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Understanding The IS Experience Cycle: A Model Of ERP Implementation

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Abstract

This paper focuses on the experience cycle of information systems in organisations (Markus, Tanis, 2000). This area of research has dramatically increased since the 1970s (Lucas, 1978), but still fails to present a unified approach (DeVaujany, Fomin, 2001). Although the current literature on IS implementation offers substantial results regarding various steps of the experience cycle; there is still a significant gap to fill regarding the understanding of the process as a whole. This paper contributes to the IS field, by considering the IS experience cycle, as a process composed by three phases (chartering, project and diffusion), which cannot be understood in isolation from each other. As an illustration, this paper uses a system dynamics model to understand the implementation and more specifically focuses on the case of Enterprise Resource Planning. The paper applies a coupled pair of simple differential equations to simulate a real organisation and successfully fits the model to the observed data. The model is able to predict the implementation time under various conditions and shows the necessity of not analysing the project and diffusion phases independently from each other.

Key words: Diffusion of Information Systems, Process theory, Experience Cycle, Simulation, IS modelling, ERP

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1 Introduction

Contemporary organisations are increasingly facing the challenge of business innovation and technological requirements, which have rendered information technology a key factor in obtaining a competitive advantage in the marketplace. Consequently, strategic management of information technology activities tends to play a significant role in increasing modern corporation's profits and market shares. That is to say, better information provides firms with a competitive advantage, partly because of recent management strategies resulting from the innovative use of information systems (IS).

As a result, understanding the use of IS within an organisation appears to be both an important research and applied topic, in the pursuit of a competitive advantage for organisations. Since the 1970s, this issue has raised various research questions and has resulted into a substantial amount of literature within the academic arena, and a large amount of contributions to the IS field (Lucas, 1978). IS researchers tend to agree on the distinction between two IS concepts; namely IS design and its use or implementation (DeVaujany, Fomin, 2006). This paper only focuses on the use perspective excluding the IS design, which corresponds to IS innovation and conception stage. Within the current IS literature, the use perspective expresses a general tendency to analyse isolated phases of the experience cycle without linking them with each other. Regarding this matter, DeVaujany and Fomin (2006) outline a dichotomy within this use perspective, stating that 'for instance, the bulk of current ERP research focuses on selection and implementation (Dong et al., 2002; Esteves, 2001; Jacobs & Bendaly, 2003), most research on intranet technology is focused on the post-implementation phase, especially structurational approaches (Ciborra et al., 2001; Vaast, 2001)' (DeVaujany, Fomin, 2006: 2).

On the basis of Markus and Tanis' research, this contribution distinguishes three phases of the IS experience cycle, namely the *chartering phase* – which leads to the decision to proceed with the IS or not, the *project phase* – which constitutes the implementation of the new IS (including training), and the *diffusion phase* – which leads to "normal operations", and which constitutes the final fit between the initial managerial goals and the actual use of the system (Markus, Tanis, 2000: 189).

These actual phases readily observed in reality have been the object of several organisational theories, which rarely aimed at linking them into a continuous process. As a result of this existing gap in the literature, the first aim of this contribution is therefore to think about a process approach which could understand the IS experience cycle as a whole, linking different phases of its cycle within an organisation. From a more theoretical perspective, the second aim of this contribution applies a popular simulation method (borrowed from dynamical systems research) to provide a better understanding of a process approach of IS.

In accordance with its main objectives, this contribution consists of two parts. The first part of the paper stresses the importance of considering three phases in the cycle of IS within the organisation, which are interdependent. Then, the second part applies a simple differential equation based model to a real organisation, in this case adopting an ERP system. This second part, although only a first step, illustrates that simulation methods could provide a powerful tool to highlight the complex feedback between the project and the diffusion phases of the IS experience cycle.

2 Toward a process approach of the IS experience cycle

Based on the experience cycle described by Markus and Tanis (2000), this part of the paper stresses the importance of interrelated phases, to detect failures of the IS process, as a whole. Put differently, the main idea here is that the understanding of the reasons for failure or success of an IS implementation has to be found in a larger process, which is the experience cycle. This cycle evolves from the chartering phase of the new IS through its implementation phase, leading ultimately to its use by the entire community in the organisation.

Hence, the first phase constitutes the pre-adoption of an IS by the manager(s). This *initial phase* determines the needs and resources of the organisation and assesses the skills of its potential users. At the end of this phase, if the decision to adopt an IS is taken, it gives rise to the beginning of the post-adoption period, which consists of two phases: the project phase and the diffusion period.

In this post-adoption period, the *second phase* starts with integrating the IS to the company, through a specific development. Then, emphasise is put on training, by loaning "experts" by freeing them from their daily tasks to assist their colleagues, or outsourcing training to a third party service company providing training to potential users. This project phase particularly focuses on learning processes, at both individual and collective levels.

Finally, the *third and final phase* is the period of diffusion of the IS to the entire community of users. This phase enables the managerial team to compare the actual use of the IS with the initial goals, set up in the chartering phase.

The experience cycle could be represented as follows.

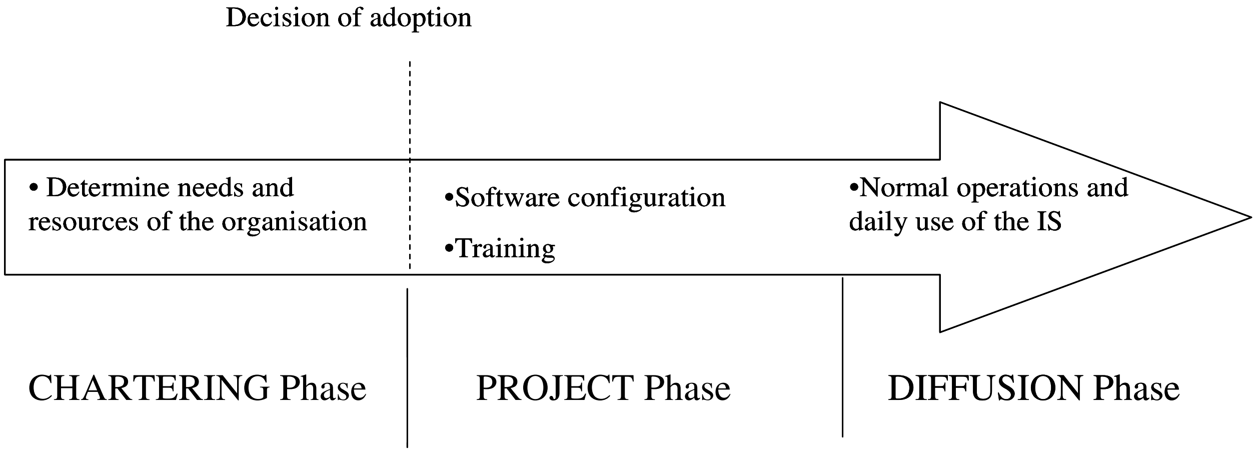

Figure 1 represents the three phases composing the experience cycle of an information system

In accordance with this conceptual framework, it is necessary to analyse the success of each phase in relation to the success of previous phases in time, and, hence, to use a sequential approach. As highlighted by Markus and Tanis, this approach allows us to better identify global problems, 'tracing back problems and suboptimal success at each phase to variances arising in earlier phases' (Markus, Tanis, 2000: 200). As an illustration, the configuration of potential failures during the final phase of diffusion may emerge from past mistakes, which have occurred during the chartering phase (bad estimation of the objectives, poor skills assessment), or during the project phase (poor composition of the project team, inappropriate training).

In this context, this first part of the paper consists of two sections. The first section briefly outlines the existing approaches, regarding IS implementation. This section seeks to stress the gap existing in terms of process approach and IS experience cycle. Then, the second section argues in favour of the use of simulation methods to propose a process approach of IS implementation.

2.1 Received approaches of IS implementation

This section does not constitute a literature review on IS implementation, but rather a selected set of examples of theories which fail to provide a process theory of IS implementation. In general, existing theories of technology focus on the outcomes of the introduction of a new technology or on the effects technology could have on organisational change.

This is the case, for instance, of the most common theory of technology, known as the structuration theory, and whose main authors include DeSanctis and Poole (1990) and Orlikowski (1992). Structuration models are often used in the IS domain because they focus on the interplay between technology and the social process of technology use. This school of thought reacted to the Decision Making School, which mainly explained information technology failures through an 'engineering view', based on the idea that information technologies contain inherent power to shape human behaviour, which forces individuals to adapt to the technology. This decision making approach was strongly deterministic, giving a predominant role to the technology properties, as a source of failure of the process as a whole (Pinfield, 1986 ; Orlikowski, Baroudi, 1991). By contrast, the structuration approach was willing to develop a non deterministic view of the use of the technology in organisations, arguing against the developments made by the Decision Making School that 'there are not clearcut patterns indicating that some technology properties or contingencies consistently lead to either positive or negative outcomes' (DeSanctis, Poole, 1994: 124). As a result, structuration theorists considered cases in which the same technology (presenting the same properties) could lead to different outcomes in terms of implementation or use in the organisation.

Although there is no doubt that the structuration theory constitutes a more adequate theory to understand our perspective of IS implementation than the Decision Making School or the Institutional Theory (DeSanctis, Poole, 1994: 123); the structuration approach still fails to provide a detailed analysis of the IS life cycle. In fact, the structuration theory focuses mainly on the appropriation phase, arguing that the technology is in constant evolution due to the users modifying it (Hussenot, 2008).

Other theories are more concerned with making practical recommendations to companies regarding the implementation of IS in organisations. This is the case of organisational learning theories, and more particularly of the contribution made by Argyris in his 1982 article on 'Organisational Learning and Management Information Systems'. Considering individual competencies as constitutive parts of an organisational form is compatible with the process approach used in this contribution. Therefore, this approach cannot ignore the relationship between the experience cycle and the evolution of individual and collective competencies within the organisation. This evolution between individual and collective competencies is in turn based on the concepts of individual and organisational learning. Argyris (1982) seeks to provide the main reasons underlying the implementation gap or cases of IS failures. According to the author, IS represent 'a part of a more general problem of organisational learning', Argyris defined organisational learning as the result of identifying and correcting errors made by the organisation. In his article, Argyris shows the limits to the usual recommendations made for the implementation of IS in the literature, and concludes his article by 'recommend[ing], therefore, an alliance among line executives, MIS professionals and behavioral scientists to conduct research on how to develop MIS that are more effectively implementable'. However, organisational learning theories do not provide a conceptual framework in terms of process management and the IS experience cycle.

2.2 Toward an 'integrative' approach to the use perspective of IS

As Markus and Tanis (2000) pointed out, the benefits of an experience cycle based theory could be useful for the researcher's point of view, as well as meaningful for the practitioner. It could be used *retrospectively* – by tracing back problems and failures at each earlier phase and *prospectively* – by identifying potential problems that should be addressed in 'basic and contingency plans' (Markus, Tanis, 2000: 200). The possible outcomes emerging at each phase of the experience cycle could be summarised as follows:

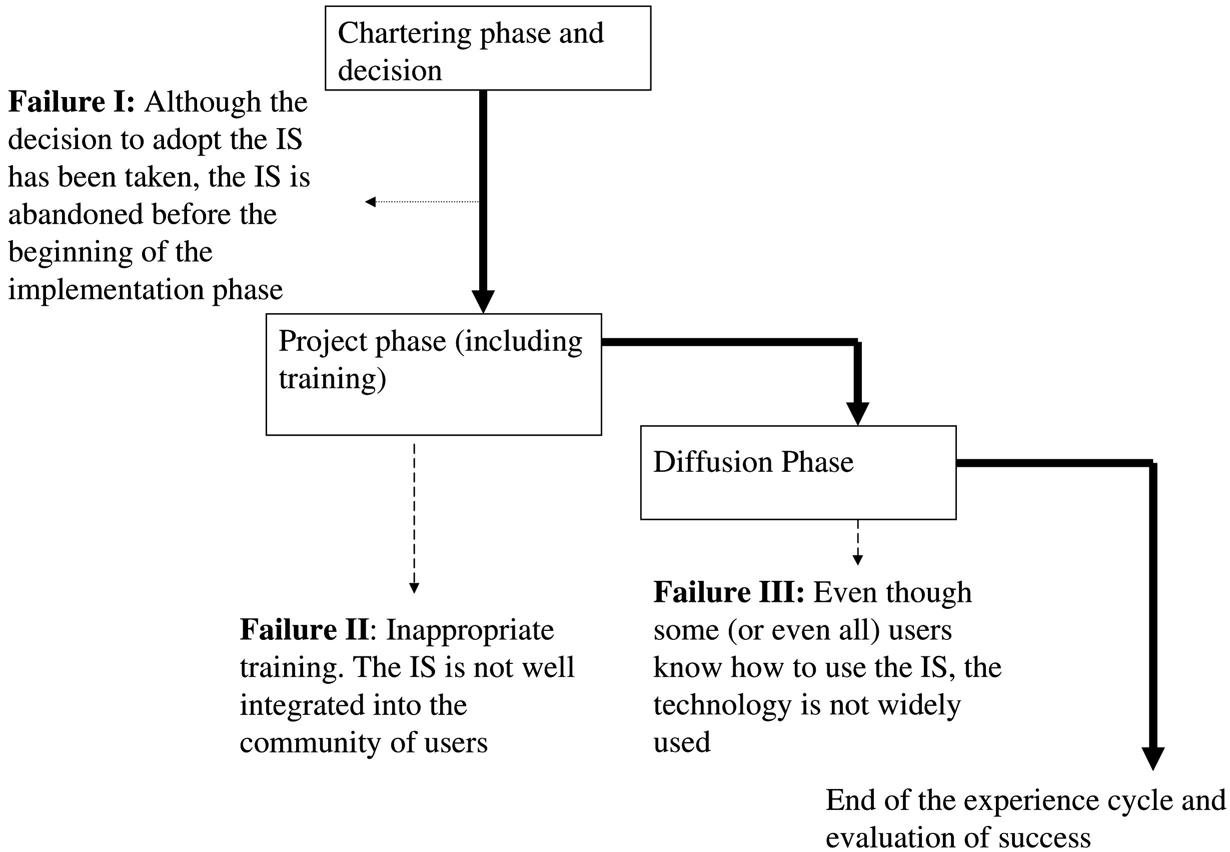

Figure 2 represents an IS experience cycle coupled with the possible negative outcomes at each phase

This figure shows the entire process of the IS life cycle within the organisation (excluding the design phase, and the appropriation phase, as they have been stated in the introductory remarks of this paper). On the basis of Markus and Tanis (2000), each phase depends on an earlier phase. In the same way, an error emerging in the diffusion phase might be correlated with earlier difficulties in implementing the IS. It is intuitive that the diffusion phase depends on the project phase. However, as shown in the previous section and as DeVaujany and Fomin stated in 2006, 'the sociotechnical dynamic of each phase, their interplay, the way they overlap, remain largely overlooked by the scholar' (DeVaujany, Fomin, 2006: 3).

For all these reasons, this paper uses a simulation to provide a better understanding of the dynamics and the interplay between the different phases. Simulation methods are increasingly used by the community of researchers in management, while remaining used much less by practitioners.

Simulation models have recently received particular attention in the management research literature (*American Journal of Sociology*, Special Issue January 2005 ; *Academy of Management Review*, Special Issue : Simulation Modeling in Organizational and Management Research, October 2007). However, these models used by some management researchers are still poorly understood by the management research community as a whole, mainly because simulation methods still have a perceived link with deterministic optimisation models. On the contrary, it could be argued that one of the main reasons for the use of simulations is that the complexity of managerial reality is often very difficult to analyse from empirical observations and human intuition alone is rarely adequate. On the one hand, traditional quantitative analysis or data processing statistics - which tend to homogenise agents in order to make better predictions - are often too simplistic in explaining management complexity. On the other hand, the use of a single case study to address a general management research question can lead to an emphasis on specific details of a particular company or technology and obscures the governing dynamics by flooding the analysis with superfluous details.

In this context, numerical simulation methods may provide an alternative path between theory and purely empirical studies. As Axelrod pointed out, simulation is "a third way of doing science. Like deduction, it starts with a set of explicit assumptions. But unlike deduction, it does not prove theorems… induction can be used to find patterns in data, and deduction can be used to find consequences of assumptions, simulation modelling can be used as an aid to intuition." (Axelrod, 1997: 4). Thus, such models provide a better understanding of collective phenomena arising from complex heterogeneous individual entities, and aim at providing a simplified though realistic analysis of the real world. Consequently, because simulation models constitute the artificial reconstruction of a real system or phenomenon, simulation methods present the advantage to approach the dynamic nature of certain managerial concerns, in a more realistic and useful way than abstract models. For our purpose, this paper suggests that simulation methods could help understanding the dynamics, the interplay of each phase and the way they overlap (DeVaujany, Fomin, 2006).

Dooley (2001) distinguishes three main schools of simulation practice in organisational studies:

- Agent-based models[1] (which include cellular automata), – this simulation involves 'agents that attempt to maximise their fitness (utility) functions by interacting with other agents and resources' (Ibid: 829);
- Discrete event models[2] – this simulation is the most often used in the case of a system defined as 'a set of entities evolving over time according to the availability of resources and the triggering of events' (idem);
- System dynamics[3] – these models are used when the simulation involves 'identifying the key « state » variables that define the behaviour of the system, and then relating those variables to one another through coupled, differential equations' (Idem).

The simulation model developed in the next part is built on the work of Repenning (2002), who used a system of differential equations to model technology implementation. The next part of the paper uses the third simulation practice referred to by Dooley (2001) namely system dynamics. In his article, Repenning examined the possible occurrence of failure associated with the introduction of a new technology within the organisation and, more specifically associated with its diffusion among its community of users. Our contribution is a variant of Repenning's model and is more particularly concerned with factors of failure, regarding the implementation of an Enterprise Resource Planning system within an organization. Our model aims at linking the project and the diffusion phases of the IS experience cycle.

3 Using simulations to understand the IS experience cycle

As argued in the previous part of this contribution, simulations are considered as a tool providing a better understanding of the IS experience cycle, as a management process. This part of the paper is divided in two sections. The first section constitutes the development of a system dynamics model which seeks to understand the IS implementation. The model links the project and the diffusion phases, and uses a real company to show how necessary it is to have a process approach to the IS implementation – which constitutes the post-adoption phase (See. Figure 1 of the paper). The second section comments on the model and shows how simulations could be used in reality. The second section is a first step which seeks to highlight how simulation methods could be used to understand IS implementation, considering project and diffusion phases, as interrelated.

3.1 Simulating the IS implementation: the case of ERP

The first step of this section is to build a model on the basis of the dynamics of diffusion of IS in an organisation. Then, the second step uses a real case study to provide real parameters to the model.

Model :

In the same line of research as Repenning (2002), the following model seeks to understand the dynamics lying behind the diffusion of a new technology within an organisation. More precisely, this contribution focuses on the case of implementation of an Enterprise Resource Planning System. The choice of adoption of an ERP by an organisation could be justified by various reasons. This information system is, indeed, a factor of organisational reconfiguration, and enlarges the choice of best management practices available to the manager, and his teams. An ERP is based on a single and common database gathering data from various departments of the firm and shared by its various business functions, such as customer relationship management, financial service, or computing service. This system makes the diffusion of information easier and reduces multiple errors through the standardisation of a modular software design. Obviously, these benefits are only made possible by the smooth functioning and success of the implementation of ERP to its community of users.

Also, the adoption of an ERP, if used by members of the organisation, would provide a benefit to the users of the technology and to the company as a whole, especially in terms of competitive advantage. However, very often, the implementation of this system fails, as pointed out in the introductive remarks. Repenning's main argument for these failures is associated with a lack of use of the new technology by its community of users. In turn, this lack of use could be explained by a low opinion of the new technology made by its users who, consequently, do not convince positively non-users to use the ERP system. The low number of users may also be explained by a lack of pressure coming from the managerial team. However, our model only focuses on the first explanation of failures. In this context, there are three important variables in the analysis of the implementation of an ERP:

(1) The number of users of the ERP, $N(t)$;
(2) The benefit the user obtains by using the ERP[4], $B(t)$;
(3) The link between $N(t)$ and $B(t)$ provided by the users opinion of the technology.

These variables constitute a formalisation of the terminology and of the experience cycle outlined in part I of the paper (See. Figure 2). The benefit B corresponds to the project phase; once a user has been trained to use the technology she may be able to obtain some benefit from using it. The number of users N can then increase as users of the technology teach non users to learn how to use the technology; this spread of the technology from the initial user base corresponds to the diffusion phase. These phases are linked by the "word of mouth" feedback function (See figure 6, below).

In the model *N(t)*, and *B(t)* are the variables modelled using a pair of coupled non-linear, 1^{st} order, ordinary differential equations (ODE's). The rate of change of *N(t)* is proportional to the product of the number of users and the number of non-users. That is to say, there are *N(t)* people available to persuade the non-users, to use the technology. The number of non users is simply $N_{tot} - N(t)$, where N_{tot} is the total number of employees, assumed to use the ERP.

Therefore

$$\frac{dN(t)}{dt} \propto N(t)\{N_{tot} - N(t)\}\,. \qquad (0.1)$$

The benefit obtained from using the technology is defined as being $B(t) = 1 - D(t)$, where *D(t)* is the number of defects which is reduced by the introduction of the new information system. Inversely to Repenning (2002), who uses the defect variable, *D(t)*, this contribution chooses to explicitly introduce the concept of associated benefit[5]. In fact, by contrast with this author, who used a range of parameter values to examine the model behaviour, we test the model by applying it to real observations of a firm. Hence, in this context, it appears empirically very difficult to collect and measure a proxy variable of defect. However, the use of the benefit variable is empirically testable, making the selection of parameters much easier.

Schneiderman (1988) found that the number of defects emerging with the introduction of an ERP system decays exponentially over time, which assumes the existence of an increasing learning process. Whereby the rate of decrease in *D(t)* is proportional to *D(t)*, therefore the rate of increase in *B(t)* is also proportional to *B(t)*

$$\frac{dB(t)}{dt} \propto \phi\{B(t) - B_{\max}\} \qquad (0.2)$$

In this equation, we assume that the benefit can not exceed some maximum value, $B_{\max} = 1 - D_{\min}$. The prefactor ϕ is known as the decay constant. It is a measure of how long it takes to learn how to use the technology by its users. The larger ϕ is, the quicker the benefits obtained by using the technology are. However, the benefit also depends on the number of people using the technology; therefore we use the modified version of(0.2):

$$\frac{dB(t)}{dt} = \phi\{B(t) - B_{\max}\}N(t) \qquad (0.3)$$

With the initial benefit, $B(0) = 0$.

Now, we can link the number of users, *N*(t) to the benefit associated to the use of the ERP, *B(t)*. This is done by a functional *f[B(t)]* which links the feed back or 'word of mouth' between users and non-users of the technology. If the users notice some benefit, then, they will recommend the technology to the non-users, and conversely if the users notice no or little benefit then they will not recommend it. We can write a functional *f*, which measures the influence of the benefits obtained by the users on their propensity to persuade non-users to start using it, because

$$\begin{array}{ll} f[B] > 0 & \text{if} \quad B \geq B_{\min} > 0 \\ f[B] < 0 & \text{if} \quad B < B_{\min} \end{array} \qquad (0.4)$$

As long as *f* satisfies the property (1.4), its exact form does not significantly change the results (Repenning, 2002 : 116). We have used a smoothed step function. Therefore returning to (0.1)

$$\frac{dN(t)}{dt} = \omega f[B(t)]N(t)\{N_{tot} - N(t)\} \qquad (0.5)$$

where ω is the rate of interactions between users and non-users.

We now have a pair of coupled differential equations (0.3) and (0.5) for both variables defined by 1) and 2), respectively the number of users of ERP, $N(t)$, and the benefit the user gets from using the ERP system, $B(t)$. The final part of the model is the functional form (0.4) which links the feedback between the number of users of the ERP and the benefit from its use, defined in 3).

Parameters of the model :

It is argued that when a simulation model is tested against real world data and is able to make predictions which agree with other data, the model is considered valid (Cartier, 2003: 210). This section uses this principle and therefore collects some observations of a real company, to illustrate and validate the model presented in the previous section.

The collection of data has been made after having identified a particular company which has implemented an ERP system, long enough ago to enable us to interview its users after the implementation has been completed. The company we selected (renamed for confidentiality reasons "Prestige Service & Co.") operates within the sector 'Leisure Industry, Hotels', and has 3,500 employees. In 2000, Prestige Service & Co. took the decision to implement a new information system, which was replacing the existing internally developed system. Management teams argue that the reason for the adoption of an ERP was primarily a way to make the company more easily auditable. The community of users of the ERP only represented 10% of the entire company and concerned three business departments, namely the IT service, the administrative functions, and the purchasing department. In total, there were approximately 350 users of the new technology. Interviews conducted within the company were semi-directive and were conducted within the three different services using the ERP. Each manager of the three services was interviewed independently and we selected ten users by department who attended the introduction of the ERP in 2000 and agreed to answer our questions.

On average for a single user, the managerial team estimates the necessary learning time for the ERP, to be one month. In our model, this variable is represented by the constant ϕ, which estimates the amount of learning necessary for the use of the ERP by its users and appears in:

$$\frac{dB(t)}{dt} = \phi\{B(t) - B_{\max}\}N(t) \tag{0.3}$$

This constant ϕ corresponds to the project phase of the experience cycle, outlined in Part I of the paper. After taking into account that the learning time was on average 30 days per person and setting the constant ϕ[6], we get the following result for the whole company:

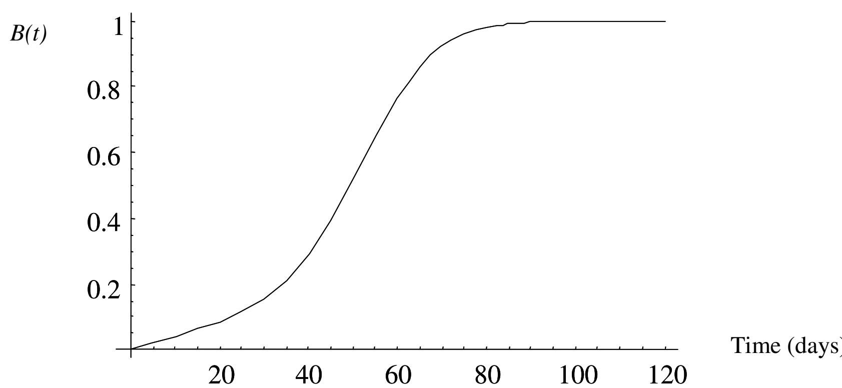

Figure 3 shows the evolution of the benefit variable, *B(t),* over time.

The y-axis shows the benefit, *B(t)*, against time, assuming that the minimum benefit from the ERP is 0, and its maximum value is 1. This graph chooses a time period of four months (120 days). The curve shows that the initial benefit is small before increasing sharply between the 40th and 90th day, by which time the full benefit is obtained - which corresponds to the technology being fully implemented across the firm. This implementation period of three months is predicted by the model as ϕ was set to give an implementation time for an individual of one month. The shape of the curve and the increase in time required for the full implementation can be explained by the benefit depending on the number of users (the appearance of *N(t)* in equation (0.3)). The number of users depends on the feedback function, *F[B(t)]*, as expressed in equation (0.5), which is reproduced below:

$$\frac{dN(t)}{dt} = \omega f[B(t)]N(t)\{N_{tot} - N(t)\} \qquad (0.5)$$

with ω, the interaction rate between users and non-users.

The setting of the model parameters consists of estimating the interaction rate ω, empirically. On average, during the three months of training, the users of the ERP interacted once a week with the non-users. In setting *f[B(t)]*, we get the following result:

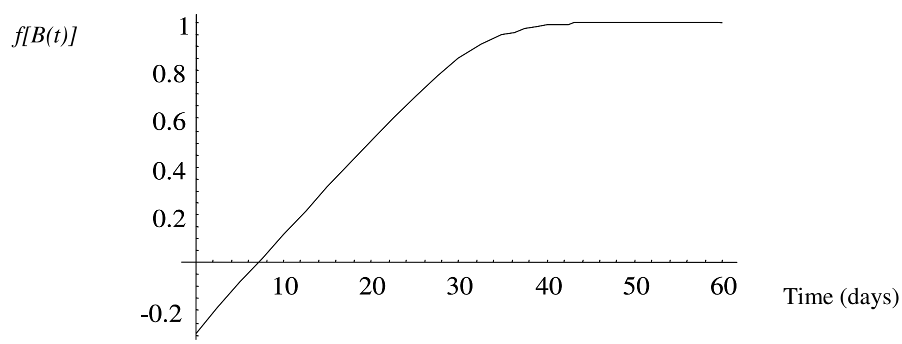

Figure 4 shows the evolution of the feedbacks variable over time

This curve is initially negative, due to the small initial benefit (see Figure 1), and grows linearly until approximately day forty. At this point in time, the curve reaches the value of 1[7], i.e. the maximum value, meaning that the users of the ERP recommend it very strongly to non-users.

If we now look at the dynamics of the number of users, *N(t)*, the equation can be reproduced below:

$$\frac{dN(t)}{dt} = \omega f[B(t)]N(t)\{N_{tot} - N(t)\} \qquad (0.5)$$

Based on our empirical observations, we can now set the model with ω = 1/7, and N_{tot} = 350. Thus, the solution to equation (0.5) could be expressed graphically:

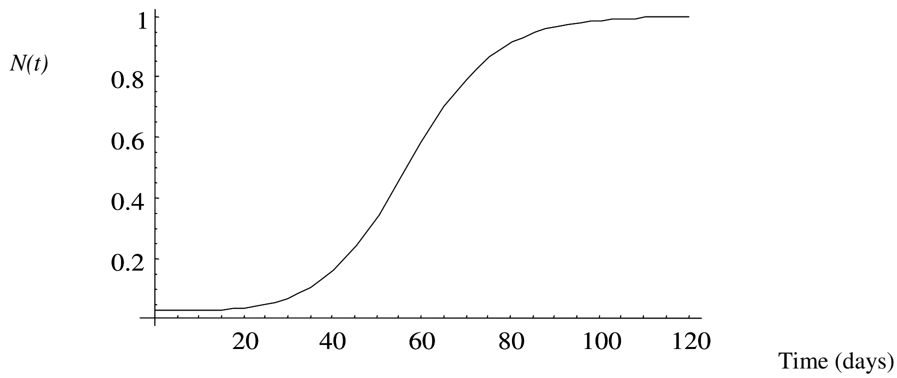

Figure 5 shows the evolution of the number of users over time

The number of users *N(t)* remains roughly constant for the first 40 days, by which time the users have formed a strong positive opinion of the ERP system (see figure 2) persuading the non-users to adopt it, causing *N(t)* to sharply increase until the third month of implementation of the ERP. By day 90 (end of the third month), the ERP has penetrated the whole community of users. In accordance with our model, one of the explanations is that workers initially do no recommend the technology as there is little benefit from using it. Once some users have had time to learn how to use the ERP, they obtain more benefit from it and recommend it. More people use it and go on to recommend it. This feedback continues producing rapid 'viral growth' and the new technology becomes the new standard after 3 months. The initial goal expressed by the managerial team is then reached.

This argument validates the model presented by Repenning (2002), by strengthening it with empirical variables. Our model used a value of ϕ corresponding to a learning time of 30 days[8]; the time required for a user to get the maximum benefit from the use of the ERP. However, the model is able to predict that it will take 3 months for everyone (350 users in our context) to adopt the ERP.

This gap between the mastering of the ERP and the current use of the ERP by the whole community is largely due to the time required for people, not only to learn to use this new technology, but also to be convinced to use it. This feedback loop or positive reinforcement described by our model confirms the idea of Repenning (2002), and can be summarized as follows:

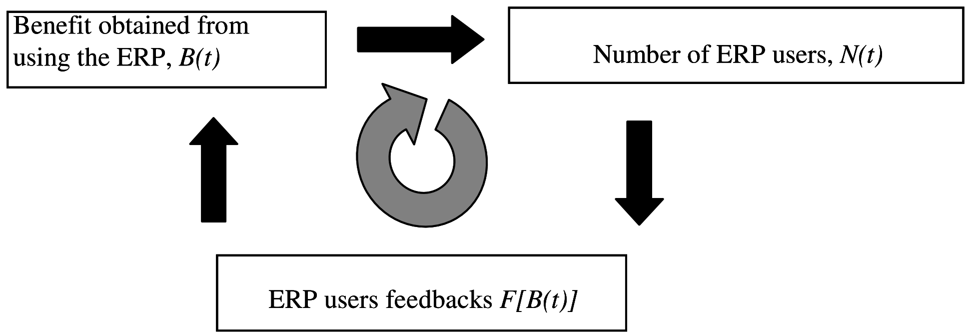

Figure 6 shows a modified version of the feedback loop introduced by Repenning (2002), and adapted to our model of ERP implementation. The functional *F[ ]* links the project phase, expressed by the benefit *B* obtained from using the technology, and the diffusion phase which is concerned with the spread of the technology users *N*.

3.2 II.2. Concluding remarks:

At this stage of the analysis, it now seems relevant to confront the predictions of the model to what has actually happened in the reality of Prestige Service & Co. The main theme of the questionnaire was directed towards the project and the diffusion phases of the ERP system within the organisation. Prestige Service & Co. started a training plan which lasted three months. This training - initially provided by a service company specialised in ERP implementations – first focused on training 10 people, that the managerial team qualified of ‘experts’. These experts were then removed from their usual daily duties to train and to persuade 20 more people that managers describe as 'super users'; this stage took one month. These ‘experts’ and ‘super users’ were then scattered throughout the three services, to interact with the rest of the firm who were all non-users. At the end of the second month of the implementation process, half of these non-users had mastered the technology (160 more people). Three months after the start, the entire staff was using the new system.

The model provides a better understanding of the dynamics of IS implementation, by allowing fictitious scenario to be simulated, something what would be very costly if done in practice. We compare our model to what would have happened if Prestige Service & Co. had adopted another strategy (e.g. by training a higher or lower number of initial users or 'experts'). This gives the following results:

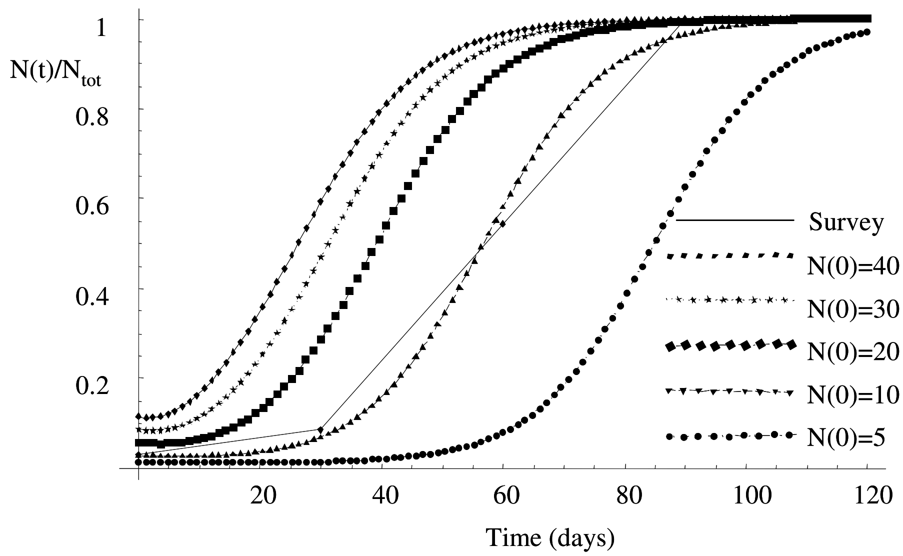

Figure 7 shows the fit between our model and the reality of Prestige Service & Co. where N(0)=10. Also shown is the effect of varying the initial number of users.

This graph requires several comments. The first relates to the period of implementation of the ERP. The model can be fit the data very well, with 10 initial users (N(0) = 10), the modelled curve agrees with the curve obtained by surveying Prestige & Service Co., which has initially formed 10 experts. In both cases, three months are necessary to achieve the full use of the ERP by the whole community. We can investigate the effect the initial number of users has on the implementation time. If the team management had decided to train, initially, only five users, it would have taken a month longer (120 days) for the whole community (350 users) to use it. It is not clear here about what the optimal number of users to form initially has to be. One would have to compare the cost of training of 5 more experts with the gain associated with the use of ERP a month earlier.

However, it is interesting to note that if Prestige Service & Co. had more experts initially, it would not have proportionally accelerated the required time before its use by the entire community. In fact, if the company had trained 20 initial users (instead of 10), approximately 70 (instead of 90) days would have been enough for the whole community to use the ERP, which may have been worthwhile. While in comparison, training 30 people would have only reduced the implementation time to approximately 65 days. A negligible reduction in implementation time is obtained by training more initial users. This means high levels of investment in training projects may not have the expected consequences on the speed of using an ERP.

In a more theoretical framework, this model provides a better understanding of the dynamics behind the implementation process of a new IS, considering the project and the diffusion phases, as sequential processes, which could not be understood in isolation from each other. In fact, the diffusion phase could not emerge without the necessary step of the learning process. However, if training is necessary for the IS implementation, it does not guarantee the successful completion of an IS life cycle. In accordance with Markus and Tanis' (2000) IS experience cycle, this model showed the necessity to consider this cycle as a process with interdependent phases.

4 Conclusion

The aim of this paper was twofold. First, it has sought to emphasise the limits in existing theories for understanding the experience or life cycle of an information system. As Part I, section 1 has shown, the existing theories concerned with IS implementation tend to focus on one of the phases of the cycle, while ignoring the relationship between phases. The second aim of the paper was to suggest that simulation methods could be used to provide a better understanding of the IS experience cycle. The paper does not provide a simulation model, which aims at understanding the entire process, but rather suggests a model which links the project and the diffusion phase. The simulation model suggested by the second part of the paper therefore constitutes a first step and hints at what could be done, to link the different phases of the IS life cycle. This paper constitutes a first attempt to use simulation methods, to understand retrospectively and prospectively the IS experience cycle.

5 References

Argyris, C., (1982), Organizational Learning and Management Information Systems, *ACM SIGMIS Database*, 13(2-3), 3-11.

Argyris, C., Putnam, R., MacClain Smith, D., (1985), *Action Science: Concepts, Methods and Skills for Research and Intervention*, San Francisco, Jossey-Bass.

Axelrod, R., (1997), *The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration*, Princeton University Press, Princeton, NJ.

Baum, J.A.C., (ed.) (2001), *Companion to Organizations*, Basil Blackwell, Cambridge, MA.

Cartier, M., (2003*), « La dynamique de l'adaptation d'industries : Simulation par algorithme génétique »*, Thèse de Doctorat en Sciences de Gestion, Université de Paris IX- Dauphine.

Davenport, T.H., (1998), 'Putting the enterprise into the enterprise system', *Harvard Business Review* (76), 121-131.

Dooley, K., (2001), Simulation Research Methods, in *Companion to Organizations,* Baum, J.A.C., (ed.), Basil Blackwell, Cambridge, MA.

Edwards, C., (2008), Computing and Mobiles: The Pirhanas of Processing Await, in *The Guardian*, Thursday July 17th.

Hatchuel, A., (2000), « Quel horizon pour les sciences de gestion ? Vers une theorie de l'action collective. », in *Les nouvelles fondations des sciences de gestion*, David, A., Hatchuel, A., Laufer, R. (eds), Vuibert, Collection FNEGE, 7-43.

Hollocks B., (1992). 'A well-kept secret? Simulation in manufacturing industry reviewed', *OR Insight*, 5: 12-17.

Hussenot, A., (2008), 'Between Structuration and Translation: An Approach of ICT Appropriation', *Journal of Organizational Change Management*, 21(3): 335-347.

Liarte, S., (2006), « Implantation concurrentielle des entreprises multi-unités multi-marchés : une simulation par automate cellulaire, *Revue Française de Gestion*, 32(165), 139-160.

Lucas, H.C., (1978), 'Empirical Evidence for a Descriptive Model of Implementation', *MIS Quaterly*, June, 2(2): 27-41.

March, J., (1991), 'Exploration and Exploitation in Organizational Learning', *Organization Science,* 2(1), 71-87.

Markus, M.L., Tanis, C., (2000), 'The Entreprise Systems Experience-From Adoption to Success', in Zmud, R.W. (Ed.), *Framing the Domains of IT Research: Glimpsing the Future Through the Past*, Cincinnati, OH: Pinnaflex Educational Resources, Inc.: 173-207.

Martin, M.H., (1998), An ERP strategy, *Fortune 2*, 95-97.

Missonier, S., (2008), *'Comprendre pour aider: Analyse réticulaire de projets de mise en œuvre d'une technologie de l'information : le cas des espaces numériques de travail'*, Ph.D. Thesis, University of Nice-Sophia Antipolis.

Oz, E., Jones, A., (2008), *Management Information Systems*, 6th Edition, Course Technology, Division of Cengage Learning, Inc.

Phan D., Amblard F. Eds. (2007) *Agent-based Modelling and Simulation in the Social and Human Sciences*, Oxford, The Bardwell Press.

Repenning, N.P., (March-April 2002), A Simulation-Based Approach to Understanding the Dynamics of Innovation Implementation, *Organization Science*, 13(2), 109-127.

Schneiderman, A., (April, 1988), Setting quality goals. *Quality Progress*, 55-57.
Ward, J., Peppard, J., (2002), *Strategic Planning for Information Systems*, Third Edition, Wiley Series in Information Systems.

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[1] Examples of multi-agent models include cellular automata and K model. For further details, cf. Phan, Amblard (2007).
[2] Used, for instance, in March (1991).
[3] Method used by Repenning (2002).
[4] This variable can be understood as the benefit that the user gets from using the ERP instead of using the former internally developed system, 'home-made' by the computing department.
[5] It is here necessary to draw a comparison with Repenning's contribution. The author defined the defect variable in three different ways. (Repenning, 2002 : 115). The first one, could represent a defect in a certain category of processes. For the purpose of our paper, this could be the case of an increase into the delay of payments after the implementation of the ERP. The second meaning of the defect variable could be associated with an error made by the members of a service within the firm. In the case of an ERP adoption, we could think of a bad use of the tool and of mistakes made in the collection of data, mainly due to a lack of learning from the staff. Finally, the third interpretation of this defect variable by the author is the result of a lack of specific competencies of the users.
[6] It can be shown that $\phi \approx 7\ln(2)/t_{learn}$ where t_{learn} is the time it takes to a user to obtain maximum benefit from the technology. We know that $t_{learn} \approx 30$ days for the technology of interest in this study, ERP. Therefore $\phi \approx 0.16$.
[7] 1 corresponds to a 100% benefit associated with the use of the ERP.
[8] Based on our case study.