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New Technologies Stuck in Old Hierarchies: The Diffusion of Geo-Information Technologies in Dutch Public Organizations

Procedural and Institutional Change: Four Perspectives from Abroad

Some 25 years after the introduction of the first geo-information technologies in public organizations, strategies to manage their diffusion are still inadequate. This is problematic in light of the new generation of geo-information technologies that has become available and aims to invest in these new information technologies in order to advance e-government. This study questions how strategies for diffusion of geo-information technologies in public planning organizations can be improved. It shows that classic top-down management often enhances informal diffusion activities that deviate from the formal diffusion strategy. A knowledge management approach, in which geo-information specialists and planners participate in the formation of diffusion policies, can enhance the quality of the formal strategy, thereby preventing deviation and informal diffusion activities. The authors recommend that public planning organizations use this knowledge to improve their diffusion strategies for geo-information technologies.

To keep up with the pace and demands of a globalizing information society, governments need to invest in information technologies (Bretschneider 2003; Farazmand 2004; Huber 1990; Kraemer et al. 1993; McClure 1997; Stowers 2003). Information has become the lifeblood of government in the digital age. Information technologies help government organizations to more effectively and efficiently store, analyze, and retrieve data (Bretschneider 2003). Still, many governments are among the laggards of society in using information technologies. A decade ago in the United States with the National Performance Review, and more recently in Europe with the Lisbon Agenda, the issue of catching up on the backlog and moving toward e-government entered the public debate (Brown and Brudney 1998; European Union 2000; Gore 1993; Netherlands Ministry of Economic Affairs et al. 1999). Owing to the geographic component of 80 percent to 90 percent of government information, geo-information technologies are among the major information technologies in which public investment is needed (Brown and Brudney 1998; Huxhold 1991). We define these technologies as an organized collection of computer hardware, software, and geographic data designed to efficiently capture, store, update, manipulate, analyze, model, and display all forms of geographically referenced information (Anderson and Associates 2005). Some examples are geographic information systems (GISs), planning support systems (PSSs), and spatial decision support systems (SDSSs). For a broader range of examples, we refer to Stillwell, Geertman, and Openshaw (1999).

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Diffusion is the process by which geo-information technologies are communicated through certain channels over time among members of an organization (Rogers 2003). The diffusion of geo-information technologies in government organizations has experienced many failures (Caron and Bedard 2002; Chan and Williamson 1999). Such failures often evolve from visionary middle-level and frontline public servants' attempts to innovate. Their attempts often end up in a process of incrementally "groping along" the hurdles of bureaucracy before fading away entirely (Behn 1988; Borins 2000). As an answer to the many failures, since the early 1990s, studies have recommended paying more attention to the *informal aspects* instead of just the *formal aspects* of the diffusion of geo-information technologies (Croswell 1991; Huxhold and Levinsohn 1995; Innes and Simpson 1993; Masser and Onsrud 1993; Nedovic-Budic 1998; Obermeyer 1990; Pinto and Azad 1994; Sieber 2000; Tomlinson 2003). These formal aspects consist of

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"predetermined goals, prescribed roles, authority structure and rules and regulations" and are contained within the so-called *formal setting* of an organization. The *informal setting* contains informal aspects and refers to "the various kinds of informal practices, norms and social relationships among the members of an organization" (Chan and Williamson 1999; Rogers 1983). Diffusion-oriented actions taken within the formal and informal settings constitute a *diffusion pathway.*

Notwithstanding the recommendations, few authors have actually studied the informal aspects in relation to the diffusion of geo-information technologies within organizations, thus obscuring their role (Caron and Bedard 2002; Chan and Williamson 1999; Sahay and Robey 1996). The importance of informal aspects is strikingly shown in a recent study by Caron and Bedard, who show that geo-information technology projects often follow an informal diffusion pathway that deviates from the formal diffusion pathway presented by officials (Caron and Bedard 2002). This indicates that some 25 years after the introduction of the first geo-information technologies in public organizations, strategies to manage diffusion of these technologies are still inadequate. With the rise of new, more advanced geo-information instruments that are dedicated to the demands and capabilities of government workers and more technologically sophisticated than former instruments, there is a strong need for more effective diffusion management strategies and best practices (Brail and Klosterman 2001; Geertman and Stillwell 2003).

In this study, we explore ways to improve the effectiveness of strategies for the diffusion of geo-information technologies in public planning organizations. In particular, we aim to find more effective strategies that can prevent diffusion processes from following a deviant informal pathway instead of the formal pathway. To achieve this aim, we apply the technology acceptance model in combination with a more process-oriented model that shows diffusion as a communicative learning process that takes place in the formal and informal settings in planning organizations. We apply these models to study the diffusion of advanced geo-information technologies in Dutch regional planning organizations, aiming to find the main diffusion bottlenecks, the applied solutions, and their success. The analysis will contribute to the formation of best practices in public sector innovation management and furnish planning organizations with a vision of good practice for the organizational diffusion of the new geo-information technologies they are confronted with. The analysis will also be useful as a reference for the information technology changes needed in government organizations to reach the goals of the Lisbon Agenda.

Theoretical Approach

Diffusion Framework

In contrast to some of the most influential studies of diffusion in public organizations, which have adopted a holistic and empirically driven approach (Borins 2000, 2001b), we base our analysis on the theory of organization, innovation, and management. The diffusion framework for this study combines a *diffusion process model* with the *technology acceptance model* (Davis 1986; Venkatesh and Davis 2000; Venkatesh et al. 2003). The diffusion framework distinguishes the formal and informal settings and the communication processes that lead to diffusion within these settings. The model emphasizes the process-oriented aspects of diffusion.

The core of this diffusion framework is a model outlined by Crossan and colleagues that describes the strategic renewal process as a result of a range of learning processes among members of an organization communicating across organizational levels (Crossan and Berdrow 2003; Crossan, Lane, and White 1999). This model has been modified to represent the formation of informal and formal diffusion processes and pathways. The technology acceptance model describes a broad range of factors that explain information technology acceptance. The model has been updated and extended many times, and for our current study, we apply a version of this model that is dedicated to explaining organizational and individual acceptance of geo-information technologies (Vonk, Geertman, and Schot 2005). The model describes how organizational and individual awareness, consideration, acceptance, and continued use of geo-information technologies are influenced by perceived innovation characteristics, personal and organizational characteristics, social and environmental influences, organizational facilitators, and vender marketing efforts.

Diffusion framework of our current study (figure 1) combines both models, thereby accounting for the dynamic process-oriented aspects, as well as the static explanatory factors of diffusion. This combined approach allows us to analyze patterns in the diffusion of geo-information technology innovations rather than diffusion flows or acceptance factors alone (Glor 2001). The framework puts forward a *formal diffusion pathway* consisting of a range of learning processes that communicate knowledge across organizational levels (Crossan and Berdrow 2003; Crossan, Lane, and White 1999). The chains of connected processes directed up and down the organizational levels describe the exploration of new knowledge flowing from the individual to the group to the organizational level and the exploitation of knowledge that has already been institutionalized in the opposite direction (Crossan and Berdrow 2003; Crossan, Lane, and White 1999; March 1991).

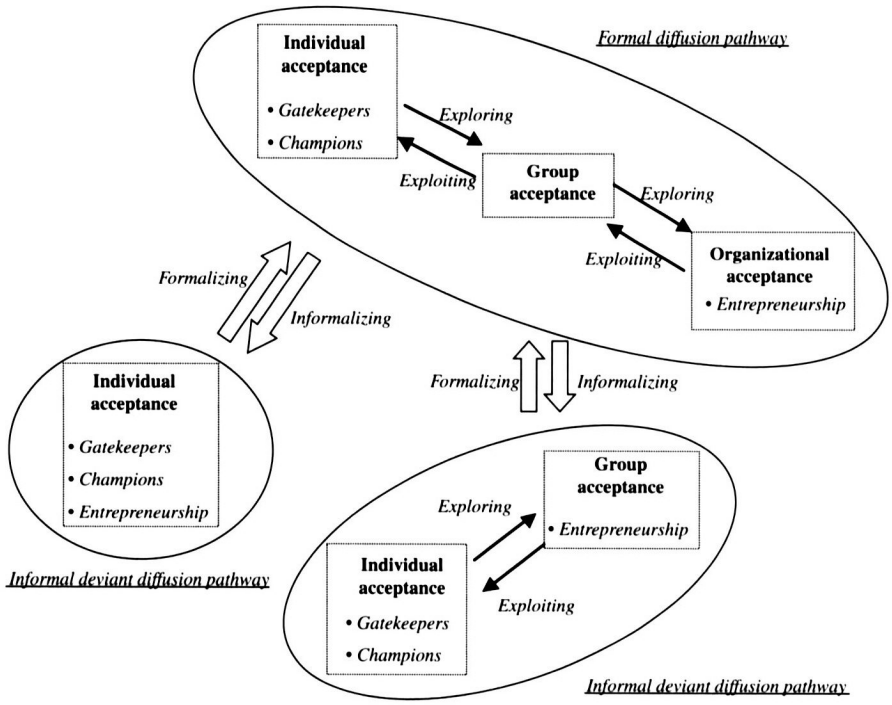

Figure 1 Formal and Informal Deviant Diffusion Processes

During organizational diffusion, individuals, groups, and the organization are faced with a choice between accepting and learning the technology before they can start using the technology in their daily practices.

Individuals who have a disproportionately large effect on the effectiveness of the learning and acceptance processes are described as *change agents* (Rogers 2003). We distinguish the *gatekeeper* as a change agent who stands either at the interface between the organization and the external environment or at the interface of subunits within the organization (Cohen and Levinthal 1990). In terms of our framework, the gatekeeper intuitively brings new knowledge into the organization. We also distinguish the *champion* as a change agent who possesses a large set of skills and charisma and is able to answer questions about the technology and propagate the technology within the organization (Tomlinson 2003). Champions easily communicate knowledge from the individual level to the group level, or directly to the organizational level, and thus foster institutionalization. Who actually fills this role—and how effectively—is very important to our analysis.

Apart from the formal diffusion pathway, the framework shows two *informal deviant diffusion pathways.* Based on the theory of reasoned action (Fishbein and Ajzen 1975), its modifications (Triandis 1979), and social cognition theory (Bandura 1986), we assume that individuals and groups change their behavior from following the pathway indicated by the formal diffusion strategy to a self-driven informal diffusion pathway (*informalizing*), and vice versa (*formalizing*), as a result of two major factors: (1) the perceived rationality of formal/informal behavior, and (2) social pressure to display formal/informal behavior.

Starting from formal behavior, a low perceived rationality of formal behavior relative to informal behavior among groups and individuals may cause them to start informalizing their behavior if this is not sufficiently corrected by social pressures to remain with the formal strategy. Starting from informal behavior, a low perceived rationality of informal behavior relative to formal behavior among groups and individuals may cause them to start formalizing their behavior, particularly if social pressures to behave according to the formal strategy are relatively strong.

In terms of our framework, informalizing is likely to occur when ideas from individual or group exploration processes do not reach the organizational level and influence strategy formation. In such situations, they are guided by management-supported exploitation processes that conflict with their own ideas of rational behavior. If individuals and groups subsequently start informalizing their behavior because of a lack of social pressure to remain with the formal strategy, they will start showing their own entrepreneurship and take informal diffusion-oriented actions in agreement with their own ideas of a good diffusion strategy. These informal actions are often the source of informal deviant diffusion pathways that cause

formal diffusion pathways to be ineffective. Low-level entrepreneurship, independent of entrepreneurship at the organizational level, is therefore a likely cause of informal deviant diffusion pathways. We emphasize that informal diffusion behavior may occur in nearly all parts and hierarchic levels of the organization. Only the diffusion behavior of the management team as a whole is seen as exclusively formal with regard to its effects on the organization. Informal and formal diffusion processes, then, do not automatically coincide with bottom-up or top-down processes.

Managing Diffusion Pathways

Theoretically, the problems of an inadequate formal diffusion strategy and the evolution of an informal deviant diffusion pathway can be alleviated in one of three ways: (1) by adapting the informal setting to the formal setting, (2) by adapting the formal setting to the informal setting, or (3) by adapting both to meet somewhere in the middle. These options correspond with three approaches to managing the diffusion processes. These approaches differ in terms of who is involved in formulating the diffusion strategy and, as a result, the tasks required of groups in acquiring new knowledge (exploration) and utilizing existing knowledge (exploitation).

Diffusion management strategy 1. The strategy that adapts the informal to the formal setting corresponds with the classic way of managing strategic renewal processes (Mahnke and Aadne 1998; Minzberg 1981; Minzberg, Ahlstrand, and Lampel 1998). Strategies are formed at the top of the organization and implemented in a straightforward process, aiming to get groups and individuals to accept the formal strategy and behave accordingly. In general, this exploitation-oriented diffusion strategy improves the formal strategy by convincing people of the rationality of the formal pathway or by socially repressing the informalizing process.

Diffusion management strategy 2. The strategy that adapts the formal to the informal setting corresponds to a bottom-up approach. It acknowledges that the whole organization has potential to contribute to thinking about new futures with their ideas and knowledge, not just top management. This involves acquiring new knowledge by decentralizing power and responsibilities, an approach that is known as *organizational learning* (Argyris and Schön 1978; Doughty 2004; Huber 1991). In general, this diffusion strategy improves the formal strategy by allowing all kinds of exploratory learning processes to take place and to influence the formal strategy instead of holding them back, as in classic management.

Diffusion management strategy 3. The strategy that adapts both settings is associated with knowledge management (Barret et al. 2004; Malhotra 1996; Rubenstein-Montano et al. 2001). It acknowledges organizations' need to explore and learn new ways of doing things while also exploiting what they have already learned to reach organizational goals. Like the second approach, the whole organization is involved in strategy formation in a bottom-up process. Managers are faced with the critical challenge of recognizing and managing the tension between exploration and exploitation (Crossan and Berdrow 2003). In general, this diffusion strategy attempts to find a balance between allowing informal learning processes in order to influence the formal strategy and exploiting what has been learned, thereby repressing informal deviant processes.

Methodology

The foregoing theoretical approach was applied to study the successes and failures of the diffusion of planning support systems (PSSs) based on geo-information technologies in regional planning organizations in the Netherlands. These PSSs are defined as computer-based decision-support systems dedicated to supporting those involved in planning to "explore, represent, analyze, visualize, predict, prescribe, design, implement, monitor, and discuss issues associated with the need to plan" (Batty 1995). We see organizations in which successful adoption was followed by successful intraorganizational diffusion as success stories in diffusion and all others as failures. The method applied consisted of five steps.

First, we selected 12 regional planning organizations—the provincial governmental organizations in the Netherlands. These organizations function in a three-layer policy structure that consists of national, provincial, and municipal governments and govern geographic areas of approximately 1,400–5,000 square kilometers. These provincial organizations are highly comparable, as most of them have 15 to 20 years of experience in applying geo-information technologies in their practices, but they are still in the early stages of applying dedicated geo-information technologies for planning support, which makes them highly suitable for studying the origins of successful diffusion strategies.

Second, we invited 63 employees from these organizations to participate in our study. In particular, we asked for three types of employees who play an important role in the diffusion of PSS: the geo-information specialist, the spatial planner, and the manager. In the end, 43 employees were found who were willing to participate. The participants were geo-information specialists (15), spatial planners (12), managers (3), and people with strongly related specializations (13).

Third, we conducted an employee survey based on the technology acceptance model to find the main factors in the failure of the diffusion of PSS within the

studied organizations. Such a broad start helped us to select which focal points to study more extensively during the interviews that followed. In the survey, employees were asked to judge a series of 62 potential factors regarding their importance in blocking the diffusion of PSS. Respondents could choose between "unimportant," "important," "very important," and "don't know." The survey was more or less similar to an earlier worldwide survey (Vonk, Geertman, and Schot 2005).

Fourth, we held 12 in-depth group interviews with the 43 participating employees to investigate stories of success and failure and to find patterns in them. We asked the employees to explain three issues: (1) the motives for diffusion within their organizations, (2) how the failure factors they identified had caused the failures; and (3) how success in the diffusion of geo-information technologies has been achieved or could be achieved.

Fifth, the results were interpreted to find the formal diffusion strategies that have led to success. For this purpose, we compared the results with the three distinguished management strategies and our theoretical framework. In the following section, we describe the results and their interpretation.

Results

Analysis of Motives for Diffusion

The results from the survey and interviews were analyzed in three steps: First, the interview results were analyzed to find the prime sources and motives for diffusion in relation to success and failure. Next, the survey and interview results were analyzed to identify success and failure factors for technology acceptance or rejection within the organizations. Finally, the interview results were analyzed to identify how these factors influenced success or failure in the diffusion processes of these organizations. In this section, we describe the outcomes of the three kinds of analyses.

Table 1 shows the *motives* for the diffusion of PSS in the studied organizations. From the table, it is clear that one group of initiatives concerning PSS diffusion was inspired by a problem or crisis. This group contained more failures than successes. Another group of initiatives were prompted by opportunity. Two of these initiatives resulted in successes and the other six in failure, in the sense that either the innovation was not picked up by a gatekeeper or the intraorganizational diffusion was not completed. Finally, an outlook of prestige produced only one success story.

Table 1 Motives Underlying PSS Diffusion within the Studied Organizations

Motive	Success Stories	Failure Stories
Experienced problem/crisis	1	2
Experienced opportunity	2	6
Outlook of prestige	1	

The initiatives inspired by a problem or crisis that ended up in failure had great managerial impetus at the start that gradually faded away. This strong managerial impetus initially gave way to innovative thinking; one geo-information specialist commented, "When the governor presented the plan of a highway exit where a new urban district was located for five years already, this was the signal that fundamental changes in geo-information management were required." After the swift start, however, the shock of the problem or crisis among managers faded rather quickly, causing criticism of the new projects to gradually rise. When this was the case, intraorganizational diffusion slowly resulted in failure: "One year after the highway-exit planning incident, we do not have enough people or funding anymore to develop a good data system," noted a geo-information specialist.

The success story inspired by a problem or crisis concerned an organization using PSS containing land-use models and doing experiments with electronic sketching on a smart board: "Our governor used real-time scenario calculations in discussions with the minister," said one manager. The success was enhanced by the fact that implementation efforts consisted of formal and informal exploration throughout the organization, supplemented by exploitation efforts by management, particularly enlightened governors.

The failure stories inspired by opportunity had in common geo-information specialists who had informally started diffusion activities based on a perceived opportunity to improve the organization using geo-information technologies. Such processes usually ended up in messy processes in which the geo-information specialists provided the impetus by learning and teaching but continuously faced resistance from managers, spatial planners, the organizational structure, and insufficient data, all of which caused the intraorganizational diffusion process to go very slowly: "Investments in ICT always take twice as long and are three times as expensive as planned," said one manager. Such processes tend to remain rather technical in nature, which causes them to have few users and to fade away, failing to meet the potential predicted by advocates: "We were the first to start developing such a tool but it never really became widely used within the organization and, despite all our efforts, right now it is hardly used any more," commented a geo-information specialist.

The successes that arose from opportunity included one organization that had developed dedicated tools for planning information supply, and another that was in a somewhat earlier stage of diffusion and made

fast progress. Employees in both organizations had convinced management of the value of geo-information technology. They both followed a path of explorative learning supplemented with institutionalization and support.

The success in diffusion that followed from an outlook of prestige as a reason to start using a PSS shared many characteristics with the one that followed a problem or crisis. At the start, managers provided the impetus and made way for a lot of innovative thinking for the prestigious project: "When the governor needed an advanced risk map as a prestigious accomplishment to show at his retirement, all resources were mobilized and innovation in geo-information technology became possible," one geo-information specialist observed. However, when the projects were finished, employees usually had to go back to their daily business, allowing the newly obtained knowledge and skills to become lost again instead of being exploited to improve daily practice. Therefore, these were only short-term successes.

Analysis of Success and Failure Factors

The failure factors that resulted from the survey based on the technology acceptance model were grouped in a number of categories to gain consistency. Figure 2 shows the importance of these failure factor categories in explaining the adoption of PSS for the organizations involved (cutoff at 30 percent).

The results clearly show the relative importance of organizational and human failure factors to the use of PSS within the studied organizations: "attitude of management," "social organization of users," "awareness of potential," and "implementation support by organization" were the factors that scored particularly high. Other software or system and provider-related issues were considered significantly less important or even unimportant. The results confirmed the need to focus on human and organizational explanatory factors during the interviews in order to find out what underlay the high-scoring factors.

Table 2 shows the success factors for the diffusion of PSS that were revealed by the interviews, the involved employees, and the effects on adoption by gatekeepers and subsequent intraorganizational diffusion.

Of the eight success factors shown in table 2, several related to the activities of only one of the three mentioned actors, such as "support for innovation" and "perform gatekeeper role," and several others related to the activities of more than one actor, such as "awareness and affinity" and "cooperation as champions." The success factor "existence of data warehouse/implemented GIS" was not related to the activities of specific actors but to a state of the organization. Several of the indicated success factors positively influenced the adoption by the gatekeeper only, such as "social network" and "perform gatekeeper role," whereas several others positively influenced intraorganizational diffusion only, such as "cooperation as champions" and "awareness and affinity" or both, such as "opportunity to innovate" and "enthusiasm." Although the factors shown in figure 2 and table 2 provide some overview of what underlay the successes and failures in PSS diffusion in the studied organizations, a process approach is needed to better understand just how the successes and failures actually came about.

Analysis of Patterns of Success and Failure

Interview respondents cited a wide diversity of factors to explain the failures and successes. Many of these factors related to the roles of and interaction between geo-information specialists, managers, and spatial planners, and most were applicable to innovation diffusion driven by a problem or crisis, opportunity, and outlook of prestige.

A major failure factor for opportunity-driven PSS diffusion was that managers and spatial planners were usually unaware of PSS and its potentials and were

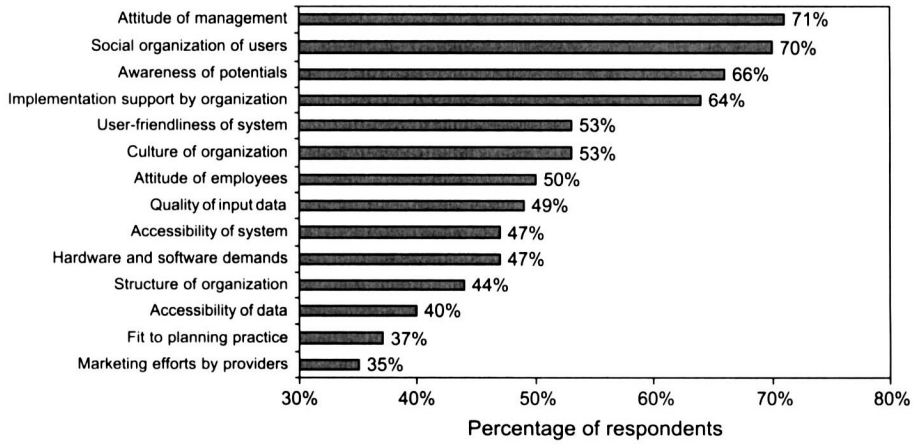

Figure 2 Failure Factors for PSS Diffusion (Survey)

Table 2 Success Factors for PSS Diffusion (Interviews)

Factor	Involved Employees			Positive Effect On:	
	Geo-information specialist	Planner	Manager	Adoption by gatekeeper	Organizational diffusion
Awareness and affinity	*	*	*		*
Social networks	*	*		*	
Opportunity to innovate	*	*		*	*
Enthusiasm	*			*	*
Perform gatekeeper role	*			*	
Support for innovation			*	*	*
Cooperation as champions	*	*			*
Existence data warehouse/ implemented GIS					*

not able to keep track of PSS developments because they had little affinity with geo-information technology: "Why do we still do a lot of work by hand? Because nobody ever shows us what else there is!" said one spatial planner.

The geo-information specialists were usually aware of the opportunities of geo-information technology for spatial planning support in general, but few had heard of PSS specifically, which could be attributable to the insufficient social organization in interorganizational networks, which was seen as a main bottleneck: "Our current networks consist of only geo-information specialists, but I think that *social networks of both planners and geo-information specialists are needed* to further these technologies," said one geo-information specialist. Nonetheless, this does not fully account for the gap between supply and demand or its solution, as geo-information specialists claim to have enough affinity with geo-information technology and see themselves as sufficiently educated to keep track of PSS developments. This makes them the most likely to function as change agents (gatekeepers and champions).

A significant number of geo-information specialists had already adopted these roles as change agents, and some of them had done so successfully. Although geo-information specialists have the potential to utilize PSS, many indicated that they had so many tasks and worked under such intense time pressure that innovation by means of undertaking opportunity-driven experiments with PSS was often not possible, even though they were willing to spend time on it: "I would very much like to do more advanced analyses in my work, but we are expected to do data maintenance, GIS work and a part of the automation for the whole organization with just a few people, so there's no time," said one geo-information specialist. To solve this problem and to utilize the potential of PSS for the organization, geo-information specialists need to be given opportunities to scan the environment for new geo-information technologies, experiment with and evaluate geo-information technologies, and spread the news throughout the organization. According to one geo-information specialist, "PSS will be an initiative from the work floor, as has been the case for GIS." By showing real-world instead of fictional examples, awareness and support among management and end users can be developed: "We tried to make managers aware and convince them by telling the stories, by showing examples of applications, and by showing the broader developments in the policy field that the organization needs to face."

> A major failure factor for opportunity-driven PSS diffusion was that managers and spatial planners were usually unaware of PSS and its potentials and were not able to keep track of PSS developments because they had little affinity with geo-information technology.

However, time is not everything. The interview results suggest that quite a few of the geo-information specialists lacked an innovative attitude and therefore could not perform the critical change agent role. In some cases, this evolved from being fed up with managerial resistance to bringing new ideas further within the organization: "Maybe we should just wait until the present generation of managers has retired," wondered one geo-information specialist. These geo-information specialists were not well equipped to convince their managers and the spatial planners of the benefits of using PSS. The success stories show the importance of enthusiasm on the part of employees, charisma, innovativeness, and openness to learn, illustrated by a successful geo-information specialist: "Waiting? No way! It cannot go fast enough if you ask me. People are not aware of what's possible at this moment and we continuously try to make them aware." Managers have an important role in making these geo-information specialists perform as change agents.

If geo-information specialists are not capable of reaching managers with innovative ideas because of lack of opportunity and effort, in their turn, these managers will see no particular reason to stimulate the use of PSS. Certainly, as spatial planners, being end users, do not demand PSS because of lack of awareness and time: "Our products need to be finished yesterday rather than tomorrow," said one spatial planner. Furthermore, managers themselves usually have little affinity with PSS. The lack of managerial structural support and geo-information specialists' "advertising" efforts causes geo-information specialists to become isolated from their managers, further complicating the implementation of PSS. Consequently, although geo-information specialists' efforts may slowly change opinions and internal culture through a learning process, increasing structural changes require that the outcomes of their informal learning and teaching become formalized, be fed upward in the organizational hierarchy, influence the formal strategy, and be followed by managerial support: "We used to just show examples and give people software, but stopped this because it ended in disappointment, as we had not been given the means to facilitate them," said one geo-information specialist.

Without managerial support, geo-information specialists are hardly capable of reaching spatial planners. In such situations, there is clearly a discrepancy between questions from planners and offers by geo-information specialists: "You never hear from them [geo-information specialists] and if they do show themselves it is with products you never asked for," noted one spatial planner. This indicates a total miscommunication in our cases of failure. One of the important exploiting efforts on the part of management is the organization of geo-information specialists and spatial planners in such a way that technical knowledge and process knowledge come together in order to learn from developments in the mutual fields and enable functional innovation: "Functional applications will have to come from cooperation with policy departments," one geo-information specialist observed.

The interviewees also proposed the realization of a good data warehouse and the implementation of GIS before starting with PSS. Most organizations agree that the implementation of PSS follows these preliminary steps. This causes some organizations to focus on the realization of these technologies rather than the implementation of PSS: "PSS is nice and all, but it is just one step too far for us, since right now our main task is to organize our geo-data," said one manager. This causes initiatives in organizations without a good data warehouse to reach no further than the gatekeepers.

Interpretation and Validation

The results of our survey and interviews provide many clues about the effectiveness of management strategies for the diffusion of geo-information technologies. Interpretation of the results, in combination with the distinguished management strategies, results in five inferences on the effectiveness of management strategies.

Many managers and planners are hardly aware of the existence and potential of many geo-information technologies and have so little affinity with them that they cannot develop a good strategy.

First, the diffusion of geo-information technologies in regional planning organizations is more likely to start from the bottom up than from the top down. Many managers and planners are hardly aware of the existence and potential of many geo-information technologies and have so little affinity with them that they cannot develop a good strategy. Geo-information specialists are often the only ones in the organization who are capable of initiating adoption and implementation from the bottom up in their roles as gatekeepers and champions. Their diffusion-oriented actions are often motivated by a perceived opportunity.

Second, the suppression of opportunity for innovation by management and a lack of the required personal characteristics often prevents geo-information specialists from functioning as gatekeepers for geo-information technology. Furthermore, the exploring processes of geo-information specialists who do possess the required personal characteristics to be gatekeepers are often repressed rather than nurtured.

Third, regional planning organizations often exploit management-supported strategies for geo-information technology diffusion. These strategies often hold back significant steps in diffusion, as they are based on a persistent negative image of geo-information technology that exists among many managers. Geo-information specialists who do take up their role as gatekeepers often face a wall when trying to convince managers of the value of new developments in geo-information technology. Showing examples in real projects has proved to be a good means of convincing managers, but their preparation requires time, which geo-information specialists often do not have. This traps diffusion in limbo.

Fourth, the origin of an informal deviant diffusion pathway lies exactly here. Unheeded geo-information specialists and unwilling short-term-oriented managers cause a misalignment of formal and

informal settings, which may lead to informalizing among geo-information specialists. The subsequent deviating attitudes, behaviors, and actions cause deviant informal diffusion pathways. A management strategy in which geo-information specialists are facilitated in their role as gatekeepers and champions for geo-information technology could result in the formation of more rational diffusion strategies, thereby decreasing the chance that they will opt for informal deviant pathways. Becoming a learning organization and applying knowledge management would be a way to do this. Figure 3 shows the evolution of informal deviant diffusion pathways (left), as well as the cure that knowledge management offers by making informal diffusion pathways rejoin (right) in terms of the (summarized) theoretical framework.

Fifth, geo-information specialists themselves are hardly ever able to reach spatial planners and cooperate with them. If they do, they often encounter a discrepancy between planners' questions and geo-information specialists' offers that obstructs successful cooperation. This hampers the development of useful innovations that can be applied in planning practice, as these are likely to evolve from the cooperation of geo-information specialists and spatial planners. To solve this problem, managers should take the actions required to involve geo-information specialists in the spatial planning process and to convince them of their role as change agents.

Several arguments support the broader validity of this interpretation toward the diffusion of geo-information systems in regional planning organizations. We expect the involved employees to be capable of providing us with a good and representative overview of perspectives on diffusion of PSS technology, as the types they represent are common to virtually all planning organizations in Western and non-Western societies, independent of the planning system, planning style, and administrative system of each country. Furthermore, we expect broader validity of our results than only for the involved organizations based on three factors. First of all, the structure of the studied organizations is a form that occurs quite often in governments (Anthony 1965; Minzberg 1981; Minzberg, Ahlstrand, and Lampel 1998). Second, the culture of most of the involved organizations is characterized by conservativeness regarding investment in geo-information technologies, particularly among managers. According to earlier studies, this is characteristic of planning organizations in general rather than just the involved Dutch organizations (Vonk, Geertman, and Schot 2005). Finally, the applied management concepts have cross-cultural value.

Third and still more convincingly, our results are very much in agreement with Borins's results for public management innovation in the United States and Canada. He concludes that in the United States and Canada, public management innovations are most frequently initiated by local heroes—visionary middle-level and frontline public servants. Second, they are a result of both comprehensive planning and incremental groping along. Third, the most frequent obstacles to innovations are internal to the bureaucracy, usually overcome with persuasion or accommodation (Borins 2000, 2001b). Following a different theoretical research approach grounded in technology acceptance and organizational theory and a methodological approach that builds on Osborne's voluntary participation instead of Borins's innovation awards (Borins 2001a; Osborne 1998), our results for regional planning organizations in the Netherlands are very much in agreement with Borins's results for North America. This suggests the broader value of both Borins's and our own findings and provides a strong argument for the often-doubted existence and broad validity of best practices in public management innovation (Borins 2001a; Lynn 1996; Overman and Boyd 1994).

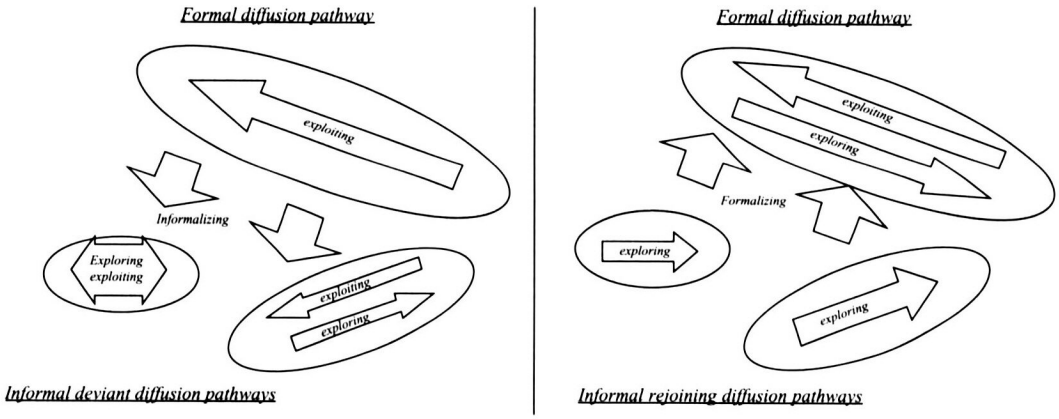

Figure 3 Evolution of Informal Deviant Diffusion Pathways (left) and the Remedy that Knowledge Management Offers (right)

Conclusions and Recommendations

We conclude that the diffusion of geo-information technologies often follows a deviating informal pathway because of the informal activities of geo-information specialists. A combination of several circumstances leads them to informally undertake the construction of a diffusion pathway that is in accordance with their own ideas. First, they perceive the formal strategy as less rational than their own ideas for diffusion. Second, they do not experience sufficient social pressures to persist in following the formal strategy. Finally, they are not able to influence the formal diffusion strategy with their own ideas. The resulting diffusion pathway usually deviates from the formal strategy. To counter this problem, the formal diffusion strategy can be improved in a range of ways described here, from which we have arrived on a set of recommendations for planning organizations and researchers.

Because learning organizations use the knowledge and learning capacity distributed throughout the organization for strategy formation, they are more likely to find, appreciate, adopt, and implement geo-information technologies successfully than classic top-down organizations.

For planning organizations that want to start using geo-information technologies, we first recommend adopting the management style of a learning organization using knowledge management. Because learning organizations use the knowledge and learning capacity that is distributed throughout the organization for strategy formation, they are more likely to find, appreciate, adopt, and implement geo-information technologies than classic top-down organizations. The second recommendation is that recruiters should hire geo-information specialists who possess not only technical qualities but also the gatekeeper qualities necessary to ensure that innovations are picked up. A third recommendation is that an innovation manager be appointed to perform the role of champion. This champion should ensure that the innovations picked up by gatekeepers are fed forward within the organization in order to reach management levels and, once there, influence the formation of diffusion strategies. This should be a person with both technical and policy knowledge, as well as a member of the management team. An innovation manager would be much more capable of performing this role than a geo-information specialist. Fourth, we recommend that managers devote attention to bringing geo-information specialists and planners together, as their cooperation is needed for the development of successful PSS applications. These changes will contribute to more effective diffusion of geo-information technologies and may be necessary to keep up with the demands facing public organizations today.

For researchers within the theoretical domains of public management innovation, public sector information technology, and geo-information technologies in particular, we first recommend conducting additional methodological research concerning the acceptance and diffusion of geo-information technologies in public organizations. Given the information technology backlog in many public organizations and the many failed attempts at diffusion, it is of great importance to induce best practices. Without these practices, governments will not achieve their aims for renewal, and promising technologies will not stand a fair chance to prove their worth in practice as a result of messy diffusion processes. Second, we recommend that researchers study how to implement knowledge management as a strategy for the diffusion of geo-information technologies in public organizations. Third, we recommend that researchers develop good and coherent insights into the benefits of existing geo-information technologies for planning support. Such supporting data would be helpful in convincing managers and thereby stimulating the diffusion of geo-information technologies.

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