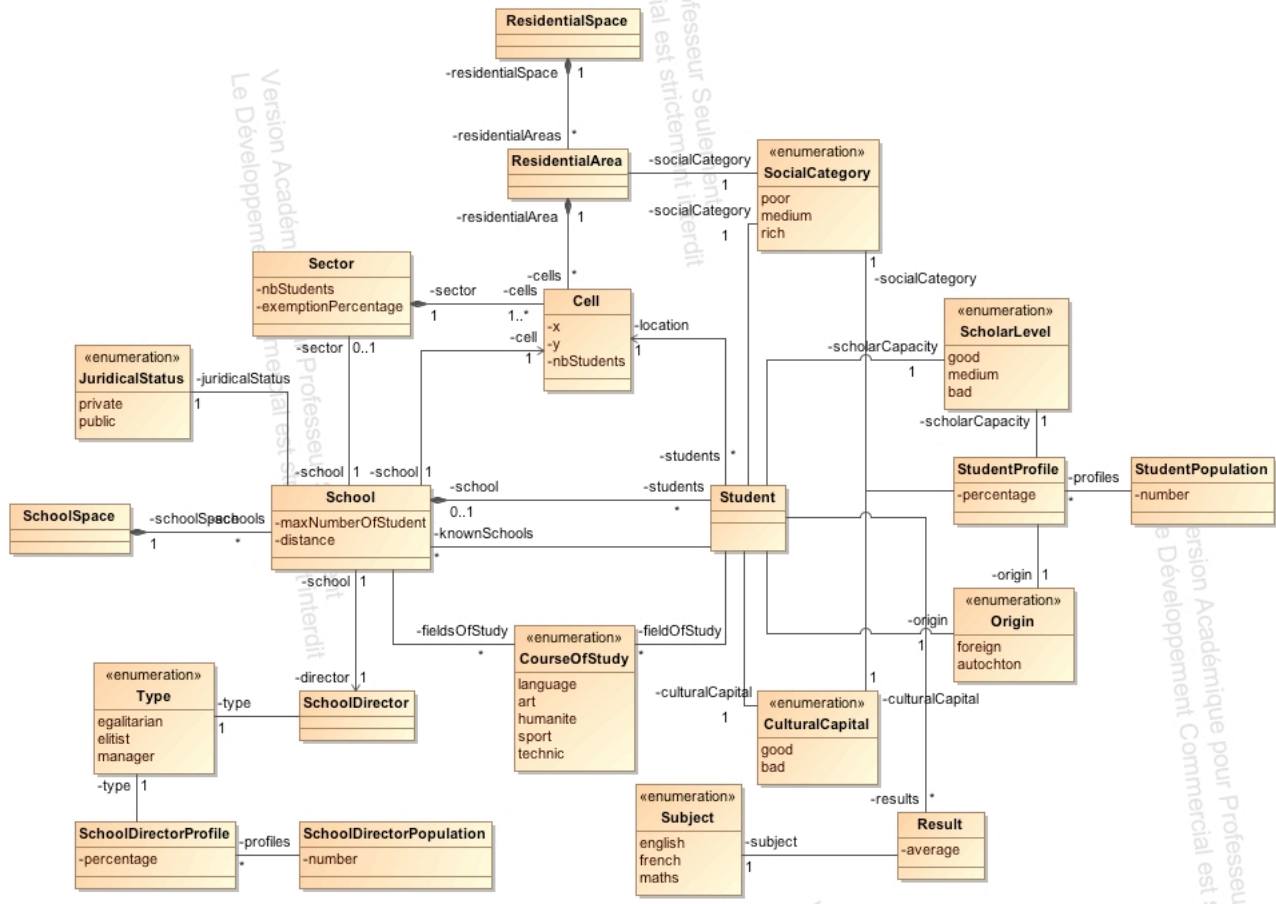


Figure 6: A possible synthesis

Figure 6 illustrates one possible merging of the previous points of view. It makes the systematic assumption that the concepts with the same name in each point of view are identical. For example, there is no discrepancy between the school as geographer sees it and as the students do. To take the case of the student, another possibility could be that "Student" in figure 6 represents the student from the geographer's point of view and there is a "DirectorStudentRepresentation" attached to the school director, a "StudentStudentRepresentation" attached to the student, etc. . Note that the geographer and the education authority do not appear in the schema. They could but it was decided to only represent the actors having a dynamics in the model.

4. Conclusion and discussion

In this paper, we have proposed and illustrated a methodology we think appropriate for modelling social systems. Rather than directly building a single model, we propose to

enumerate the various so-called actors, both the actors of the social system to be modelled, and the actors concerned by the social system either as scientist or decision makers. Each of these actors provides a point of view on the social system and therefore a specific ontology to describe it, in particular the actors themselves, their resources, institutions and territories.

It has been shown that this process makes explicit a fair number of simplifying assumptions that results from the merging of these various points of view into a single model. That way, the ontological approach is a useful tool to pick out eventual redundancies in the theoretical construction. In particular, the choice of making or not the actors' representations distinct (and possibly contradictory) among themselves and with respect to the actual situation is more easily disputable.

Considering the building of the model, next step will be to incorporate the dynamics of the system. A process of supply and demand will be developed: the rules which govern a student's school choice as well as the ones leading a school director to accept or reject a student's demand have to be specified. These developments will lead to the introduction of new concepts (demand, accept/reject for example). The associated rules are not clearly expressible with ontology, but their expression will be facilitated by a robust and well defined ontology.

This ontological approach of the modelling of a social system's dynamics has shown its potential to highlight differences in disciplinary views on a common object of interest. Indeed, the construction phase of the ontology has led to the identification of fundamental similarities and differences between the geographers' and economists' points of view. Further work will concentrate on deepening this identification (in particular emphasizing the economist's point of view), which should enrich knowledge building on the functioning of scholar segregation. That way, the ontological approach, has a potential of reinforcing the theoretical construction of the thematicians.

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