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Challenges during the development of transnational information systems

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There is an increasing interest in and demand for information systems that transcend organizational and national boundaries – transnational information systems. The interorganizational and international nature of these systems introduces development difficulties. Transnational information systems are developed on an *ad hoc* basis; there are currently no set tools and guidelines to aid their development. This paper addresses transnational information systems development using case research to raise issues concerning the transnational information systems development process and to discuss actual development difficulties and their solutions.

Introduction

The economic and public order has become internationalized on a grand scale. Internationalization is a continuing and pervasive trend and is not just a temporary or occasional matter. In Europe this development has been speeded up by the continuing expansion of the European Union (EU) and by further integration of the EU member states.

Such internationalization has raised the interest in and demand for information systems that transcend national boundaries – transnational information systems (TIS). As examples of such systems one can think of international payments systems, systems linking customs agencies from various countries, systems supporting transnational police activities (cf. Interpol) and systems linking welfare and social services departments in different countries. Some of these systems are currently operational, while others are under development.

The development and management of TIS is not straightforward. The interorganizational and international nature of these systems introduces difficulties and problems. As the needs and opportunities for TIS becomes more prevalent, there is an increasing need for generalized knowledge and guidelines concerning the development and management of TIS. Organizations want to know how to avoid difficulties and, if problems should occur, how to solve them. As yet, TIS are being developed on an *ad hoc* basis, but it should be possible to start collecting data about existing TIS and to collate experiences of TIS development. In this way generalized knowledge becomes available which can facilitate the development processes of other TIS.

This paper addressed TIS development using case research to raise issues concerning the TIS development process and to discuss the actual development difficulties and their solutions. The paper proceeds as follows. First, some of the research contributing to the understanding and development of TIS is briefly reviewed. Then two cases are presented which provide empirical examples of TIS and which form the basis for the subsequent discussion about TIS development. Next, issues at various TIS development phases are discussed and the concept of the level of aspiration of the TIS introduced. The paper concludes with a summary of the findings and with suggestions for further research.

Transnational information systems

There is little existing research about TIS and the little that has been done focused on the private sector (King and Sethi, 1994). Much more work has been done in the area of interorganizational systems. Since TIS imply the development of systems that cross organizational boundaries, previous research on interorganizational systems should be able to provide some insight into the difficulties confronting TIS development. Like interorganizational systems, TIS require different organizations (each with their own aims, rules and traditions) to look beyond their own boundaries and to

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consider common ground with other organizations. The drawback with the interorganizational literature is that little attention had been paid to the confrontation between different national cultures, judicial systems and political priorities. These latter issues are addressed in the literature on information systems linking different divisions of multinationals (Ives and Jarvenpaa, 1991; Palvia and Palvia, 1994).

The current state of technological advance makes the physical building of TIS easily possible. Many of the earlier technological difficulties in terms of the different hardware, software and telecommunications standards in various locations can now be addressed by technical solutions. However, the development of TIS is not a purely technical affair (e.g. Deans and Kane, 1992; Wang, 1993). Other issues include the legal aspects, economic interests and cultural differences.

Wang (1993) argued that different legal requirements concerning privacy issues complicate the development of TIS. TIS may be hampered by different regulations about transborder data flows and about laws concerning the protection of data and information and by required security procedures.

The economic aspects involve the various fiscal regulations in different countries and the different financial arrangements used in the normal conduct of business (Deans and Kane, 1992). In addition, the level or state of economic development can affect the ability of a country's organizations to partake in a TIS.

The cultural differences include obvious differences in terms of the language, currency and national symbols. However, different nationalities also tend to operate according to different values and norms. These, in particular, can make the development of a TIS a complex and time-consuming task. Some nationalities accept a system built by and introduced by foreigners more readily than others, while some nationalities expect higher levels of user participation during the development than others. It is not always easy during TIS development to be sensitive to and to respect all differences (Deans and Kane, 1992).

The literature about interorganizational systems reveals a number of issues affecting development that are potentially also of relevance to TIS. Such issues include the importance of creating interest in and commitment for the system, trust, the type of interdependence, standardization and the political and cultural environment within which the system is to operate.

Commitment among the management and users of participating organizations is an important condition for the success of interorganizational systems (e.g. Grover and Teng, 1994). It is important that the various parties that will be affected by the system feel involved in the system by being kept informed, by having the opportunity to participate in the development and by being trained and prepared appropriately.

Meier (1995) concluded that the participants in a project to develop interorganizational systems have to trust each other. Trust is enhanced when the benefits of the system for the various participants are made clear. An interorganizational system is best served by creating a win–win situation for the participants. Competition between the participants will then be minimized.

The systems linking various organizations reflect the different types of interdependency among the partners (Robey and Sales, 1994; Kumar and van Dissel, 1996). Systems which build an interface between local systems and a central system are the simplest to coordinate and incorporate the least potential for conflict among the participating organizations. In contrast, fully integrated networked interorganizational systems require more intricate coordination mechanisms and imply a high potential for conflict. Hence, the type of system itself and its configuration implies potential risk and conflict in the development process and during the ongoing management of the systems.

Many interorganizational systems require the standardization of data and procedures by the participating organizations. Standardization extends to the applications used to communicate between the organizations (Picot *et al.*, 1993). Standardization is more easily achieved when there is a genuine interest in and commitment to the system among the participants.

The content of a system and the development process of a system are not only affected by the visions and actions of the managers that are responsible for development (Webster, 1995). Often the environment of the system may necessitate the development of a system. Similarly, economic, political and cultural conditions may affect the way in which a system is developed.

Altogether, hardly any research has yet been published about systems that cross organizational and national boundaries and, in particular, little is known about such systems in the public sector.

Two case studies

The empirical data for this paper are derived from two case studies of existing TIS. Case study research was considered appropriate since little theory and empirical evidence has as yet been published about TIS (Yin, 1994). This is an inductive study using grounded theory methods (Glaser and Strauss, 1967; Layder, 1993). The case descriptions are based on in-depth interviews with the main actors and on documentation concerning each TIS. The stories reflect, as much as

possible, the interpretation from the actors in the case rather than the interpretation of the events by researchers (Walsham, 1995).

Both cases concern links from public to public organizations internationally. The cases were Eucaris and Transit. Eucaris is a TIS that enables personnel in different countries to view individual car and driving licence registration systems and its primary aim is to lower the number of stolen cars being registered in other countries as legal vehicles. Transit is the TIS that is being developed to speed up and facilitate custom's administration concerning goods that are imported into the EU.

Eucaris*

The incidence of car theft has increased alarmingly during the past 10 years. Often stolen cars are taken across borders to be re-registered (and thus whitewashed) in another country. The car registration organizations know that this problem exists but are relatively powerless to stop the cross-border trade in stolen cars. The registration authorities are obliged to register a car unless they can prove within a short period of time that the car is registered elsewhere and therefore is a stolen car. When in doubt about the legality of a car that is being offered for registration, the authorities traditionally write to, phone or fax foreign registration authorities. This process is inadequate as it is time-consuming and difficult to manage. Instead, the idea was formed of building a transnational information system to enable instantaneous, electronic searching and checking of car registration data across Europe. The system was called Eucaris (European Car Registration Information System).

The Eucaris initiative came from the Dutch car registration authority, headed by an enthusiastic director who became the system's champion. Very early on it became clear that it would not be possible to integrate the registration systems of various countries into one large system. There is at present no single European car numbering system to identify individual cars Europe-wide. In addition, the current registration systems each use different data definitions which complicates the possible development of a single system. Individual registration authorities also value their autonomy and a central registration system would threaten that autonomy. Hence, for a number of reasons, it was decided to develop a relatively simple system: a common shell to provide a query interface to the separate systems of the participating countries. The common shell provides a standard query interface, enables entry into country-specific systems and presents the requested information on-screen in a standard format.

Building Eucaris was a relatively simple affair. The design of the system was not complicated: the TIS is not a separate system and there is no physical integration of the various national registration systems. Instead, a software shell was built to provide for the logical integration of the systems. The system was built by the initiator (the Dutch car registration authority). When there were time or manpower constraints the necessary programming and other development was outsourced.

Organizationally Eucaris is more complex. Eucaris is a project within the various participating organizations. Now that the system has become operational Eucaris should no longer be considered a project but should be institutionalized and become part of the everyday organization. In addition, the coordination and management of Eucaris should no longer remain in the hands of the Dutch car registrators, but should be handled by an overseeing body. The need for such changes is recognized but it is proving difficult to achieve these changes.

The first results of Eucaris are highly encouraging. The participating countries have direct, on-line access to the registration systems in other countries. Hence, they can elicit the necessary information about used cars within legal time periods. The participating countries are finding that far fewer stolen cars are being offered for registration. Interest in Eucaris is increasing. Currently six countries are on-line (The Netherlands, Belgium, Luxembourg, the UK, Hungary and Poland), 14 other countries are preparing to go on-line, and another ten are enquiring about participation. In terms of functionality there is a call for using the information in the system to provide management information and statistics – not only to car registration authorities but also to other national authorities such as the police, department of road transport and insurance companies. Eucaris is slowly becoming acknowledged as an international base registration of cars which is more accurate and more up-to-date than the databases maintained by other authorities.

Transit†

Goods that are brought into the EU are subject to taxes and duties. Once the duties and taxes have been paid the goods can be used, passed on and sold on the free market. Payment can take place at the point of entry into the EU or at the point of destination. Since payment is not necessarily required at the point

*A detailed description of the Eucaris case can be found in Zuurmond (1996).

†More details about the Transit case can be found in Mantelaers (1996).

of entry, European customs officials have to keep track of the goods moving within Europe and, in particular, have to be able to trace what duties and how much taxes have been paid. The customs have organized tracking of international goods transport in a decentralized manner with the aid of paper forms.

There are a number of problems with the current procedures. Because of the Single Market regulations there are no checks of goods transport at national boundaries within the EU. This has led to an increase in fraud: the duty on some goods is not paid or is only partly paid, while other goods apparently 'disappear' between the point of entry and the point of destination. Within The Netherlands the cumulative fraud figures are now over 300 million European Currency Units (ECUs), in Germany the figure is higher than 500 million ECUs and in the whole of the EU customs fraud concerning goods in transit adds up to several billion ECUs. Another difficulty concerns the slowness of the clearance system. All the customs transactions take place using snail mail; hence, customer may have to wait several weeks before their goods are cleared for use within the EU. In addition the original customs document is filled out using pen and paper with the concomitant problems of unclear handwriting and unreadable final copies.

In all, it has been clear for a long time that these problems need to be addressed. The computerization of the international customs process seemed an obvious solution: it would facilitate the tracking and tracing of goods, it would enable an immediate comparison of the goods and duties paid, speeding up the clearance process and it would produce readable, accurate and up-to-date information at any customs office. The private sector would also benefit because of the faster clearance procedures. The fraud issue, which is reaching alarming proportions, has now placed the computerization of the transit procedures high on the list of priorities of the EU.

The current project to build a TIS is the third attempt at developing computerized procedures. An attempt in the early 1980s evaporated; the project did not have a high priority and the TIS was considered to difficult to build (in technical terms). In the early 1990s a second attempt was made at organizing a TIS. The focus of the development discussions was on building a technically highly efficient system (e.g. by centralizing the clearance procedures). Various countries felt threatened in their autonomy and thwarted attempts at cooperation. It was then decided to delay the TIS development indefinitely.

The fraud problem has now forced the customs authorities of the EU countries to take action, overcome their differences and build a TIS. The European Parliament passed a resolution in November 1995 in which all countries pledged to cooperate and spend whatever was necessary to get the TIS off the ground. The TIS project is called Transit (as it deals with procedures for goods in transit within the EU). Electronic data interchange (EDI) messages have been designed, national gateways are set up and for each country one customs application host is built. The organization of customs is different in various countries; by using one application host per country the diversity in the local systems and organizations need not affect the central TIS.

A major difficulty faced by the development team concerns the varying degrees of information technology (IT) penetration in the different countries. For instance, in The Netherlands there are 36 customs offices, all similar in size and each fully computerized using local area networks; across the border, in Belgium and in Germany, there are many small offices which are not networked. Varying IT penetration occurs even among the most advanced countries in the EU; that means that not all offices in all countries can be linked to the TIS.

At the end of 1996 the transit project was in its pilot phase; the customs authorities aim to have the system fully operational as soon as possible.

Summarizing the cases

Both cases provide insights which, when taken together, paint a rich picture of the issues concerning the development of TIS. Some of the more striking features of each case are summarized at this point.

The Eucaris case highlights the importance of a champion and an enthusiastic group of early participants in moving a TIS from the; 'nice idea' phase to an operational system. The case also shows that a crucial moment is reached when the system has become operational. In terms of organization around the system it then becomes crucial to have a coordinating body to manage and continue developing the system. In addition, the institutionalization of the system in the local organizations is vital but can prove to be difficult.

Unlike Eucaris, Transit is a TIS developed in the context of an existing coordinating body. In this case the difficulty of getting beyond the identification phase of development is highlighted: only on the third attempt at getting Transit off the ground did development take place. Another feature of the transit case is the challenge posed by participant with different abilities and with different levels of IT penetration.

Clearly the two TIS are different stories and present individual idiosyncrasies. The primary aim of this study was to identify and collate the difficulties that were encountered during the development process. The cases certainly enable the researcher to do that.

Table 1 Problems and solutions at each phase of TIS development

Phase of development	Problem	Solution
Identification	Need for TIS identified, but technology not far enough advanced to build TIS (Transit, first attempt)	Delay indefinitely
	TIS identified but not seen as high priority (Transit)	Delay indefinitely
Design of the TIS	Diversity of systems that need to be linked (Transit and Eucaris)	Opt for common interface and local gateway configuration (Eucaris and Transit) Allow for different levels of functionality (Eucaris and Transit)
	Rivalry among participants and fear of loss of autonomy (Transit, second attempt, and Eucaris)	Delay indefinitely (Transit) Start development with a few committed partners only (Eucaris) Opt for technical solution that is highly decentralized (Eucaris)
	Different IT abilities of the participants (Transit)	Allow for phased implementation
Building the TIS	Time/manpower for TIS development difficult to find among the participants (Eucaris and Transit)	Outsourcing of development
Implementation of the TIS		
Ongoing maintenance and development of the TIS	Difficulty of coordinating various parties (Eucaris)	Outsourcing of day-to-day operational management of the TIS Set up coordinating body for general management
	Long-term integration into existing systems (Eucaris)	Not yet satisfactorily addressed
	Expanding the system to include more tasks/actors (Eucaris)	Not yet satisfactorily addressed

Difficulties at the various system life cycle phases

Every system moves through a number of recognizable phases during the development process and every phase contains different tasks and activities and, thus, the problems during system development vary from phase to phase. At each phase different issues come to the fore and different problems have to be addressed. Hence, this section has been separated into subsections each addressing one phase of development and each summarizing the problems found in the cases and the solutions that were applied by the case organizations.

Authors use different names for the various phases of development but researchers generally agree on the different phases to be distinguished. First, the need for a system must be identified and an agreement must be reached to try to develop a system. Then the precise requirements of the system must be identified and the design of the system has to be arrived at. Next, the system has to be physically built, which involves programming and networking. Then the implementation of the newly built system has to take place so that the system becomes operational and the users interact with the system in support of their daily tasks. Finally, the development process moves to the phase of maintenance and ongoing development of the system. These five phases can also be distinguished in TIS development.

Table 1 summarizes the difficulties faced by the cases during TIS development and also shows what solutions were found for each of the difficulties. The problems and solutions at each phase of development are listed in Table 1 and are discusses in more detail below.

Identification of a TIS

The bottleneck of this phase of TIS development relates to the issues which prevent parties from moving beyond the identification of a potential TIS.

During the first attempts to build a Transit system the need for such a system did not appear very great compared to other information issues in the various customs organizations. Hence, the project was accorded only a low priority and its development was put off. The third attempt at developing the Transit system was characterized by a strong need: fraud had

begun to add up to billions of ECUs and led to the European Parliament targeting the Transit project as a priority issue for the EU. The TIS of Eucaris was also developed in response to a real need for a system: the registration of stolen cars was reaching unacceptable proportions.

The difficulties in the identification phase appear to be inversely related to the apparent urgency of the problem that is to be addressed by the TIS. When the issue is considered important and urgent, the identification of and agreement about the concept of a TIS is relatively easily reached. However, when the problem that the TIS addresses is not considered a high priority, difficulties seem to mount up and the TIS does not get beyond the 'nice idea' phase.

Designing the TIS

The system design in both cases was characterized by trying to find a design that was acceptable to all and that least affected the individual autonomy of the various organizations/countries involved. One obvious design is a standardized or integrated system solution. However, participants may resist such a configuration because of fears of a loss of autonomy and a loss of control over national (and possibly sensitive) information.

It is difficult to select a single hardware platform or an appropriate software application to service all the participants. The individual systems in various countries have developed independently and are likely to be highly diverse; in both the Eucaris and the Transit case this caused difficulties. In addition, when there are many participants there are likely to be differences in the level of IT use and in IT sophistication at various sites; this was a problem in the Transit case in particular.

Both Eucaris and Transit opted for interface solutions, linking local systems to an interface which interacts with a central system. In Eucaris it is a software application – an interface which enables access to other systems and which translates the local data so that information can be read by other systems. In Transit a hardware solution was most appropriate; each country has to build a single customs application host that interacts with the central system while the local systems that operate behind the single customs application remain unchanged.

Building the TIS

A TIS is a system beyond the boundaries of any one of the participating organizations. Hence, the building of the system is a joint responsibility. In the Transit case a separate project organization was set up and the actual building was outsourced. Eucaris was built by one of the participants (the Dutch car registration authority) with outside help when manpower was scarce.

The earlier phases of development (i.e. identification and design of the TIS) can only take place by close cooperation between the participants themselves. The building of the TIS is not a strategic activity and can be outsourced.

Implementing the TIS

When a TIS has been properly identified and has been agreed upon by the participants, the implementation is not a difficult matter. In both the Transit and Eucaris cases, the implementation is proving to be relatively straightforward.

Ongoing maintenance and development of the TIS

Management and maintenance present a challenging phase of the development. The early euphoria and interest in the TIS wears off after implementation. And yet management issues remain: ensuring that the participants see to their local systems so that they interface correctly with the TIS, enforcing standards and continuing use of the TIS, developing new functionality and increasing the scope of the TIS. Eucaris is a good example of a TIS that has reached this phase and that faces the new challenge of keeping the early momentum going. The Transit case could not provide information about this phase as the Transit project is still in the implementation phase.

Solutions for development difficulties: adjusting the level of aspiration

The previous section (in Table 1) listed the problems faced by the two TIS cases during the various phases of development and the solutions that were applied. When looking closely down the column of solutions it appears that many of them are solutions to the symptoms rather than solutions to the causes of the problems. The symptoms are addressed by lowering the level of aspiration of the system, thus circumventing the difficulty instead of addressing it.

Clearly, an ambitious TIS is more difficult to develop and manage than a relatively simple TIS. Hence, the level of aspiration can indicate the level of difficulty that is to be faced in the development process. In both the Transit and Eucaris case the actual level of aspiration was lower than the potential level or the level that was initially envisaged. The aspiration

levels were adjusted during the early phases of development.

The cases show that the level of aspiration of a TIS can be toned down and adjusted in a number of ways. In the following list the case(s) where the particular means of TIS aspiration adjustment was used is given in parentheses.

(1) Start with a limited number of participants and gradually add more participants (Eucaris and Transit).
(2) Start with a limited functionality and expand the functionality over time (Eucaris).
(3) Allow the participants to join the TIS at various levels of use (Eucaris and Transit).
(4) Avoid full integration and start with a less ambitious system configuration (Eucaris).
(5) Delay the development and implementation (Transit first and second attempt).

The actors do not necessarily have to accept an adjusted level of aspiration, but it appears that participants quite readily lower their expectations of a TIS. The new level of aspiration is rationalized using one of several arguments. Firstly, cooperation among the participants and, in particular, the TIS is a new phenomenon; the participants convince themselves that it is not possible to achieve the desired level of aspiration of the TIS straightaway. In addition, in both the Transit and Eucaris case, the participants felt that the TIS issue was so important that the TIS implementation and wide participation was imperative – even if it meant lowering the level of aspiration of the TIS. Another argument concerns the benefits of the TIS: even at low levels of achievement a TIS such as Eucaris or Transit can be claimed to be a success since the cost–benefit balance is skewed towards the benefits. All three of these arguments were used in each of the two cases. A fourth argument, used in the Transit case only, concerns priorities and need. The early attempts at developing a Transit system ended up in indefinite delay; the participants accepted this arguing that the TIS was not a high priority issue and therefore did not need to be pursued aggressively.

The level of aspiration of the TIS appears to be an important variable when investigating the development and management of a TIS. The barriers to a high level of aspiration are the number of participants, diversity among the participants, and disagreement among the participants. Such difficulties and problems are intrinsic to the development and management of systems that cross organizational or national boundaries. The difficulties seem to be avoided by lowering the level of aspiration of the system. A reduced level of aspiration is rationalized so that all parties accept it readily. The case evidence suggests that it may be more important to get a TIS of some kind in place than to build the 'optimal' TIS.

Even when the participants have agreed to a diminished level of aspiration for the TIS, the problem may resurface – at later stages of development. When the 'simplified' system works, attempts are made to increase the level of aspiration. For instance, in the Eucaris case the aim is now to add more countries to the system, to increase the functionality and to link other types of participants (i.e. not only car registration organizations, but also police and insurance companies) to the system. At the time when the level of aspiration for the system is increased, the problems which led to a reduced level of aspiration in the first place surface again. Hence, reducing the level of aspiration does not eliminate the problems; it merely postpones the moment of having to face the initial difficulties.

Concluding comments

This paper discusses the development process of TIS. Currently little evidence has been published about TIS and no tools, techniques or guidelines are available to guide organizations participating in and developing such systems. Two TIS (both European and both in the public sector) were described. This case evidence was used to highlight the difficulties in the development process and to discuss solutions.

The early and latter phases of the system development life cycle appear to present most difficulty. During the system identification, deep-seated issues concerning the real need for the TIS, cooperation with other participants and fear about autonomy and independence come to the fore. Such issues are not easy to overcome. In order to bypass the difficulties concessions are made with regard to the level of aspiration of the system.

During the management and ongoing maintenance phase the participants have to find ways to move beyond early enthusiasm to the institutionalization of the TIS within their local environments. This is not necessarily easy to achieve. In addition, once the TIS is implemented the participants may become aware of the need for or the desirability of expansion of the TIS, thus increasing the level of aspiration of the system. At that time the problems encountered in the system identification phase surface again and need to be addressed in a new way.

The difficulties arising during TIS development are not necessarily exclusive to TIS; many of the difficulties identified here arise on a regular basis during the development of systems that have to be used by different groups, developments or organizations. The interorganizational nature of TIS implies that indi-

vidual participants are autonomous entities that can withhold consent or withdraw participation. This highlights the importance of good relationships among the participants. The international nature of TIS implies legal and cultural differences among the participants. The combination of interorganizational and international aspects makes TIS particularly complex systems to develop and manage.

This study was exploratory in nature. Any results from the study must be treated with necessary caution. Further study is required to enable generalization concerning the major issues and to enable the formulation of guidelines and concepts to aid TIS development. In further work particular attention should be paid to the early and latter phases of development since they appear to present the most difficulties.

This study has shown that nearly all the difficulties in the development process are initially addressed by lowering the level of aspiration of the TIS. The difficulties reappear on the TIS agenda in later life cycle phases when attempts are made to increase the scope or size of the TIS. Further research could try to place TIS development challenges into a rank order, giving an indication of which are the most important and need to be solved first. Such findings could contribute in practice to facilitating the overall development process.

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