Understanding and Supporting Knowledge Management and Organizational Memory in a City Council

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Abstract

The paper develops a generic framework for analyzing knowledge management in formal decision groups and applies it to council work. Requirements are deduced for a sociotechnical support of their knowledge management and organizational memory. It is then shown how this computer support has been implemented for the Stuttgart City Council. The Cuparla system has been in widespread use since fall 1997; therefore, we can include usage experiences.

1 Introduction

City councils are the local public decision makers. Their particular structure and situation highlights problems of collective decision making, the collective building of organizational memory, and its collective use. This paper is based on the introduction of groupware into the Stuttgart City Council during the Cuparla project. The remainder of this section briefly introduces the research methodology, the Cuparla project, the council work, and a model for analyzing knowledge management and organizational memory issues. Then we present requirements for the design of a sociotechnical system (i.e. consisting of human, organizational and technical components) supporting their work. We then show how it has been implemented and how it has been used.

Research methodology and the Cuparla project: The Cuparla project was launched in the Stuttgart City Council in fall 1995. The primary objective was to support city council work. Over a period of three months in winter 1995, a group of three researchers observed the collaboration of council members both in their parties and in their committee meetings following the Needs Driven Approach (NDA) [9]. Based on these observations, the council members' need for support was elicited in a series of GroupSystems for Windows meetings. In summer and fall of 1996 we designed and implemented the Cuparla Software with Lotus Notes 4.x. Through 1997 we introduced the software into the council work, received feedback from the users, and adapted the software. The large majority of the council members had their systems installed by summer of 1997. By January 1998 all 57 active members of the Stuttgart City Council were equipped with a notebook, MS Office and the Lotus-Notes based Cuparla CSCW environment. These notebooks are connected to a central Notes Server via ISDN. Council meetings were supported by a mobile GroupSystems for Windows Electronic Meeting System. A detailed project description can be found in [9].

Council work: By law, a German city council has two tasks: 1. To decide all important local matters 2. To control the administration. A lot of power results from these tasks, particularly with regard to the administration. Theoretically, an administration can accomplish little without the consent of the city council. In practice, however, most matters are handled and predecided by the administration. The city council passes most proposals without changing them, sometimes even without understanding them. How can this happen? The administration overwhelms the city council with information. A member of the Stuttgart City Council receives about 1,000 decision proposals per year, each about ten pages long; in Munich the council decides on about 3,000 proposals each year. Even if most matters are decided in subcommittees, the individual council member remains flooded by information.

Many council members are ill prepared, so meetings tend to become unproductive. Meetings take up much of a city council member's time, and this explains, in part, why there is so little time for preparation. A detailed analysis of the Stuttgart City Council revealed that a member spends, on average, more than 40 hours a week on activities related to the council (more than 20 hours in formal
meetings!). Since council membership is an honorary duty, most council members also have a “primary job.” Having a primary job poses an additional problem to the council member: Unless there is a meeting, normal office hours are spent on the primary job. When a council member has time to prepare for the meetings in the evening or during the weekend, the administration officials cannot be contacted at their offices. Questions or requests for information arising during the meeting preparation have to be postponed.

Organizational memory and knowledge management: Inspired by Kuhlen’s [6, p. 85] model of information work we propose the following model of knowledge work in formal decision groups (Fig. 1).

![Diagram of knowledge work process]

Fig. 1: Model of knowledge work

Any kind of stimulus—usually a problem—serves as a trigger for knowledge generation by a person or group. If this knowledge is interesting or potentially useful, it is distributed and shared in the standing group and with other relevant persons and organizations. Knowledge is typically distributed to and shared with increasingly larger groups in several steps. If the knowledge is relevant and useful, it is used in the next step, typically contributing to a decision. Afterwards it is stored in organizational memory.

Organizational memory is later activated by an outside trigger, because it is assumed to contain useful information for the current situation. Thus activation works with some kind of index or table of content of the organizational memory. Specific information is then retrieved from organizational memory and reused. Reuse can include not only the use for a decision process but also the prior distribution and sharing with others. In any case, it includes the insertion of the information into the new active knowledge network of the current working context. The changed networking structure must then again be stored in organizational memory. This leads to the necessity of updating organizational memory after it has been used. We want to model the work processes on the basis of the life cycle of a given chunk of knowledge (that can be stored, for instance, in a paper document, digital information system or human memory). We understand “knowledge management” as an administrative function that enables information work. Our model explicitly includes the use of organizational memory (see e.g. [10,11]).

2 Issues of knowledge management and organizational memory support

The knowledge management challenges in city councils are, in many aspects, basic: How can knowledge be shared between council and administration in non-conflict situations? How can any knowledge that is generated by the council or the administration be distributed and shared in an efficient way? How can the council efficiently use knowledge in the decision process? How can knowledge be stored in an organizational memory? How can stored information be activated again? How can information be retrieved from organizational memory? How can the retrieved information be reused? And how can organizational memory be updated, after it has been reused? We will use the same structure to analyze all knowledge management and memory processing issues: We will first briefly explain how the issue was handled in 1996. We will then explain the problems and use examples to highlight them. From these we will deduce requirements for an improved knowledge management and organizational memory support. These sections are described from the perspective of the situation in 1996. In a final section we will look at the organizational structure: How can the fact be represented that there is no homogenous council but different parties with conflicting interests? How does the relationship between council and mayors, administration, and citizens affect knowledge management and organizational memory?

Knowledge generation: The vast majority of all information is generated by the administration. The council is
mainly reactive and often perceived by the administration and the public as being difficult to calculate as it tends to bring up unexpected new issues at surprising times. However, often its behavior can be explained by outside triggers, e.g. by citizens, interest groups, or the press. The strategic knowledge is mainly created by the administration; council members focus on specific issues of small interest groups or on issues with a wide visibility.

There is no systematic process in the council to generate knowledge; new knowledge pops up by chance, e.g. during a council meeting or during a discussion with a citizen. The rest of the factual knowledge is introduced into the council by the administration. With the knowledge generation process the administration monopolizes the initiative regarding strategic questions, and the council takes care of the minor issues. Researchers and experts regard this redistribution of responsibilities of council and administration as problematic [5]. What does knowledge management contribute to the solution of this problem? The council needs knowledge to work on a strategy, and there is no systematic knowledge generation in the council work.

1. There is no process or institution for knowledge generation inside the council nor at the collaboration level of the council and leading administrators.

Requirement G1: Knowledge management must provide a forum for knowledge generation by the council.

2. Strategic issues are mixed with complex legal, formal and administrable issues up to the point that they are indistinguishable. Only the administration appears to have the knowledge to handle this delicate mixture. The underlying problem is this: Proposals do not distinguish between outcome (what do we want to achieve? e.g. fewer unemployed young people) and output (how is the outcome put into measurable terms? e.g. by a public employment program generating 100 jobs) and the implementation of the output. Only outcomes are strategic.

Requirement G2: Strategic outcome information must be separated from output information and implementation information.

3. Strategic knowledge is fragmented and presented bit by bit as decisions have to be made. It is concealed by specific decision processes and tends to be forgotten.

Requirement G3: Knowledge generation processes for strategy must be separated from specific decision processes.

4. There is no systematic qualitative knowledge generation by the citizens or knowledge elicitation from the citizens. Quantitative surveys and ad-hoc interactions with citizens are not sufficient. This leads to requirement G4:

Requirement G4: There must be a forum and processes for the knowledge generated by the citizen.

Large parts of G1-G4 have been implemented in the city council of Christchurch [4].

Knowledge distribution and sharing: Once knowledge has been generated, it has to be distributed and shared with others, because city councils are a collective decision making body. A brief introduction to the current distribution follows: Most decision information is distributed by the administration. Each administrative division supplies the council members with decision proposals related to its area of expertise. While there is an elaborate coordination process between the divisions, if several divisions are responsible for a proposal (e.g. most of the time, the Finance Division is involved), there is no central coordination of knowledge distribution. There is only an administrative agency which collects motions from the parties and distributes them to the other parties and to the affected agencies. Inside the parties knowledge is managed by the party office and the party leadership. They collect all the additional important information and convey it to the party members, mostly in the weekly party meetings. Party meetings also serve to pool the knowledge of the party members. This distribution of knowledge leads to the problems already addressed above. The council members are both overloaded with information and feel they do not have enough knowledge for decision making. How can that happen? We start by making explicit our understanding of information and knowledge: 1. Knowledge is linked information 2. Humans typically communicate information, not knowledge. Thus all collaboration processes transform information into knowledge (to relate it to other knowledge) and transform knowledge into information (to communicate it to others) (Fig. 2).

**Fig. 2: Information and knowledge**

Based on this understanding, many knowledge distribution problems can be subsumed under 'missing link problems' and 'dangling link problems' (Fig. 3).

**Fig. 3: The missing link/dangling link model**
A council member has a missing link problem if new information cannot be linked to current knowledge. Reasons can be personal cognitive capacity (information overload), lack of time, lack of interest, etc. Missing link problems lead to information rejection. A council member has a dangling link problem if a link leads to nowhere but there is awareness (on a higher level of knowledge) that there should be knowledge. Reasons can be a general expertise in knowledge processing ("you always need information on costs"), conclusions by analogy, deducing from abstract principles etc.

Dangling link problems typically lead to a request for more information. If this information is poorly prepared, it can again lead to a missing link problem. Thus, a vicious circle of alternating missing link problems and dangling link problems can develop.

Let us now look closer at a decision proposal to understand how these problems are coming up in the beginning. A decision proposal includes all information necessary to make a decision, or more precisely, all information the administration judges necessary to make a decision. Consequently, it is a document that can be read in isolation. While this can be regarded as a service, it can be the reason for several problems:

1. As it has to be comprehensive, a decision proposal tends to be too long. This leads to missing link problems because of a lack of time or cognitive resources.
2. A decision proposal has no or few prepared links to strategy or other issues. Links have to be made by the council members themselves. If they do not succeed, they have a missing link problem.
3. If there are links (e.g. to budget positions), they are usually difficult to trace. This leads to a dangling link problem.
4. However long, a decision proposal is necessarily incomplete. This leads to dangling link problems, at least for some council members.

This list of missing link problems and dangling link problems is by no means complete. But it is already long enough to motivate requirement DS1.

Requirement DS1: Knowledge distribution management must provide mechanisms to efficiently handle 'missing link problems' and 'dangling link problems.'

It is interesting to observe that processes for knowledge distribution and 'knowledge pooling' are elaborate but not always efficient. Under 'knowledge pooling' we understand processes that bring together the knowledge from different sources in order to make shared use of them. The typical knowledge pooling process is a meeting.

The traditional practice of knowledge distribution leads to timing problems, targeting problems, and problems in information presentation: Council members frequently complain that information comes too late. From the individual council member's point of view, information is also provided at the wrong time: All background information on an issue is made available when the administration wants to reach a decision. At that time the council member may not be interested in a topic, resulting in a missing link situation. However, when triggered by a citizen on an issue and wanting to react, the council member has to make a big effort to get the information from the administration. Thus, while it is very easy to push information to her, it is difficult for her to pull the information. The council work requires a better balance between information push and information pull.

All council members are entitled by law to receive the same information from the administration (with some exceptions due to membership and confidentiality in committees). To abide by this rule, all information is sent to every council member, which is a rather untargeted way of information distribution. While it is obvious that in a democracy all council members get access to the same formal information, it is questionable whether all information needs to be conveyed to them. Would not immediate access and good overview information or a notification be sufficient? At least it would save the council member a lot of time. Furthermore, all information is presented in the same way to all users. While this is useful in knowledge pooling phases, for individual use information should be presented according to individual preferences. To summarize the argument in a pointed way, the current mechanism for knowledge distribution and sharing leads to too much information and too little knowledge.

Due to the difficulties in knowledge distribution, meetings are also used to distribute information. Meetings are purely oral; therefore, as more people attend, the meeting is less productive.

The Media Richness Theory [2] and Media Synchronicity Theory [3] give advice on what media should be used for what purpose. In addition, we advise that factual knowledge should be distributed asynchronously and in writing; judgmental knowledge and opinions are best shared in face to face situations. As there is a large gray area between factual knowledge and judgmental knowledge/opinions, there should also be an appropriate gray area of mechanisms and media.

Requirement DS2: Knowledge management must provide efficient mechanisms and media for knowledge distribution and knowledge pooling. This must at least include push and pull mechanisms for information.

How much knowledge is shared inside a party is highly dependent on the party culture. While one large Stuttgart party is rather secretive (even the minutes of the party meetings are reserved to the leadership), another party openly discusses most matters. For this reason, there cannot be a single comprehensive knowledge management for all. This leads to requirement DS3:

Requirement DS3: Knowledge management must include push and pull mechanisms for information. The council work requires a better balance between information push and information pull.
**Requirement DS3:** Knowledge management must provide room for different cultures and the resulting information distribution and knowledge sharing behaviors.

**Knowledge usage:** The activities and knowledge processing of the city council cumulate in the council decision. The council decides on community issues (primary decision), or it needs decisions to allow the control of the administration (e.g. requests for information on an administrative activity). The decision processes are highly efficient in terms of decisions per hour, but is this a good measurement? Looking closer, we discovered that the decision process is highly fragmented; i.e. there are many decision, often on minor issues. A single decision is made by a final yes/no vote after a discussion. Typically, there are no more sophisticated voting schemes like prioritization.

Generally there appears to be a lack of prioritization in decision activities. For example, there is little correlation between the significance of an issue and the amount of time that is spent on it. Rather, there appears to be a correlation between the amount of knowledge in the council regarding an issue and the time spent on the issue: The more knowledge the council members have, the more they discuss. In some instances, dangling links may be the reason (the more knowledge there is, the more dangling links can potentially exist); in other instances, the council members want to gain profile in the public. This is only possible in areas where they have knowledge. This prioritization mechanism may be understandable, but it is not beneficial from a rational point of view. From a rational point of view, the time spent on an issue should be (ceteris paribus) equivalent to its strategic or political importance. This topic has several implications for knowledge management:

**Requirement K1:** Knowledge management should enable the council members to gain knowledge in areas of strategic or political importance.

This is currently handled well in areas of political importance and less well in areas of strategic importance. Once the council members have the knowledge on important topics, there is a better chance that time will be spent on strategic issues. This is, however, only a long-term solution. It is, at the present, hindered by the seemingly more urgent day-to-day business. The principal agency conflict [7] between the administration and the council can be particularly hindering in this respect. It may be useful from the perspective of the administration to provide the council with ever more information on unimportant issues in order to get the administration’s important proposals passed with a minimum of information and trouble.

**Requirement K2:** Knowledge management must focus on a prioritization of issues. A prioritization of issues should be reflected by a prioritization of information.

Prioritization can result in a more rational distribution of discussion time (prioritization in the agenda-setting) and in a more rational usage of resources. The example of Christchurch again demonstrates that this requirement can be realized. It also shows that prioritization should be a joint process of council and administration.

In meetings council members tend to lose focus. One way to lose focus is a lack of a shared understanding. A shared representation of the current issue can foster a better shared understanding than leaving the issue 'in the air' during a purely verbal discussion. Currently, the printed decision proposal serves as a shared representation of the relevant knowledge. However, if the proposal is changed during the debate, council members tend to lose focus and frequently leave the meeting without knowing exactly what they have decided. The loss of a shared representation becomes critical in budget deliberations. The Stuttgart budget plan comprises several hundred pages, mainly with figures. While the chairmen have a sophisticated system for focusing the council on the same budget position at the same time, council members frequently lose the overview after a couple of changes and do not know what the exact budget deficit is.

**Requirement K3:** Knowledge management should provide a shared representation of the relevant knowledge.

An example of a shared representation of knowledge is a mind map on a flip chart or an electronic chart with the budget figures. It is not productive to make all decision-related discussions in the meeting. This results in requirement K4.

**Requirement K4:** Knowledge management should provide a forum for predecisions outside meetings. To fulfill the requirements of democracy, this forum must be as visible as public meetings.

**Knowledge storage in organizational memory:** Knowledge on decisions and their background is stored in the memory of the participating actors. There it is a valuable resource for future work. Some participants make personal notes to augment their personal memory. Council members also have personal archives. In these personal archives they store all decision proposals and motions that interest them. These archives normally cover only a fraction of all the decisions, even of the running term, simply because the council members do not have the space at home to store all documents, and they do not have the time and energy to build up a systematic archive. The parties have more complete archives. They typically contain all party motions, the minutes of the council meetings, and the minutes of the party meetings. They normally do not contain a complete set of the decision proposals.

The administration is the originator and the owner of the official organizational memory. It has paper-based and digital archives with all proposals, agendas, motions, and
minutes on the council deliberations and decisions. The information is entered into the official organizational memory by the administration. Besides writing the decision proposals, preparation of the meeting minutes is the most important activity for the storage of knowledge in the organizational memory. Only those events that are recorded in the meeting minutes 'happened.' The administration stores the organizational memory in three forms: a tape with the oral discussions, an extensive written summary prepared by the minute takers, and a short abstract in a host database.

If a council member wants to get access to the formal organizational memory, typically a request is forwarded to the administration, and then the documents are delivered, often some days after the request. The council members heavily rely on the organizational memory system of the administration, because it is the only complete and official storage. This leads to requirement KS1.

**Requirement KS1:** The official formal organizational memory must be complete (and is by definition complete).

As difficulties of this approach become more apparent in later phases, we will formulate any other requirements on storage. It may only be said that the current approach is very labor intensive.

**Activating organizational memory:** Organizational memory is typically activated by an outside trigger that refers to events in the past. This can be a report in the press, a request by the administration, a change of law or regulation by some other state agency, or an event such as a recurrent meeting on the same subject (e.g. the yearly budget sessions). Activating organizational memory means that a dangling link is created. Information recall from the organizational memory is the consequence if the search appears to be worthwhile. Judging the value of organizational memory and the cost of accessing it in advance is an essential qualification for a council member. A responsible council member does not only take her costs into account but also the costs for the party office or the administration if requesting the information. It happens in practice that a council member unknowingly blocks the work of an administrative clerk for several days or even weeks by requesting information.

**Requirement A1:** Knowledge management must qualify council members to make a sound cost/benefit analysis before accessing organizational memory, provide them with a stable environment that makes such an ex ante assessment possible, and give them tools and procedures that support the assessment in complex cases.

A tool that supports assessment could be a simple overview of the information available inside the party/administration or a database on the costs of prior requests. A procedure could be a qualified request for information, asking the responsible staff in the party office or the administration to supply the information only if the cost is below a given threshold. If the cost is above the threshold, a cost estimate should be supplied instead of the information.

A lot of recall from organizational memory is ritualized in the city council. For example, in every yearly budget proposal the figures of the last two years appear beside the proposed figures. Proposals try to refer to previous decisions on the same matter. Thus a dangling link to the previous decision is explicitly created. Furthermore, the process of meetings follows a strict ritual which appears like a continuous enactment of organizational memory. This observation leads to requirement A2:

**Requirement A2:** Knowledge management must take the ritual activation and enactment of organizational memory into account.

Problems in activating organizational memory surface in those actions where the initiative comes from the council. Currently, the administration is poorly prepared to react to motions and agreements that come up during meetings without prior notification of the administration. The administration tends to forget promises and motions made in the heat of a meeting. Repeated or conflicting decisions on the same matter are one consequence; angry reactions of council members who have to carry the burden of activating the organizational memory are another consequence. Some event-based or time-based triggers are best implemented in the organizational memory system. They can provide the council members and the administration with a link to the relevant information.

**Requirement A3:** Knowledge management should provide predefined triggers for activating organizational memory inside the organizational memory system.

A very simple mechanism would be a suspense file. More sophisticated mechanisms should be implemented with care so the council members are not confused or overloaded. Once a proposal has been decided on, the information is stored in the formal organizational memory and often forgotten by the human actors. Currently, there is no mechanism to control whether the administration has really executed what the council has decided. An organizational memory system could be usefully augmented by a controlling system. Such a combined system could then trigger an alarm that activates organizational memory if performance is not satisfactory.

**Information retrieval from organizational memory:** Unless an embedded trigger provides the information with the link, activation of an organizational memory provides only a dangling link. The next step is information retrieval from organizational memory. Typically this is done by searching: The council member can search in the individual archives, recall the memory of colleagues by a telephone call, search in party archives, or make a deal with the local newspaper to get access to the newspaper archives or access other external archives. As mentioned
above, these archives are not complete and often poorly organized. Most of the time the council member accesses the organizational memory by informally calling persons in the administration or requesting information from the administration, because the administration provides the most convenient interface to the informal and formal organizational memory. By calling the administration, the council member can assign the effort of searching to the administration. Then the administration has the trouble of finding information in its rather poorly organized organizational memory system. While some problems may be specific of the Stuttgart situation, others are typical of 'organically grown' organizational memory systems. They also serve as an indicator for requirements for a better organizational memory system. Both organizational and informational changes are necessary. Major problems mentioned by council members and administration officials are as follows:

There is no central storage of all paper-based or digital organizational memory. There is not even a central catalogue. Some administration officials just know where to search for some information. There is a lack of information overview ("Do we know what we know?"). This leads to long search times. Unless a request is very urgent, it can take days to deliver the information to the council members. Furthermore, the administration cannot guarantee complete information unless the council member knows the exact document numbers.

Requirement IR1: Formal organizational memory should be easily accessible by all entitled council members. This includes direct access and good overview information.

Stored information is not sufficiently structured. For example, to-dos are not made explicit. Furthermore, there is no decision tracking information. This makes it difficult to later understand the rationale of the decision process and the decision.

Much information is not sufficiently linked. A given decision is at least linked to a decision proposal, a meeting agenda, and meeting minutes. There may even be several decision proposals, motions, and meeting minutes related to one topic. The current paper-based and digital archive stores each of them separately. Links may be mentioned in the decision text (at least if a later text refers to an earlier text), but these may not be complete, and there is no support for retrieving all information related to one topic at once. A thorough discussion of storing semantically rich information can be found in [8].

Requirement IR2: Digital organizational memory should capture semantics of decision topics. This includes structuring the documents, central key-wording, and linking related information.

The information is presented in a 'one size fits all' manner. Even if the council member is interested only in one paragraph of a long document, the whole document is reproduced. There are no information browsing, aggregation, or advanced selection mechanisms.

Requirement IR3: There should be user-friendly ways to retrieve information from organizational memory.

There is no difference between short-term memory and long-term memory. In practice, however, there are different requirements for both. If a decision proposal is moved from one committee to another, the members of the second committee need to be informed on the decision of the first committee before they convene. The second committee’s primary need is to get information fast, even if it is incomplete (e.g. does not contain all the discussions). As council members stress, they would even accept information that contains errors in some cases (e.g. if the minute taker has misunderstood a comment, and the chairman has not had a chance to correct it) if only they would get the information on time. Information from long-term memory, however, should be correct, precise, and complete.

Requirement IR4: There should be both a short-term and a long-term organizational memory. Short-term memory must be fast; long-term memory must be correct, precise, and complete.

If the requirement is met as specified, information could be directly retrieved from organizational memory by the council members. It would ease some of the current problems of council members and potentially change their information processing behavior. Currently, the council members heavily rely on the administration and thus are entrapped in a principal agency conflict. The information they receive from the administration may be late and biased. Access to information has to be preplanned (e.g. all weekend requests have to be deferred to the next working day) and is expensive.

Reusing the retrieved information: The retrieved information can be used the same way as the primary new information has been used: as part of a decision-making process. There are two prominent forms of information reuse in the city council:

1. Retrieved information is reused for controlling purposes. Controlling is one of two primary tasks vested in the city council by law. In order to control an organization, a council member needs a model to explain behavior and needs information to pinpoint responsibility.

2. Retrieved information is used as a weapon in the political discourse. In the Stuttgart City Council, one member had systematically built up his private council archive. Part of this archive was a computer-based information system with personal notes on all decisions. After some years of collecting information this way, the council member became one of the most powerful members of the city council. He was renowned for standing up during a meeting, citing precisely what had been discussed and de-
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The chairman of a district council links the council with the district council. The chairman needs access to the organizational memory on all issues related to the district. He or she receives all the formal regulations of the administration (local law etc.) but does not automatically receive the decision proposals and the council decisions. He or she has to order them from the parties or the administration. This procedure causes a lot of friction, because the council relies heavily on the expertise of the district councils in local matters.

Interested citizens, party members outside the council, and the press link the council with the general public. These external persons need good information from the administration and council in order to give qualified input to local political work and to provide the public with sound information. By law, the official organizational memory is public, except for 'internal deliberations' and 'secrete information.' In practice, only the press and very few citizens have the expertise to extract and manage information from the official organizational memory on political matters.

The discussion on aligning knowledge and organizational memory to organizational structures highlights another point: If knowledge is decentralized, many knowledge management functions must be decentralized, too. For instance, the knowledge management of a party cannot be taken over by the administration. However, the central administration can provide the council parties with an environment that enhances productive party knowledge management. Such an environment should be a mixture of organizational support, person based information services, and a computer-based information system. Such an information system will be presented in the next sections.

3 Knowledge management and organizational memory in the Cuparla System

The Cuparla System has been developed as a teleoperation system, i.e. a system that supports the information, communication, coordination, and cooperation in council work. The Cuparla software currently provides the council members with distributed document management tools, information databases, electronic mail, and shared calendars and electronic meeting support. This functionality is implemented in a context-oriented environment: There is a digital "private office" where the council member works alone, a digital "party room," where the member collaborates with party colleagues, a digital room for committee meetings, a digital room for work groups, a digital private post office, and a digital library for filed information.

The council member creates a document in one room (e.g. private office) and then shares it with other council members in other rooms. If a document is moved into the room of the respective political party, the member shares it with her party colleagues; if it is handed to the administration, the member shares it with public administrators and officials as well as with all other council members, etc.

We will now show how the Cuparla system has contributed to the improvement of council work. The first four sub-sections describe requirements that have been directly met by the Cuparla System. The latter four sub-sections contain mainly management problems; here a computer-based system can only provide a small part of a solution.

**Forum:** 1. Rooms and forums: Cuparla provides the council members with room for working on their own initiative. Separate rooms have been established: a forum for collaboration with the citizens (the Internet room, requirement G4) and a forum for collaboration in the council and in the parties (requirement G1). Decisions outside real meetings can be discussed in the committee or the local council room (K4). The latter are, however, not public; for public discussions the Internet room should be used as a forum. Knowledge generation processes of the council (G1) and with the citizens (G4) can also be supported by GroupSystems meetings. There is the possibility to use creativity techniques.

2. Culture and forums: The separation of working contexts allowed different collaboration cultures to develop (DS3). One hierarchically organized party mainly used e-mail and coordination features; a more collaboration-oriented party used GroupSystems for party meetings, and it used the party room in a collaborative manner. Some council members used GroupSystems for a three-day workshop with citizens as part of the worldwide Agenda 21 process. Both the council members and the citizens called the workshop and the computer support a success. As Internet support for council members only started in June 1998, it is currently too early to judge its effect.

**Distribution over networks:** 1. Distribution efficiency: Cuparla distributes information electronically. The council members replicate their notebook databases in regular periods (e.g. daily) and can then work asynchronously. While the organizational cost for entering the information into the database is still high, distribution costs can be drastically reduced by electronic media. Duplication and distribution of decision proposals and agendas to the city council cost about DM 250.000 per year (variable costs). Electronic distribution is estimated to cost approximately DM 40.000 per year (variable costs). Furthermore, electronic distribution can save one to two days in delivery time. Electronic distribution is, therefore, more economical (DS2).
2. Information push: The decision proposals and meeting minutes are presented to the council members in three rooms: The local council room and the committee room contains all the current information on council work and committee work, respectively. New information (i.e. information that has not yet been read by the individual council members) is marked by a red asterisk. Information is automatically removed from the rooms when the meeting has taken place and a grace period of ten days has passed. Thus, the local council room and the committee room push information to the council member in a similar manner as conventional delivery by paper mail (DS2). Informal information can be pushed to individuals or groups by Email.

3. Information pull: All information in the formal organizational memory is also accessible from the administration room. Here, the members can search in a database containing all electronic documents (including more than 8,000 documents covering the deliberations between January 1997 and March 1998 and more than 100,000 abstracts covering the deliberations between 1987 and 1996). They have a query interface that allows them to retrieve the information they need. Thus, the administration room provides the council members with an information pull mechanism (DS2). The opportunity to easily and actively pull information from organizational memory is heavily used by council members and rated as one of the most important features of Cuparla. It appears to lessen their 'dangling link problems' (DS1).

4. Knowledge pooling: The Cuparla collaboration infrastructure is shared by the city council members. It allows parties or working groups to easily pool knowledge by entering it into the Cuparla system (DS2). Currently, knowledge pooling with Cuparla can only be observed in the parties.

Digital documents: 1. Reuse: Cuparla stores most of its information in digital form (only scanned-in documents such as maps or drawings are stored as bitmaps) (R2). Digital information can be reused. We observe that council members frequently reuse information from short-term memory for writing new documents. We, however, have not yet observed frequent reuse of information from long-term memory. Thus digital storage of knowledge is justified for short-term memory because it allows information reuse; it is justified for long-term memory because it allows information retrieval.

2. Freezing information: Cuparla uses the Lotus Notes mechanism for freezing documents in the organizational memory system (U1). A frozen document cannot be changed, not even by a link inside a document. Stored information can only be changed by annotations or links to documents (U2). Frozen information can be reused by making a new copy. Working with frozen documents appears very natural to the council members. Links and annotations to organizational memory have not yet been implemented simply because we have not been able to identify a person or organizational sub-unit that feels responsible for doing the work. This is an example (by far not the only one) where a useful feature is not implemented because the beneficiaries are not the same people as those who have to do the work. We, however, expect that the council will request the administration to do some basic linking later in 1998.

3. Shared representations: In traditional council meetings, printed documents of the decision proposal are shared. As long as no or few changes occur, they meet the requirements. Cuparla replaces these paper documents by digital documents. The latter can immediately reflect changes. We have not yet been able to test on-line changes of shared documents, simply because the meeting-room network is not adequate. One experiment with a mobile GroupSystems environment in a committee meeting showed how committees can become much more productive by working in a shared environment. Council members frequently share the same knowledge representation in asynchronous collaboration and in GroupSystems meetings in the party (K3).

Database: 1. Basic database features: Cuparla stores information in a computer database. A document database meets a set of the requirements: Formal organizational memory is easily accessible by all entitled council members (IR1), and all have an equal opportunity to reuse information (R1). The council member can access digital organizational memory any time and from almost any place (wherever one can go with a notebook). In particular, the flexibility with view to time is much appreciated by the council members: About 60 percent of all replications occur outside normal office hours (9 a.m. - 5 p.m.).

2. Retrieval and interface: The Cuparla team has long struggled with designing a user-friendly interface to retrieve information (IR3). Finally, we ended up with a set of deeply nested views presenting information in different sortings (e.g. by committee, by date, by topic). These sortings provide the council members with overview information (IR1). In addition, there is a full text index. Council members use the index for simple keyword search; more sophisticated searching mechanisms (e.g. combining keywords with Boolean algebra) are too complex for almost all of them.

3. Keywords: The Cuparla system captures some semantics of decision topics: Central key-wording turned out to be more problematic than we estimated in the beginning, because each party had its own scheme for organizing office work. We, therefore, supplied the council members with a central official keyword list. We also offered to define and use their own keyword list. While some parties successfully implemented their specific key-
words, others shunned the work to organize their own list and only used the public keyword list.

4. Other semantics: The electronic decision documents have an improved structure: The involved committees, the publicity status (public, non-public), the decision dates, the summary, and the topics are made explicit. The structure and connection with the electronic availability of documents make it easier to transfer information once the council member leaves the city council. In addition, we made the past activities on the document explicit (who has worked on it and at which time). Here both the administration and the parties insisted that their past activities must not be visible to the 'other side.' We have not yet succeeded in linking related information except by keywords. We are, however, confident that the structured presentation of information and key-wording allow for a faster selection of relevant information reducing the cognitive load and solving some dangling link problems (DS1). In 1999 the administration will introduce an electronic suspense system and will separate to-dos from other information in meeting minutes. This will be a first step towards predefined triggers for activating organizational memory inside the digital organizational memory system (A3). Still open to political debate is whether only the administration or also the council will receive this mechanism. It would greatly enhance the council's controlling abilities.

A curious but not untypical side note: The administration is renowned for 'forgetting' motions by the council or answering them months or even years later. Currently, council members use the Cuparla document overviews to check if the administration has worked on their motions. If a motion has been worked upon, it has an 'answer document.' These answer documents can be easily seen in a document’s overview. The administration has since reacted to this behavior by working on motions very soon after they have been submitted. Frequently, the administration writes an answer document that contains only the text “We will work on this motion later.” This behavior makes all controlling by means of document overviews pointless. The council members again have to bear the effort of checking all motions individually.

Cuparla supports the council directly by means of forums, distribution over networks, digital documents, and databases. Strategy, content, focused information, and economy require managerial work.

Strategy: The Stuttgart City Council is currently stuck in a debate on the strategic role of the council. While the administration wants the council to focus on strategy, the council does not trust the administration and does not want to lose contact with the electorate. There have been efforts to separate strategy discussions from day-to-day activities, particularly by organizing yearly strategy workshops (G3). However, these workshops have not been successful. For this reason, Stuttgart is not yet at the point where it can separate strategic outcome information from output-information and implementation information (G2), and the council is not willing to concentrate its learning efforts on areas of strategic importance (K1).

Content: 1. Completeness: From the beginning of the Cuparla project, the council insisted on completeness of the supplied information (KS1). This means that the processing of decision proposals had to be turned digital in all parts of the Stuttgart city administration (more than 5,000 personnel). The City of Stuttgart tackled this problem with an internal system, which is only partially successful. After a more than one year effort, only a minority of the administration personnel was technically and organizationally able to digitally work on proposals with shared databases. Completeness of content could only be achieved by allowing submittal of diskettes to a central entry office. By September 1997 completeness could be guaranteed; this marks the point in time when the council members started to seriously work with Cuparla.

2. Long-term and short-term memory: The council very early requested not only a long-term organizational memory support but also a digital short-term memory. The Cuparla system takes the document life cycle into account by differentiating between different document locations: A room has desks for very short-term organizational memory and collaboration, shelves for medium-term organizational memory, and an archive for long-term organizational memory. The administration has also made great efforts to supply 'important minutes' fast (IR4); however, up to now it has been impossible to implement specific short-term organizational memory in the Stuttgart administration. We have simulated a short-term memory as far as possible by using the council room and the committee rooms. Here we electronically select all information from long-term memory that we think should belong to short-term memory. Some additional efforts for their own short-term memory have been made by council parties.

Focused information: 1. Prioritization: As long as it remains unresolved whether the city council wants to concentrate on strategic issues, it is difficult to prioritize issues (K2). The chairmen of the meeting now ask the participants at the beginning of the meeting which topics they want to discuss. This allows for some preplanning, and only those administration officials whose topics will be discussed have to stand by. Furthermore, the council has one focus topic every two months. However, prioritization of issues is still so poor in meetings that the local press has taken up this topic and bitterly complained about the unprofessional meeting management [1].

2. Experts and novices: Experts and novices receive the same computer environment. One novice who has replaced a council member during the term (November 1997) has reported that the computer support made it sig-
nificantly easier to get accustomed to council work. We assume that the environment makes some important process knowledge and overview information explicit. Experts report that they value the possibility of searching information, but they miss detailed information on the status of projects. They still have to actively request information on project status. Even the ritual activation of organizational memory only works reliably if the administration wants the activation to happen (A2). For example, the administration tends to promise a yearly progress report on some topics and then forgets it. In a recent meeting, council and administration have agreed that future progress reports will be supplied via Cuparla. However, this does not keep the administration from forgetting. The council members also miss an electronic budget that allows them to drill down to various levels of specificity.

**Economy:** Currently, the council members do not have any mechanisms or processes to make a sound cost/benefit analysis before accessing organizational memory (A1). Cuparla only touches this problem: Now, the council members know what information can be provided without effort; they still cannot estimate how much an official request for information costs the administration. To our knowledge, no processes have been installed to tackle this problem. We are not confident that they will be implemented soon, because any sound cost estimate would require the participation of the people doing the information searches. For this reason, contact between them and the council would need to be established. If this contact would be channeled through the administrative hierarchies, costs and time spent would be prohibitive. On the other hand, a direct contact between the council and the office clerks (e.g. by e-mail) would not be in the interest of the administrative managers.

### 4 Lessons

We have developed a framework for analyzing issues of knowledge management and organizational memory that is based on real field problems. Pilot studies in other cities and a market survey with more than 1,000 council members show that many of the observed knowledge management and organizational memory problems are typical, at least for German councils. Therefore, the German Telekom has decided to commercialize Cuparla and to re-implement the system as a scaleable software. Two other large German cities are already considering the introduction of Cuparla in 1999.

We also believe that many knowledge management problems are generic of formal committees even outside councils: The model of knowledge work could also be successfully applied to company boards, lobbies, and associations. We believe a particular strength of the model is the integration of organizational memory into knowledge work and the explicit analysis of organizational memory activation processes. They provide a fruitful link to many controlling problems. We also believe that the distinction between generation, primary use, and primary storage of information and the reuse and update processes may be somewhat artificial in practice but highlights differences in knowledge management.

We observed missing link and dangling link problems in many other contexts, e.g. in project contexts. The Cuparla analysis of information requirements and presentation of information in distributed collaboration environments may serve as an example of how to tackle this problem. It was particularly interesting for us to analyze the segmentation of organizational memory. There appears to be a correlation between different collaborative cultures and organizational memory structure. A good organizational memory system should, therefore, support this segmentation. We have shown with the Cuparla system how this segmentation can be implemented based on a room metaphor.

### 5 Literature