A Group Problem Solving Approach to Business Process Redesign: Combating Organized Crime in Amsterdam

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Abstract

This paper presents and evaluates an approach that can be used to support modifications both in an organization (reengineering) and, especially, in its supporting information systems. The approach is a blend of the (group) problem solving approach from Delft University of Technology with work involving Group Decision Support in the context of information system design coming from the University of Minnesota. A study performed at the Amsterdam Municipal Police Force is used to illustrate and evaluate this approach. Results from this experience show the effectiveness and efficiency of the aproach and point toward directions for enhancements.

1. Introduction

In 1992, the Criminal Investigations Department (CID) of the Amsterdam Municipal Police Force established as a priority the reorganization of the department to better deal with the growing threat of organized crime. In addition to the structural reorganization, it was necessary to develop information systems to support the new organization. The CID was assisted in this process by personnel form the School of Systems Engineering, Policy Analysis and Management (SEPAM) at Delft University of Technology.

The departmental reorganization and redesign plus the design of an accompanying information system served as a test of using Group Decision Support (GDS) as an aid to both business process reengineering and information systems design. Moreover, this setting provided the opportunity to explore the integration of the problem solving approach that has evolved at SEPAM [3,36] with a group-based information systems requirements determination process that has been successfully employed by researchers from the University of Minnesota [40,41].

To begin this paper, we will first present an overview of organizations and their adaptation as a problem solving setting. Also we will discuss the use of information technology as a mechanism for supporting coordination for new ways of working. The next section of the paper expands on organizational redesign as a problem solving process and elaborates on the combination of procedures developed at the two research centers. The following section of the paper presents the problem setting at the Amsterdam Municipal Police Force. The paper concludes by presenting overall results and insights we have learned from what we have done.

2. Organizations, adaptation and information technology

It is commonly recognized that in the post-industrial society organizations find themselves in a changing, demanding environment, see e.g. [21,25]. Because organizations supposedly behave like purposeful systems, [1], they are subject to a constant need to adapt their structures, processes, and technologies in order to meet new demands from their environment, [6,24]. In response to these demands, organizations are often inclined toward applying Information Technology (IT) to *automate or support their current way of working*. Hammer [19] claims that more substantial gains and improvements can be achieved by applying IT as support for *changing or reorganizing the current way of working*. There is some evidence which supports Hammer's assertion, see e.g. [9,14,15,19,28,37].

Reorganizing (in fact 'organizing' in the sense of structuring) the current way of working implies reorganizing the way in which an organization achieves the *coordination* of its business processes and constituent activities, [8,30]. Coordination of activities within organizations involves communication and hence *information exchange* between the people performing these activities, [18]. Thus, one resulting problem associated with changing an organization's way of working is that a requirement is created for also changing the (manual or computerized) information systems that support the modified organization.

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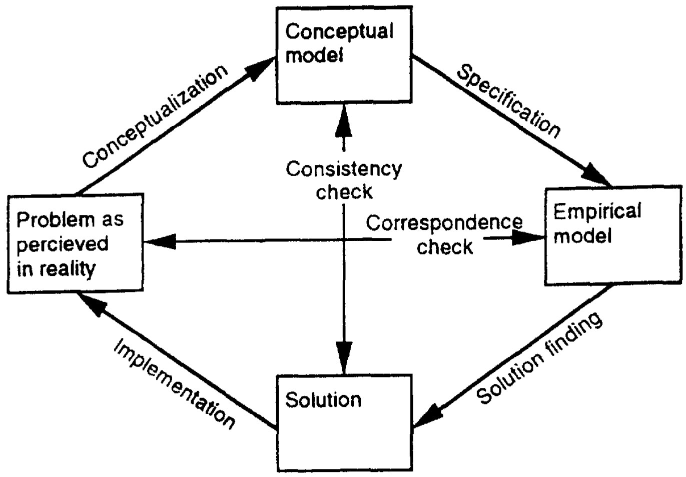

figure 1 The process of problem solving.

At the same time, new information technologies are emerging offering support for new ways of coordinating business processes. Examples of such technologies include, but are not restricted to: Electronic Data Interchange (EDI), Documentary Information Systems, E-mail Facilities, Local and Wide Area Networks (LANs and WANs), Computer Supported Cooperative Work (CSCW), and Group Decision Support Systems (GDSS). Malone and Rockart [27] observe in this respect, that the use of IT is increasingly shifting from supporting pure computational activities towards supporting coordination activities as well. As a result there is a tendency towards more coordination intensive organizational structures, such as the adhocracy, decentralized markets, [26], or network structures, [7,13].

Summarizing, we see that modern organizations are challenged to simultaneously deal with pressures from their environment to adapt their business processes and supporting information systems and to apply new emerging information technologies offering support for new ways of coordinating business processes.

3. Design as a group problem solving process

3.1 A problem solving perspective on design issues

Modifying an organization's processes and its supporting information systems can be considered to be a very complex activity. There are many possible courses of action, many actors involved, and many variables to consider. Options for organizational change are often dangerous or impractible to test in reality so that the effects of these changes are not known in advance. Similarly, the effects of the information systems on the organizational processes are often hard to predict and anticipate. We therefore argue that designing organizations and their supporting information systems can be seen as solving an ill-structured problem, see also [36].

Based upon the work of Mitroff et al. [31], Sol [36] describes a process that can be considered to be a suitable approach for solving ill-structured problems. The suggested process of problem solving consists of six activities that are linked by four stages, see figure 1.

The process starts with a problem perceived to be real by a problem owner. Next a conceptual model of the problem situation is constructed. This is a data void representation of the problem solver's mental model of the problem situation in terms of the concepts he or she perceives. This model is the basis for the specification activity, in which the problem situation is specified in more detail, resulting in an empirical model. Then a correspondence check is performed in order to assess whether the the empirical model is a valid representation of the problem situation as it was originally perceived. From the empirical model, solutions have to be identified, analyzed and compared. Solutions also have to be checked to see whether they are consistent with the conceptual model. One solution may be selected for implementation in the real world. This, according to Sol, may initiate a new problem solving cycle.

For an elaborate discussion of this cycle we refer the reader to [36]. We will now take a closer look at the relationship between organization design and information system design in the context of the problem solving cycle.

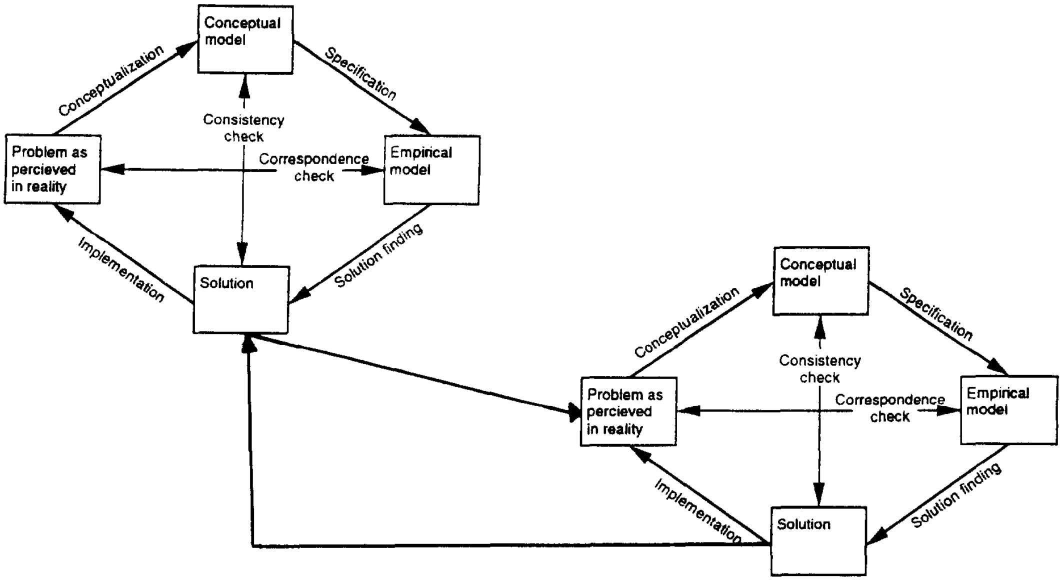

figure 2 A phased process of problem solving.

Suppose the cycle starts with an organizational problem. After the solution finding activity, it may be apparent that one or more of the solutions of the problem concern a new way of working involving the design of an information system to support the solution. The need to design an information system initiates a second problem solving cycle. After the system requirements are specified and alternative designs (solutions) have been evaluated, the system can be built and implemented in the organization. This concludes the second problem solving cycle. At the same time, this cycle may result in a new problem situation: the introduction of the information system may have unforseen impacts on the organization's proposed new way of working. People may start using the system in different ways than it was intended, and new system's requirements may surface. So, a new cycle starts.

In other words, a sequence of problem solving cycles may be initiated by the need to design an *organization* as well as by the need to design an *information system* supporting the organization. The process of designing organizations and their supporting information systems can therefore be described as an ongoing phased process of problem solving, see figure 2.

3.2 Supporting groups in problem solving activities

With respect to designing organizations and their supporting information systems, the notion of a *group* is becoming more and more important. Experience shows that organization design and information system development in most cases involve a great number of people, [40]. There are several arguments that suggest that activities as complex as these should explicitly be considered to be carried out by groups instead of individual problem solvers, [23, pp. 6-9]. We submit that four especially good reasons for group design include:

- *Complexity.* The problem of designing organizations and their supporting information systems is complex, because they involve large interconnected systems. No single person alone can understand all aspects, issues, and variables of an intricate reorganization process.
- *Interest.* Usually many members of an organization have a strong interest into organization design problems and their IT implications.
- *Evaluation.* A group of stakeholders is more capable of pointing out shortcomings in proposed solutions than any individual proposing the solution.
- *Acceptance.* A proposed solution has a better chance of being accepted, because the people affected by the

proposed solution are involved in the process that generates the solution.

The increasing occurrence of networked computers and communication technology has provided the opportunity for new technology that offers support for group involvement in reorganization processes, see e.g. [10]. In general terms, this technology is called *groupware*, [23], a subset of which concerns *Group Decision Support* (GDS). A Group Decision Support System (GDSS) aims to improve the process of group decision making by removing communication barriers, providing techniques for structuring the process of decision analysis, and systematically directing the pattern, timing, or content of discussion, [12].

Compared to 'traditional' group settings, the use of a GDSS appears to increase the effectiveness, efficiency of group decision processes as well as the satisfaction of the participants of such processes, see e.g. [33,40]. Important characteristics of GDSS that bring on these benefits include anonimity, parallel processing, and group memory, see e.g. [11].

3.3 Integrating the group problem solving approach with GRIPPPER

When the problem solving approach is carried out by groups, it can be referred to as a group problem solving approach, [38]. So far, our description of the group problem solving approach has only introduced a way of working, which explains what models should be built *when*, but not *how*. At this point, we will introduce a process which combines the group problem solving approach with a variation on the process suggested by Wanninger and Dickson [40,41]. Inspired by the consumer product development model, these authors introduce an approach they call GRIPPPER™ which stands for Group Requirement Identification Process (GRIP), Prototype, Pilot, Evaluation, and Rollout.

GRIPPPER advocates Joint Application Design (JAD) sessions, [2], to make the design process a team effort. The notion of Critical Success Factors (CSF), [35], is used to initiate determination of the information requirements of managers and to link these CSFs to the strategy of the organization. Another key component of the GRIPPPER approach concerns testing and evaluating different versions (prototypes) of the information system by its future users. Within GRIPPPER the use of GDS is strongly recommended and defined to support the group involved in the requirements specification process (GRIP).

Within the original GRIPPPER approach there is a strong focus on information system design. In our version of the GRIPPPER process, however, we applied the techniques from GRIPPPER to support the *organization design cycle* in addition to information system design. In this context, the activities of our cycle are as follows:

- *Conceptualization.* In order to conceptualize the problem situation, the CSFs and related critical processes are identified and prioritized by the group involved in the process. Also, the information needed to support the CSFs is identified.
- *Specification.* During this activity the problems associated with the CSFs, critical processes and required information are identified and prioritized by the group.
- *Solution finding.* On the basis of the prioritized problems, the group generates a number of solutions to handle the identified problems. Solutions may include alternative ways of working and new information systems to support these. From the generated solutions one solution (or a combination) is selected.
- *Implementation.* The selected solution is implemented in the organization.

As stated before, if an organizational solution requires the design of a supporting information system, then a new cycle is started. The *information system design cycle* is supported by GRIPPPER as follows:

- *Conceptualization.* The conceptual model consists of the CSFs, the related critical processes and the required information to carry out the processes associated with the solution selected in the previous organization design cycle. The group determines to what extent existing information systems fullfil the information requirements.
- *Specification.* During this activity the group defines the functional and data specifications of the system. Based on these specifications, a first prototype of the system is built.
- *Solution finding.* During a series of Prototypes, Pilots (the prototype is extensively tested in a real life situation) and Evaluation (modifications are determined by the group and/or it is decided to implement it in a final version), the process iterates towards a satisfying solution to the information system design problem.
- *Implementation.* Finally, the information system can be implemented in the organization. (In GRIPPPER this is called Rollout).

In the remainder of this paper, we will illustrate the application of the general approach we have just described. As noted at the beginning of this paper, the setting for this case study is the Amsterdam Municipal Police Force. Our illustration focuses on the organization design cycle and

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conceptualization and specification activities of the information system design cycle up to the point where the prototype information system has to be built. Hence, in terms of GRIPPPER, we stop after the GRIP phase. For a discussion of the prototype development and subsequent activities, the reader may consult Vreede and Sol [39].

4. A case study: organized crime

4.1 Problem situation

Organized crime no longer is an exclusive problem of Italy and the United States. Today criminal organizations operate globally and the annual profits are estimated at 1 trillion US$, almost as much as the U.S. annual federal budget [32]. In the Netherlands, the Criminal Investigations Department of the Amsterdam Municipal Police Force has been forced to reconsider the way it is organized to combat organized crime. For some years, the department was organized to focus on individual criminal activities without seeing the broader scope in which organized crime takes place. Experiences with this approach, both in The Netherlands, elsewhere in Europe, and in the United States have shown that there may be better ways to address organized crime, see e.g. [5,16,17,22]. With the individual approach, the best result one can achieve is harassing a criminal organization for a short time. This approach has been shown to be less effective in wiping out an entire criminal organization, [4].

Based on this knowledge, the management of the Criminal Investigations Department (CID) decided to shift its approach in combating organized crime to focus on criminal organizations as a whole [34]. This means, for example, that drug traffickers occasionally are not arrested in order to pursue more global investigations of the logistic flows used by the total criminal organization. When the structure of the criminal organization is known, there has been shown to be a much greater probability to identify and arrest the leaders of the organization and thereby wipe out the entire organization.

The department's first results with this new strategy have been promising. However, several problems remained concerning the CID's organizational structure and working process in taking a holistic approach to dealing with organized crime, [29]. One particular problem concerns *information*. Information is becoming an important factor in the preparation and execution of the large investigations that result from the new strategy. More and more (criminal) information needs to be collected, processed, enriched, and communicated within the CID. Under the organization in place at the beginning of this project, information processing activities were scattered over a number of subdepartments. Accordingly it was difficult to coordinate these units in a way that their joint efforts resulted in a high quality end-product. Therefore, the management of the CID initiated a project to reorganize in order to amalgamate all information processing subdepartments into the so-called *Information Department*.

It was in 1992 that personnel from SEPAM became involved in the CID reorganization project. SEPAM proposed to address reorganization in a formal problem solving manner. In early 1993, SEPAM moved into new physical facilities which included two 14 workstation Group Decision Rooms (GDRs). A decision was made at this point to attempt to integrate GDS into the SEPAM problem solving approach, in this instance, GroupSystems V. It was also at this time that a visiting faculty member from the University of Minnesota with extensive GDS experience in joint applications design (JAD) arrived to work with the SEPAM staff. This combination of resources is what led to imbedding both GDS and the GRIPPPER approach into SEPAM's problem solving environment. The next two subsections describe the details of performing the activities described generally in Section 3. Subsection 4.2 deals with applying GDS to the organizational redesign and Subsection 4.3 addresses how the requirements for the new supporting informations system were determined.

4.2 Organization design: the information department

Before the creation of the Information Department, the information processing subdepartments were organized according to the type of information they processed. There was, for example, a subdepartment for political information, one for information related to drug trafficking, and one for 'hard' information such as addresses and criminal records. We call this an "information type" organizational form.

The group decision process on reorganization was begun with a session to determine the CSFs for the CID in relation to the Information Department. Twelve members of the CID participated in a seven hour session using GroupSystems V. The session made heavy use of the Idea Organization and Vote tools in GroupSystems V. Obviously, much of the time in this session was devoted to working with the group members on elimination of duplicate ideas, restatement of ideas, combination of ideas, and so forth. On the basis of the CSFs, a number of problems were identified that blocked supporting the CSFs. The most important CSFs and problems that came out of the session are summarized in tables 1 and 2.

As solutions to the problems mentioned above, it was decided to blend the subdepartments into a *functionally* organized Information Department. Concentrating on information functions rather than on information type was agreed upon as enhancing the coordination between the

Critical Success Factor (CSF)
Insight into the work domain of CID Good coordination with other departments Clearly stated goals and policies Adequate collection and processing of information Adequate IT support Highly skilled personnel Finding new methods and techniques to combat organized crime

table 1 The most important CSFs for the CID.

Problem	Explanation
Autonomity	The subdepartments created their own workload, there was no control, and little coordination with other subdepartments.
Unawareness	The subdepartments did not know what 'products' the other subdepartments produced. As a result, the same information sometimes was collected and processed more than once.
Poor information quality	Information was only registered. It was not enriched by combination or analysis.

table 2 The most important problems in the CID.

employees working with the same information and thereby increasing the information quality. The resulting subdepartments (and consequently the main functions) in the reorganized Information Department are listed below:

- *Collection and processing.* This subdepartment concerns the collection and processing of all (criminal) information.
- *Preparation and advice.* Here investigations are prepared and the CID management is advised on which investigations to start.
- *Supply.* Information is supplied to other police units. In other words, this subdepartment serves as a front desk to the 'clients' of the Information Department.
- *Foreign contacts.* This subdepartment maintains contacts with foreign crime fighting organizations.

From the group session it became apparant that the most important CSF for *both* the Information Department and the CID overall concerns having a detailed and complete picture of the workload of the CID. In other words, there are far more criminal organizations to be investigated than the CID can process. Therefore, understanding of the work domain is needed to consciously decide what investigations to prepare and initiate, and what information has to be collected to support CID activities.

Consistent with our discussion in Section 3 a new information system providing the understanding of the CID workload was required by the new organization. This information system is called the ACOST, and a second design cycle was initiated to design this system (see figure 2).

4.3 Information system design: the ACOST

ACOST stands for Atlas of Criminal Organizations and Societal Trends. The ACOST had to be able to represent information with respect to criminal organizations as well as societal developments. Societal developments sometimes create opportunities for criminal organizations, for example, the introduction of environmental law introduced the opportunity for environmental crime. Stakeholders had divergent ideas about the ACOST. Therefore, it was imperative in group sessions to communicate system requirements and to iterate toward a solution that would be desirable for all parties involved.

The main CSF related to the ACOST, the insight into the workdomain of the CID, served as a starting point for the second design cycle. A number of group sessions were organized, which included participants from other organizations combating organized crime other than those represented by the original participants. During these sessions the participants clearified their requirements by

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Critical Processes
Scanning information sources to collect relevant information on organized crime and societal trends
Consciously collecting information on certain high priority issues
Maintaining a network of contacts that provide (criminal) information
Preparation of information to be used in investigations

table 3 Critical processes associated with the main CSF.

Problem Areas
Currency exchange offices that change large sums of cash; no questions asked
Using drugs money to sponsor sporting teams or organizations
Organized prostitution by illegal residents in the Red Light District
Investing criminally earned money in bars and restaurants in order to launder it
Chemists working for criminal organizations with respect to producing the chemical drug XTC
Risks of corrupt behavior in the process of issuing Municipal invitations for tenders
Smuggling nuclear material from former communist countries

table 4 Examples of problems areas about which the ACOST should be able to manage information.

defining the critical processes associated with the main CSF, by giving examples of information the ACOST should be able to process, and by generating prioritized lists of examples of problem areas (such as criminal organizations) that the ACOST should be able to produce. Examples of the critical processes and problem areas are listed in tables 3 and 4.

With respect to the data specification, information on criminal organizations and societal trends is required to be represented at three levels:

- The lowest level deals with specific problem areas, so-called *Fields of Attention.* This can, for example, be specific criminal organizations transporting narcotics.
- The middle level deals with more abstract problem areas, so-called *Areas of Attention.* This level depicts conceptual structures according to which criminal activities or societal trends take place. This can, for example, be the way in which illegal residents in the Netherlands misuse social security and health care services.
- The third level is called the *Topics* level. On this level a number of Areas of Attention can be grouped into a Topic, according to common characteristics of the policy of the CID.

Problem areas (Fields of Attention and Areas of Attention) are described in terms of actors and relationships between them. To be able to prioritize problem areas, the concepts of 'criterion' and 'opinion' were required. An opinion concerns a judgement of a certain problem area according to a number of (weighed) criteria. Following the data specification, three main functions were indicated that the ACOST should be able to carry out:

1. *Collection.* Two types of information can be collected and entered into the ACOST: *Non-specific information*, refering to information that might belong to a certain problem area about which, at the time of collection, is little known, and *specific information*, refering to information that is collected to broaden the knowledge about a certain problem area that is already known to the ACOST.
2. *Insight.* The ACOST visualizes, both textually and graphically, criminal organizations and societal trends on the three levels described above.
3. *Selection.* The criteria can be used to evaluate Fields of Attention and Areas of Attention. Based on this evaluation, single criterion or multi-criteria prioritized lists can of problem areas be generated.

Based on these specifications (of which a detailed description can be found in [20]), a first prototype of the ACOST was able to be built and presented to the stakeholders from the CID in a very short time period. Additional GDS sessions were used to modify and evolve the prototype and lead to rapid implementation of the system.

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5. Conclusions and insights

5.1 The police case: some outcomes

As of this writing, the status of the reorganization and the information system development at the Amsterdam Police Force is as follows:

1. The CID has been reorganized as described and an Information Department formed which is organized by function.
2. An information system, the ACOST, went through several prototyping phases (the 2nd 'P' in GRIPPPER), and has been implemented in a network version.
3. Partly based on the nature of the ACOST, the Information Department is now heading to a 'product organized' structure: information teams are being created representing all four functionalities. Each team will work on a specific problem area. This second phase of reorganization is consistent with the arguments presented in Section 3.1 and figure 2.

In short, the objective of solving the complex problem of reorganizing the CID has been achieved. In addition, an information system supporting the new organization has been designed, developed, tested, and implemented. The problem solving approach, supported by GDS according to the GRIPPPER process, has played an important role in this successful experience. Not only was the global objective achieved, but moreover, attributes of the process were effective as well. Included are:

1. The development cycle was efficient compared to what may be expected using traditional methods. The entire project of both reorganization and development of the information system took a year. The CID reorganization including data gathering, meeting planning, and analysis took three months and the ACOST process including several requirements meetings, prototyping, and development took another nine months.
2. The satisfaction of participants in the process and with the outcomes of the process is high. The following quotation from one person is illustrative of overall attitudes: *"The ACOST is a system that we built together, And it's something that we should be proud of and proud to present to others."* There was a "bond" between the users and the ACOST prototype. The prototype was accepted as a joint effort instead of something imposed upon the organization by systems developers.
3. With respect to the design and development of the ACOST prototype, the GDS technology proved to be a key critical success factor. There is a high level of satisfaction on the part of both developers and participants about the technology used. A lot of information needed for the ACOST design and development was efficiently and effectively collected during the process.
4. Finally, we feel that a 'complete' specification of ACOST's user requirements was determined. We are convinced, that it would be very hard (in time and money) to get a qualitatively better set of user requirements, especially given the relatively short time period involved.

5.2 The police case: some insights into the process

Underlying the overall success of the process we have described are, we believe, several factors. Additionally, there are some other insights that we gained about the use of GDS in the reorganization/information systems development process that are worth noting. Included are:

1. Marrying the approaches of two research and development centers (TU Delft and the University of Minnesota) proved valuable. Each approach and each group added something to the process that enhanced both ultimate success and efficiency.
2. The GRIPPPER process works well with more than one GDS implementation. That is, the Minnesota work used the "SAMM" (Software Aided Meeting Management) system whereas the Delft work uses the GroupSystems V technology.
3. Because of the group design setting, the participants saw their individual demands and objectives from the group perspecitive making it easier to accept situations in which individual demands had to be sacrificed to group demands.
4. The sequence of organizational reengineering followed by information systems design and development resulted in two cycles that meshed as well as predicted (see Section 3).
5. Planning for the GDS sessions with identification of specific desired outcomes and mapping the use of the technology into the sessions proved of critical importance. Since the participants spend a considerable amount of time working individually (entering ideas, comments, thoughts, votes etc.), the goal of the session's activities and what is expected from them has to be perfectly clear.
6. Because GDS technology is capable of supporting specific activities within group sessions very well, there is always a risk that other activities get less attention. An example of such an activity is the oral discussion of generated ideas, voting results etc. During the ACOST

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sessions it proved to be very important to leave more than sufficient time for the participants to discuss intermediate results. If this was not done, the participants would tend to be less likely to buy in to the results of the session.

- Using GDS we observed a risk of attributing unwarranted accuracy to results, especially during voting activities. For example, if a large number of participants bypass during a voting session (they may feel that they are unqualfied to offer an opinion on a particular topic), the results of the vote must be considered suspiciously. The same goes for situations where the ballot items are not clear to the participants. Aggregated voting results often do not reveal this condition. Therefore, careful examination and discussion of the technology's (numerical) output is critical.

5.3 The police case: future directions

Overall, the authors are very satisfied with our outcomes to date. We have enhanced and enriched the "problem solving environment" with additional technology and process (GDS and GRIPPPER). The future directions we envision are to continue to add tools and work toward even more effective processes.

In particular, current plans involve adding two additional tools to the problem solving environment. One is to add simulation and animation techniques to the process, something the researchers at Delft University of Technology have used effectively in a variety of settings [37]. Another is to explore the use of new features in the GroupSystems technology, in particular, TeamGraphics. This tool allows different types of diagrams to be drawn, such as entity relation diagrams, data flow diagrams, and task structures. Doing group redesign of organizations or organizational processes and performing information systems design are seemingly fertile application areas for this new capability.

Finally, we fully intend to continue the cooperation of researchers at multiple centers in moving our work forward. We have found that the different frames of references, skill sets, and technologies to be of substantial value. We recommend this approach to others.

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