About Appropriation of Mobile Applications - The Applicability of Structural Features and Spirit

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ABOUT APPROPRIATION OF MOBILE APPLICATIONS

-THE APPLICABILITY OF STRUCTURAL FEATURES AND SPIRIT

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Abstract

This paper presents early findings of a study on how users appropriate a computerised mobile system designed to administer service orders. The theoretical lens used was Adaptive Structuration Theory (AST) and focused on Structural Features, Spirit and Appropriation of Structure. In order to accomplish the purpose, two aspects were to be considered: the system's structure and the user's appropriation, because the structure of a system affects the appropriation of the system. The study was conducted at a large international company's Swedish subsidiary operating in heavy industry, machines and transportation. The methods used were a blend of several instruments, such as analysing documents, observations and interviews. These qualitative empirical data were analysed from the perspective of AST. The initial results demonstrate that some of the tested constructs within AST are not applicable to computerised mobile information and therefore some adjustments must be made in AST to fit the mobile computing domain. In order to test these results further, at least two possible strategies lie ahead: either a closer study of the underlying assumptions of Structural Features and Spirit or a broader test of more of the propositions in the AST framework.

Keywords: Adaptive Structuration Theory, AST, Mobile Information Systems, Nomadic, Nomadic Systems, Appropriation, Structural Features, Spirit

1   INTRODUCTION

Our needs, when it comes to computers and computer systems and the way we use them, are changing at the same pace as the systems are developing. Systems using different kinds of network solutions are becoming more and more frequent and the introduction of new communication technologies, such as 3G (third generation of mobile phone standards, successor to GSM (Global System for Mobile Communications)), Wireless WAN and Bluetooth, increase the possibility to establish wireless connections to computer networks. These changes in infrastructure are regarded as the next big shift in technology within the IS domain. At the same time, terms like "mobile decennium" have already been put into use as a description of the technologies that lie ahead (Urbaczewski et al. 2003, Stafford et al. 2003). As a result of the assertions mentioned above in combination with the fact that an increased number of mobile devices, which can communicate via these communication technologies, are becoming available, opportunities for certain occupational groups emerge. Groups like, for example, security guards, health care personnel, ambulatory repairmen, realtors, chauffeurs and salesmen, who don't have an assigned workplace, today have the opportunity to connect to their company's computer network from afar. These occupational groups can be viewed as modern nomads who travel constantly and don't have the possibility to return to home base when they need to access their computer network. These modern nomads are able to communicate using ordinary mobile phones through GSM (Global System for Mobile Communications) and/or GPRS (General Packet Radio Service) communication, smartphones with 3G communication, PDAs (personal digital assistants) that use Wireless WAN/Bluetooth or a combination of the above-mentioned devices and technologies (Bagrodia et al. 1995, Kleinrock 2001, Lyytinen & Yoo 2002). However, what effect does implementing a computerised information system have when these technologies and applications are used within an organisation? What are the effects at the user level? These changes in technology raise several questions relevant for managers.

Up until today, the majority of approaches within mobile computing research have concerned the building of artefacts and applications but less effort has been put forth concerning theory testing and building a cumulative knowledge in this domain (Andersson 2007). Regarding a frequently used object of study, some effort has been put into investigating young people's use of mobile phones (Cueno 2005) and how individuals (not employees) use simple mobile services based on SMS (Short Message Service) or more advanced services with special purpose applications (John et al. 2004). Studies regarding mobile information systems used in business environments are less well illuminated. What do exist are invitations to perform studies within business environments and mobile computing (Lyytinen & Yoo 2002, Schick 2005).

This study is part of a larger multiple case study aiming to contribute to our understanding of effects at the individual level originating from computerised mobile information systems.

The purpose of this specific paper is to report early findings from the research in progress studying the appropriation at the micro level of a computerised mobile service order system (henceforth MobIS) implemented in a large Swedish organisation. The empirical data were analysed from the perspective of Adaptive Structuration Theory (DeSanctis & Poole 1994). Adaptive Structuration Theory is further described in section 2 of this paper.

1.1   The object of the study

The study is being conducted at a large international company's Swedish subsidiary. The firm operates in heavy industry, machines and transportation. It is crucial that the company is kept anonymous in this study in accordance with the agreements made with the firm's executives and hereafter the Swedish subsidiary will be referred to as the Firm. The Firm has mobile service technicians (henceforth STs) who operate from the Firm's service trucks (each contains a small workshop and spare parts). On an ordinary day, the ST leaves his (the ST is more often than not male) home, travels

directly to the client's facility and starts working on the servicing of the client's machinery. After completing a day's work, the ST drives directly home. Ordering spare parts is done by phone and the postal service or a transportation firm delivers the spare parts.

1.2 Structure of this paper

This article is organised as follows: the next section presents the theoretical framework used in this paper. The focus of the theory is on the *Structure of Advanced Information Technology* and *Appropriation of Structures* because these are the main constructs discussed. In the following section, the research settings with methodological considerations and a closer description of the case are displayed. Subsequently, the results from the empirical study are presented. Finally, there are conclusions made from the work with the empirical data.

2 THEORETICAL FRAMEWORK

It is often stated that information systems can only add value to organisations if they are accepted and used (Davis et al. 1989). However, this is only part of the picture: *how* the system is used is also important for the information system to yield value. It is a fact that the individual use of information systems can alter, although the settings could be similar, across the sites. In order to increase our understanding of these differences and help researchers, DeSanctis and Poole (2004) developed the Adaptive Structuration Theory (AST) which departs from Giddens's (1984) Theory of Structuration. The key concept of AST is to confront the Structuration Paradox (Barley 1986). AST is frequently used as a framework for studying GDSS and similar technologies (Jones & Karsten 2008) but "the concepts and relationships posited […] could be applied to other advanced technologies and other organisational contexts" (DeSanctis & Poole p 125, 1994). According to Jones and Karsten (2008), AST is one of the most used theoretical frameworks within information system research. However, the perspective on agency has some critics. The AST origin from Giddens (1984) assumes that the user has the opportunity to choose to use the information system: in other words, a free will. However, this assumption is questionable when studying information systems used within a work situation. If the information system is required in the work and the employees want to keep their jobs, they will probably use the system whatever their opinions of it. This should be considered when data is analysed. Another aspect to be considered in this study is the process perspective. This paper presents findings from what could be treated as a snapshot, not a study over time. However, the findings should be valid without the process perspective.

The Weltanschauung of AST is that both the technology's structure in symbiosis with the social structure establishes the output of an IS. The technology's structure promotes some actions and devalues or even hinders some other actions. However, the social structure made visible in the users' actions can moderate or even alter the intention of the technology's structure. This interleaved dependency is the duality of structure and the ongoing process in which people and technology shape and reshape their dependencies is the structuration process. The basic constructs of AST are nine to the number, *Structural Features*, *Spirit of Technology*, *Other Sources of Structure*, *Group's Internal System*, *Appropriation of Structure* and *Decision Processes*, *Emergent Sources of Structure*, *New Social Structures* and *Decision Outcomes*, and how they affect each other (Figure 1).
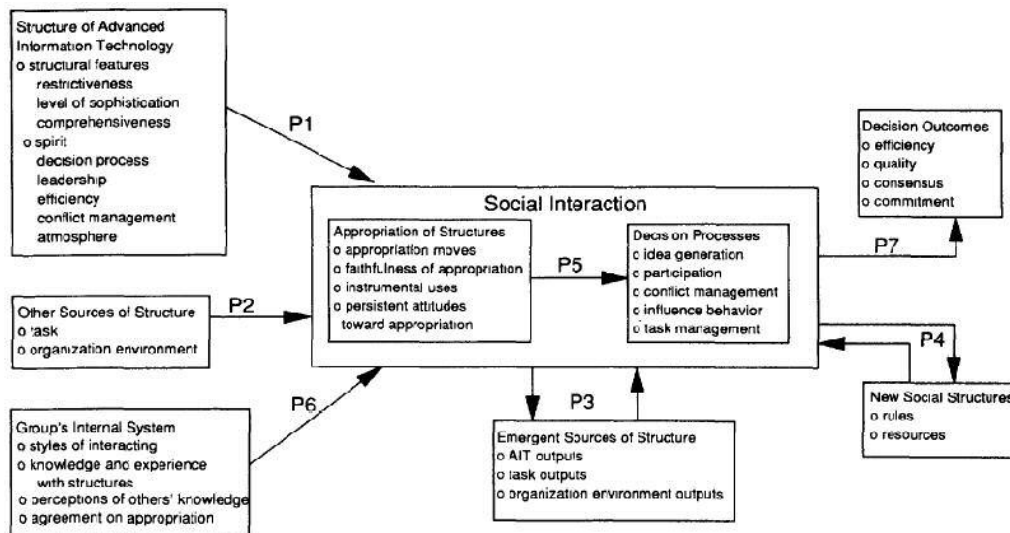
Figure 1. AST and the seven propositions declared by DeSanctis and Poole (1994).

This specific study focuses on the use and the departure is the appropriation and Proposition 1 in the AST framework. "P1, AITs provide social structures that can be described in terms of their features and spirit. To the extent that AITs vary in their spirit and structural sets, different forms of social interaction are encouraged by the technology" (DeSanctis & Poole p 128, 1994).

The structural potential is revealed with studies of *Structural Features* and *Spirit*. Spirit should be treated as the "general intent with regard to values and goals underlying a given set of structural features" (DeSanctis & Poole p 126, 1994), meaning that the spirit is how to act when using the system and how to interpret the built-in features. Spirit is displayed by the design metaphors, how features and items are labelled, the nature of the user interface and training materials. The structural features are examined by studying manuals, handbooks and regarding aspects such as resources and capabilities of the system. They govern how information is gathered, manipulated and managed by the user. What is interesting about structural features and spirit is, according to DeSanctis and Poole (1994), that although the structures of the system do not determine the use, they do indicate the preset or inbuilt Weltanshauung of the system. This preset Weltanshauung is central when analysing to what degree the system matches the existing organisational structures.

Structural features are instantiation of the system's *restrictiveness*, *level of sophistication* and *comprehensiveness*. Restrictiveness concerns how accommodating the system is of alterative paths and alternative actions. If only one sequence of actions is allowed, the system has a large degree of restrictiveness. The level of sophistication focuses on how advanced the system is: just communication or adherence to changing work rules, for example. Comprehensiveness concerns the amount of features offered by the system (see Table 1) (DeSanctis & Poole 1994).

Spirit is instantiation of the *decision process*, *leadership*, *efficiency*, *conflict management* and *atmosphere*. The decision process regards the type of decision process that is favoured: consensus or rational, for example. Leadership concerns whether the technology will foster leaders or not. Efficiency focuses on the extent to which the system speeds the process or not, in reference to actual time consumption. Conflict management deals with interactions: will it hinder or foster changes in viewpoint and opinion? Atmosphere concerns whether the system has a formal nature or not (see Table 2) (DeSanctis & Poole 1994).

Structure	*Dimensions*
Structural features	S1: restrictiveness
	S2: level of sophistication
	S3: comprehensiveness

Spirit	S4: decision process
	S5: leadership
	S6: efficiency
	S7: conflict management
	S8: atmosphere

Table 1. Selected level of appropriation analysis for structures and related aspects (DeSanctis & Poole 1994).

When performing appropriation analysis, three levels of analysis are suggested: *Institutional Level*, *Global Level* and *Micro Level analyses*. *Institutional analysis* concentrates on multiple groups or across organisations. *Global level analysis* focuses on entire meetings and multiple meetings and, finally, *Micro Level analysis* studies speeches or other acts and parts of meetings (meeting phases). *Micro Level* is the most suitable level of analysis in this study because the focus is on the actual users and their individual use of the IS at hand. When studying appropriation, four aspects are at hand: appropriation moves, faithfulness of appropriation, instrumental use and attitudes toward appropriation (see Table 2) (DeSanctis & Poole 1994).

Level of Analysis	*Unit of Analysis*	*Aspects of Appropriation*
Micro	speech or other acts	A: appropriation moves (types and subtypes)
		B: faithful vs. unfaithful appropriation
	meeting phases	C: instrumental uses of structures
		D: attitudes toward structures

Table 2. Selected level of appropriation analysis for structures and related aspects (DeSanctis & Poole 1994).

Depending on the technology structure, users can appropriate the offered structures in different ways: nine different appropriation moves (A) are described (see Table 3) (DeSanctis & Poole 1994).

(A) Appropriation moves (types)	*(subtypes)*
Direct use (structure is preserved)	A1. Direct appropriation
Relate to other structures (structure may be blended with another structure)	A2. Substitution
	A3. Combination
	A4. Enlargement
	A5. Contrast
Constrain the structure (structure is interpreted or reinterpreted)	A6. Constraint
	A7. Affirmation (structure is accepted)
Express judgments about the structure (structure is rejected or ignored)	A8. Negation
	A9. Neutrality

Table 3. Appropriation moves and their types.

Users can also choose to appropriate technology features faithfully or unfaithfully (B). In other words, the features embedded in the system can be handled in a fashion that the designer did not intend, i.e. unfaithfully. If the embedded features are aligned to the social structure, then faithful appropriation is expected.

Instrumental use (C) is the third aspect in the study of appropriation; it goes beyond just *what* and *how* and tries to answer *why* a certain structure is used.

The fourth aspect is the attitudes toward appropriation (D), which attempts to reveal a sort of prerequisite of appropriation. Are the users willing to adopt new technology from the beginning? Do they believe that the technology would be useful to the user? Are the users willing to work hard to excel in the use of the new technology?

3 RESEARCH SETTINGS

3.1 Methodological considerations

The methods used were a blend of several instruments, as suggested by Yin (2003) when carrying out case studies. The manuals, handbooks and teaching material handed out to the STs were read and analysed in order to establish a view of the structural features of the technology. Observations were performed in order to reveal how the actual work with the handheld devices was performed. Interviews were carried out with STs, the STs' foreman and clerks who handled the administration of service orders. A total of 250 pages of written documentation were read and analysed, eight hours of observations and four hours of telephone interviews were conducted. Notes were taken and the qualitative empirical data was analysed from the perspective of AST (Silverman 2006). The data from the document study and interviews were coded according to AST constructs S1–S8, A1–A9, B1–B2, C and D (see Tables 4, 5 and 6).

3.2 Chronological order of empirical studies

- Phase 1: demonstration of how the system was used in the field (recorded conversations, notes and pictures).

    - The first task was to establish a basic level of domain knowledge in order to proceed with the analysis of written documentation. The ST demonstrated how the MobIS was supposed to be used. The ST had saved service orders from the previous week and demonstrated activities by performing the actual reporting of work. The ST also demonstrated the previous workflow with written paper-based service orders.

- Phase 2: studying of printouts of manuals, handbooks and teaching materials in order to find matches or mismatches between the actual use and the embedded workflow in the IS (coding).

    - Comparing the old paper-based service orders and the new MobIS displayed to what degree the handling of information was different between the two information channels. To what degree did the user have possibilities to choose different paths? How was error handling performed (how to deal with actions that did not fit into the standardised workflow)?

- Phase 3: second observation and an interview with one user (recorded conversations, notes and pictures).

    - With some knowledge of the domain and the information system, another more in-depth observation was possible. This observation raised an opportunity to double-check if previous assumptions about structure and features were correct.

- Phase 4: telephone interview with a clerk (notes).

    - One of the individuals who previously worked with the administration of the paper-based service orders was interviewed in order to study if their work had changed after the implementation of MobIS. The interview also gave indications on how the STs use the MobIS.

- Phase 5: telephone interviews with four STs using semi-structured questions (notes).

    - Four STs with different views on the MobIS were interviewed and notes were taken.

- Phase 6: telephone interview with one foreman (notes).

    - In order to gauge the foreman's opinion about what had been a workflow change for the STs, a telephone interview with rather structured questions was held.

The different phases approached the different aspects as follows: phases 1, 3, 4, 5 and 6 concerned the appropriation and phases 2 and 3 concerned the structural features of MobIS. In selecting informants, an expert selection strategy was used. The clerk recommended STs to interview due to their knowledge and opinion of the system.

3.3 The STs' daily workflow

The previous workflow was as follows: the customer called the service order office, which created a service order that was sent by mail to the ST and, after the service was completed, the ST filled in a service order sheet and sent it to the main office. At the main office, a clerk entered the data into the Firm's ERP system and an invoice was created and sent to the customer. This process took about two to three weeks and sometimes up to four weeks.

In order to shorten the time from a customer's call to a sent invoice, a computerised system was developed and implemented into the STs' workforce (the MobIS). Every ST was equipped with a sturdy mobile device with the inbuilt ability to send data via the GSM network. The mobile device exchanged information with the Firm's ERP system via middleware.

The workflow today is as follows: the ST receives the service order via the mobile device when it is synchronised, a routine that the technicians are instructed to do at least twice a day. The service orders are filled in via a touch screen and a pen, similar to a Palm Handheld. With this new routine, the workflow from a customer's call to a sent invoice is shortened significantly to an average of two to three days, sometimes up to four days.

Figure 2. The actual handheld device and a sample screenshot from MobIS.

4 FINDINGS

Structure	Dimensions	Finding
Structural features	S1: restrictiveness	High degree
	S2: level of sophistication	Low degree
	S3: comprehensiveness	Low degree (level 1)
Spirit	S4: decision process	Not applicable
	S5: leadership	Not applicable
	S6: efficiency	Low
	S7: conflict management	Not applicable
	S8: atmosphere	Formal

Table 4. Occurring structural features of advanced information technology from the document study.

The study of manuals and education material displayed a system that was exact and strict. The workflow was clear with no alternative paths and few options to handle unpredicted actions. In fact, the system was a strict transformation of the previous paper-based service order. Each "part" of the paper-based service order had its own screen view (if it was possible to fit this into the small screen, otherwise it was divided into smaller views). However, passing judgement on the structural features of MobIS was anything but easy. The first reflection was that the system ought to have a high degree of task-fit. After phase 2 (see previous section), it seemed that a good overview of what the workflow looked like for the STs had been established. Despite this, discussing workflow with the STs in phase 3 and phase 5 revealed that some misunderstandings had occurred, originating from a lack of deep domain knowledge. Even the observation in phase 3 and phase 5 revealed that the "strict paper" was not that strict as it allowed the ST to do workarounds when, for example, buying repair parts from a local dealer instead of using the Firm's products. The MobIS was a much more restricted and time-consuming environment in which to administer service orders compared with the paper-based service order system.

Appropriation moves	Appropriation subtype	Finding
Direct use (structure is preserved)	A1. Direct appropriation	Explicit use; openly use and refer to the structure (faithful)
Relate to other structures (structure may be blended with another structure)	A2. Substitution	N/A
	A3. Combination	Paradox combination; combine contrary structures with no acknowledgement that they are contrary (unfaithful)
	A4. Enlargement	N/A
	A5. Contrast	N/A
Constrain the structure (structure is interpreted or reinterpreted)	A6. Constraint	N/A
	A7. Affirmation (structure is accepted)	N/A
Express judgments about the structure (structure is rejected or ignored)	A8. Negation	N/A
	A9. Neutrality	N/A

Table 5. Occuring appropriation moves.

The main reason for building the MobIS was to reduce the time it took from service order creation to invoicing the client – the analysed documents made it clear that this had been achieved. The previous workflow took on average two to three weeks and occasionally up to four weeks, and with MobIS this time was reduced to two to three days, and at the most four days. This resulted in a time reduction of almost two weeks on average. However, the administrative costs for the service orders have shifted from the clerks and foremen to the STs. The clerk claimed that she was doing the same amount of work but with different content. The system had a malfunction in the sense that service orders could disappear when the handheld device was synchronised with the ERP system. The amount of effort made to overcome his problem was unknown to the informants, but the informants claimed that the consultants who developed the systems were aware of the problem. Therefore, the clerks had new duties in correcting faults and tracing missing orders. In essence, the staffing remained the same but the tasks have changed a little. So, the MobIS was time-consuming in one aspect but time-saving in another aspect.

According to the clerk and the foreman, the perspective and opinion of MobIS varies a lot, and two categories could be identified: the negative users, the STs who followed the rules and under protest took action to compensate for the malfunction in MobIS, and the don't care users, the STs who did not care if information was lost and customers were never billed for completed work.

The following are four illuminating extracts from the interviews:

You could probably divide the STs into two groups: the negative and those who don't care. And the users who don't care cause the most problems. We are missing service orders due to problems with synchronisation and the fact that the don't care staff do not take notes. (Clerk)

Well, if I do synchronise the unit, and the information is lost, what can I do? You can't expect me to write down everything. But I really do like the system and I do not want to go back to paper orders. If you were a bit smart, you could take a day off and blame the system: no one would be able to check. (ST1)

It is already time-consuming working with the mobile unit. Writing memos in my calendar triples the time spent on administrative tasks. I'm a service technician, not a clerk. This is not why I started working with service and repairs. My colleague N.N. has already left the firm because of this system. (ST4)

It is very irritating that you must do everything twice, first on paper in your calendar and then in the handheld. Nowadays my reporting takes one to two hours a day, compared with the old system where it took about fifteen to thirty minutes a day. It is a bad and time-consuming system. I would be better off with the paper-based service orders, and I am sure that the customers would receive more accurate invoices then. (ST2)

There was no mismatch between the system and the task, but between the MobIS's view of an ST job and the STs' perception of a job as an ST. The STs and the foreman regarded that being an ST at the Firm meant a job with a high degree of freedom: freedom to plan your day for at least a week in advance. This was an important aspect to the STs. Rules and legislation limit their freedom and independence and an employer with a high degree of rules and control is a lot less attractive.

When the ST hypothetically discussed the system and assumed that the problems with synchronisation had been solved, other problems were identified and the two categories of users became more related. They often ran into problems when entering data that did not match preset data. For example, regarding the repair parts stored in the van, if the inventory list was not correct, there was no easy way to handle this. The service order had to be blocked and the ST had to call the clerks or the foreman to make them alter the inventory status. There was a similar procedure when buying parts from local dealers: there were no inherent routines to handle this in an effective fashion.

When studying the notes from the interviews, the negative users' appropriation moves had the best match with category 3 – combination, paradox (relate to other structures, structure may be blended with another structure) – whereas the don't care users' appropriation was determined as category 1 – direct appropriation, explicit (direct use, structure is preserved). However, the malfunction of the system probably interfered and, without that, the reading could be different. Both groups declared an unfaithful appropriation (B) although by completely different means. Why these structures (C) were used most likely depended on the fact that the STs valued the freedom and independence in their work situation. This is probably one major reason for the negative appropriation, although the STs considered themselves technology friendly (D) and considered that MobIS had the possibilities to have a large and positive impact on their work. Of course, this positive impact would only occur if the malfunction was taken care of and that coming versions of the system supported the STs instead of controlling them.

	Dimensions	Finding	Motivation
(B) Faithful vs. unfaithful appropriation	B1. Faithful		
	B2. Unfaithful	Even though some users seemed to be positive, they were in fact ironic	Regardless of opinion; negative or ironic
(C) Instrumental uses of structures	C1. Why?	Unclear, free will is questionable	Forced use, loyalty?
(D) Attitudes toward	D1. Preconceptions	Positive	Regarded themselves as

| structures | about the MobIS | | technology friendly |

Table 6. Appropriation of structure: constructs B, C and D.

Compared with the previous paper-based service order system, the design of MobIS enforced a rigid structure and control upon the service technicians. This was done by only offering a strict workflow that was an exact match of the paper-based service order. An important fact was that the paper-based service order in fact allowed workarounds such as making notes and writing explanatory comments. Combining this rigid system with the fact that the service technicians highly valued the freedom and independence they had working as service technicians, there was a mismatch between the system and the perception of the job. This became evident in the discussions on how the malfunction in the synchronisation was handled by the users. The malfunction that caused service orders to vanish when synchronising with the ERP made it possible for some users to limit the control that MobIS enforced upon them. For some users (don't care users), it was an opportunity to ignore the structure and more or less take advantage of the malfunction. For other users, the malfunction just caused irritation and more work. How much the missing service orders are costing the firm is unknown, just because they are missing. However, as the Firm did not take action to correct the malfunction, the savings most likely were larger than the costs of missing orders. The savings originated from the reduced time from creating a service order to sending an invoice.

5   REFLECTIONS AND CONCLUSION

As previously mentioned, AST seems to be a valuable framework when studying how information systems are appropriated by users in work organisations, considered that AST was developed for studies of several types of advanced information systems and it has mainly been used in studies of GDSS and similar information systems. Therefore, one could argue that some reflections on how the framework works on another type of information system (mobile information systems) would be fruitful.

The purpose of this specific paper is to report early findings from the research in progress studying the appropriation at the micro level of a computerised mobile service order system (henceforth MobIS) implemented in a large Swedish organisation.

The focus has been Proposition P1 in the AST framework: *AITs provide social structures that can be described in terms of their features and spirit. To the extent that AITs vary in their spirit and structural sets, different forms of social interaction are encourage by the technology* (DeSanctis & Poole p 128, 1994). If this proposition should be regarded as valid, the construct within this proposition should be meaningful. In addition, if this somewhat deterministic proposition is valid, some concurrent opinion should be found among users within the same category of users.

The study indicates that some of the constructs of *Structural Features* and *Spirit* were not applicable or were almost impossible to investigate and as a consequence were not meaningful. S4 (decision process), S5 (leadership) and S7 (conflict management) were not applicable due to the design of MobIS. S1 (restrictiveness) was somewhat ambivalent; the initial document study displayed that the system would be perceived as an electronic version of the paper-based service order but, during interviews and observations, I realised that the paper-based service order allowed a more free form of communication than the MobIS does. I argue that, so far (further research is needed), the perception that the system can be described only by studying documents probably originates from an unrealistically positive view of what an information system can offer in terms of functions, in which there seems to be no limitation to what can be implemented. In mobile computing, the technical limitations are so hard to overcome that many expected or wanted functions cannot be offered. To carry out the analysis of *Structural Features* and *Spirit,* some degree of use or users' domain knowledge must be incorporated: the manuals alone are insufficient. Regarding *Appropriation of Structure*, the findings were contradictory and the causality of the proposition is questionable.

However, I do stress that these are early findings, but the findings are strong enough to motivate a closer investigation into Proposition P1.

To test AST and its applicability to mobile information systems further, two different strategies are at hand. One is to study the inbuilt mechanisms in Proposition P1; the other strategy is to extend the study to incorporate the Propositions P2 and P6. The former should benefit from a qualitative approach, while the latter should probably benefit from a quantitative study.

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