Chapter 21
Reinforcing the Place of Dynamic Spatialised Indicators in a Generic Socioeconomic Model

Fenintsoa Andriamasinoro
BRGM, France

ABSTRACT

This chapter describes and discusses a work aiming to contribute to how dynamic sustainable development indicators may be spatially represented in a generic spatial-integrated socioeconomic model (SISM). It means that, at a socioeconomic level, the resulting SISM should be capable of supporting applications modelled at different territorial scales and, at a spatial level, the SISM should be capable (a) of spatially representing the temporal evolution of the indicators by itself and (b) of exporting, at any time during a SISM simulation, the temporal evolution of the spatial state of the model as a (new) map exploitable in a GIS tool. The proposal from this chapter is to design a generic object-based SISM resulting from a combination of a multi-agent model and an object-based version of a system dynamics model so that all selected indicators can be spatialised via shaped objects independently of the territory study and the modelling approach.

INTRODUCTION

Dynamic Indicators

Due to the recommendation initially defined by the Bruntland Report regarding the Sustainable Development (SD) perspective (Bruntland, 1987), increasing interest has been shown over the last few decades in the research of methodologies for analysing the temporal evolution of SD indicators (hereafter *indicators*). Indicators are pertinent data from the real-field or from a model of a given application, selected by analysts in agreement with stakeholders (Lanini & al., 2004), the evolution of which they wish to follow. Indicators may be spatial, such as the position of players (Jaques & al., 2006), the position of resources (Deschamps & al., 2006), the surface area of resources (Leistel, 2005), or non-spatial, such as water pollution levels, jobs, incomes or health (Chamaret & al., 2007).

DOI: 10.4018/978-1-4666-1924-1.ch021

One of these methodologies is the simulation of what we call a spatial-integrated socioeconomic model (hereafter *SISM*) in which the indicators are conceptualized (Daniell & al., 2005; Haberl & al., 2009). SISM are models in which socioeconomic players, situated in a geographical space measured at a territorial scale, exploit natural resources to satisfy the needs of the present with the purpose of not compromising the ability of future generations to meet their own needs. Regarding SISM design, two approaches are often used, even though non-exhaustive. On the one hand, when a SISM is designed at a micro (local) territorial scale, a multi-agent system (MAS) approach (Wooldridge, 2002) is appropriate (Hugues & Drogoul, 2002; Andriamasinoro & al., 2005). In this object-based approach, the indicators are selected among the properties of objects representing agents, environment, etc. On the other hand, when a SISM is designed at a larger scale, approaches such as system dynamics (Aburdene, 1988) are often used (Andersen & Ford, 2000; Adl & Parvisian, 2009) even if a MAS is still valid. In this non-object based approach, indicators are selected from the interconnected numerical variables forming the system dynamics model (as may be noted, properties and variables are selected at the model point of view while indicators are selected at the user point of view). At a simulation level, the common method often used to follow the temporal evolution of indicators during a simulation is by curves (Daniell & al., 2005, Orru & al., 2007; Andriamasinoro & Angel, 2007).

Since we are in a SISM context, we believe that following such dynamic evolution by means of the spatial environment should also be possible. In that case, the indicators must first be *spatialised*. Spatialisation can be defined as the mapping of a non-spatial indicator to the spatial environment by means of a shaped object, i.e. spatial objects having line, circle and polygon forms. As for spatial indicators, they are not concerned with a spatialisation process since they are implicitly spatialised. After a spatialisation is performed, the user may then, during an ongoing simulation, (a) visualise the evolution of the selected spatialised indicators inside the simulation platform itself (if such a displayer exists) and/or (b) export the current spatial environment state, at any time during the simulation, as (new shape) map data. These data are next imported into a GIS tool and visualised there as a superposition of files showing the spatial state of one system at different times.

Objective of the Chapter

The objective of this paper is to present and discuss our contributions at both socioeconomic and spatial levels of a SISM regarding the conceptualisation of indicators. First, at a socioeconomic level, we propose an improvement of a MAS model to a more generic model, which is capable of supporting not only MAS based applications but also an object version of system dynamics based applications. This first step is necessary because, as outlined above, the spatialisation process, as defined here, is only possible for shaped objects. MAS models are already object-based models while system dynamics models are not. Second, at a spatial level, we propose an improvement of the conceptual integration of the two ways of visualising dynamic spatialised indicators (i.e. inside a SISM platform or a GIS tool) as detailed in the previous subsection.

In this second perspective, when the monitoring of spatialised indicators is made directly inside the SISM platform, we use what we call indicator display methods (hereafter IDM). IDMs may be: for a (poly)line object, a width, for polygon and circle objects, a surface size, for mobile objects, a moving track, and for all of them, a colour and a value label (label for short). IDMs may be combined if possible. Thus, during a simulation, when an indicator evolves, the corresponding IDMs also evolve. This results in a display of dynamic spatial shape data information, even on non-moving shapes. Next, to make the display of spatialised indicators via a GIS tool possible,

Related Content