Exploring new coordination scenarios for workflows in the Amsterdam Police Force
Simulation-games as organizational change instruments

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Abstract

In this paper we discuss the value of simulation-games as organizational change instruments. We present a case where new information and communication technology is introduced in the Amsterdam Police Force to enhance coordination and communication in workflows like handling firearm criminality or handling youth criminality. Policemen have participated in 9 occurrences of a social simulation-game where they perform daily tasks and explore new coordination scenarios. From our action research study we conclude that simulation-games provide more detailed insight in coordination issues than oral participatory design discussions. Furthermore we discuss how simulation-games can serve different interests in the different phases (unfreeze-rebalance-move-freeze) of an organizational change process.

Keywords:

Gaming-simulation, organizational prototyping, business engineering, organizational change, coordination, distributed work, computer supported cooperative work (cscw).

Introduction

Through the ages organizations have faced the challenge of organizing (distributed) work and coordinating the efforts of (distributed) organizational members. The increasing rate of development of information- and communication technologies (ICT) in the past 20 years has raised some new challenges around this old issue. At first sight there seem to be numerous opportunities to solve well-known coordination problems more easily. By adopting the new technology coordination, collaboration and the accomplishment of work itself can become independent of time and place. This independence leads to more flexibility for individual group members in accomplishing their tasks and may thereby improve individual performance, work group performance as well as organizational performance. Malone and Crowston (1994) predict a shift to more coordination-intensive organizational structures, like for instance adhocracies (Mintzberg, 1983; Toffler, 1970), network organizations (Van Alstyne, 1997) and (inter) organizational networks as a result of the decreasing costs of coordination.

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But in practice it proves to be quite difficult to utilize these ICT opportunities. Most organizations fail to fully utilize the opportunities for improving their coordination. They tend to stick to their usual ways of working and rely on traditional communication media. Mediated collaboration and coordination in distributed work settings is perceived to be more complex and less effective than coordinating or collaborating face-to-face (Abel, 1990; Finholt et al., 1990; Rice, 1994; Strauss and McGrath, 1994). Furthermore numerous examples of problems and failures when trying to change traditional ways of coordination have been reported and discussed in literature (Bardram, 1997b; Grudin, 1988; Grudin, 1994; Holmstrom, 1999; Howcroft and Mitev, 1999; Markus and Connolly, 1990; Orlikowski, 1992; Swan et al., 2000). Shulman (1996) even states that the major consequence of the introduction of new information technologies has not been better communication but faster misunderstandings.

So, ICT brings benefits as well as new problems and the added results may be unclear. Researchers as well as practitioners struggle with integrating ICT, tasks, structures and human behavior in organizations. There is a growing confidence that successful virtual collaboration or distributed work does not depend on the degree of technological sophistication. It is "how the tools are appropriated and used" that matters (Qureshi and Zigurs, 2001). Vreede (1995), who uses dynamic modeling and GSS as support for participative design, suggests that gaming-simulation techniques may be valuable design instruments to let organizational members experience change alternatives within their future organizational context. Gaming-simulation could in that way provide socio-technical prototypes of possible future work situations. It could enable a rich discussion on human, technological and organizational issues in an early phase of the design process.

In this paper we present an action research study carried out in the Amsterdam Police Force, where we applied gaming-simulation as an instrument to support organizational change. Simulation-games aimed at revealing sources of coordination problems and aimed at valuing new coordination scenarios in future work situations. In the next section we give an overview of relevant theories with respect to coordination of distributed work and ICT adoption (theories about the real world problem) and with respect to organizational change and the use of gaming-simulation (theories of design). In section three we discuss our research strategy and method. In the fourth section we present the work flow coordination problems in the Amsterdam Police Force (real world problem), the design and playing of the neighborhood team knowledge game (model situation and game sessions) and the game results (learning experiences). As such our paper covers the whole gaming process cycle pictured by Hofstede and Meijer (2004). In our discussion we reflect on the final stages of this cycle: What learning experiences are most valuable for the Amsterdam Police Force? How can these learning experiences be disseminated throughout the whole organization? And what are the lessons of this study for theories concerning the use of gaming-simulation and organizational change?

Theoretical background

Coordination of distributed work

Various authors agree that the division of work and coordination are the two main principles of organizing (Aken, 1994; Gulick and Urwick, 1937; Kastelein, 1990; Mintzberg, 1983). First work has to be decomposed into tasks (specialization), and these tasks have to be allocated, as the resources of one man are limited. Subsequently this division of work into tasks gives rise to the adjustment and integration of these tasks (coordination).

Distributed work is work that is jointly executed by a group of interdependent actors while some of them are (part of the time or all the time) working at different sites. Such groups often rely on media supported coordination means in addition to face to face coordination. The ICT that support coordination, communication and decision making are called Groupware: "information technologies that mediate electronic interpersonal interaction" (Coleman, 1997). The framework of DeSanctis and Gallupe (1987) distinguish between available media and technologies by taking into account which time- and place constraints could be valid.

Classification of media based on time and place constraints

	Same place	Different place
Same time	Conversation, meeting, flip-over, slide projector	telephone, video conferencing, document sharing, chatting
Different time	shared room, billboard, reading corner	letter, fax, e-mail, voice mail, computer conferencing, shared database

In this figure it is easy to recognize two clear benefits of ICT use for coordination. As work and communication can be carried out "any time, any place" both division of labor and coordination become more flexible. Employers mention a larger pool of possible job candidates, greater access to scarce experts, greater utilization of the workforce, more opportunity to work at the customers site and possibly a round the clock workforce. Employees mention increased independence, larger pool of jobs to choose from, and greater flexibility (Haywood, 1998). However, studies in the field of CSCW (Computer Supported Cooperative Work) have shown that use of ICT at the same time creates new coordination problems. For instance, a lack of media richness may result in a decrease of the quality of interaction (Daft and Lengel, 1984;1986). Also, contacts may become less frequent (Finholt et al, 1990; Rice, 1994). This lowers the amount of 'group awareness': the up to the minute knowledge of each other's activities. Furthermore, contacts may become more formalized (Abel, 1990; Finholt et al., 1990). This results in too much focus on efficient task completion and too little attention for group development and socialization. This may decrease trust and cohesiveness in the group and thereby influence performance negatively. Finally, especially coordination in the asynchronous mode asks for different skills and points of attention (Hiltz et al, 1996; Hooff, 1997). Lack of experience may thus decrease performance.

Coordination theories also differ in their views on the value of ICT. Mintzberg (1983) adopts a rational organizational design perspective towards coordination. He talks about the creation of positions, units and structures (division of labor), dependencies between these work arrangements and different coordination mechanisms to manage these dependencies. Contingency factors determine the appropriate work arrangements and in turn the most suited coordination mechanisms follow from the dependencies between these work arrangements. The main coordination problem is reduction of uncertainty and complexity (Galbraith, 1973). Uncertainty is defined as the difference between the amount of information required to perform the task and the amount of information already possessed by the organization. Consequently more information or more information processing capability will lead to a more effective solution in situations of uncertainty. Given this line of reasoning it is not surprising that Galbraith (1973) sees opportunities for ICT to improve information processing capability of the organization and thus an opportunity to increase performance in situations of high uncertainty. In contrast, Weick (2001) talks about loosely coupled systems (division of labor), connections between these loosely coupled segments (dependencies), variable strength of these connections, heedful interrelating and collective mind (coordination). In his theory the

main coordination problem is coping with ambiguity. When people create different subjective realities the issue is to give meaning to each other's reality and to reach a state of committed interpretation. Therefore Weick (1985) and others who adopt this view (Shulman, 1996; Velde, 2002) are critical about the value of ICT. In their opinion there is no need for more and faster information processing, but a need for more interaction and time for interpretation and sensemaking.

Adoption of ICT and structuration of work

Grudin (1988; 1994) identifies some factors why groupware implementations often fail, for instance: lack of critical mass, the disparity between who does the work and who gets the benefit and the ignorance of social and political factors. Okamura et al. (1995) give an overview of some famous interventions that may help technology adoption: technology champions, training during introduction and ongoing training, facilitators, expert users, local gurus and experienced users. Cole (1995) identifies leader's participation, degree of supporting execution of critical tasks, benefit for all group members (not only management), and consistency with group norms as important factors. Finally, Vreede (1995; 1997) discusses the importance of user's participation during the design of organizational coordination mechanisms.

Adaptive Structuration Theory (DeSanctis and Poole, 1994) argues that advanced information technologies trigger adaptive structurational processes which, over time, can lead to changes in the rules and resources that organisations use in social interaction. The impacts of technology on the group depend on: the structural potential of the technology (its spirit and structural features), how technology and other structures (such as work tasks, the group's internal system, and the larger organisational environment) are appropriated by group members, and what new social structures are formed over time. Appropriations which initially occur in micro-level interaction eventually may be reproduced to bring about adoption of technology-based structures across multiple settings, groups and organisations.

In accordance with that theory, recent case studies and theoretical contributions stress the importance of taking into account organizational context and social factors (Robertson et al., 2000): organizations should be hospitable for technology (Ciborra, 1996). Furthermore GSS needs to be flexible and responsive to the needs of the group (Fjermestadt and Hiltz, 2000), and GSS should be useful (Liao and Landry, 2000). However, good process design proves to be important as well: GSS can improve good processes, but can make badly designed processes worse (Qureshi and Vogel, 1999; Vreede et al., 2002). Organizational coordination and ICT have to be designed and implemented in an integral way. ICT will not impact an organization's performance unless corresponding investments are made in the people, tasks and structure of the organization (Vreede, 1995; Morton, 1992; Leavitt, 1965). But given the involvement of technological, work and social aspects, supporting and improving distributed coordination and collaboration proves to be a complex issue (Qureshi and Vogel, 1999).

Cole (1995) and Okamura et al. (1995) emphasize the importance of an ongoing learning process. The integral design methods should be applied in a more continuous manner: resulting in structural gradual changes instead of a radical change once in a while. Design methods should more and more become a part of the implementation and change process. Although these processes are already seen as cyclical instead of sequential, redesign is often still an instantaneous process. Adaptable new ICT can enable redesign approaches that get near to continuous redesign, continuous change and continuous learning. Okamura et al. (1995) point at the importance of 'technology-use mediation'. This is defined as the

deliberate, organizationally-sanctioned intervention within the context of use which helps to adapt a new (general purpose) communication technology to that context, modifies the context as appropriate to accommodate use of the technology, and facilitates the ongoing usefulness of the technology over time. CSCW mediators carry out this intervention. It is a continuous process that carries on after design and introduction of the technology in the organization.

Management of organizational change

Boonstra (2004) distinguishes between three approaches to organizational change and connects these approaches to the five approaches sketched by Caluwe and Vermaak (2000).

1. Planned change (*programmatic; top down; focus on formal structure and systems*)
    *   Blue print thinking (*define goals and steps, monitor and control implementation*)
    *   Red print thinking (*motivate people with incentives or penalties*)
2. Organizational development (*emergent; collaboration between managers and employees facilitated by consultants; joint optimization of social and technical systems*)
    *   Green print thinking (*make people aware of incompetencies, learning*)
    *   Yellow print thinking (*interests, power; create coalitions or win-win options*)
3. Continuous change and constructing realities (*endless modifications; managers, employees and consultants collaborate in a non-hierarchical manner; multiple realities*)
    *   White print thinking (*utilize human energy, dynamism, complexity, conflicts*)

Boonstra suggests two ways of coping with this variety of approaches. One is a contingency strategy, which means choosing for one approach given the circumstances of a case. Another is adopting the third approach of continuous change as a fusion of the former approaches and continuously alternating between the approaches or combining them. In this way the third approach gives opportunities to understand the complexity of organizational change processes and to position one between multiple paradigms. Boonstra warns however that mixing change approaches without being aware of the inherent tensions between them leads to tensions and less transparency in change processes.

Change often unfolds in phases. The well-known three stage model of Lewin (1951) discerns between unfreeze (create support for change, create consensus about problems, decrease resistance to change), move (the actual change) and freeze (embed changes into the organization) and belonged to the "planned change" perspective. Weick and Quinn (2004) have adapted this three stage linear model into a four stage cyclical model that fits the "continuous change" perspective. They name the phases freeze-rebalance-unfreeze-freeze, where the rebalance phase is a process of reinterpretation, re-labeling and sensemaking.

Simulation-games as instruments for organizational change

Gaming-simulation is a particular form of simulation. Simulation can be defined as the process of designing a model of a concrete system and conducting experiments with this model to understand the behavior of a concrete system, to evaluate various strategies for operation of the system, and/or to study the impact of scenarios representing a particular path to a hypothetic future situation (Meinsma, 1997; Shannon, 1975; Sol, 1982). Different types of simulation can be distinguished based on the degree of human involvement and interaction in executing the simulation model (Bockstael-Blok, 2001): computer simulation (no human involvement during execution); interactive simulation (part of the model is executed by the computer, part of the model involves action and decisions of one or more human actors, but these actors do not interact directly with each other); and gaming-simulation (humans interact and make almost all decisions).

A simulation-game is thus a specific kind of simulation model that represents a complex problem area and contains different roles to be played by participants and game administrators, intended objectives to be achieved, activities to be performed, constraints on what can be done, and payoffs (positive and negative) as a result of their actions and the actions of other elements in the system (Caluwe, 1997; Caluwe et al., 1996; Greenblat, 1988; Meinsma, 1997). In a simulation-game the game roles, goals, activities, constraints and consequences and the linkages between them are patterned for real life, or simulate the above mentioned elements of real-world systems (Greenblat, 1988). Consequently, some games (like for instance card and board games) are not simulation-games, as they are not designed to represent real-world systems. Similarly, many simulations that do not incorporate human decision making or focus on the training of one actor rather than the interaction between actors are not simulation-games. Greenblat (1988) states that for that reason also role-playing differs from gaming-simulation in the degree of structure and formalization (respectively freewheeling versus an interacting system) and in the focus on playing individual roles rather than interaction processes.

Caluwe (1997) describes the use of a simulation-game as the core intervention instrument in an organizational change process of a large insurance company. The game was played over 100 times an approximately 1400 employees participated in these sessions. Caluwe concludes that the intervention had a positive effect on acceptance of the change, on awareness what the change requires from employees, on lowering the resistance to change and on awareness for what still has to be learnt. He positions gaming-simulation within green-print thinking: it triggers the start of a learning process with regard to acceptation, awareness and personal learning goals and is thus particularly relevant in the early phases in a change process. However, he also frames it as a training instrument in which the new work practice and behavior is learnt. Furthermore Caluwe argues that a simulation-game can act as a mirror (how do you work now) and as a window of opportunity (how could you do it differently), that it can aim at changing cognition, behavior or attitudes, and that it can act as a vehicle for debate and mutual learning.

Bardram (1997a, 1998) describes how two organizational prototyping sessions have been organized as part of the design process of an alternative information system. This system (Patient Scheduler) supports coordination between departments in a hospital. Bardram defines organizational prototyping (in line with adaptive structuration theory) as "a dual process of both adapting the tool to the organization and adapting the work practice to conditions of the tool". In the sessions a prototype of the Patient Scheduler is demonstrated and potential usage scenarios are discussed with hospital employees. After the sessions Patient Scheduler and the work processes are adapted.

Research design
From our theoretical exploration we conclude the following:
- the impact of ICT use on intra-organizational coordination is unclear;
- organizational coordination and ICT have to be designed and implemented in an integral way and in an ongoing learning process;
- this corresponds with green/yellow/white print thinking rather than blue/red print thinking in change management;
- a simulation-game can be a valuable intervention instrument in a green print change process and in a change process aiming at ICT adoption and work structuration.

Given the numerous implementation failures we argue that there is a need for design approaches that support the redesign and implementation of media-supported coordination and that gaming-simulation can be a valuable element of such an approach. To explore how simulation-games can be utilized in the redesign of media-supported coordination we conducted an action research study in the Amsterdam Police Force. We simulated an existing coordination problem in a game and reflect on the design process and on the results of 9 occurrences of this game.

Ontologically, our research follows an interpretivist philosophy, subjectively interpreting observations of reality. We focus on studying *a simulation games as a change instrument for coordination of distributed workt* in its natural environment. In this study, an *action research* method was followed. Action research can be defined as 'an inquiry into how human beings design and implement action in relation to one another' (Argyris, 1982). It is intended to have the dual outcomes of action (or change) and research (understanding). An action researcher participates or intervenes in the phenomenon studied in order to apply a theory to practice and evaluate its worth (Checkland, 1981).

Action research can be seen as a subset of case study research (Galliers, 1991). Benbasat et al.(1987) describe three criteria to determine whether case study research is appropriate. A case can be made that these three criteria are also applicable for action research. First, there is *a need to study the phenomena in its natural setting*. We argue that given the importance of the organizational context and human factors it is necessary to study the application of games as change instruments for coordination of distributed work in its natural setting. Second, there is *an emphasis on interest in the 'how' and 'why' questions*. For this study, the goal is to explore how simulation games can be applied in the design process, why they are beneficial for particular purposes and in certain phases and why not, and how they need to be designed to contribute maximally. Hence, it is more appropriate to explore the *process* of gaming-simulation than to explore the resulting *products*. Third, there is *a lack of previous studies, and we aim at elaborating theoretical understanding*. Although numerous studies on ICT adoption and work structuration are known, few of them include gaming-simulation as an intervention instrument. Finally Qureshi and Vogel (1999) state that the research on distributed coordination and collaboration is inherently complex in nature and requires multiple research sites in order to arrive at more generalizable conclusions.

Real life problem and simulation-game

Task allocation and knowledge sharing in the Amsterdam Police Force

The duty of the Amsterdam Police Force is to ensure safety, livability and societal integrity and to deliver a reliable service to the inhabitants of the city. The police force is organized as a matrix organization. On the one hand the core organization is hierarchically subdivided in geographical areas called neighborhood-teams, who form the front office. On the other hand there are numerous staff departments responsible for handling of cases and suspects and for information analysis who form workflows on all kind of topics like for instance, 'fire-arms', 'youth', 'drugs and drugs addicts', 'car hijacking' and 'burglary'.

Within the neighborhood-teams professionals for each workflow topic have been appointed. These professionals work part of their time on general duties and part of their time they function as members of regional projects (a kind of communities of practice on the various workflow topics). Because the police work in a 24 hour, 7 days a week schedule and incidents are unpredictable one cannot guarantee that a fire arm case is always carried out by a fire arm

professional. The available policemen need to deal with the cases at stake at a certain moment. Consequently a major task of the professionals is sharing of expertise with local colleagues of their neighborhood team as well as with distributed experts their regional community of practice.

The matrix organization is a concept that tries to integrate two extremes: geographical specialization (because of diversity in market needs) as well as functional specialization (because of a growing complexity of tasks). The coordination and control burden in this kind of organizations is enormous (Mintzberg, 1983). Especially the coordination of skill and expertise across neighborhood-teams within the regional projects is problematic as the members are distributed all over Amsterdam. There is a growing feeling that there is too little coordination among these police employees and that overall productivity is influenced negatively.

One of the problems observed is that the quality of work in the neighborhood teams decreases. Besides factors like a low priority for the task, time pressure and lack of capacity, the difficulty of consulting expertise is indicated as a reason for poor quality of performance. From the analysis follows that regional projects invest heavily in anticipatory coordination like training experts, developing work procedures, writing newsletters, organizing meetings and workshops. However, little attention is paid to the appliance of all this generated knowledge and skills for daily problem solving. Then local experts may not be present, handbooks may be inaccessible or out of date and distributed experts are hard to contact. As such all the anticipatory efforts are lost when adaptive coordination during execution is failing.

At the moment several information- and communication technologies are being developed or have just been introduced in the police organization, in order to support dispersed coordination and collaboration (for instance the police-intranet). However, ICT development is not the highest priority of top management. Although there are technology champions, expert users, facilitators, local gurus, and most critical tasks are technology supported, there is clearly a lack of training. Therefore it is not clear what the exact effect of the introduction of these new technologies will be under these circumstances.

The action research study focuses on daily problem solving in the neighborhood teams, being an early and crucial process in the workflow. The major question to be answered is whether and how consultation of distributed expertise (supported by new ICT) can improve the quality of daily problem solving in the neighborhood teams?
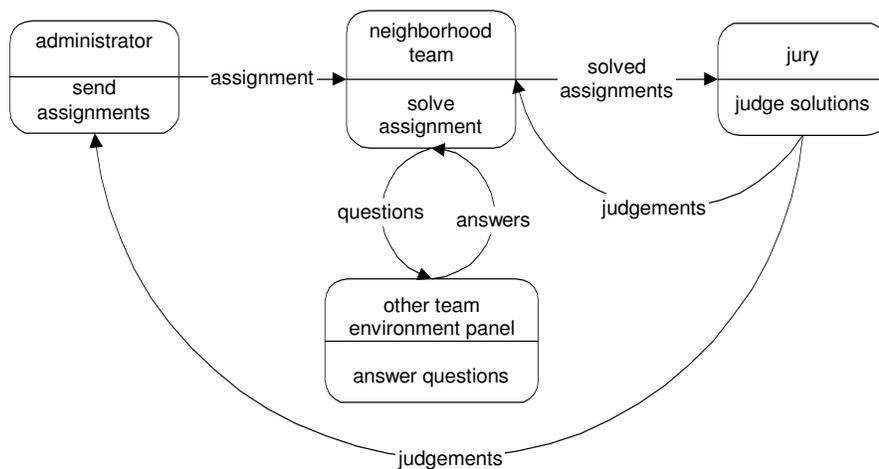
The neighborhood team knowledge game

For the development of the simulation-game we rely on the 7 step method of Caluwe et al (1996): draw up a functional set of requirements; analysis of processes and mechanisms; design of an integral framework; draw up a game-technical set of requirements; construction of a prototype; testing of the prototype; and final adjustments to improve the game. For a comprehensive description of each of these steps and related design choices we refer to Laere (2003). Here we give an overview of the main purposes and characteristics of the game.

The game serves multiple interests: A design interest (to explore to what extent new forms of coordination of distributed work are successful, and how they can be improved), an awareness interest (to make policemen aware of the issue of coordinating distributed expertise and related problems) and a training interest (to guide policemen how to behave in future).

Key element of the game is the consideration of a policeman whether he will or will not make use of expertise from outside his own neighborhood team to solve a daily work problem. If so, a second key element is to determine how he can make use of this expertise productively. In the game more information- and communication technologies are available than in the daily work setting. Policemen can be reached by their colleagues any time, any place. The participating policemen create the required organizational context. Furthermore policemen are stimulated to use the new coordination options. At the end of the game the group of participants needs to conclude whether, or under what conditions, the new working method leads to improvement of performance. To support this forming of opinion the quality of performance is measured and the participants receive continuous feedback on their performance. Key actors in the game are the neighborhood teams (consisting of a mix of generalists and experts), a jury (who assesses the solutions to the problems) and the simulation-game administrators. Furthermore there is an environment panel who play the roles of organizational members not directly represented in the game. Thereby participants in the game can contact anybody within the police organization they might need.

Actors in the game and their interrelations

The game administrators send assignments to each of the neighborhood teams. These teams consist of 2 or 3 policemen, who are a mix of generalists and experts. When developing an approach for an assignment, a neighborhood team could consult intranet or one of the other neighborhood teams or the environment panel. The environment panel also represents the knowledge center. When an approach is finished it is sent to the jury. The jury judges both the solution to the problem (content) as well as the coordination the neighborhood team has undertaken to arrive at the solution (process). Their assessments are sent both to the neighborhood teams and to the game administrators. The search for know-how or experts can be coordinated in various ways in the game:
1. rely on own expertise (when it is a familiar or not so complex problem for the generalist);
2. search on the intranet (when the generalist knows enough of the problem and the problem context to be able to locate the related know-how on the intranet and interpret it correctly);
3. contact knowledge center (when the generalist is under time pressure or knows too little about the problem area to locate know-how or experts himself, he can ask the knowledge center to locate the know-how or experts for him);
4. contact one or more experts (when the problem is too complex to be solved by only consulting the intranet);
5. put a question on the bulletin board (when the generalist wants to involve a larger group of colleagues, for instance for a multi-dimensional or highly complex problem or when a creative solution is desired).

To support the successful execution of these consultation steps, some tools for coordination are offered to the simulation-game participants. These are:

- an overview of skills, phone numbers and e-mail addresses of experts in the police force;
- a search-tool that can list all policemen from a particular expertise area or with a specific skill who are currently on duty;
- the existing police intranet, with a roughly categorized overview of existing procedures and best practices;
- a phone and an e-mail connection for each neighborhood team and shared bulletin boards (there are separate bulletin boards for each expertise area).

For the development of the computer support for the game we choose to use MS Access '97. The main reason for this is that this software is available on the police computer network and that it supports building of a relational database (team, assignment, approach, coordination strategy, assessment, score et cetera). During the simulation-game the participants can make use of the existing intranet (internet explorer 4) and e-mail facilities (pegasus mail). As there is no bulletin board software available yet the bulletin board feature as well as an overview of experts and their skills are also developed in the MS Access environment. By interviewing some experts in the police organization we develop about 60 assignments varying in topic and complexity. For each assignment a "standard-solution" is described to support the jury in the assessment process.

Game results

The game has been played 9 times. Each time between 6 and 15 policemen participated for half a day. They are grouped in neighborhood teams of 2 to 3 persons. Each game consists of a briefing, a first play-round, a short debriefing, a second play round, and a large debriefing. On average 30 assignments are solved in each game.

We first present some figures and then interpret these results together with the outcome of the debriefing discussions. The first table shows how often each coordination strategy is applied.

Coordination strategy usage (in %) for each game

Strategy	1	2	3	4	5	6	7	8	9	Mean	Stdev
Own expertise	76	44	54	77	47	73	59	83	78	**66**	**14.7**
Intranet	24	56	42	46	73	13	41	45	39	**42**	**17.2**
Help desk	0	6	8	0	17	0	21	3	7	**7**	**7.6**
Expert	16	38	27	6	57	16	21	28	19	**25**	**14.9**
Bulletin board	0	0	8	0	3	3	7	3	4	**3**	**2.9**

In 66% of the assignments policemen rely on their own expertise or the own expertise plays a distinctive role in the development of the solution. The most used coordination strategies to consult distributed expertise are searching on the intranet (42%) or consulting an individual expert (25%). The help desk and the bulletin board are only marginally used, despite the fact that the game was an experimental situation where exploring new avenues for consultation was strongly promoted. The figures vary considerably from game to game, resulting in high standard deviations. Still we can conclude that policemen rely more on own expertise than that they consult intranet ($p = 0.019$; student t-test, one tail, matched pairs, $\alpha = 0.05$). Also intranet is more often consulted than experts ($p = 0.001$), and experts are more often consulted than the help desk ($p = 0.001$) and the bulletin board ($p = 0.001$). The difference between help desk consultation and bulletin board use is not significant ($p = 0.055$).

The next table shows which coordination strategy led to the best performance (jury score).

Score per coordination strategy (on a scale from 1 to 5) for each game

Strategy	1	2	3	4	5	6	7	8	9	M	SD
Own expertise	3.48	4.14	4.07	3.78	4.14	3.30	3.47	3.38	3.27	**3.67**	**0.37**
Intranet	3.67	3.44	4.55	4.63	4.23	4.18	3.75	4.00	4.17	**4.07**	**0.40**
Help desk		5.00	3.50		4.60		3.33	5.00	3.00	**4.07**	**0.90**
Expert	3.67	4.17	4.00	4.50	4.12	4.33	3.33	4.5	3.74	**4.04**	**0.40**
Bulletin Board			3.50		4.00	4.00	3.00	5.00	1.00	**3.42**	**1.36**
TOTAL	**3.55**	**4.00**	**4.19**	**3.94**	**4.23**	**3.54**	**3.41**	**3.52**	**3.23**	**3.73**	**0.36**

The best average score is reached with the coordination strategies of intranet and help desk consultation (4.07), closely followed by the average score of expert consultation (4.04). The average scores when relying on own expertise (3.67) and when using the bulletin board (3.42) are lower than the overall average score (3.73). For the help desk and the bulletin board this figure suffers from higher standard deviation, which may partly be due to fewer observations. The scores for consulting intranet or another expert are significantly higher than when relying on own expertise (respectively $p = 0.024$ and $p = 0.026$; student t-test, one tail, matched pairs, $\alpha = 0.05$). The score for help desk consultation is not significantly higher than relying on own expertise ($p = 0.19$).

From these figures we can conclude that:
- The great differences in strategy use between games reflect that some groups of policemen have more explored or adopted the new coordination strategies than other groups. Learning experiences and level of adoption may therefore differ strongly between groups.
- In general policemen still rely mainly on their own expertise (which is not wrong at all), but the figures for intranet and expert consultation in the games are much higher than in current practice (where it is almost zero). This implies that policemen have at least explored and possibly adopted these new coordination strategies.
- Furthermore it seems to pay to consult distributed expertise. Consultation of intranet and experts outperform reliance on own expertise.
- Finally we can conclude that intranet and experts are more reliable sources than the general help desk and the bulletin board. For the last two the average scores fluctuate dramatically.

The impressions from these figures are largely confirmed in the debriefing discussions. Policemen who play the game are positive about the new opportunities for coordinating. Both in the debriefing and in an evaluative questionnaire they indicate that policemen more often need to consult distributed expertise. However, they also identify problems with regard to consulting distributed expertise.

There is hardly any insight in what expertise is available. A function name like Firearm professional is not sufficient to select the most suited expert. Some of them know more about firearm identification, others know more about legislation, but on paper their function is the same. Secondly, for a single problem several people have part of the solution. So often more people need to be located and contacted (each time with reasonable difficulty) to arrive at a complete solution.

Intranet is currently seldom used for consulting professional knowledge. Most policemen are not aware of the professional knowledge available on intranet, or do not master the basic skills to navigate on intranet. A clear outcome of the game is that numerous policemen "discovered" the large amount of professional knowledge on intranet and state that they certainly will make more use of intranet in their daily work from now on.

Policemen are reluctant to bother colleagues with their problems. Their basic strategy is first trying to search for the needed knowledge on their own. Only if they do not succeed they contact a colleague. This explains why searching on intranet is the most used coordination strategy despite the drawbacks of intranet that will be discussed below.

Many policemen experience frustration while consulting the intranet. They complain about the badly performing search engine, the inconvenient structure, and the long-winded or incomplete texts. Most policemen start almost immediately by using the search engine. There is a very strong belief that a better search engine will solve all problems of locating the needed expertise. However one could argue that the police intranet is so small that it is easier to locate information by navigating through the basic structure. But the intranet structure is also not ideal. The regional projects have developed their intranet pages quite independently. Therefore common elements are placed under different headings or located in different areas. For the neighborhood team policemen it means that every time he visits another topic he has to rediscover the complete structure of this knowledge area which is very time consuming. Finally a lot of the regional project's intranet pages are too long and too general. Policemen desire more examples of practical cases where general procedures or laws are applied.

With regard to consultation of the central help desk and individual experts there is a strong desire that the central help desk is available 24 hours a day. Especially during the nights it is hard to locate and contact an expert as fewer people are on duty. Furthermore policemen like the idea of a search-tool that helps to select the best expert for the job who is currently on duty, but they make a sharp distinction between expertise information and contact information. They stress that expertise information should be specific and detailed: not only topic Firearms, but a break down in knives, firearm legislation, firearms in catering, firearms at schools, firearm technical recognition et cetera. Furthermore each policeman himself needs to actively maintain these data. In contrast contact information can be rough (night shift / morning shift / afternoon shift), and should require minimal maintenance. Preferably the duty-lists are automatically integrated in the electronic phone book.

The bulletin board is received with great reservation as may be clear from the marginal use percentages reflected in the earlier presented figures. The main reasons for this are that the policemen experience too much uncertainty with regard to the speed and reliability of the answers. However, despite the rare use policemen stress that the bulletin board can become a valuable alternative for consulting distributed expertise under the following conditions:
• Distinguish between questions needing a quick and reliable answer and more broad discussions focused on exploring opinions or gathering and developing innovative ideas.
• Central control is needed to guarantee quick and reliable answers. Furthermore measures should be taken to have youth related questions answered by youth professionals.
A broadly valued point of this coordination alternative is that policemen who are not directly participating in solving the problem can learn a lot by just reading the questions and answers. For other strategies the consultation process is not visible for policemen that are not directly participating.

Discussion

The focus of this discussion is more on the lessons of our action research for theories of design (how can we apply simulation-games in change processes) than on lessons for theories of the real-world problems we studied (how does distributed work need to be coordinated). The topic of coordinating distributed work and the Amsterdam Police Force case are utilized to show the strengths and weaknesses of applying simulation-games in change processes. Key question in the discussion is what simulation-games contribute to the change process. We will respectively discuss the direct value of the game results, the problem of embedding these learning experiences in the police organization and a more general discussion what functions a simulation-game could have in an organizational change process.

Value of the game results

The game had a design-, awareness-, and training interest. The value of the game as a design instrument is illustrated by the numerous design recommendations that follow from the debriefings of the simulation-games. The comments in these evaluative discussions are much more detailed than in earlier re-design discussions (that aimed at exploring coordination problems, ICT opportunities and coordination alternatives to be included in the game). For example, game participants stress the need for uniform navigation structures on intranet by giving examples of information they cannot find because different names are used for similar issues in different regional projects. These examples are much more compelling and easier to put into practice than the more general request for uniform navigation structures in the design teams.

Furthermore game participants underpin their opinion with numerous practical experiences from the simulation-game. The members of the design teams are much more speculating about possible effects. For instance, it appears during the game that a lot of prejudices with regard to the bulletin boards are still present and that the bulletin board is hardly used, whereas the design teams are rather enthusiastic about this option. Also here, detailed comments are gathered how the use of bulletin boards can be stimulated in the police force. These examples show the value of practicing the new coordination mechanisms, rather than only discussing them. New coordination alternatives can be improved and fine-tuned before they are actually implemented and embedded in the organization.

Another design related outcome that we observe in our action research study is that simulation-games provide a rich and deep insight in the interactions between work, humans, technology and organizational context of a possible future situation. Traditionally applied design instruments in business engineering like for instance task-actor models only give a rough overview of a new work process and its coordination (by highlighting the actors involved, the information they exchange, and the sequence of processes they perform). Our theoretical exploration has emphasized that this broad scope of factors included is very important for a topic like coordinating distributed work.

With regard to awareness the participating policemen indicate that they are convinced that they need to consult distributed expertise more often. Furthermore some policemen "discovered" the large potential knowledge gathered on intranet. Game participants also gain insight in what coordination alternatives are feasible under what circumstances, whether benefits outweigh the costs and when they do and when they do not. As such they become aware of the dual impact of ICT on coordination. The training aspect is illustrated by the fact that game participants learn from each other how to navigate on intranet (as they operate in the game in groups of 2 or 3 people), or how to choose between coordination alternatives.

Disseminating learning experiences in the organization

An important consideration when applying simulation-games as change instruments is to make sure that the learning experiences captured in the debriefing of the game are embedded in the daily work processes of the organization. A pitfall that may arise for radical, interactive and innovative redesign processes or interventions like these games is the danger of being perceived as a pleasure trip or becoming a ritual. Therefore the facilitator of the redesign and change process should stress a strong relationship between the games played and the implementation and change process afterwards (Caluwe at al, 1996).

In our action research case embedding the learning experiences has been problematic. Some of the experimental conditions in the game (like new ICT and leadership that promotes knowledge sharing) are not yet available in the daily work setting, which impedes or blocks adoption of the new coordination alternatives. Nonetheless we have tried to embed the learning experiences in various ways:

- At the end of the game in the debriefing sessions policemen are stimulated to formulate improvement steps that they themselves can directly adopt in their daily work.
- In two neighborhood teams small pilots have been started to see to what extent learning experiences from the games can be incorporated in their daily work process.
- The results of the action research studies have been documented and communicated formally and informally with top management, lower management, regional project coordinators, the ICT department and the HRM department. Also a follow-up plan has been proposed that consists of an integrated approach guided by members of these different organizational units. This approach includes embedding the game as training instrument and a concerted change of ICT implementation, priorities in the line organization and professionalization of the regional projects.

The impact of these follow-up actions has been limited. Some individual policemen that participated in the games and some regional projects have changed their work practices. The proposal for an integrated approach by various organizational units has not been rejected, but is still waiting for implementation. A manager from the ICT department commented once that this research came too early, and that the implications were too far-reaching to be adopted immediately. That may imply that at some time the organization still could benefit from these early explorations.

In short it can be concluded that the organization is not yet willing to change, although the games revealed a lot of issues to work on. Reasons why we did not succeed in triggering a major change could be:

- As researchers we were primarily focused on the value of the simulation-game in the change process and in studying the topic of coordinating distributed work. We had less attention for the larger change process (follow-up, influencing management). Appointing an internal change or project manager could have made a difference. Caluwe (1997) also warns for the risk of leaving the responsibility for the change too much with the external party. He argues that internal management should lead the process, and external consultants or researchers should assist.
- Top-management did not participate themselves in the games. They only read a report and watched a presentation. Bardram (1997a) argues that it is important to involve decision makers in the games to ensure that there is enough commitment to decisions that follow from the learning experiences in the games. Involving police top managers more actively could have made a difference.

- In the insurance company case (Caluwe, 1997) all 1400 employees played the game. In our case only 81 policemen of the in total approximately 3500 policemen played the game. It may be clear that impact would have been larger when all employees would have participated. Moreover, when an organization decides to invest so much time (3500 policemen, half a day) there would also be more priority for productive follow-up actions.
- In the insurance company case (Caluwe, 1997) the success of the green print game intervention is partly caused by a preceding blue print intervention (business process re-engineering, design of team based organization) and red print intervention (changing functions and job descriptions and re-assessing all managers and employees). So in the insurance company the game was part of a major change process, whereas in the police organization such a change process still has to unfold.

From the latter two points we conclude that both our police game and the insurance company game have been valuable, but in different ways. In the last part of this discussion we elaborate on this and identify multiple roles games can play in an organizational change process.

Different uses of simulation-games in an organizational change process

There are some large differences between our action research study in the police force and the use of gaming in the insurance company (Caluwe, 1997) and the use of organizational prototyping in the hospital case of Bardram (1997a).

The most striking difference is the phase in the change process where the games are applied. Most existing simulation-games have an awareness (unfreeze) or training (freeze) interest. As such they are applied either at the start of a change process to lower resistance to change, or at the end of a change process to facilitate embedding of the new work practices in the organization. Whether the insurance game of Caluwe (1997) is framed as an "unfreeze" or "freeze" game depends on the demarcation of the change process. When the change process is pictured as starting with the blue print and red pint interventions, then the game can be typified as the final green print phase where the earlier developed team based organization is embedded in the organization. Note that the insurance case is then an example of alternating between different change approaches (Boonstra, 2004). When the green print phase itself is seen as a change process, then the game can be seen as the start of the change process where employees are being detached from their old working practices. The author himself shifts between both frames in different parts of his book.

In contrast the examples of our police case and the hospital case of Bardram can be situated in the rebalance or move phase of an organizational change process. In these interventions the organizational design is not yet fixed but subject of discussion. In other words we use a simulation-game as a tool to facilitate interactive design rather than as a support tool for the final implementation stage of a linear design (Laere et al., 2000).

Another difference that can be related to phase of the change process is the degree of freedom that game participants have in their roles. In the insurance game the roles of the players are rather tight and limited considering what they need to do and how they need to perform these tasks. In our police game the roles are less strict. Policemen need to solve assignments, but have considerable freedom how to gather information and how to answer them. In the hospital case there are also few constraints, participants have to react on cards describing a situation and attach action plans to them (how the organization needs to act in that situation, and what needs to be changed in structure, job descriptions, ICT support et cetera to enable the organization to function properly).

A final remarkable difference is the depth and scope of the both design-games. The hospital game focuses in detail on the functionality of one ICT tool. Work practices and behavior of employees are more roughly analyzed as the game participants only talk about the actions they have to undertake to complete a task. In our police game multiple tools are included. The focus of analysis is less on the features of these tools and more on how they are used by policemen. In our game policemen need to execute several tasks, so they get hands-on experience with regard to these tools and they need to interact with each other in various ways. Therefore we argue that we get a more detailed insight in work practices, employee behavior and organizational context. The police game is more dynamic, the hospital game is a static analysis.

In summary we conclude that simulation games can be used in various ways in an organizational change process. Our police game has been valuable early in a change process to enable policemen to explore future work practices and to give rich feedback to ICT designers and organizational designers. The hospital game of Bardram (1997a) has similar value for a more focused discussion on features of one specific ICT tool. The insurance game of Caluwe (1997) proves to be valuable to embed new work practices in an organization in the final stages of a change process. In each three cases follow up activities are required to exploit the game results.

We hypothesize that a single simulation game could be used in different stages of an organizational change process as illustrated in the table below. This would mean that although simulation games are costly to develop, they do not only offer a high quality learning environment, but they can also be useful over a longer period of time. For instance, a group or organizational department could play the same game several times in the various stages of their change process to monitor their performance, progress and degree of adoption of earlier learning experiences.

Evolution of a simulation game during a design process

Change process phase	Game features	Game type	Change approach
Unfreeze	Broad scope, free roles	Police	Green / yellow
Rebalance/move	Broad scope, free roles	Police	Green / white
	Focused, free roles	Hospital	Green / white
Freeze	Broad scope, tight roles	Insurance	Green / blue / red

Conclusion

We argue that our action research study on the topic of coordinating distributed work in the Amsterdam Police Force shows that the use of simulation-games in business engineering and organizational change is promising. They may prevent many of the implementation failures that are caused by a negligence of social, behavioral or contextual issues. Our police game fulfills a design interest because it provides much more detailed feedback on future work practices than oral design discussions in an early phase of the change process.

Furthermore we hypothesize that simulation-games can serve different interests in the different phases (unfreeze-rebalance-move-freeze) of an organizational change process. In the beginning the game can help to create support for change amongst management and workforce, later the game can serve as a rich discussion environment to explore new work practices (either isolated or within their organizational context), and finally the game can be used to embed the new work practices in the organization.

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