

Modelling the integration of Geo-ICT in a scientific discipline

‘In search of an explanatory model – 2’

‘In search of an explanatory model – 1’ presented our initial thoughts on a model for the integration of Geo-ICT in a scientific discipline. We identified seven stages through which the use of GIS gradually intensifies from explorative publications by a small number of ‘champions’ to a full adoption for research and teaching. We use the interviews and literature that form the basis for the VI Matrix articles on GIS in individual disciplines to gradually refine our theoretic model(s) to develop this model further. Our discussions with economists have shed some new light on the model, particularly on its limitations. An important objective of the two-day conference that will take place in the autumn of 2007 is to further refine our framework and to complement it with additional models in order to enhance its practical legitimacy. The final results of our theoretical investigation will be presented in a book, together with a selection of the conference papers.

Models by Nolan and Davis

Perhaps with the exception of technology studies, no other discipline has contributed more to our knowledge of the dynamics of technology innovation than economics. To what extent can we, for the further development of our own theoretical framework, benefit from models that economists have developed to describe the integration and impact of new technology in organisations?

A first model from which we can draw inspiration is Richard Nolan’s famous S-shaped stage model for the use of computer technology in organisations (see: figure 1) [Nolan, 1973; 1974; 1976; 1979]. Assuming that changing levels of ICT-investment are indicative for shifts in its use and management, Nolan identified four stages of technology adoption: Initiation, Contagion, Control and Integration. The main strength of his model lays in the fact that it provides a clear and fairly straightforward view of *how* the process of integration evolves over time. What it fails to do, however, is to provide insight into the dynamics behind this process, i.e. explain *why* it evolves in this particular way.

Nevertheless, there are a number of lessons that we can draw from it. Firstly, that the process of integration is not linear, as we initially portrayed it, but consists of numerous S-shaped curves, referring to stages of growth, stagnancy and decline. Moreover, Nolan’s model highlights the importance of not simply labelling the different stages, but also to describe their meaning *consistently*. If we believe that full integration implies a certain level of adoption in both research and teaching, then we have to describe for *each* of the stages in our model the status of GIS-use in *each* of these activities. Finally, our framework, as it currently stands, is not quantifiable. We either need to resolve this issue (by incorporating information on Geo-ICT investment or the numbers of GIS-publications and -courses), or accept its implications (since our model is not measurable, we cannot statistically test its practical legitimacy).

Like Nolan’s model, our framework is an ‘evolutionist’ model: it presents GIS-integration as a process with a clear *direction* and *destination of change*, presenting a sequence of stages, where each stage is the logical precursor for the next one. However, in order to explain ‘deadlocks’ and ‘growth spurts’ in this process (i.e. shifts in the direction or pace of change) it will be necessary to turn to additional, ‘evolutionary’ models that focus more on the underlying dynamics.

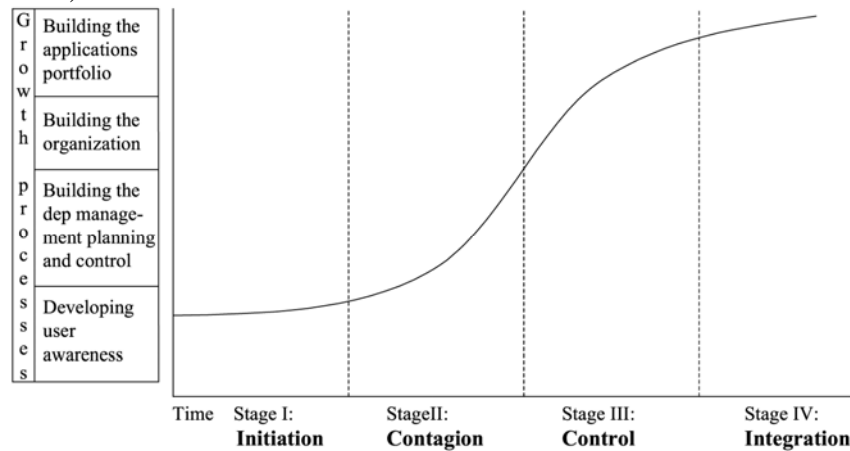
One prominent ‘evolutionary’ model is the ‘Technology Acceptance Model’ (see figure 2) [Davis, 1989; Venkatesh & Davis, 2000]. The TAM is different from life-cycles (such as Nolan’s curve) because it focuses on user-behaviour *at a certain moment in time* and tries to reconstruct the social and cognitive processes that lay behind this behaviour (intention to use, perceived ease of use and perceived usefulness). The strength of this model is that it provides *reasons for* intensified, stagnant or declining use.

Both Nolan’s stage model and TAM were developed to assess innovation processes in a business environment – hence, their legitimacy in an academic context has not been confirmed. Yet, whether we decide to use either of these specific models or to develop our own, the main lesson that we can draw from this investigation is that our project requires both *types* of models. If we want to reconstruct the process of integration of Geo-ICT in science sufficiently, both its course as well as underlying stimuli and obstacles, we will have to improve our ‘evolutionist’ framework and complement it with an ‘evolutionary’ one.

Niels van Manen, Henk Scholten and Rob van de Velde
 SPINlab, Vrije Unversiteit, Amsterdam

Afbeelding 1

Source: Hans Voordijk, Robert Stegwee & Rogier Helmus, ‘ERP and the changing role of IT in engineering consultancy firms’ in: *Business process management journal*, (August 2005).



Afbeelding 2

Figure 2

Source: Viswanath Venkatesh & Fred D. Davis, 'A theoretical extension of the Technology Acceptance Model: four longitudinal field studies' in: *Management Science* Vol. 46, no. 2 (Feb. 2000): 186-204.

Figure 1 Proposed TAM2—Extension of the Technology Acceptance Model

