EVALUATING THE ROLE OF INDIVIDUAL PERCEPTION IN IT OUTSOURCING DIFFUSION
An Agent based Model

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Abstract: The decision to adopt innovations has been investigated using both international patterns and behavioural theories. In this work, an agent-based (AB) model is created to study the spreading of innovation in enterprises (namely, the adoption of Information Technology outsourcing). The paradigm of AB simulation makes it possible to capture human factors, along with technical ones. This makes it possible to study the influence of perception, and the resulting bias. This work is focused on small and medium enterprises (SME), in which a restricted managing pool (sometimes just one person) decides whether to adopt a new technology or not, and bases the decision mainly on perception.

1 INTRODUCTION

A technological development often does not seem to be matched by a parallel movement towards adopting and exploiting the opportunities it offers, through economic organizations, especially for SMEs. Therefore, an important goal is to outline the methods through which firm decision makers choose to start innovative investments and identify, at the same time, the criteria with which this choice is made. This was first discussed in the studies carried on by Rogers (1983). The author outlined five features of innovation (relative advantage, compatibility, complexity, observability and triability), which influence its adoption, and consequently affect its circulation rate. Besides, the spreading of IT innovations cannot be modelled simply by taking into account pure technical issues; sometimes the forecasts made with a statistical - or process-based model, which considers just the engineering or financial aspects (i.e.: production process, activity decomposition, scale economies, product life cycle and so on), prove to be inaccurate or even wrong. This was the case with cellular telephones, air-cooling systems, personal computers

and other fields in which some external influences have led to results which are very different from the initial pre-dictions obtained through prevision tools. The purpose of this work is to examine the circulation of an emerging technical innovation: using IT services in Application Service Provider (ASP) mode. The spreading of this technology should not be affected by phenomena like fashion, as with cellular phones, and its adoption is not considered as a status symbol, although, there are some other influences which can-not be taken into account by a process-based or statistical model, i.e.: the effects of individual perception about savings, strategic impacts and so on. Therefore, a very important bias seems to be individual perception, and, in turn, the social links that exist in the network connecting the enterprises, from which the perception mainly originates and spreads.

2 PERCEPTION ISSUES

Proper perception of the benefits granted by the adoption of an innovation is a crucial element in

order to understand the circulation potential and the growth rate for that innovation.

By following a strictly rational approach, it often proves difficult to understand the reasons for development difficulties and also for the delays in the circulations of innovative goods and services.

It may therefore prove useful to analyse the reasons that may distort perception of the advantages resulting from the outsourcing of IT services in the ASP mode by SMEs, which are on the other hand the parties which are likely to benefit from the greatest advantages provided by the broadening in the offer of such services.

The reduction in initial investments, the easier and less onerous opportunity to benefit from the improvement of technology, as well as the greater certainty about costs and their manifestation in time should be strong motivations for the spreading of such services among smaller enterprises, once the infrastructure prerequisites related to the performance and reliability of data transmission networks and to the existence of an offer market capable of creating competition have been established.

However, we should take into account the fact that Italian SMEs are late in IT-related expenses and investments.

Indeed, a recent research published in Italy (Confcommercio, 2007) stresses how 53% of IT-related expenses and investments come from enterprises with over 500 employees, or even 76%, if we also take into account enterprises with over 100 employees.

IT-related expenses and investments are therefore restricted to a limited number of larger enterprises than the over 5 million Italian enterprises with a lower number of employees which have invested little or no money, whereas it is known that the ICT-productivity growth ratio is extremely high. This ratio is obvious, not only in industry but also in trade and services. The European committee itself has requested that, at a micro-enterprise level, the element represented by shared organisations be developed.

SMEs' requirement to benefit from IT services that are fit to face existing competition challenges is therefore a priority for their very existence.

However, the growth rate in resorting to outsourcing by SMEs has proved lower than expectations up to very little time ago.

In order to try and understand the reasons that might distort the perception of outsourcing advantages, it may be helpful to mention the fear experienced by smaller enterprises of ending up

depending from opportunistic behaviours that might be adopted by the suppliers of such services, and which smaller enterprises fear they may be more vulnerable to, owing to their lower bargaining power and more limited understanding of the alternatives offered by the markets (information asymmetries).

Indeed, opportunistic behaviours represent one of the reasons for market failure that cause enterprises to internalize the activity, in order to gain some kind of insurance. The existence of such behaviours causes transaction costs to increase and, in the event of a high level of asset specificity, encourages enterprises to maintain such activities within the company or to internalise them.

This issue is related to the problem of accurately assessing switching costs to be borne in the event that the outsourcing IT services supplier is changed, which are even more difficult to evaluate by an enterprise that lacks specific competence.

Another problem which significantly hinders outsourcing is related to the confidentiality of information and data contained in the enterprise information system and hence depends on the reliability of the supplier of the service involved in safeguarding the data themselves, both during the course of the cooperation agreement and in the event of termination of services, also if this is related to controversies that may have arisen between the enterprise and the supplier.

A SME may perceive this risk both because it lacks the resources and skills required to asses the reliability of the systems and process implemented by the privacy supplier and because of the belief, especially strong in Italy, as to the non-existence of a prompt and efficient legal protection in the event that one's privacy rights are infringed.

The bounded rationality characterising the above mentioned processes is amplified by formalised, but above all informal, relations among the parties involved, within an enterprise, but also among parties belonging to different organisations.

The "confidence" and "trust" problems characterising many SMEs' approach to IT outsourcing represent a restraint to horizontal communication between enterprises, which on the other hand could represent a major innovation propagation factor.

3 MODEL DESCRIPTION

A computational model is built, by using Java coding. It consists of a user interface, in which the initial simulation values are set. According to

defined rules, the model computes these data, in order to give final aggregate results.

The main purpose is to analyze how individual perception can bias real and objective evidences. A number n of macro-agents is built, representing the SMEs; each of those is composed of a random number of agents (with a min/max range), representing the managing pool.

The agents belonging to the same enterprise are connected by a social network; the links feature a random weight, with a modifiable threshold. The network has the purpose of transmitting the information about the technology. Some of the agents can be connected to others, belonging to different enterprises, thus spreading their opinion over the network. The perception is derived from real savings allowed by the new technology, but not only that; there could be a bias (non-perfect perception), representing other factors, like trustfulness towards the company supplying the IT outsourcing facilities, personal inclination towards IT and so on. The agents spread their own perception to the others connected to them and this will be modified ac-cording to the weight of the specific individual link. Only agents are directly connected, not the enterprises; agents represent persons, which can be connected some-how (e.g.: friendship), while enterprises are considered "connected" among them if and only if the people belonging to them know each other. Since the focus is how social relations and individual perception influence the spreading of IT outsourcing in SMEs, the model, through repeated execution, shows the diffusion over time, when changing one parameter at a time, while leaving the others unchanged (coeteris paribus).

3.1 Parameters and Iterations

Here follows a list of the main parameters in the model:

a. Total number of enter-prises
b. Average number of agents per enterprise [managing pool]
c. Percentage of SMEs that already adopted
d. Costs for the innovation (*una tantum* and variable cost)
e. Average saving allowed by the new technology
f. Perception BIAS [double, perfect, inverse, random perception]
g. Satisfaction Threshold (ST) for adoption [range: 0 to 1]
h. Requested majority to adopt the IT outsourcing in the enterprise.

These parameters can be changed at the beginning of each simulation, in order to create a scenario. Here follows the sequence of steps performed by the simulation:

1) The first step is the adoption of the new technology by a number of enterprises
2) This has installation costs, and brings a positive or negative saving
3) These will be perceived by the agents in the enterprise, filtered by a personal BIAS
4) Each agent randomly spreads her own perception, and the agents linked with her will form their own opinion, according to the average of the received opinions
5) According to the ST, the agents will individually decide whether to adopt or not
6) Once all the agents in an enterprise form their own opinion, according to the re-quested majority, the SME will adopt the new technology or not. Loop from 2).

There is not a metaphorical correspondence between the steps and time units. It's possible to realistically think about each step as one month time.

4 RESULTS AND COMMENTS

Several experiments have been done on the model, by changing the parameters in order to mimic different scenarios. Two are the core parameters studied in this work that affect the diffusion over time: a different connection level and a different perception level. In particular, since we compare the results with empirical data coming from a localized market (namely, Italian one), sooner or later there will be a saturation level, that's a threshold beyond which it's not possible to go (i.e.: a limited number of agents can be reached by an innovation, since a limited number of enter-prises exist in a market). So we aspect an highly connected network to generally increase the diffusion speed over time. We think to horizontal connections (e.g.: clubs of managers). In those situations, people spread their opinion among others working in the same field or, at least, with the same job and position, making their message more effective. The saturation threshold is represented by the parameter called "Total number of enterprises" that multiplied per "Average number of agents per enterprise" gives a good approximation of the total number of agents in the simulation (not exact, due statistical distributions and consequently to sampling effects). On the graphs, the total adoptions versus time step are shown. A total of 500.000 macro agents (enterprises) are set in the model and an

average of 5 is the managing pool hypnotized. In order to simulate a realistic situation, 20% of enterprises are considered as already reached by the new technology at time zero. The costs for the innovation and the average savings allowed by the new technology are deduced by interviews made with a sample of Italian SMEs. The requested majority is set at 51%, since we imagine all the members of the managing pool having the same decisional power. With a low perception index and a loosely connected network, after one simulated year, from the initial 100.000 enterprises that already adopted IT outsourcing, we have that 1.399 moved to the new technology, that's a tiny 1,4% increase. Same poor figure for the following years: 1,1% for the second, 1,2% for the third, 1,6% for the forth and finally a slightly better 2,5% for the fifth. The slow increase, even with the high savings allowed by adopting the new technology, are to be explained taking into account the low perception index. The bias that the perception introduces in the model is enough to make a very good deal to look like an average or poor one for many agents in the model. Besides, the loosely connected network prevents the agents to spread the good news about their savings to many others and so, after 5 simulated years, less than 10% new enterprises stepped to the new technology, from the original 100.000.

The same values were for the 2nd experiment, but for the level of connection for the network, now an highly connected one. This is an unrealistic scenario, since it would mean that every manager knows almost all the other ones. The perception in this experiment is still very low, meaning that even a big advantage is not perceived as such.

The results are now quite different. The first year brings an increase of 21%, the following simulated years also have a very good trend: in fact, the second year brings an increase of 15%, the third of 12%, the forth of 8% and the last one of 10%.

The 3rd experiment is about a loosely connected network, as that in the 1st experiment, but with almost perfect perception, i.e.: the few managers reached by the word of mouth given by others, perceive the advantage deriving from the new technology. Thanks to the high perception, we have the following increase rates: 11%, and then 12-14% circa per year, for the following periods. After 5 simulated years, a total of 169.129 enterprises have moved to the new technology, even if the network is loosely connected, meaning that a lot of agents are never reached by the news about technology. The trend is again an increasing one, meaning that when more agents are reached, there is in turn an higher

probability to reach other ones, and so on. The last experiment is carried on with high perception and highly connected network; now the spreading is pervasive; after one year, we have an unrealistic 60% increase compared to the time zero, and the trend continues in the following simulated years, so that, after 60 months, 418.274 out of 500.000 enterprises are reached by the new technology.

5 CONCLUSIONS

The role of perception is investigated by studying innovation diffusion. In particular, IT outsourcing is a crucial innovation for enterprises and is used to empirically vali-date the presented framework. An agent based model is implemented, since it allows to explore the human factor behind social phenomena. Different experiments were carried on, by varying the level of perception and of connection along the social net-work. Validation for the results is carried on by using tools coming from data-mining (Remondino and Correndo, 2005). The results obtained are straightforward: an high perception of the advantages given by an innovation is crucial in the spreading mechanism, and so is a good connection level among the agents. By comparing the real figures (coming from *AITech-Assinform/NetConsulting*) about Italian market, we see that they look like the ones obtained in the 1st experiment. In fact, the delta in IT outsourcing adoption from 2003 to 2004 is about 1%, stepping to 1.6% for 2004 to 2005, and to over 2% from 2005 to 2006. We conclude that the Italian SME market is one in which there is a low perception of the benefits and a loosely connected net-work.

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