

Explaining stranded diffusion by combining the user-IT-success factors (USIT) and adopter categories: the case of Electronic prescription systems for general practitioners

Roel W. Schuring
University of Twente
Department of Technology and Management
PO BOX 217
7500 AE Enschede THE NETHERLANDS
phone: +31 -53-4893502
e-mail: r.w.schuring@sms.utwente.nl

Ton A.M. Spil
University of Twente
Department of Technology and Management
PO BOX 217
7500 AE Enschede THE NETHERLANDS
phone: +31 -53-4893497
e-mail: a.a.m.spil@sms.utwente.nl

Abstract

*Although diffusion of new IT in healthcare does not seem to level off, successes are reported frequently. Many of these successful cases experience enthusiastic use of the innovation by a limited group of physicians or other users. This paper explains **stranded** diffusion by differentiating the match between user and IT s' to adopter categories (the User-IT-match or USIT-model). This match is described by the (sub)-dimensions of **affection/resistance, relevance, requirements and resources**. Once the sub-dimensions are determined for all adopter groups, it might become clear that different sub-dimensions play a role for every adopter group, and thus in every successive stage of the diffusion process. The diffusion process strands if there is no match with the sub-dimensions that play a role for the adopter category that was to adopt the innovation in that stage. A total of 56-case-studies on the diffusion of an Electronic Prescription System (EPS) for general practitioners in the Netherlands was used to test the explanatory power of these factors. We conclude that USIT is of high value to determine adopter-category specific diffusion problems, and thus to understand stranding diffusion. The relevance-factor has the biggest impact within USIT. The paper includes discussion of the limits of the model and suggestions for elaboration. The paper discusses diffusion problems that are specific for this EPS.*

Introduction

When caring for a patient, specific knowledge and know-how is often needed, and this compels the HC-sector into a networked mode of operation, with a lot of communication needs. With this in mind, it is astonishing to see how slowly the HC-sector has adopted new information and communication technologies (IT). Currently, however, a major revolution might be on its way, and the health care industry will become a key application area for IT, and an object for both national and international programs to promote usage of IT [1]. Also, certain practitioners are way-ahead of their fellows within the same healthcare system. [2]

This paper focuses on the problem of stranded diffusion of IT use. The Rogers [10: 99] discusses this problem briefly and notices that this problem is not studied sufficiently. Existing survey-approaches and questionnaires do not address the problem adequately. It is debatable if this problem can be captured in a survey-approach. This paper picks up the ball and explains *stranded* diffusion by differentiating the match between user and IT s' to adopter categories (the User-IT-match or USIT-model). This match represented by the factors *affection/resistance* and *relevance* on the user side and the factors *requirements* and *resources* on the technical side. Instead of survey-research, a total of 56-case-studies on the diffusion of an Electronic Prescription System (EPS) for general practitioners in the Netherlands was used to test the explanatory power of these factors.

The paper first discusses current approaches to study IT-diffusion. Then, the USIT-model will be introduced. Next, we will introduce the diffusion problem of Electronic Prescription Systems in selected countries, and, particularly the background of the systems that we studied. Then we will report our methodology and our case-study findings. The final section draws specific conclusions for the EPS case study and conclusions on the value of the model, including suggestions for further elaboration.

Critical Success Factors to IT diffusion: an overview

Theory of various origins is instrumental to study the introduction of IT in healthcare. There is a body of knowledge on determinants of IT success in general. Second, we use theory on success factors to Decision Support Systems (DSS), as the type of IT application that we study here is of this particular nature. Finally, we use general theory on the diffusion of innovation. These three streams all provide ingredients for the USIT-model that is introduced in the next section.

Explaining IT-success: general models

The success of an information system is dependent on four variables [3]: success of the development process; success of the use process; quality of the IT product; and, impact of the IT on the organization. However, there are various other ways to model IS success.

The three level distinction in pragmatic, semantic and syntactic, is quite common in the information science literature [4] but to our opinion these three levels do not grasp the whole problem. Iivari and Koskela [4] give a good set of quality norms for each level. On top is the pragmatic level, which is about intentional use of signs. They state that quality should be a normal management judgement and that effectiveness is only a general term to be filled in specifically for every information system. However, the way they present this (Economical, Social, Political, Organizational, and Technical) can span all quality-aspects. The semantic level is about the relation between the patterns in the information systems and what happens in reality. On the semantic level they give user satisfaction as quality criterion. Syntactics is the lowest level. It describes the general rules for composing complex signs from simple ones. On this level they give efficiency criteria to measure the quality of the information system.

The semiotic framework [5] is more precise. It adds the social level on top the pragmatic level. This is introduced because it is only when a social effect is obtained that information realizes any actual value and it must be remembered that the intentions of the information provider will not always lead (intentionally or not) to the desired effect. The layers “empirical level” and “physical world” beneath “syntactics” deepen the fundamentals of the model. “Empirics” refer to the meaning of the signs of the physical level, and thus link the “physical world” to “syntactics”. Reliability is a major concern on this level, as it focuses on correct generation, communication and interpretation of data. Finally, technical devices and people are the physical level. Cost are related to this level.

When we regard the IT platform as a whole (physical/empirical and syntactical), we previously stated that there are four determinants for the success of an information system [6], namely:

1. Affection/resistance on the social level;
2. Relevance on the pragmatic level;
3. Requirements on the semantic level;
4. Resources on the physical level.

Here, we define the Affection/resistance determinant *as the personal attitude of all stakeholder groups towards the introduction of an information system*. The main IS-quality aspect of resistance/affection is the attitude and the willingness to change. The determinant may vary from negative (resistance= low) to positive (affection = high). Pare and Elam [7] also choose for the attitude of the professional when they assess clinical information systems. Total quality management taught us that for this aspect we have to deal with communication, information and deliberation. The end users have an important role because their norms and values determine the effectiveness of the information system.

On the pragmatic level, the *relevance is the extent to which the delivered information system with the main providers intentions adds value for the end-users*. In this study, the main providers, we identify the suppliers and the national representative organizations of the GP's. It is scored by the researchers on the basis of statements by the potential adopter and it rates from low (= not relevant to the subject) to high (= highly relevant to the subject).

On the semantic level, the *requirements* determinant has to measure the meaning of the information system. *Requirements are the functional specifications that establish what the Information System in a functional sense has to arrange.*

It is rated from low (= the IT requirements are not available) to high (the required IT configuration is already in use)

Resources are the people, the information technology, the money and the information needed and the interaction of these four elements for both developing and implementing the Information System. The main focus of the quality determinant resources will be on the people and on the information technology these people use. For successful implementation of IS all determinants need to be positive. It is rated from low (all types of required resources not available) to high (all types of resources sufficiently available).

These four factors are used as the major dimensions in our USIT model.

DSS success and failure

Decision Support System are known as systems that are more dedicated towards users and in measuring their success, extra attention is paid toward the behavior of the users. Normally also a distinction in type of users is necessary but in this case we have a uniform group of users, the general practitioners. Finlay & Forghani [9] make a distinction in ensuring the appropriate environment and maintaining the commitment. They investigated 39 cases with face to face interviews, preferably more than one in each case to get a more balanced view. In the first category, the major factors of success were:

- ◆ Benefits and disbenefits to the major actors;
- ◆ Their commitment to the DSS;
- ◆ The relationships between the major actors;
- ◆ The technical capability of the actors and the organization in general;
- ◆ Staff workloads.

Maintaining commitment has the following factors of success:

- ◆ Adaptability of the DSS;
- ◆ Decision making benefits arising from the DSS;
- ◆ Ease of use;
- ◆ The learning and support infrastructure surrounding the development;
- ◆ The match of DSS to the issues facing the user and the organization;
- ◆ The quantity and quality of the information provided;
- ◆ The time between deliverables;
- ◆ Understanding of the DSS by the actors;
- ◆ Understanding of the actors of the importance of their contributions.

As the reader may notice, the CSF's above are DSS-specific refinements of the factors that were discussed in the previous paragraph. A similar picture emerges when studying CSF's for IT in other applications. We have constructed specific measures for the USIT-dimensions for the EPS-case study.

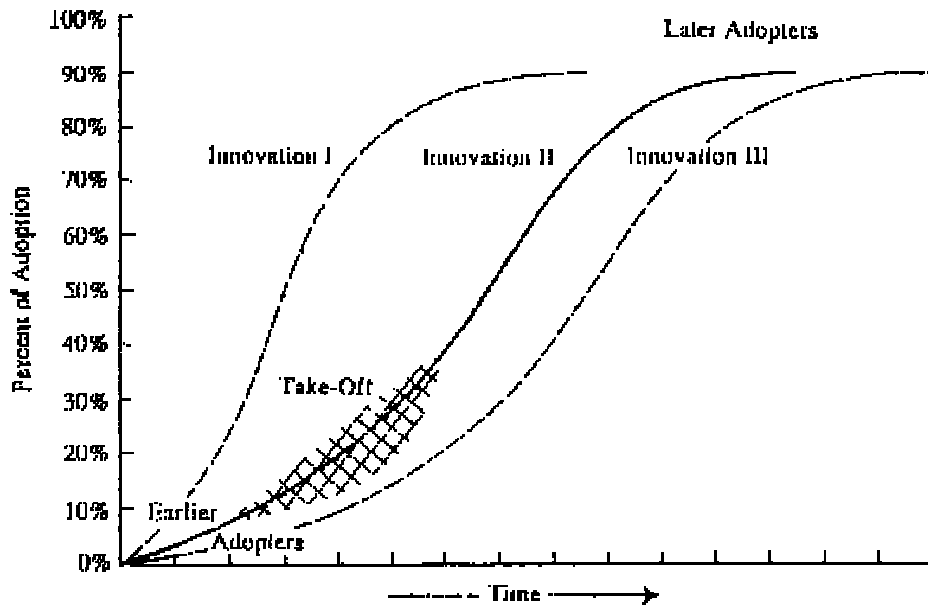


Figure 1: the diffusion-curve of three innovations.

Innovation diffusion theory

The third ingredient to our theoretical framework is the innovation-diffusion theory by Rogers [10]. This theory builds on a wide range of empirical studies, including studies in the HealthCare sector. (e.g. [11]). Diffusion is the process by which (1) an innovation (2) is communicated through certain channels (3) over time (4) among the members of a social system. Diffusion is a special type of communication concerned with the spread of messages that are perceived as new ideas. The four main elements in the diffusion of new ideas are (1) the innovation, (2) communication channels, (3) time, and (4) the social system.

An innovation is an idea, practice, or object that is perceived as new by an individual or other unit of adoption. The characteristics of an innovation, as perceived by the members of a social system, determine its rate of adoption. Figure 1 shows the relatively slower, and faster, rates of adoption for three different innovations.

Innovations possess various characteristics that are relevant to their rate of adoption. Most relevant is the degree to which an innovation is perceived as being better than the idea it supersedes, the “relative advantage”. Relative advantage can be economical, social and the like. There are a number of sub dimensions of relative advantage: the degree of economic profitability, low initial cost, a decrease in discomfort, a savings in time and effort and the immediacy of the reward. The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters is called “compatibility” and is again positively related to the rate of adoption of an innovation. An innovation can be compatible or incompatible with (1) socio-cultural values and beliefs, (2) with previously introduced ideas, or (3) with client needs for innovation. Other characteristics of innovation that are relevant to its rate of adoption are its’ “complexity”, “trialability” and “observability”. Together, these characteristics explain 49 – 87 % of the rate of adoption of innovations.

Also characteristics of the diffusion process help to explain the rate of adoption. This has to do with the nature of the decision process, the communication channels being used, the nature of the social system and the role of change agents. Most relevant is the diffusion effect, i.e. the effect that the adoption levels of once a threshold level of knowledge/awareness has been passed. . Re-invention is the degree to which an innovation is changed or modified by a user in the process of its adoption and implementation. Discontinuance is the result of replacement of the innovation by a better idea. However, misuse may lead to disenchantment. This is more likely to happen to later adopters than to earlier adopters of the innovation.

Innovativeness is the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system. There are five adopter categories, or classifications of the members of a social system on the basis on their innovativeness: (1) innovators, (2) early adopters, (3) early majority, (4) late majority, and (5) laggards.

- Innovators are the first 2.5 percent of the individuals in a system to adopt an innovation. Venturesomeness is almost an obsession with innovators. This interest in new ideas leads them out of a local circle of peer networks and into more cosmopolite social relationships. Communication patterns and friendships among a clique of innovators are common, even though the geographical distance between the innovators may be considerable. Being an innovator has several prerequisites. Control of substantial financial resources is helpful to absorb the possible loss from an unprofitable innovation. The ability to understand and apply complex technical knowledge is also needed. The innovator must be able to cope with a high degree of uncertainty about an innovation at the time of adoption. While an innovator may not be respected by the other members of a social system, the innovator plays an important role in the diffusion process: That of launching the new idea in the system by importing the innovation from outside of the system's boundaries. Thus, the innovator plays a gatekeeping role in the flow of new ideas into a system.
- Early adopters are the next 13.5 percent of the individuals in a system to adopt an innovation. Early adopters are a more integrated part of the local system than are innovators. Whereas innovators are cosmopolites, early adopters are localites. This adopter category, more than any other, has the greatest degree of opinion leadership in most systems. Potential adopters look to early adopters for advice and information about the innovation
- Early majority is the next 34 percent of the individuals in a system to adopt an innovation. The early majority adopt new ideas just before the average member of a system. The early majority may deliberate for some time before completely adopting a new idea. "Be not the first by which the new is tried, nor the last to lay the old aside," fits the thinking of the early majority. They follow with deliberate willingness in adopting innovations, but seldom lead.
- Late majority is the next 34 percent of the individuals in a system to adopt an innovation. The late majority adopt new ideas just after the average member of a system. Like the early majority, the late majority make up one-third of the members of a system. Adoption may be the result of increasing network pressures from peers. Innovations are approached with a skeptical and cautious air, and the late majority do not adopt until most others in their system have done so. Their relatively scarce resources mean that most of the

uncertainty about a new idea must be removed before the late majority feel that it is safe to adopt.

- Laggards are the last 16 percent of the individuals in a system to adopt an innovation. They possess almost no opinion leadership. Laggards are the most localite in their outlook of all adopter categories; many are near isolates in the social networks of their system. The point of reference for the laggard is the past. Laggards tend to be suspicious of innovations and change agents. Resistance to innovations on the part of laggards may be entirely rational from the laggard's viewpoint, as their resources are limited and they must be certain that a new idea will not fail before they can adopt.

Active information-seeking by professionals in any field usually is characteristic of individuals (and organizations) who are elite, research-oriented, and endowed with adequate resources. The health care professionals who most need medical information resources are at present least likely to receive them, as Rogers and Scott (2001) state[11].

The insights that were collected by Rogers are to our value in two senses. First, the characteristics of innovations help us to refine the major dimensions of our USIT model. Second, the adopter categories serve as a starting point to find explanations for stranding diffusion. We presume that the USIT-dimensions get different values for different adopter categories. If one adopter category adopts the innovation, it is not sure that others will follow, since other things are important to those less-innovative adopter categories.

USIT Model: our research framework

Figure 2 shows the USIT model. It builds on the four dimensions that we have introduced used to this study. It merges the insights that we derived from the DSS literature and the innovation diffusion literature in the determinants for success of an information system. These USIT dimensions are shown in the left part of the figure. By doing so, we created a framework that links general determinants for success of information systems to measurable properties. The right side of the figure links the various adopter-categories to their situation regarding the USIT-dimensions. This is to be described for every adopter category. After completing the schedule, we have an image of the pattern of diffusion amongst the entire population. Completing the schedule requires to establish measures for the USIT-dimensions and criteria to place those who may adopt the innovation in the various adopter categories.

USIT		Laggards	Late majority	Early majority	Early adopters	innovators
Resistance/ affection (social)	<ul style="list-style-type: none"> ▪ Attitude of user (aided by) <ul style="list-style-type: none"> – network intensity – behaviour of change agents – diffusion effect – no misuse of innovation 					
Relevance (pragmatic)	<ul style="list-style-type: none"> ▪ Relative advantage, i.e., benefits: <ul style="list-style-type: none"> – economic – social (both aided by: low initial cost, degree of discomfort, saving in time & effort, immediacy of reward) ▪ – compatibility to socio-cultural values, previously introduced ideas and need for innovation ▪ – low complexity (aided by possibility of re-invention) ▪ – trialability ▪ – observability 					
Requirements (semantic)	<ul style="list-style-type: none"> ▪ Semantical logic ▪ User interface ▪ Ease of use (all supported by contemporary nature of IT) 					
Resources (physical)	<ul style="list-style-type: none"> ▪ Time ▪ Information Technology, i.e. <ul style="list-style-type: none"> – hardware – software ▪ Support functions <ul style="list-style-type: none"> – learning & support ▪ Money 					

Figure 2: USIT Model (figure 6 shows findings)

Electronic Prescription systems: a diffusion problem

Our research-project was set up to both assess the situation regarding the diffusion of an electronic prescription system “EVS” in the Netherlands. This gave us the opportunity to test the model that we had envisioned long since [6, 8] This section first discusses the general problems regarding Electronic Prescription Systems in selected countries. Next it focuses on the particular EPS that was studied in The Netherlands.

Electronic prescription in Europe, a selective overview

The central idea of electronic prescription systems is that they help physicians to prescribe more effectively. There is particular focus on the cost of over-treatment.

Also, the replacement of brand-drugs by non-propriety labels may help to reduce expenses. Additional expenses on IT help to reduce the total cost.

If we first focus on pharmaceutical expenditure induced by General Practitioners in four European countries, figure 3 shows that the pharmaceuticals' share of GDP in the Netherlands is relatively low. The impression is that Dutch medical professionals make cost sensible decisions when prescribing pharmaceuticals.

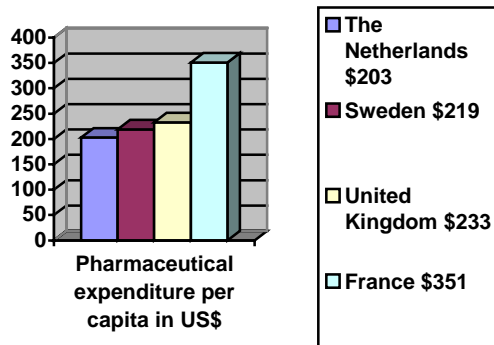


Figure 3 – Pharmaceutical expenditures per capita in 1997 (source: OECD Health data 1999)

If we then shift to the use of IT and databases, we notice that many drug databases exist in France [12,13], but until now their main contribution was in detection of drug interaction. Riou [13] was faced with a lack of standards and the importance of the user interface. The design of a web technology must make it possible to integrate the databases with a computerized drug system

In the United Kingdom, Thornett [14] shows the benefits of decision support systems in primary care:

- Improve the quality of medical care [15]
- Disease prevention and other prevention [16]
- More appropriate dosing
- Management of chronic physical illness

Mitchell and Sullivan [17] show however that computer use during consultations lengthened the consultation. Still patients and doctors were generally positive about the use of computers in general.

In Sweden [18], 85% of the 4000 general practitioners already used a computer based patient record in 1995. According to Forsstrom [19] the Swedish prescription system is similar to the Finnish EPS which is stated the first internet-based electronic prescription system in Europe [20]. In Australia [21] and Canada [22], there are some promising web based Electronic Prescription Systems to be studied in the near future.

It seems that various countries share the concerns of increasing pharmaceutical expenses and try to control this problem by introducing IT systems. This paper focuses on Electronic Prescription System that is introduced in The Netherlands.

Electronic Prescription in The Netherlands: an introduction

The Electronic Prescription System (Dutch: Electronisch Voorschrift Systeem; EVS) that we studied is an IT-system that gives general practitioners recommendations on the therapy that can be given to patients on the basis of the diagnosis of the practitioner [23]. This diagnosis is coded by use of the International Code for Primary Care (ICPC). The value of the system, as compared to the traditional situation, lies in the fact that the system takes characteristics of the patient into account. The recommended therapy is customized on the basis of the age and gender of the patient, existing pharmaceutical therapy for other diseases and is based on the formulary, which is a list of drug-preferences that is set up by professional associations. Figure 4 shows the working principle of the EVS.

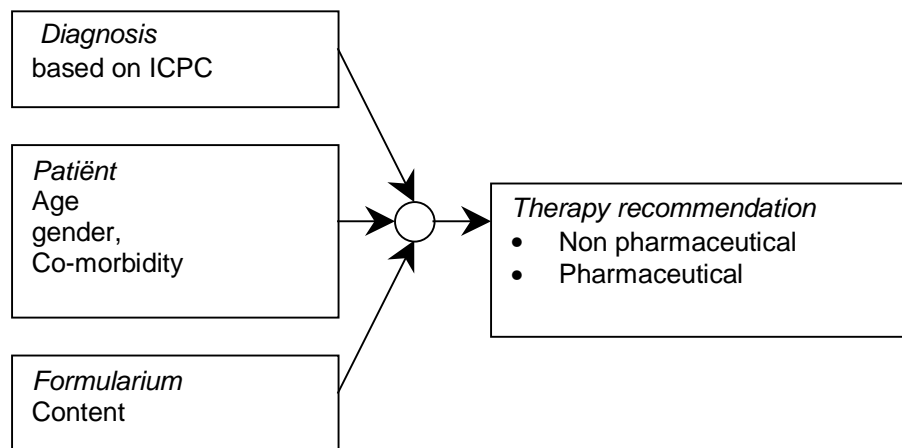


Figure 4 Working principle of the EVS electronic prescription system

The EVS is available as an add-on to practically all information systems that exist for GP's in this country (GP IS).

Case study design & results

Case study design

To measure the USIT-dimensions, a semi-open questionnaire was designed that was geared to the EPS situation. We deliberately chose for a semi-open questionnaire, to prevent bias. Interviews took between one and two hrs. Case-study reports were made for all 56 case studies. The answers were categorised and then entered in a SPSS system. This enabled us to do a find relations that we would otherwise have overlooked. We went back to the individual case-study reports to assess our findings. In line with the case-study approach by [24] we discerned different case-situations on the basis of our theoretical framework. We distinguished adopter categories on the basis of the degree to which GP's had adopted previous innovations. We had data available on the size of each category, which enabled us to determine the impact of our qualitative findings. The size of each category matches with the usual distribution by Rogers [10].

Case study findings

Below we cluster the major findings of our research that took place in the summer and fall of 2000. For a full overview of the empirical research findings, see [25].

Laggards

These general practitioners use a patient record on paper, called “green card”. The group of laggards is small, but we have managed to find two cases. In both cases the EPS was low on the agenda and both physicians did not have resources and no technical capabilities to use EPS. They thought that using a computer would impact their interaction with the patient negatively.

Late Majority

This group of more than 16% of the GP’s uses the computer as an administrative support tool only. They did not have a structural way of classifying medical diagnoses. They just used the GP IS for names, addresses and bills. They had no commitment with the new EPS and some showed a CD-ROM with the EVS-software, without a having a player to put it in. Just two of them said to have an IT-level of a medium level.

Early Majority

This group uses the medical module of their GP IS to a limited extend, that is, the so-called subjective/objective/evaluation and plan method for more than 40 % of their patients. Thirteen case studies were done in this class. About 60% of this group did not feel a priority toward the use of EPS. From the early majority 10 out of 13 physicians mentioned spontaneously that communication was their most relevant problem at that moment. This large group of GP’s could not see the benefits that were coming with EPS and only saw benefits on governmental or other central levels.

Early Adapters

The next group that we distinguished consists of GP’s who said to use the international code system ICPC for more than 40% of their patients. A total of 22 case studies were done in this large group. These GP’s have more communication with colleagues than those in the previous groups. More than half of them said that time pressure was the main problem at that moment and that EPS was more a time consumer than a time winner. In most cases in this group the resources were sufficient to install an EPS. In 16 out of the 22 cases was EPS medium or high on the agenda. This means that this group of GP’s can be made “ready” for EPS.

Innovators

Finally, nine out of 56 cases said to use the EPS (16%) but still two third of them did not use it during their consult but only afterward. As a major benefit from the system they mentioned the use of it as a mirror for their actions. They all had EPS on their priority list and therefore think it was a relevant system.

	No computer	Admin. use of PC	Medical module	Internat. code	Electronic Prescription
Laggards					
Late majority					

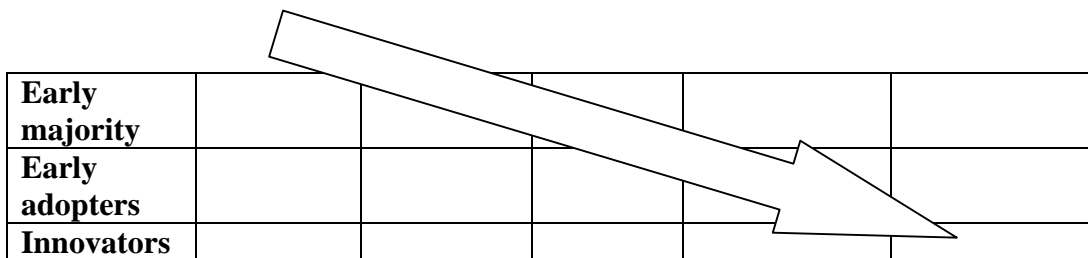


Figure 5: Position of adopter categories

Figure 5 shows the position of the adopter categories. It also illustrates that the EVS system would have to fit to all these different starting situations to achieve full diffusion. This was not the case in practice. As a consequence, the gap between early adopters and late adopters will widen.

DSS criteria

The overall score on DSS success criteria was not very promising for those who favour quick diffusion of the EPS. The only benefit that is mentioned by more than one physician is the second opinion that the system delivers. Disadvantages of the EPS that were mentioned were mainly that it takes time to operate and that the system had the international coding as basis. The commitment of the interviewed GP's to the EPS varied by category, but was low in every category below the innovators. The technical capability is on average too low to use the system and the staff workload of the GP is very high.

Other criteria

The EPS is a system that builds upon the GP IS and therefore it is also dependent upon the quality of the underlying product, a criterion that is unique and specific for this situation. The development of new IS for the GP's has come to a complete stop in the last year and the GP's are therefore reluctant to put effort into the old system, even if the EPS is a qualitative good update. One of our recommendations in the practical study therefore is to build a totally new GP IS based upon new modern standards and the detailed average daily practice.

USIT	Laggards (no computer)	Late majority (admin. Use)	Early majority (medical module)	Early adopters (internat. Code)	Innovators (e-prescription)
Affection/Resistance (social)	Low	Low	Medium	High	High
Relevance (pragmatic)	Low	Low	Medium	Medium	High
Requirements (semantic)	Low	Medium	Medium	High	High
Resources (physical)	Low	Medium	Medium	Medium	High

Figure 6 : The score in the USIT model (figure 2)

Figure 6 depicts the core of our findings. It should be noted that the scores on every dimension are an overall-score on various sub-dimensions. For example, if some GP has a low score on Resources, it means that he has nor the time, the capability, the IT-resources and the support to start using the innovation. In that sense, a “low” score of a less innovative adopter category on a certain USIT-dimension does not mean that the innovation is simply “less relevant” or “needs some more resources”. Rather it is conceivable that different sub-dimensions play a role for every adopter group. For example, this innovation has compatibility-problems for the innovators and early-adopters, in the sense that the system does not react adequately to all international code they have in use. However, once we are down to less innovative adopter categories, entirely new compatibility problems arise. For example, the EPS requires the use of the computer during the patients’ visit, which is not the current practice for those general practitioners. Once this group would use the system, the coding problem of the more innovative group might not re-emerge, as this group has less stringent demands to the fit of the coding. Within our study, we found similar patterns a number of times. For example, “observability” is a relevant subdimension of relevance for innovators and early adopters, but “low complexity” is a relevant sub-dimension for the later categories. This phenomenon explain stranded diffusion to us: if the characteristics of an innovation match with the sub-dimension that plays a role for one adopter category, it is possible that diffusion strands when there is no match with the sub-dimensions that play a role for the next category.

Conclusions

EPS for General practitioners

Although the working principle of EVS-electronic prescription system seems rationally alright, the diffusion in practice is stranded. This can be explained on the basis of the USIT dimensions. If we look at the overall image of these factors, we see that the scores are low to medium for most adopter categories. The relevance of the EVS to most adopter categories of general practitioners was low on the time of the study. The economic and social benefits were scarce, as the main problems on the agenda of general practitioners were (1) communication between practitioners, with the hospital and with the pharmacy and (2) time pressure. The EVS did not help to solve these problems. Also the initial cost was high to many practitioners, as the IT-use in their starting-situation was by far not sufficient to be able to use the EVS system. About 27% of the general practitioners made sufficient professional use of the computer to be able to start right away with the EVS-use. The remainder first would have to further structure their electronic patient records, or would even have to start using the computer professionally at all. As a result, EVS has a low compatibility and a low trialability and high initial cost. On the level of technical requirements, the semantical logic of the program did not give any fundamental problems. However, the logic of the ICPC coding did not fit the needs of the general practitioners at all. An increase in experience in ICPC coding did not solve this problem. On the contrary, those who had relatively much experience in using the code had more complaints than those who just started using the code. The user-interface and the ease-of use were both hampered by the outdated nature of the software. Finally, on the level of resources, time, support functions and money had fundamental shortcomings. Our findings had a severe impact on the discussion about the EVS amongst the insurance companies, the professional associations of General Practitioners and the central government.

Conclusions regarding the USIT model and stranding diffusion

The USIT model distinguishes dimensions of the user-IT match that can be of great value when studying diffusion problems. Once the sub-dimensions are determined for all adopter groups, it might become clear that different sub-dimensions play a role for every adopter group, and thus in every successive stage of the diffusion process. The diffusion process strands if there is no match with the sub-dimensions that play a role for the adopter category that was to adopt the innovation in that stage.

To use the USIT model requires criteria to discern the adopter categories. Also, the USIT-dimensions need to be specific for every individual innovation that is to be studied.

Relevance is the most important determinant for success, in this situation especially for the early majority. Instead of focussing on "cost reduction on central level", the objectives of the EPS project would have been improving the quality in the GP office. This together with a relation to their real problems, communication and time pressure could and can help EPS diffusion in the GP practices. Further research on our data-set

will help us to draw a more subtle picture of the role of relevance to diffusion and use of the system.

It should be noted that the USIT model focusses only on the match between user and IT. There are a number of other factors that help to explain diffusion. For example, the role of change-agents or certain organizational factors. These factors are not considered in the USIT model.

Conclusions for diffusion management

In order to achieve successful diffusion of an innovation, it is not sufficient to take the opinion of some “volunteering” into account. These volunteers will often be innovators or early adopters and the USIT sub-dimensions that play a role for these adopter categories might differ considerably from those who are at work for less innovative adopter categories. In future cases the system analysts have to move into the real practice to reach a profound level of detail. The starting situation and requirements of all different adopter categories should be mapped separately. This can lead towards a successful new system.

References

- [1] Suomi, R (2001) "Streamlining Operations in Healthcare with ICT", IN Stegwee, RA & Spil, TAM (eds)(2001)*Strategies for healthcare IS*", Idea group publishing, Hershey USA.
- [2] Giversen, I.M. and Gattiker, U.E. (2001) 'IT in medical practice: an exploratory case study in Denmark's publicly financed healthcare system', *Int. J. Healthcare Technology and Management*, Vol.3, No.1, pp.24-47
- [3] Saarinen, T & Saaksjarvi (1992) "Process and product success in information system development", *Journal of Strategic Information Systems*, 1, 5, pp266-277.
- [4] Iivari, J & Koskela, E (1987) "The PICO model for IS design", *MIS Quarterly*, September, pp400-417.
- [5] Liu, K (1993) "*Semiotics applied to information systems development*", PhD thesis, University of Twente, Enschede
- [6] Spil, T A M (1996) "*The effectiveness of strategic information systems planning in professional organizations*", PhD thesis, Enschede.
- [7] Pare, G & Elam, J J (1999) "Physicians' acceptance of clinical information systems: an empirical look at attitudes expectations and skills", *International journal of Healthcare Technology and Management*, 1, 1, pp46-61
- [8] Schuring, R.W. (1988) *The diffusion of automated assembly and the occupational structure*, MSc. Thesis, International Labour Office, Geneva(CH), University of Twente, Enschede (NL)
- [9] Finley, P.N. & M. Forghani, (1998) "A classification of success factors for decision support systems" *Strategic Information Systems*, 7: 53-70
- [10] Rogers, E M (1983) "*Diffusion of innovations*", The free press, New York.
- [11] Rogers, E M & Scott K L (1997) "The Diffusion of Innovations Model and Outreach from the National Network of Libraries of Medicine to Native American Communities", <http://www.nlm.nih.gov/pnr/eval/rogers.html>
- [12] Milstein, C, De Zeher, I & Venot, A (1995) "Modelling Drug Information for a Prescription-oriented Knowledge Base on Drugs", *Methods of Information in Medicine*, 34, 4, pp318-327.
- [13] Riou, C, Pouliquen, B & Le Beux, P (1999) "A Computer-Assisted Drug Prescription System: the Model and its Implementation in the ATM Knowledge Base
- [14] Thornett, A M (2001) "Computer decision support systems in general practice", *International Journal of Information Management*, 21, pp39-47.
- [15] Delaney, B C, Fitzmaurice, D A, Riaz, A & Hobbs, F D (1999) "Can computerised decision support systems deliver improved quality in primary care?" *British Medical Journal*, 319 (7220), 1281, 13 november.
- [16] Sullivan, F & Mitchell, E (1995) "Has general practitioner computing made a difference to patient care? A systematic review of published reports", *British Medical Journal*, 311:848-852, 30 september.
- [17] Mitchell, E & Sullivan, F (2001) "A descriptive feast but an evaluative famine: systematic review of published articles on primary care computing during 1980-97" *British Medical Journal*, 322:279-282, 3 february.
- [18] Nilsson, G, Petersson, H, Ahlfeld, H & Strender, L E (2000) "Evaluation of Three Swedish ICD 10 Primary Care versions: Reliability and Ease of Use in Diagnostic Coding" *Methods of Information in Medicine*, 39, pp325-331.
- [19] Forsstrom, J (2001) "e-prescription over the internet – Legislation and Technology", electronic proceeding E-health Europe conference, Maastricht.
- [20] Soderland, R & Brannback, M (2000) "Computer-based Drug Therapy: Challenging more than 700 years of tradition" Proceedings of the eighth European Conference on IS, Vienna.
- [21] More, E & McGrath, M (2001) "Reengineering the Healthcare Supply Chain in Australia, The PeCC Initiative", IN Stegwee, RA & Spil, TAM (eds)(2001)*Strategies for healthcare IS*", Idea group publishing, Hershey USA.
- [22] Chan, Y E & Ramsden, D J (2001) "Understanding Health Information Networks in Canada" IN Stegwee, RA & Spil, TAM (eds)(2001)*Strategies for healthcare IS*", Idea group publishing, Hershey USA
- [23] Althuis, T R & Rikken, S A J J (2000) "Electronic support for general practitioners in prescribing drugs", *Health information developments in the Netherlands*, April, pp62-66.
- [24] Yin, R.K., (1984) *Case study research, design and methods*, Sage Publications, London
- [25] Legendijk, P.J.B., R.W. Schuring, A.A.M. Spil (2001) "Het Elektronisch Voorschrijf Systeem, van kwaal to medicijn", Universiteit Twente, Enschede