IFIP

**International Federation
for Information Processing**

2nd IFIP TC8 Conference on

GOVERNMENTAL AND MUNICIPAL INFORMATION SYSTEMS

June 3–6, 1991

BALATONFÜRED, Hungary

Organized by the
John von Neumann Society for Computing Sciences

Preliminary Proceedings

iTA/392

CONTENTS

A NATIONAL LEVEL INFORMATION SYSTEMS POLICY FOR PUBLIC ADMINISTRATION IN THE NINETIES.

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Abstract

This paper presents a general framework for the description, analysis and planning of information systems in public adminis-tration. Such a framework is considered a pre-requisite for the implementation of information systems (IS-) or information tech-nology (IT-) strategies in government. The basis is an organ-ization independent taxonomy of government information systems, extended by an administrative differentiation between information management and system management (Ref.1). Information systems strategies based on the framework cover distinct levels of government and their interrelations, different stages of tech-nological development in the applications, and eventually structured innovation of public administration if that is what is required politically. The resulting IS-policies at national level are illustrated by the general principles, overall objectives and practical instruments codified in the reviewed IS-decree for public administration in the Netherlands (Ref. 2). This decree replaced an earlier one of 1980, and was also based on the final reports of the Central Committee on Government Information Systems (1986-1990).

1. The recognition of the problem

In practice and in research the introduction of modern IT into information systems in business and public administration has been a matter of growing interest for more than 30 years already. The reasons vary from time to time and from place to place, but on the whole they remain valid or reoccur again and again. General solutions for the problems encountered, have not been found yet, and specific answers have rarely proved to be very reliable.

An apparently lasting bottle-neck is the shortage of experienced high level specialists. This is strengthened by the pace of tech-nological and methodological developments. It renders empirical knowledge and practical skill out of date rather quickly, and offers opportunities both for technical hobbyism and plain level amateurism. A second reason for concern is the ever growing financial budget required for the procurement of hardware (and system software), and especially for the development and mainten-ance of IS. The latter often accounts for more than 50% of total expenses. Most of the time there is no provable or proven ex ante or ex post economic justification available. Favourable outcomes of comparative costs analysis (i.e. low IT-budgets) may as well point to lagging behind as to excellent administration.

From other points of view the consequences of the introduction of IT are even more difficult to evaluate. Protection of personal privacy and commercial confidentiality may, but need not improve,

1

long term affects on quantity and quality of employment are uncertain and societal continuity seems to be at risk (security). Lastly there is a growing awareness of the strategic importance of IT for the competitive position of private enterprises and the political and administrative authority of different government levels and agencies.

It is generally acknowledged, however, that the use of IT or the informatization of our organizations, may help to achieve our goals, provided it is taken care of in "the right way". In some sectors efficiency has been improved by the use of computers, and more complex or even problems which seemed unsolvable are being dealt with more effectively than before. Political control and the quality of service to citizens have in general cases been improved. What makes alert business leaders and some politicians even more attentive, (and uneasy) is that the use of IT-facilitates is crossing the borders of given territories. It then offers new opportunities and is considered a threat at the same time. Those responsible are looking for guidelines and want to develop policies (of which such guidelines may be a substantial part) to elevate public administration by the use of IT in an integrated way and in coherence with other objectives and other instruments.
Such IS-policies should, we propose, satisfy a number of à priori conditions.

In the first place the guidelines should be applicable at all levels of local, regional and central (national) level, and in some fields even by international government (for instance the European Commission). This means that their overall character should be of a generic nature. Only the resulting specific measures in special cases can take into account different levels of technological sophistication, changing political priorities and restricted resources (staff and finances). And they should do so, otherwise the whole will remain "paper policy" only.

Secondly it should at any moment be perfectly clear how authorities and responsibilities with respect to IS in government are being determined and agreed upon. As a start, the simplest way is to declare existing public agencies explicitly to be autonomous with respect to the way they meet their information requirements. But only as a starting point. As soon as horizontal or vertical exchange of information is necessary, and especially if the primary processes of the agencies concerned is information processing, some kind of co-ordination should be considered and even re-allocation of tasks can not be excluded. Information systems never are a matter of internal technical efficiency on the short run only. They always have to take into account external administrative effectivity on the long run as well. That is why information systems policies at a national level are required.

2. The analysis of the problem

In each country public administration is structured according to geographical and functional dimensions. The accompanying

measure of administrative decentralization and political autonomy, as well as relationships with the private sector differ from country to country and from historical period to historical period. This is one reason why a basic information framework of public administration, to be general, should be organization independent. The second reason is that, as we have seen, the informational approach of public administration puts authorities and responsibilities of government levels and government agencies at discussion, at least with respect to their information processing. This is nothing new: from the very beginning the application of computers influenced the internal organization, and since more than a decennium the integration of computer technology and telecommunication is a decisive factor in the external organization of the private sector. Organization theory has taken notice of this, both in empirical research and in explanatory theories (Galbraith, Ciborra). As was reported before, in the public sector a classification into three types of information systems helps to clarify the informational relations between government organizations and the relations with the private sector. They are:

Type A. Public registers which describe society as a whole in terms of individual entities such as population, vehicles and shipping, fixed objects (land, buildings, utility networks), societal objects (legal corporations and their locations) and e.g. cultural objects (such as those in public libraries and museums). They serve the legality of all transactions, the levying of taxes and the enforcement of law in general. They also form the basis of public statistics. These information systems usually have a legal basis sui generis, but in operation they are organized very differently. Basically they are the backbone of public administration, facilitating equality and security of rights and democratic control.

Type B. Sectorial information systems which are required by a number of similar (semi-)public organizations, such as police corps and law courts, in public health, education and public housing, public utility companies, and all agencies for income redistribution (social security, industrial subsidization etc.). These organizational units usually exchange detailed information at operational level but also have to provide higher level authorities with standardized and consistent information for policy making purposes.

Type C. Public resource information systems which serve the management of public administration. They comprise personnel information systems, financial information systems, information systems for management of materials and equipment, and all documentary information systems (both government laws and regulations and other through which government discharges its duties). A characteristic of these systems is that they may be the same for public organizations with entirely different tasks.

This classification distinguishes three groups of information systems which are homogeneous from a functional point of view. Logically, for instance definition of data elements, and techni-

3

cally, for instance specification of equipment, they may be, and to some extent will remain, separate. The main IS-policy problem is to what extent that should be the case, and how the existing situation can be changed if that is considered to be desirable. For that purpose a further analytical instrument is available. It is the dual dichotomy of concentration/centralization and informationmanagement/systemmanagement. The degree of centralization is defined as the extent to which decision making power is situated in a larger or smaller number of organizations or administrative positions. The degree of concentration refers to the number of geographical locations where decisions are carried out and resulting operational activities take place.

Empirically it has been found that the degrees of centralization and concentration differ. Decisions on information pocessing taken at one place may be carried out at a number of places and the other way around. Normatively it has been shown that each combination of positions on both continua, may be optimal, depending on technical, economic and other criteria used. This applies both for system management and information management independently. Especially in the public sector a relatively central and concentrated allocation of system management (the design, construction and maintenance of information systems) is complemented by a relatively decentralized and deconcentrated allocation of information-management (the operation and practical use of information systems by organizations).

An explanation for this remarkable result is that in the public sector the underlying information requirements are given by laws and regulations. They hold for a whole field of public endeavour and all instances of information systems, often supported by compulsory exchange of information at operational level and reporting obligations to higher levels.

In the Netherlands this resulted in a sort of codification of a number of "principles" for the organization of information systems in public administration. They are discussed in the next paragraph. This does not mean, however, that at a certain point in time, a blue-print can be given for the optimal and ultimate arrangement of information systems in public administration. On the contrary, the analytic notions explored are primarily used to conceptualize and visualize present situations and possible future ones. This is done in multi-year information plans of separate government agencies at different organizational levels, and in so-called information structure plans which give policy outlines for categories or groups of information systems. Very often they do not come under a single common authority competent for information systems in that area. The end result may, however, very well be that in order to obtain co-operation such an authority is to be established. The analysis may also show that for the time being the possible benefits of such co-ordination do not set off the efforts required to do so. And anyway the whole proces of change may take a long time.

3. An approach to tackle the problem

3.1 Shifts in administrative objectives

Up till about fifteen years ago general IT-policies in the Netherlands were restricted to the procurement of, mainly, computer hardware. In the political wave of deregulation, decentralization and privatization of the eighties, the specialized central procurement office for "office equipment" which existed since 1928, was dismantled. The general procurement agency, which anyway had no special expertise in the data processing field, was privatized. During the same period the total expenses in the public sector on hardware and proprietary software grew with a factor two or three. (The percentage of these costs as part of the total expenses on information systems, dropped from more than 50% to less than 25%).

At the administrative level attention moved from hardware to system development and its methodologies, from there to information systems planning at the level of individual government organizations, and finally to information systems policies at national level. This did not mean, however, that the attention to the former topics disappeared all together. For instance the neglected task of developing and keeping up to data the standard model contracts, not only for hardware but also for application software, body shopping and other services, was taken up again by the Ministry of Home Affairs in 1990 in co-oporation with IT-suppliers. As before this was welcomed by the private users world as well.

There also is a growing need to streamline and interface system development methodologies, also at the international level (Euro-method). This is stimulated by the increasing importance of interorganizational integration of information systems especially after the introduction of electronic data interchange (EDI) and the resulting "backward integration". It is facilitated by the fact that in the public sector in the Netherlands one form or another of Pandata's System Development Methodology (SDM) is widely used as a model for system development (SDM does not prescribe the use of specific methods and techniques, but does give a comprehensive guideline for management and documentation of the system life cycle).

Moreover most of the system development and maintenance work remains in the hands of government owned and administrated, data processing centers and software houses, some of which have recently been put at-a-distance from the departmental organizations and received a more autonomous legal status. About 25% of all work is contracted out to third parties, which is, by the way, more than the private users sector usually does. Apart from one-off, relatively small and especially isolated applications, the use of fourth generation languages and the like, is not expected to change this very much. It also stands entirely separate of the wide application of mini's en microcomputers which are more and more centrally coupled and managed in local and inter-organizational governmental networks.

5

With the first decree on information systems in government of 1980, central government agencies were obliged to prepare every one or two years information plans for their information processing activities in the next three to five years. For that purpose a special method for this type of planning was developed and used as a model for those agencies which needed some guidance and support in this new field.
Moreover since 1975 an intergovernmental committee under the chairmanship of the Minister of Home Affairs prepared the ground for exchange of systems and information between central, provincial and municipal governments.

In 1986 a new "external" commission was asked to advice on the future of government information systems. It consisted of representatives of some large ministries, leading persons with IS experience from the private sector, and experts from the universities under the chairmanship of the former minister of Education and Science and former chairman of the employers union in the Netherlands, mr. C. van Veen. The commission delivered a number of interim reports on topics such as privatization and contracting out, quality assurance, the organization of inter-organizational information projects, and the establishment of a new small "center of expertise" for independent evaluation and contra-evaluation of large critical governmental information systems.

In 1988 the government presented at the request of parliament and partly on the basis of the recommendations of the Commission a policy paper on information systems in government. The commission, which was installed for a period of four years, delivered its final report beginning 1990. Within a year the Decree on Government Information Systems of 1980 was reviewed thoroughly and officially issued by the Council of Ministers, together with the Council's standpoint on all other recommendations of the commission.

3.2 Practical principles and instruments

The title of the final report of the commission was "Information Systems for Administrative Renewal" with the subtitle "Policy Recommendations for the Nineties". The commission itself characterized this as "not a little ambitious for a commission which should make recommendations on government information systems". According to the commission it was justified, however, because of the far reaching implications in terms of pre-conditions to be fulfilled, and new opportunities to be effected by the application of information technology in the public sector and in society as a whole.

The main principles of the present information systems policy as expressed in the new Decree on Government Information Systems may be summarized as follows.

Each management of each government organization, however small and low in the administrative hierarchy, is responsible for its own operations, including the information systems required but

taking into account all functional regulations applicable in the case. Secondly a minimum functional regulation with respect to information and information systems is required because of the fact that information is by definition crossing organizational and administrative boundaries and because similar organizations need similar information systems. Therefore in each organization and at each government level, all forms of voluntary co-oporation and if necessary compulsory co-ordination should be advanced. Thirdly temporary or permanent deviations of mentioned regulations should be approved by a higher authority in advance. If the specific rules are recommendations only, deviations should uncalled for be justified in the regular planning and reporting procedures. Lastly it is recognized fundamentally, that improved information processing often asks for new forms of co-operation and may eventually bring about a re-allocation of public tasks. In a decentralized administration as the Netherlands is, such a re-allocation always requires political decisions.

These principles have been elaborated into a number of more detailed guidelines; they have been in fact been formalized in articles of the reviewed Decree on Information Systems in Government. For example information on individual objects or events which the government requires, should be based on one-off direct observation or enquiries of those directly concerned, and preferably be extracted from statutory public registers at the lowest possible level of administration (in general municipalities or other basic institutions with public tasks). Secondly systems management and information management as defined in par. 2 above should be allocated according to the general considerations discussed there. So the development and maintenance of information systems for a number of institutions with similar tasks, should be relatively centralized in comparison to the decentral actual use of information systems. The latter should be decentralized and deconcentrated in accordance with the administrative and organizational structure of the users organizations. Thirdly, whereas the minister of Home Affairs was given a general co-ordinating responsibility for information systems in the public sector as a whole, a number of ministers have been appointed as co-ordinating minister for specific fields of information systems according to the taxonomy of information systems given above. These ministers are called to establish a co-ordinating advising body for each of the fields they are responsible. They also have to prepare structural information planning which has to be submitted to the Council of Ministers and the Parliament. If accepted these ministers have to take care that the necessary bills and amendments are prepared and introduced.

At a still lower and more technical level and to make these principles and agreements effective, a number of administrative and informational instruments have been developed. The most important ones are:

- recommendations for multiyear information planning by administrative units, supported by manuals and training courses;
- preparation of structural information planning for sectors of

7

public information systems (item);
- the inclusion of separate chapters or paragraphs on informational matters in all laws which require information flows between governmental entities and with the private sector (checklist);
- guidelines and criteria for effectuating ex ante and ex post evaluation and, under special circumstances, third party contra-expertise for large, complex or otherwise critical information systems;
- guidelines for cost accounting and cost allocation in government IS. The general principle is that exchange of information is always based on the law and that its cost should be charged out if that really fosters efficiency;
- publication of a so called "data communication atlas", which gives periodicacally an overview of DC-standards and its actual use in market products and government information systems (seperate parts for managers, system designers and DC-specialists);
- regulation of security measures for personal and confidential data and security recommendations for all other information systems;
- a political-administrative model for setting up inter-organizational information analysis and subsequent re-allocation of administrative tasks if that appears feasible;
- guidelines for the foundation of new bodies to manage intergovernmental information systems if necessary.

Most of these instruments are based on practical experience during a number of years in various fields. In some cases they are based on earlier drafts or informal guidelines. As a result in most cases not only detailed instructions are available but also practical examples.

The last article of the new Decree reads that each minister has to report in the explanatory memorandum to the yearly budget on those government information systems he is responsible for; the Ministry of Home Affairs has to report yearly to parliament about the state of affairs with regard to the enforcement of the Decree as a whole. Whether these developments will eventually lead to overall formal legislation for government information systems is still uncertain.

3.3. Concluding remarks

In a country with a long tradition of constitutionally guaranteed autonomy for decentralized provincial and municipal administrations and even regular assignment of public tasks to representative private bodies, the above development is somewhat remarkable. On the whole it took about fifteen years to have it formalized, in some fields it even started 10 years earlier. One explanation might be that the reviewed Decree holds only a few really new elements. Most of the regulations and almost all recommendations existed already before in some form or another, or developments were already going in the direction indicated. Often it was simply not realized that some strategic notions behind them could be formulated succintly and by that help to

make them operational.

The most fundamental factor, however, is that information tech-
nology is influencing the external organization of the production
of goods and services, also in the public sector. In the private
sector it is the competition in the market which urges and even
forces to do so. This may lead to larger corporations but could
as well lead to smaller ones inter-connected by informational
infrastructures. If original objectives such as client-oriented
services, low prices and high quality are maintained, in the
public sector augmented or even based on the equality and secur-
ity of rights and democratic control, the availability of infor-
mation technology initiates administrative innovation. This may
be contrary to vested interests of administrative bodies and
government agencies. And even if the will to change is there,
practical problems such as differences in technological level,
lack of information specialists and scarce financial resources
make it a long difficult and virtually never ending process. It
is found, however, that an overall national policy, stating clear
objectives and offering practical supportive instruments, will
help to advance the process by introducing new procedures. They
will also enable a flexible response to new unexpected develop-
ments in the future again.

The final problem can be illustrated by two paradoxes.

Suppose government efficiency is an accepted objective for larger
wholes than individual agencies and for longer periods then the
duration of public offices. And suppose that a prerequisite to
obtain that objective is for instance the development of a common
datamodel. It is to be expected than, that, as soon as that model
is made available and seems to be workable, it will provoke
resistance to change because of the inherent re-allocation of
certain responsibilities.
Secondly, and one step further, if interorganizational or inter-
administrative information systems are a success eventually,
they need some kind of authority of their own and actually they
no longer are interorganizational or interadministrative any
more! They become intra-organizational in an new type of adminis-
tration.

References

1. Technical publications in English giving the background of the development described in this paper are:
   a. Electronic information management for administrative government, B.K. Brussaard, <u>Interdisciplinary Science Reviews</u>, Vol. 8, number 1 (1983), page 56-64.
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   c. Information resource management in the public sector, B.K. Brussaard, <u>Information and Management</u>, number 15, (1988), page 85-92,
   d. A new planning approach for intergovernmental information systems, B.K. Brussaard, <u>URISA-conference Proceedings</u>, Boston, 1989, page 149-159.

2. Official documents on which this paper is based are available in Dutch only. An official English resume is being prepared for the ICA-conference in October 1991 in Atlanta, U.S.A. The main documents are:
   a. Beleidsnota informatievoorziening Openbare Sector (BIOS), Tweede Kamer, 1987-1988, 20664, nrs. 1-2;
   b. Informatietechnologie voor bestuurlijke vernieuwing (eindverslag CCOI), Binnenlandse Zaken, 's-Gravenhage, April 1990;
   c. Besluit Informatievoorziening Rijksdienst (Besluit IVR-1990), Binnenlandse Zaken, 's-Gravenhage, November 1990;
   d. De Computer gestuurd, een nieuwe weg tot verbetering van de overheid (BIOS II), Binnenlandse Zaken, 's-Gravenhage, February 1991.

Cooperative Production
of Documents

Hinrich E.G. Bonin *

1 March 1991

Abstract

If documents are made from a number of texts from several persons
who have different areas of expertise and interests, then the commonly
used editors, e.g. WORD or VI, are insufficient. They do not support
the participatory procedure, the handling of competing modifications,
the meeting of deadlines or the calling in a substitute if the opera-
tor is not available. The following contribution outlines problems of
a cooperative text production. Approaches to solving the editing of
a so-called 'draft' [1] in public administration will be discussed. The
representation of a procedure of the order of countersignatures will be
our main interest.

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[1] German: Entwurf

11

1 Outline of issues

In the offices of businesses and public administration the production of legally binding texts dominates, e.g. in the shape of contracts (purchase, leasing, labour contracts), rulings (reminders, delivery promises, price concessions), decisions (definitition of new products, investment decisions) etc. Normally such a document is not produced by a single person, but comes into existence step by step through the cooperation of several persons.

In an organization individuals have got given positions to undertake certain tasks, to generate certain development structures on demand from within or outside the organization respectively. Who is to participate in the production of a document is determined by organization charts and the distribution of business. So the docuement initiator can (frequently completely) name those participating in the writing from the beginning.

In the following, terms like 'draft', 'final version' 'countersignature', 'final signature', as used in *public administration*, will be used to outline the issue (see figure 1, page 4). The participation of organization units (authorities, departments, divisions, areas and position) according to the prevailing division of functions and tasks is called the procedure of countersignature.[2] For an organization unit its head (or deputy) signs.

As long as the text is being edited in the framework of the countersignature procedure, it is called a 'draft'. On the draft you will find the order of countersignatures which shows the order of the participatory organization units from right to left (see figure 2, page 6). The 'final signature'completes the real text production. The 'final draft' itself represents the document.

Current tools with the capacity say of WORD, WordStar, EMACS or VI are little suited for this cooperative document production. Which draft modification is carried out by whom and which draft represents the final version, then can only be organizationally regulated with many copies. A direct support of the individual phases of a document generating process is not given – at least in the sense of a computer-aided configuration management. Especially the following areas have not been taken into consideration:

- Protected personal work phase and supervision of the actual state of editing

- Solution of conflicts of competing modifications of passages

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[2] All the administration terms used in this paper refer to German administration practice. In many cases it is rather difficult to give their equivalents in English.

12

Figure 1: Context diagramm
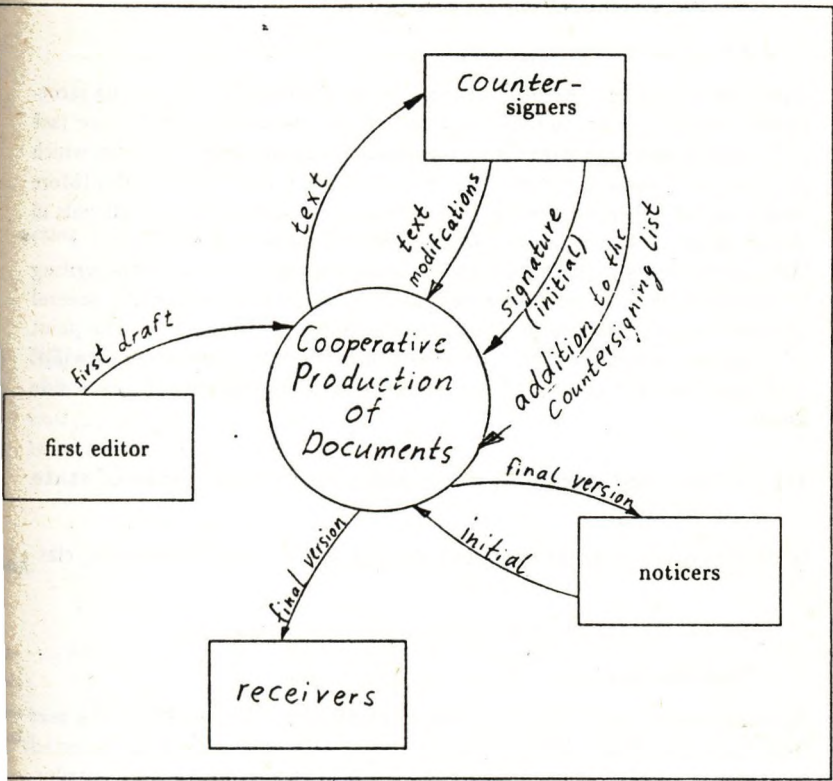
Legend:

———▶   ::=   data flow

◯   ::=   process

▢   ::=   external unit

13

- Meeting deadlines, time for editing and

- editing by jobholder or deputy.

Even the new generation of hypertext systems primarily aims at the structuring of a document and the easy navigation through this structure (see [17]). At the same hypertext is an information management system in which data (texts, diagrams, videos, etc.) are stored in a network of nodes (More details about hypertext see e.g. [1]). The coordination of several officials in charge of the matter is not a primary target of hypertext.

Word processing systems striving for such support mostly assume the writing of scientific texts. Options for commenting on single passages by several authors via means of telecommunication form the starting point. The point is to support scientists in the process of thinking and formulating (see [5]). The recording and tracing of the whole document development are a side aspect.

1.1 Protected personal work phase and supervision of state of editing

In office systems texts are frequently roughly divided into the following classes:

1. Accessible texts with and without protection of access.

2. 'Personal' texts

In context with cooperative document production the transition of a text from class 2 to class 1 is of special interest. Every official needs a protected work phase (a desk of his or her own) for formulating his or her contribution. During this time he can edit his text contribution and modify without consequences, i.e. unsupervised, by means of text systems, until he signs it, i.e. release it. In this work phase his actual draft is his 'personal' text. Only he is allowed to see and to further edit the text. (Exceptionally his deputy will be allowed to continue editing, see 1.4, page 8). After signing, the official can no longer modify the draft, because it will be sent to the next official by the system according to the order of countersignatures. At least for reasons of coordination and revision the actual state of editing has to be able to be documented at any time. For instance notations, demands for consultation etc. have to be supervised in prospect of their completion. A protected personal work phase restricts the supervision of the state of editing to the individual times of release.

14

i) . . .

$unit_n$	$\ldots$	$unit_3$	$unit_2$	$unit_1$
$initial_n$	$\ldots$	$initial_3$	$initial_2$	$initial_1$

acting as deputy/on the authority of

$unit_{n+1}$

i+1) Office 0-1
i+2) after dispatch for information of
      $unit_{n+2} \ldots , unit_{n+m}$
i+3) to be filed with $unit_1$

Legend:

$unit_1, \ldots , unit_n$	::=	organization units to participate (countersigners)
$unit_{n+1}$	::=	responsible organization unit (final signer)
$unit_{n+2}, \ldots , unit_{n+m}$	::=	are informed about the matter
$initial_j$	::=	Official who signs for organization unit, i.e. signs with initials or surname
i	::=	editing steps

Figure 2: Example: order of countersignatures

1.2 Competing modifications

Text contributions develop from different (partly potentially hostile) subject and interest positions. Therefore competing passage modifications occur. For instance, official X is in favor of the measure that has to be documented and official Y is against it. Only the higher authority can decide which contribution will be valid. Indisputably the X and Y modifications have to be archived in such a manner that they can be revised.

Moreover, if necessary, a continuation of the officials to participate in the matter will be needed to include the higher conflict solution level of the hierarchy (dynamic adaptation of the order of coutersignatures). In the end this leads to a representation and control of the hierarchial organization structure (decision competence). A possible solution would be a search algorithm, which finds common nodes of different branches of a tree structure. Potentially, hierachical levels which cannot solve the conflict can be thereby skipped. This would approximate the 'elimination' of superiors (organizational revolution!).

1.3 Deadlines and editing times

In today's office organization the type of office file[3] usually documents the urgency and confidentiality of the matter. Sealed files serve for confidential matters. Green, nonsealed files contain normal matters; red files urgent matters. Red office files with the imprint 'from hand to hand' have to be transported by the official himself to the next official without delay. In an office communication system for cooperative document production these stages of confidentiality and urgency could be simply represented.

The net plan technology (milestone deadlines, latest deadline, optimistic-normal–pessimistic estimate of necessary time) can serve as a possible approach for the supervision of the editing times.

A representation problem is the requirement on the flexibility of the manual (file) system. If the succeeding official has an important conference, then the 'from hand to hand' file will be handled according to the specific case, e.g. temporarily stored in his office. If and when an interruption of the conference is suitable or his deputy has to be included is determined by a great number of relevant facts which can by no means be stored from the beginning.

In today's office organization the target for the time of editing takes place

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[3]German: Laufmappe

from 'top to bottom' according to the organization hierarchy, in which fixing a time can frequently be regarded at a process on feedback. A strick netplan technology attempt would have the disadvantage on the drafter targeting the times for editing and times for the higher stages on the hierarchy in making the order of countersignatures (organization revolution!).

The precise quantitative specification of target-times for all single steps of editing substantiates the danger of a permanent efficiency control of the official. From his point of view a detailed evaluation of deviation between target and actual state does not have a motivating effect.

1.4 Editing by jobholder or deputy

If an official is not available (sick leave, holiday, leave of absence etc.), then his deputy will have to take over the procedure. If he is not available, too, then the procedure will have to be referred to the deputy's deputy. The rules of deputizing are based on general aspects and those dependent on the draft. E.g. for an important decision the superior deputizes for his employee. For everyday business the employee on the same hierarchial level is the deputy, whereas a subordinate deputizes in routine business. In some deputizing situations, e.g. in the case of holidays the jobholder reserves an exclusion of deputizing, i.e. the procedure shall by no means be carried out by a deputy. The approach to directly give the list of deputies for every document and, if need be, and to adjust during the process of editing is too costly. A pragmatic concept of general and case related signs of editing (not available reservation) has to be developed. At the same time it always has to be observed that the take-over by a deputy is connected with a component as regards content. It should be mentioned for example that there is a difference whether the head or the deputy's deputy's deputy finally signs the document.

2 Office automation and cooperative document production

A computerized office system is no special software system for a narrow task area. Rather it can be understood as a kit of well fitted software components (see e.g. [26]). At present these constituents primarily support word processing, simple planning and calculation tasks in connection with local and external computers. At the individual workplace performances of

the classic (central) data processing can be combined with those of the PC-oriented software via nets. Depending on the starting point and orientation three attempts can be distinguished:

- transaction systems [4] (central data base approach)

- electronic mail and conference systems (net approach)

- 'intelligent' agent models (performance of workstations as an approach)

The transaction systems extensively assume regulated work procedures which can be specified with a suitable language to start with. In the process the actual text typing is integrated into the actual treatment of the process and directly transferred from the writing pool to the officials. As an example the transaction system DOMINO (Society for Mathematics and Data Processing Ltd, St. Augustin) should be mentioned here. Such systems are enlarged step by step by exception treatment, distribution and addressing (see [12]).

Additional constituent parts supplement the originally pure distribution mechanism in the net approach. Apart from the specification of distributor lists, user profiles, degrees of confidentiality and stages of urgency the releasing of pre-defined procedures at the reception of certain messages is for example possible. A standardized document architecture (e.g. Office Document Architecture, abbreviation: ODA) and a standardized exchange format (e.g. Office Document Interchange Format, abbreviation: ODIF; for details see e.g. [13]) are significant. The communication structure should be summed up by the slogan "OSI (Open Systems Interconnection) is the *world language* for computers" (see e.g. [25]).

From the perspective of cooperative document production the starting point of the net approach is first of all the 'short' communication with standardized documents. Relatively 'long' discourse about controversial content, difficult subjects only move step by step into focus. Then the related problems of filing and searching in large sets of documents probably enforce an approximation to the data base approach (see e.g. [22] and the literature listed there).

The approaches from the research area 'Artificial Intelligence' usually start from an agent model. The 'intelligent' agents are weakly coupled with each other. They decide on the basis of their own knowledge, when and with
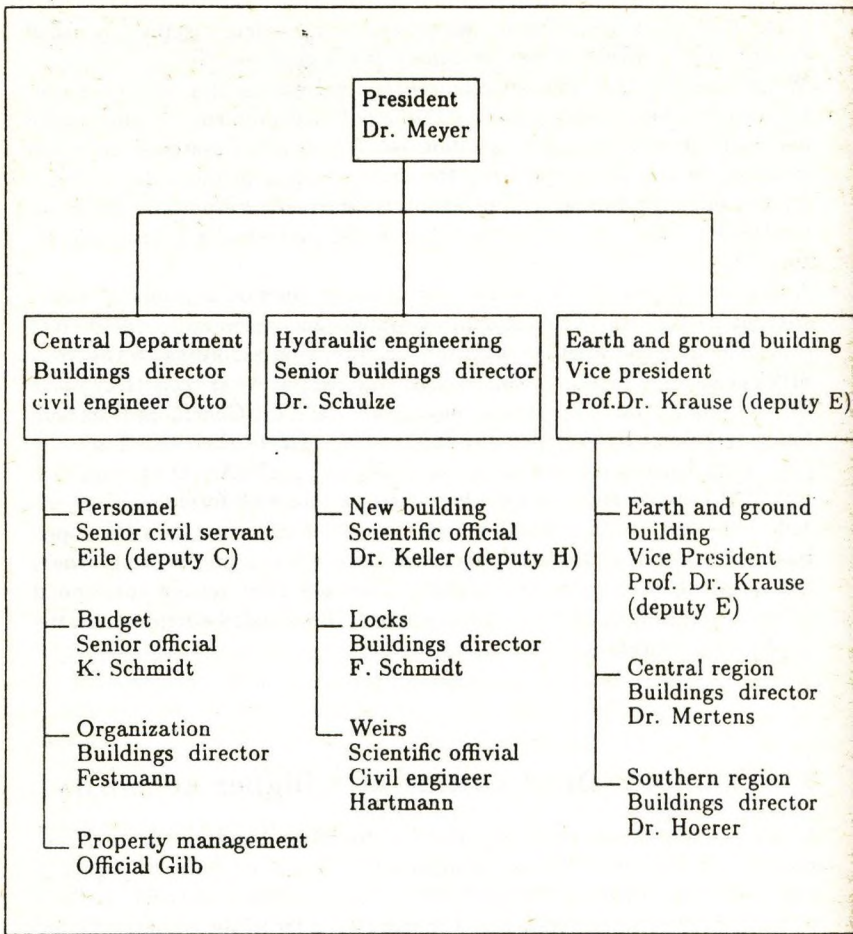
---

[4]German: Vorgangssysteme

18

whom they will have to communicate to solve a problem together. A net of cooperating knowledge-based 'assistants' is the goal (see [9]).

We assume that the software-technical implementation of a prototype contributes to a better understanding of the outlined problems of cooperative document production. The question is: Which office systems' approach is useful for this prototype? For the understanding of the order of countersignatures the approach 'transaction system' seems especially simple to implement. Below we are argumenting in the context of a transaction system.

A software system for cooperative document production is primarly a constituent part of an office automation system and secondarily an isolated tool. The question whether texts shall be prepared according to the WYSIWYG concept (acronym for: What You See Is What You Get) or to ISO-standard SGML concept (acronym for: Standard Generalized Markup Language) won't be extended any further here (For further details see e.g. [7]). With batch-oriented systems as TEX [11], LATEX [16] or nroff (see e.g. [23]) commands (markup) which direct a following formatting are added to the text. With a SGML-concept intratext inconsistencies (example: Have all quotations of court judgements been written in the same type?) and intertext inconsistencies (example: Does the final version correspond to the current office order?) can more easily be avoided compared to the WYSIWYG concept.

3 Example: Draft editing at a higher authority

As an example for cooperative editing a directives hierarchy shall be assumed according to the following organization diagram (figure 3, page 11). There head of central department buildings Otto cannot modify Dr. Keller's texts. This applies vice versa, too. For example as far as the employment assessment of a polytechnic graduate is concerned Dr. Keller's written consent cannot be substituted by buildings director Otto's rejection.

```
                          ┌─────────────┐
                          │  President  │
                          │  Dr. Meyer  │
                          └─────────────┘
```

Central Department Buildings director civil engineer Otto	Hydraulic engineering Senior buildings director Dr. Schulze	Earth and ground building Vice president Prof.Dr. Krause (deputy E)
— Personnel Senior civil servant Eile (deputy C)	— New building Scientific official Dr. Keller (deputy H)	— Earth and ground building Vice President Prof. Dr. Krause (deputy E)
— Budget Senior official K. Schmidt	— Locks Buildings director F. Schmidt	— Central region Buildings director Dr. Mertens
— Organization Buildings director Festmann	— Weirs Scientific offivial Civil engineer Hartmann	— Southern region Buildings director Dr. Hoerer
— Property management Official Gilb		

Legend: see table 1, page 12 and table 2, page 12

Figure 3: Organization diagram of higher authority

P	presidency
C	central department
CP	personnel division
CB	budget division
CO	organization division
CM	property management division
H	hydraulic engineering department
HN	new building division
HL	locks division
HW	weirs division
E	earth and ground building department
EC	coast division
EM	central region division
ES	southern region division

Table 1: Abbreviations for organization units

Ei	Senior civil servant, Eile
Fe	Buildings Director, Festmann
Gi	Official, Gilb
Ha	Scientific official, civil engineer, Hartmann
Ho	Buildings Director, Hofer
Hr	Buildings Director, Dr. Hoerer
K	Vice President, Prof. Dr. Krause
Ke	Scientific official, Dr. Keller
M	President, Dr. Meyer
Me	Buildings Director, Dr. Mertens
O	Buildings Director, civil engineer, Otto
S	Senior Buildings Director, Dr. Schulze
Sc	Buildings Director, Franz Schmidt
St	Senior official, Klaus Schmidt

Table 2: Initials of senior staff

21

The first draft, a consent, (typed by Miss Busy at time t_0) comes from Dr. Keller. He signs at time t_1. The head of personnel division senior civil servant Eile rejects the employment (t_3). His superior, the buildings director Otto rejects the employment, too (t_4). On the one hand the rejection of the central department and on the other hand the consent of the head of new building division, Dr. Keller, have to be documented. The head of hydraulic engineering department (senior buildings director, Dr. Schulze) is on a business trip abroad. His deputy Dr. Keller does not only sign for his department, but for department H (t_2), too. The final ruling depends on the decision of the president, Dr. Meyer. He consents to the employment in writing on 15 March 1991 (t_5). After consultation with buildings director Otto during the discussion of incoming mail on 16 March 1991 he changes his mind and rejects the employment (t_6). The applicant receives a rejection with outgoing mail of 16 March 1991; without information of the decision process. Only the document in the file shows this decision process.

3.1 Document with competing modifications

Draft at time t_3:

....

Federal Higher Authority X   Frankfurt, 14 March 1991
- The President -

Our reference
-O/-4.32-1 Ke/Fl

Mr. Franz Meister   *Do not employ,*
civil engineer (Polytechnic)   *because Mr. Meister*
1, Volgershall   *won't fall into*
D-2120 Lueneburg   *line. Ei 3/14/91*

Ref.:   Your application as a laboratory engineer
         (Federal Scale for Officials IVa)
         1 Advertisement of vacancy in FAZ of 12 Jan. 1991
         2 Your written application of 10 Feb. 1991
         3 Your interview on 20 Feb. 1991

Enclosure: ~~Your application documents (2 copies)~~

Dear Mr. Meister, *Unfortunately I have to inform you of my*
~~I'm happy to tell you that I would like to employ you as a laboratory engi-neer/~~ *decision to hire another applicant.*
~~Your~~ employment, Croup IVa of Federal Scales for Officials, belongs to the
new building division. This division is a part of hydraulic engineering de-
partment.   *deleted Ei 3/14/91*
Hoping that you will accept the work contract, I ask you to send back
a signed copy of the two enclosed copies signed by me. Please report the
beginning of your service (on 1 April, 1991, 7.30 o'clock.) to head of division,
~~Dr. Keller (room 204).~~ *Thanking you again for your application*
Yours truly,   *and wishing you all the best.*

- Dr. Meyer -

C	CP	H	HN

Ei 3/14/91 | deputy | Kc 3/14/91 | Kc 3/14/91

23

3.2 Document with final signing

Draft at time t_6:

....

Federal Higher Authority X   Frankfurt, 14 March 1991
- The President -

                                               Our reference
                                               -O/-4.32-1 Ke/Fl

Mr. Franz Meister   *Do not employ,*
civil engineer (Polytechnic)   *because Mr. Meisto*
1, Volgershall   *won't fall into*
D-2120 Lueneburg   *line. Ei 3/14/91*
                                               Do not employ
                                               O 3/14/91

Ref.:   Your application as a laboratory engineer
         (Federal Scale for Officials IVa)
         1 Advertisement of vacancy in FAZ of 12 Jan., 1991
         2 Your written application of 10 Feb. 1991
         3 Your interview on 20 Feb. 1991
                                        M 3/15/91   *deleted Ei 3/14/91*
Enclosure: [Your application documents (2 copies)]

Dear Mr. Meister,   *Unfortunately I have to inform you of my*
✓ [I'm happy to tell you that I would like to employ you as a laboratory engineer]   *decision to hire another applicant* *deleted* *M 3/15/9*
✓ [Your] employment, Croup IVa of Federal Scales for Officials, belongs to the
new building division. This division is a part of hydraulic engineering de-
partment.   *deleted Ei 3/14/91*
✓ Hoping that you will accept the work contract, I ask you to send back
a signed copy of the two enclosed copies signed by me. Please report the
beginning of your service (on 1 April, 1991, 7.30 o'clock.) to head of division,
[Dr. Keller (room 204)]   *Thanking you again for your applicati*
                          and wishing you all the best.
Yours truly,   *deleted*
                                                  M 3/15/91
- Dr. Meyer *3/15/91*   *deleted*   *M 3/16/91*

Letter in draft
Ei of 3/14/91
M 3/16/91

C	CP	H	HN
O 3/14/91	Ei 3/14/91	deputy Ke 3/14/91	Ke 3/14/91

24

4 Recording and tracing

The example (section 3) shows that it can easily be deduced from the order of countersignatures in connection with the stored organization diagram which officials have to edit the draft in which order. An examination if an authorized person had access to the text can be made with passwords. The protected personal work phase can be covered by a 'status symbol'. As long as the text has the status 'being processed', it can only be inspected in the previous draft, provided there is an authorization at all. When the official signs then the status symbol for the following official will be made.

In special cases it cannot be recognized straightaway if a displayed draft is the basis for the final version, i.e. represents the complete editing stage. In the example the final signer modifies the draft again despite final signing. The production of a final version has to protect the draft against further modifications. If an addition is necessary despite all of this, then it will require the initiation of a new process.

4.1 Marking of the status of editing

If an official drops out during his editing phase (see figure 4, page 17), then two points will have to be taken into account:

1. The draft has to be made available for continuation in the previous form. The modification bar for other signers, thereby for the deputy, too, has to be unlocked.

2. Interim results of the editing should at least be accessible to the deputy despite the protected personal work phase.

Therefore it would be recommendable to implement an option which makes it possible for an official to release interim and partial results without carrying out a signature for this. With the expansion of the status symbol this option can be implemented.

4.2 Text blocks with initials and time tags

The above example shows, too, that recording and tracing of the processes in the sense of a 'guarantee architecture' (see e.g. [14]) require a recording starting from the first version of draft for every modification (adding and deletion) by the respective official and a time-tag (date, time). Modifications occur which come from the same official, but happened at a different time in

Time of officials i
non-availibility
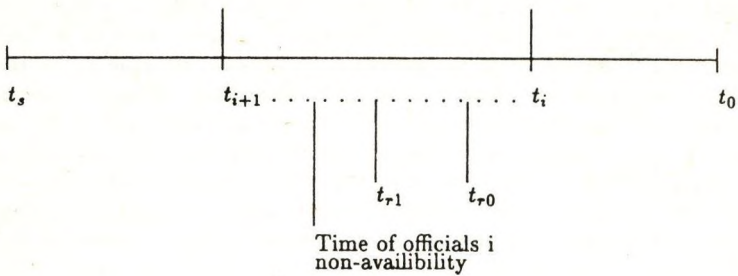
Legend:

t_s	::=	time of final signing
t_0	::=	time of first draft
$t_{i+1} - t_i$	::=	work phase for official i
t_{r1}, t_{r0}	::=	time of release of an interim result

Figure 4: Release of interim results

26

which the time for the 'final draft' is of importance. In the above example the President, Dr. Meyer, modifies his first noted decision. The document sent to Mr. Meister has to show the final version.

To simplify the reconstruction of the draft as it was at time t_i it is useful to administer the text in the form of individual text parts, called text block below. If a text blocks is modified or a new text block is inserted, then its status has to put into an archive data base with the official's initials and time tag. It would also be useful to use the classic data base management technology with 'after image' and/or 'before image' i.e. the respective text block will be copied and saved after and/or before the modification. A not insignificant question is:

How large a text block should be chosen.

In a project at the Nordostniedersachsen Polytechnic three variants were programmed ([3]):

- Variant 1: text block has the size of *one line*

- Variant 2: *text block with limited variable size*
  To begin with the number of lines of every block will be defined. Thereby constant text passages can be put into the respective text block. In the above example these could be the passages 'reference'.

- Variant 3: text block has the size of *one layout page*

A viable compromise has to be found between the redundant storing and the cost for the text reconstruction (inclusive complexity for the programming). A special demand is put on the reconstruction when already deleted texts are declared valid again. Deleted texts should again be activated as a whole (or in parts) without an effort for the official, and the facts that had once been deleted must not get lost.

Variant 2 tries to adapt to the individual environment. By a first structuring of the document in text blocks the size can be defined according to a modification prognosis. In the above example one text block could be defined from the beginning to 'reference' inclusively.

5 Representation of countersigning

In case of non-competing text modifications the representation of the coutersigning can be relatively simply implemented, e.g. one can specify with the help of a more formal language (so-called pseudocode):

Case 1:

```
IF  non competing modifications
    AND order of coutersignatures completely carried out
    AND final signing
THEN final copy := actual status of text
END-IF.
```

Case 2:

```
IF  non competing modifications
    AND order of countersignatures not completely carried out
    AND most senior countersigning position signed
    AND most senior countersigning position
    has right of directives
    AND final signing
THEN final copy := actual status of text
    After dispatch for information of non-signed
    countersigning position
END-IF.
```

Case 2 hints that the organization hierarchy and with it in the last instance officials' competence of directives have to be taken into account. A superior can take over the draft and 'liberate' his employee from involvement. Thereby gaps in the order of countersignatures come into existence. Not all gaps are permitted. The examination according to the hierarchy of directives (organisation diagram) can be understood as a problem of the graph theory. Then we assume that a node (a superior) can only cover the signing of all his child nodes (employees). Then root node of a part tree substitutes the child nodes. For instance in figure 5, page 20 node N3.2 could cover node N5.2's signing.

With competing modifications an addition to the orginal countersigning list can become necessary. We assume that only the root node of the part tree which contains the nodes that produced the conflict can solve it. If this root node is not on the countersigning list (or is not the final signer), then this node will have to be added to the order of countersignatures. With a deep tree structure the question arises whether it is useful to automatically add
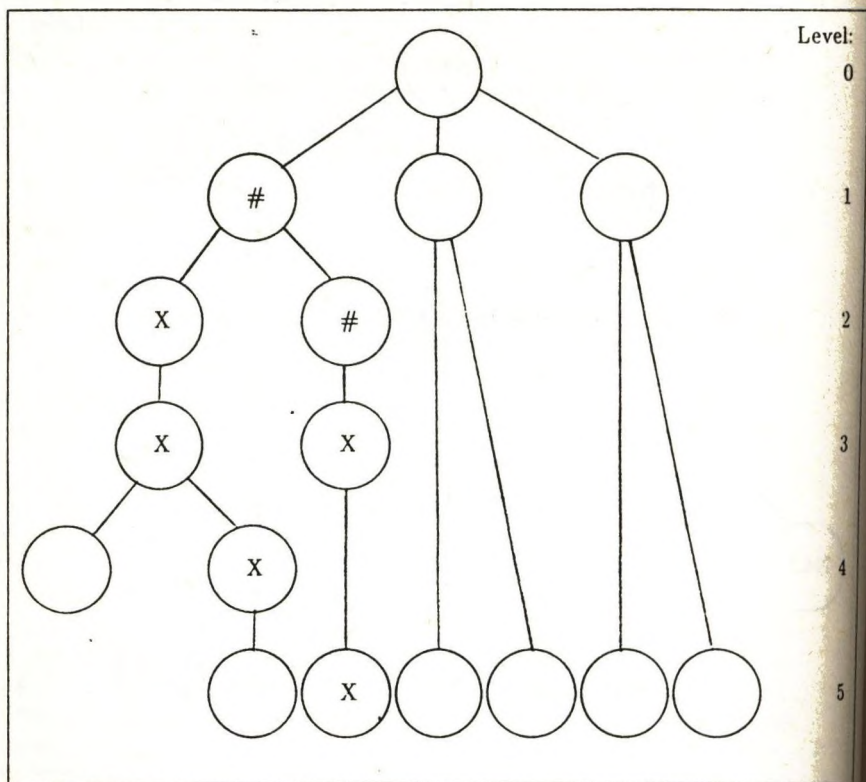
28
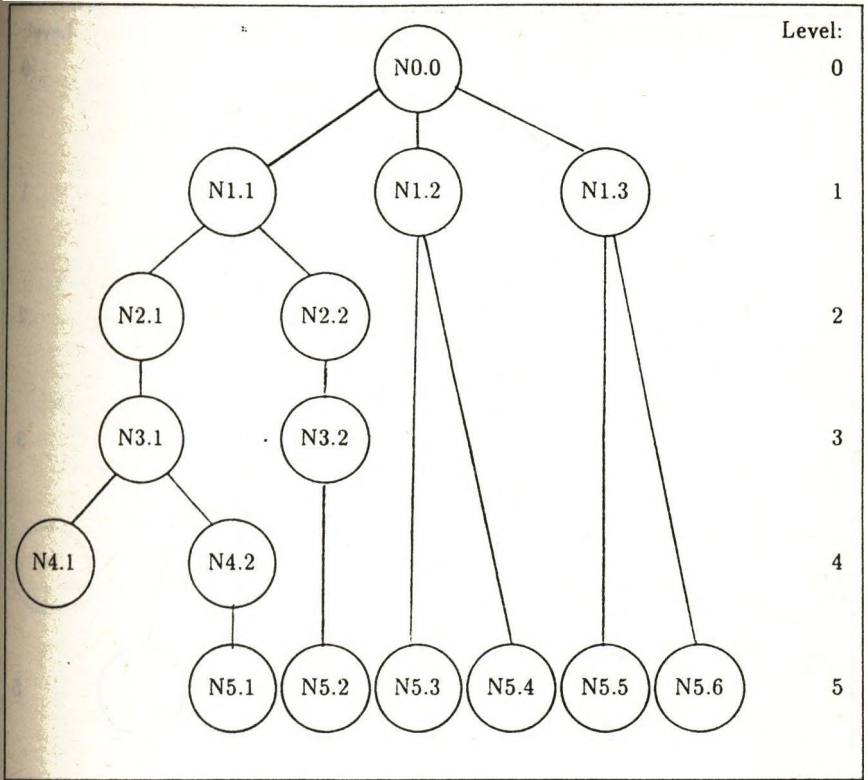
Order of countersignatures:

N2.1	N.1	N.2	N3.2	N5.2
OK	OK	¬OK	OK	

Legend:

OK	::=	non-competing modifications referring to forgoing version
¬OK	::=	competing modifications referring to forgoing version
Ni.j	::=	modes (organization units) with hierarchical level i and identification (running number) j

Figure 5: Required addition to countersigning

29

Legend:

X   ::=   countersigning list contains the node

\#   ::=   potential additions

Figure 6: Addition to the countersigning list *without* skipping superiors
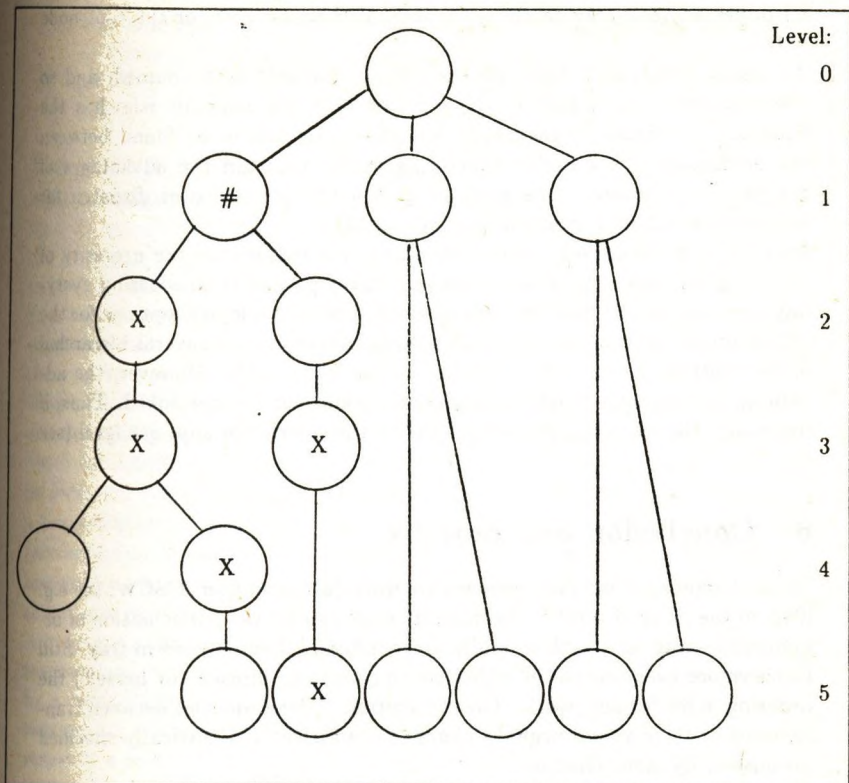
Legend:

X   ::=   countersigning list contains the node

\#   ::=   potential additions

Figure 7: Addition to the countersigning list *with* skipping superiors

31

all nodes on their way to the root node of the part tree, or the root node only.

To put it differently: Have all the official channels to be named, and so every superior (see figure 6, page 21) or only the superior who has the final say (see figure 7, page 22). A compromise has to be found between the advantage of a possible shortening of the run and the advantages of the proven structure. The generating of a distributor 'after dispatch for information' offers a compensatory possibility.

It could be progressively more difficult to give reasons for the necessity of including all superiors in part tree (directives pyramid) considering every-day experiences with fast telecom services. The technological options for the reduction of the run and the time costing agreements of several hierarchal levels contradict each other (see [20]; thesis 32, p. 27). However, the advantages of a system of interim superiors should not be overlooked. Thus, if necessary, the tasks can be carried out by the inferior or superior level (see e.g. [2]).

6   Conclusion and outlook

With Computer-supported cooperative work (abbreviation: CSCW; see e.g. [24]) in the office of public administration we can fill the participation of organization units and with it finally every individual employee's in-tray. Still furthermore every employee will have to carry out himself (or herself) the ordering of his (or her) work. The recognition of dependencies between transactions or their actual urgency cannot be sufficiently realistically specified because of dynamic changes.

The outlined ideas for the representation of the countersigning procedure within the framework of cooperative document production show that an automatic inclusion of organization units (nodes in the organization hierarchy) and the diversion of work to deputies requires the solution of essential organizational problems.

For instance the aim proclaimed by the communal office for administration simplification shows clearly that such organization questions are little discussed in public administration under the heading of word processing software.

> The long-term aim should be that word processing software put
> at disposal by information technological infrastructure supports
> all forms of writing (up to editing of data processing programs)
> [10].

This practical aim can only be a first partial step. The examination of word processing from this standardizing view , e.g. between WORD (for typists) and dBASE (for programmers) does not pick out as a central theme the cooperative production of documents in administration. To be able to design and implement profitable software here there is a need for ideas and experiences from many disciplines (see e.g. [8]). Oriented by existing administration structures the organizers are indisputably more challenged than up to now.

Within the framework of developing prototypes a critical examination of the countersigning practice is required in view of 'indispensable', 'modifiable', 'need for modification' (see e.g. [6]). Parallel countersigning would have to be included. The simultaneous text typing of several countersigners promises a decisive shortening of the run under implentation of the WYSIWIS-concept (acronym for: What You See Is What I See). The countersigning regulations analyzed up to now do not allow for this parallelism, even if in practice they sometimes do.

A stronger supervision of work remarks, as e.g. references to dependent transactions, consultations, orders for editing, would be a next constituent by a comprehensive 'return reference system' [5]. In this context the expansion option of employee control is possibly the most explosive issue. In two respects a secret and surprising control would be possible, firstly the selective intervention of the superior on an employee's results, secondly by the directness with which this can happen without the inclusion of further, perhaps critically minded employees (see e.g. [2]).

A central problem for every constituent of an office system is the manual file which is only available in one copy and therefore can only be seen by one official at one time. A stronger support for cooperative document production requires an 'automated file management' [6]. It is necessary to carefully explore this 'virgin land', i.e. with viable protypes.

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[5] German: Wiedervorlagesystem
[6] German: Aktenfuehrung

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The Behaviour Integrated Entity Relationship Method "BIER" applied to the Development of a Governmental Office Information System

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Abstract:

In this paper we descibe how we use the BIER data model to design the governmental office information system KIS (Kanzlei-Informations-System). KIS has been designed and implemented on our institute in cooperation with Nixdorf Austria. During our work we soon find out that the behaviour (state transition) respectively the historical states of the document can hardly be modelled with a relational data model. Therefore we have used our BIER-Model, a framework of modelling static components and dynamic processes in an information system. To model the static component we use an extended Entity-Relationship diagram and for the dynamic model we use a Petri net based graph representation.

The experiences with the BIER-Model show that the design of a governmental office information system can be supported in a very efficient manner and, because of the integrity management facilities, the schema created are always tested about the correctness. Furthermore the graphic method allows a step-wise extension of defined schemas.

After an introduction the first part of the paper is dedicated to the description of the BIER data model. The focus of chapter 3 is on the requirements of the governmental office information system KIS. Chapter 4 shows how to model KIS with the BIER design method. An overview of results and further activities is given in the last chapter.

Keywords: governmental office information system, information system design method, data modelling, dynamic aspects, extended E-R diagram, behavior diagram, BIER, KIS.

1. Introduction

Government agencies have lots of data to implement and evaluate their policies. Streams of information flow between many actors involved, like between governments agencies, between government agencies and quasi non governmental organizations. The coordination of these flows and the regulation of the use leads to further effective and efficient use of the collected data. For these requirements the use of information technologies in public administration is regarded.

In cooperation with Nixdorf Austria our institute has designed and implemented the governmental office information system KIS (Kanzlei-Informations-System) /GIERLINGER 88a/, /GIERLINGER 91/. The office information system supports the governmental administration in acting upon official documents, in distributing documents (define the flow of the document during the process) and in retrieving the documents. There exists a form of legal regulation (it has survived since the era of Maria Theresia) for the procedure of document handling in Austrian governmental agencies. KIS is a governmental information system which fulfills all the requirements of the governmental office, their departments and their departmental sections in the public administration in Austria.

During the design and the implementation of KIS we find out that an official document changes dynamically the state. The state transition, respectively the historical states of the documents, are a very important fact in a governmental office information system /GIERLINGER 88b/. With a relational data model the state-transition and the historical states of the documents can hardly be modelled /FERG 85/, /GIERLINGER 89/, /KUNG 86/, /SAKAI 83/, TJOA 85/. That is the point where we have started to use our own design method BIER (Behavior Integrated Entity Relationship Model) with a special data model /EDER 87a/, /EDER 87b/, /KAPPEL 86/ which is more suitable for such problems.

BIER is a general framework of information systems design /GIERLINGER 90/ which includes both, static and dynamic aspects of the universe of discourse to be modelled. To model the static component we use an extended Entity-Relationship diagram /CHEN 76/ and for the dynamic model we use a Petri net based graph representation /PETERSON 81/. Particular attention is given to a unified view of both aspects by a Behavior Integrated Entity-Relationship model.

BIER - the information system design method used in the prototype design is characterized by the following concepts:

- the underlying data model is given by the E-R model which is extended by the concepts of surrogate keys and time dimension.

- the dynamic feature of the universe of discourse can be decomposed into elementary and complex processes.

- the dynamic component of the model is described by a Petri net based graph representation.

2. The Basic Concept of the BIER Model

2.1. Motivation

Data base design is not only the process of determining the initial data base structures, but also the process of programming user applications, and the maintenance and evolution of the data base /GIERLINGER 88/. The analysis of the system subjected to the design, i.e. the system analysis phase is also included in the life cycle.

During the last years the focus of data base design and of data models have been on the static aspect only. The dynamic behaviour of the data has been represented by programs with embedded SQL-statements. This results in unsatisfied users and data base administrators /ATKINSON 89/, /DITTRICH 90/. That is why the dynamic data models are developed. With these models it is possible to represent static and dynamic information of reality.

One of the goals of this paper is to introduce a general framework of information systems design which includes both, static and dynamic aspects of the universe of discourse to be modelled. In the field of modelling dynamic aspects, different modelling methods have been investigated in the last years.

Designing a data base we usually start with developing an Entity-Relationship Diagram of the universe of discourse. In the Entity Relationship Diagram we can model the whole static information of our universe of discourse but we have no possibility to model the dynamic aspects. The dynamic behaviour of the data can only be represented by programs with embedded SQL-statements. This means that the dynamic components of the model are modelled with flow charts respectively with programs in a certain programming language /GIERLINGER 89/.

Therefore we have to design a new modelling tool which accomplishes the following items:

- to model static and dynamic information in one model

- dynamic aspects must be integrated into the data base

- documentation of the dynamic in a graphical form

- historical data base

- to achieve more semantic in the data model

We developed a model for this purpose and called it **BIER (Behaviour Integrated Entity Relationship Model)** /GIERLINGER 90/.

2.2 The Static Component

The surrogate concept

The surrogate attribute /CODD 79/ is a system controlled key and this attribute identifies every tuple of a relation of the E-R model. In other words, every entity of the first abstraction level of the E-R model can be uniquely identified. The surrogate can never be changed by the user of the data base.

Concept of "absolute time" and "entity time"

For modelling the life histories of the objects we need the integration of the time dimension in our model. The concept of "entity time" describes the different states of entities whereas the "absolute time" determines the moment of the transition into a particular state.

Modelling states with the generalization concept

We use the generalization approach as introduced in /ELMASRI 85/. In this paper entities are classified into categories according to the role they may play within the application environment. Categories are also used to represent subsets of entity sets (ISA-categories). The category attributes are graphically represented as circles and the states of the entities which result from the generalization hierarchy are graphically represented as hexagons. Using the generalization hierarchy several states of an entity set concerning one category attribute can be discussed by subentity sets of the superior entity set. In that way every subentity set contains all extensions of the superior entity set which have ever been in the particular state during their life histories.

Modelling extensions of actual states

Considering the non forgetting mode, an entity can be represented in a subentity set by several tuples with different absolute time values. It is obvious, that at any time for every surrogate exactly one tuple represents the actual state of the entity.

2.3 The Graphical Representation of the Static Component

The underlying data model of the proposed static component is the Entity-Relationship model. We assumed that the reader is familiar with the Entity Relationship concept as described in Chen's original paper /CHEN 76/.

regular-entity-set: represents a set of entities and must not be in relation with any other entity set

weak-entity-set: is a set of entities. The weak entity set must always be in relation with one or more other entity sets. Entity sets are always represented as a relation.

entity-set: either regular-entity-sets or weak-entity-sets

group-of-states: entities are classified into categories according to the rule they play in the application environment.

state-of-an-entity: represents a state of an entity in the static component.

Sets of entities are stored in a relational data base as a relation. The following two symbols are used for the relationship between the entity sets.

relationship: this relation generates a new weak entity set from two or more entity sets.

existence-dependent-relationship: represents a relationship between two entity sets. The subordinate entity can only exist if the corresponding superior entity set exists in the data base.

41

2.4 The Dynamic Component

In our model we distinguish between elementary and complex activities.

Elementary activities
All elementary activities describe operations manipulating data of **one single entity-set**, identified by its surrogate. The entity which is involved in the elementary activity can be a regular-entity-set or a weak-entity-set. Each elementary activity must start by one special kind of activity, called begin-activity and terminates with a special kind of activities, called end-activities. Each elementary activity causes the transition from a set of states of the entity set (called preconditions) to another set of states of this entity set (called postconditions).

Elementary process
We call a set of elementary activities an elementary process.

Complex activities
Until now we have only considered processes in which one entity-set is involved. To model activities which deal **with more than one entity of the same or different entity types**, complex activities are introduced in our approach. Since the dynamical features are based on the decomposition into elementary processes which always correspond to a single entity-set, we can consider a complex activity as an interface between different elementary processes. Thereby a complex activity is always the begin-activity of the one (several) elementary process(es) and the end-activity of another (other) elementary process(es).

Different types of complex activities are distinguished, namely

- the existence-dependent-weak-entity-creation-activity
- the group-by-activity
- the relationship-dependent-weak-entity-integration-activity
- the relationship-dependent-weak-entity-disintegration-activity

For modelling the dynamic aspects on the conceptual level a Petri net based graph representation with an individual token concept is introduced. It is assumed that the reader is familiar with the basic concepts of Petri Nets as it is given in /PETERSON 81/.

Each activity (elementar or complex) is characterized by its input data (i.e. preconditions = input states = prestates) which enables it to "fire". Firing means the update of an time attribute and the production of output data (i.e. postconditions =

output states = poststates) which again can initiate the succeeding activities. An activity is able to "fire" if all input data are available, i.e. all input states are fulfilled.

The corresponding Petri net based graph representation (Behaviour diagram = **B-diagram**) has the following meaning:

The states of the B-diagram are used for the representation of the states of an entity-set. These entity-sets are input data respectively output data of the corresponding activities. Graphically states are represented by double hexagons. The transitions of the B-diagram are used for the elementary activities. Graphically, transitions are represented by bars. The connection between states and transitions is expressed by arcs.

For each entity of an entity set which is involved in a specific activity and identified by a surrogate key an individual token identified by the surrogate of the entity (=marked token) is created by the elementary begin-activity.

For simplicity reasons it is possible to model several activities by a single B-diagram extension, if we introduce different types of tokens for every activity. Therefore for modelling it is necessary to introduce an individual token concept (see also /GARDARIN 85/) which means that each entity is always related to a unique token type.

Firing of a transition means the deletion of individual tokens of the same token type from the input states (i.e. actual states) and the insertion of the individual tokens to the output states. Therefore on the one hand in the corresponding input actual state relations the tuples involved by firing must get a time stamp (set end_time_status). On the other hand for the output states tuples identified by their surrogates and time stamps (begin_time_status) must be inserted into the output actual state relations.

2.5 The Graphical Representation of the Dynamic Component

Some symbols of the dynamic representation always have a corresponding symbol in the static, i.e. relationship, existence dependent relationship, state of an entity.
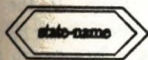
actual-state-of-an-entity: is the corresponding symbol to state-of-an-entity in the static; we consider these two symbols as a union.

elementary-activity: each elementary activity has m prestates and n poststates ($n,m >= 1$) whereby each state belongs to one single entity set. This activity fires if all input states are fulfilled.

relationship-dependent-weak-entity-integration-activity (R-activity): this activity generates from one token of one or more prestates one token of the poststate, which belongs to another entity set.

relationship-dependent-weak-entity-disintegration-activity (R^{-1}-activity):
this activity is the inverse operation of the R-activity. This activity splits one combined token of a prestate to the elementary tokens which we have combined with the R-activity.

existence dependent weak entity creation activity (E-activity): the E-activity generates from one input state which is marked with a token which corresponds with an entity identified by the surrogate α an output state marked with the token $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \ldots, \alpha_v$

group-by-activity: given a weak entity set the "group-by" activity has the task to aggregate all weak entities $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \ldots, \alpha_n$ to the superordinate entity _ by a given discriminating attribute. The discriminating attribute is always the surrogate. This activity can also be considered as the inverse of the E-activity.

connections

between actual-state-of-an-entity and an activity.

between actual-state-of-an-entity and an activity. If the transition fires the individual token of the prestate will not be deleted.

44

choice: the user chooses an entity with the mouse-button.

automatic precondition: these conditions will be fulfilled of a certain system state (i. e. time over)

computation: the user can specify a computation of an attribute of the poststate. After the activity has fired the attribute will be computed.

input: if the activity fires the user has to enter data (i.e. price of the book).

2.6 Behaviour Integrated E-R Diagram (BIER-Diagram)

Until now we have separately investigated the data modelling aspects by means of an extended E-R diagram and the dynamic modelling concepts by using B-diagram.

In the following we will show the strong interconnection between both concepts with the help of a representative example. The integrated approach is called behaviour integrated E-R diagram (BIER-Diagram). A BIER-diagram consists of two "shells". The external shell describes the static concepts, whereas the internal shell describes the dynamic concepts. This means, that the external shell represents the E-R diagram and the internal shell represents the B-diagram. In the BIER-diagram the following modification ist introduced.

3. The governmental office information system KIS

In our implementation we use the recommendation published in /ADV 87/. During the design and implementation we have concentrated our attention on the user interface. Using window techniques and softkeys, KIS is presented to the user in a modern, easy-to-learn and easy-to-understand user interface.

We have implemented KIS on a Nixdorf Targon workstation under UNIX with the programming language C and the underlying database system DDB/4 /GIERLINGER 88a/.

KIS is regarded as a part of office automation and therefore we have developed an interface to an optional text processing system. Many existing text processing systems in an office environment can be integrated in our system. The user presses a softkey and then he is switched to the text processing system /GIERLINGER 91/.

4. An example: KIS modelled with BIER

The example is taken from the governmental information system KIS.

A simplified version of KIS is modelled. Thereby a new document is created in a governmental agency if a new writing is sent to the agency. After the creation of the document, the document is treated in many departments of the agency. After the treatment the document is filed. It is also possible that other writings can be connected with the document.

4.1 The BIER Diagram
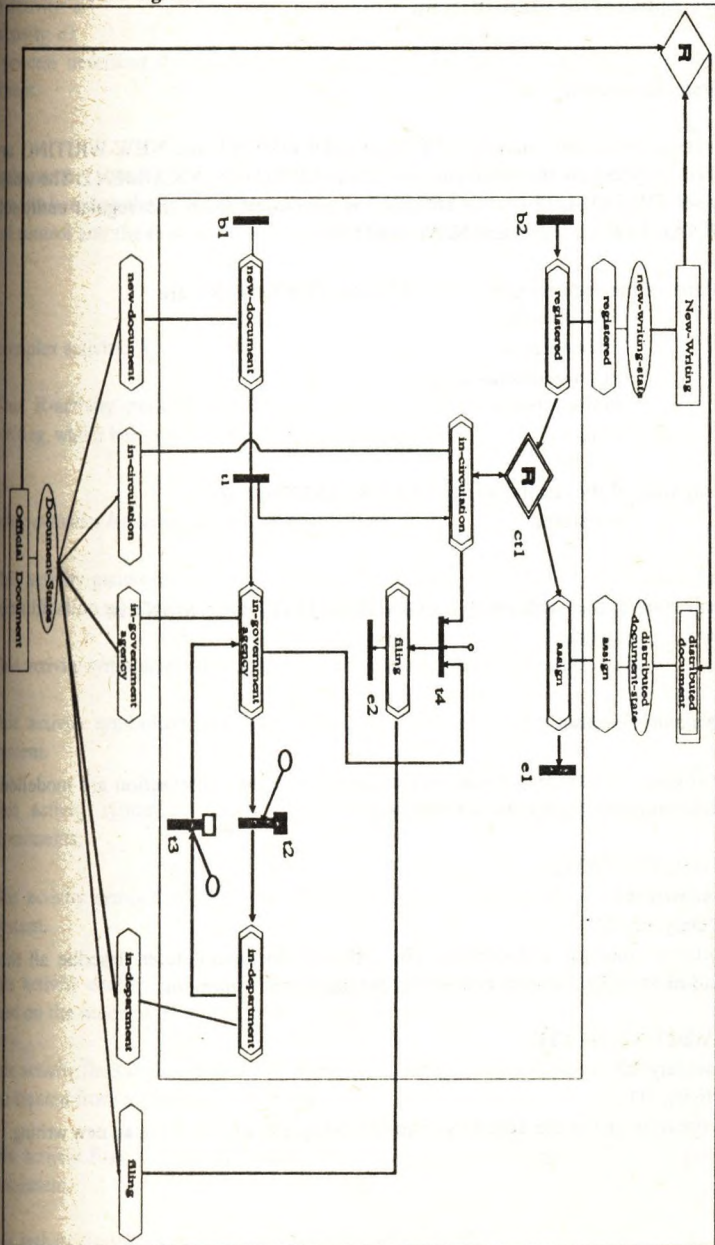
Figure 2: The BIER Diagram

4.2 Description of the BIER-Diagram

The Static Component

Two regular-entity-sets, namely OFFICIAL-DOCUMENT and NEW-WRITING are involved, respectively the weak-entity-set DISTRIBUTED-DOCUMENT. The weak-entity-set DISTRIBUTED-DOCUMENT is generated from the regular-entity-sets OFFICIAL-DOCUMENT and NEW-WRITING.

The states of the regular-entity-set OFFICIAL-DOCUMENT are:
- new-document
- in-circulation
- in-government-agency
- in-department
- filing

The only state of the regular-entity-set NEW-WRITING is:
- registered

The only state of the weak-entity-set DISTRIBUTED-DOCUMENT is:
- assign

The Dynamic Component

In the B-diagram different elementary processes and their interaction are modelled. The elementary processes are the following:

DOCUMENT-STATES
begin-activity: b1
end-activity: e2, ct1
This process concerns a document. The different document-states describe all the activities of an official agency concerning the document treatment.

NEW-WRITING-STATE
begin-activity: b2
end-activity: ct1
This process describes the activities of an official agency after getting an new writing.

DISTRIBUTED-DOCUMENT-STATE
begin-activity: ct1
end-activity: e1
This process describes the assignment of a new incoming writing with an official document.

Each elementary process describes specific state transitions of an entity set.
The arrows between the states, respectively the transitions, model the direction of the flow of control and the flow of data of every elementary process.

The complex activity:

ct1: This R-activity matches an existing official document with a new incoming writing, which belongs to the existing official document.

The other activities have the following interpretation:

b1: This activity generates a new entity "OFFICIAL-DOCUMENT" by assigning an identification number.

b2: This activity symbolizes the registration of a new writing in the data base.

e1: This activity symbolizes that the official document has no actual state in our system.

e2: This activity symbolizes the assignment of additional writings and official documents.

e2: This activity symbolizes that the official document has no actual state in our system.

t1: This activity enables the official document to be on the one hand in circulation and on the other hand in treatment of a government agency.

t2: This activity fires if the official document is in the government agency and should be treated from a special department.

t3: This activity fires if the department has finished the treatment of the official document.

t4: This activity fires if an official document is filed.

5. Conclusion

In this paper we present the BIER-System as a methodology for computer aided modelling of governmental office information systems. We show the concept and the underlying data model of the BIER-System and also some implementation aspects. In our future work we implement the QBE-interface and in a further step we like to extend the BIER-datamodel to an object-oriented datamodel /KEMPER 90/, MATTHES 90/, /SCHLAGETER 90/, /SCHMID 90/.

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PROTECTION OF PERSONAL INFORMATION :

AIMS, PRINCIPLES, TECHNICAL ISSUES

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ABSTRACT

It is generally acceptable that by exploiting modern technology information systems may be built to store and process personal information. Moreover, this information may, inadvertently or in purpose, be used against the concerned citizens' wills and / or rights. The need, therefore, for developing and adopting techniques, procedures and legislation, ensuring the correct and safe use of personal information, is apparent.

This paper addresses the problem of establishing generic principles which should govern the use of the secure computerized information systems and the issue of the technical prerequisites necessary to fulfill these generic principles as well.

KEY WORDS

Data protection, Data protection principles, Data protection procedures, Medical data protection.

1. INTRODUCTION

The fact that Information Technology (IT) today serves not only as a means of improving social wealth and well - being, but also as a strong instrument for social control is indisputable. Indeed, using this technology, Information Systems (IS's) can be developed, which, by utilizing personal - or non personal - information pertaining to some citizens, may lead to the violations of some rights of these citizens.

The term **"personal information"** applies to any piece of information pertinent to a citizen, which, if publicly released, may result in the violation of some established right(s) of his / hers. Examples of such information are political beliefs, health condition, union activities etc.

Consensus has been reached on the requirement that some personal information, such as political beliefs, must be inviolate. The same holds true on the requirement that other kinds of personal information, such as medical information, may be released to confined and select sets of individuals and / or legal bodies, when certain prerequisite conditions are fulfilled. On the other hand, divergent opinions have been expressed on the issue of accessibility / non accessibility / accessibility under conditions, of several other kinds of information, such as religious beliefs for example.

In any case, it must be noted that securing personal information is not enough to adequately protect citizens' rights. This happens because by combining non - personal information, one may deduce personal information. This results in an important contradiction: the more open, transparent and horizontally developed an IS is, the more vulnerable the information, it stores, is!

Threats against personal information are due to some inherent characteristics of IT. It has been determined [1] that:

a) **IT facilitates the interconnection of IS's;** hence the combination of information, stored in several locations for different purposes, is enabled.

b) **IT facilitates gathering and exchanging large volumes of information;** hence unification and integrated processing of information is made possible. Consequently, personal information may be revealed.

c) The ability to concentrate large volumes of information, in conjunction with the unequal distribution of the technical means for processing information, result in the **development of dependence relations to citizens,** whose personal information are not sufficiently protected.

d) **IT enables decisions,** pertaining to individuals or groups of individuals, **to be made on the basis of results obtained by automated information processing,** be that information personal or non personal. Such processing leads to attempts to objectify and quantify human performance, characteristics and skills, which are attributes by nature qualitative.

Against the various threats, emanating from the above established facts, society may oppose by three means [2]:

a) **Adoption of appropriate legislation.**

b) **Increase of social awareness.**

c) **Development of technical procedures for efficiently protecting IT's.**

1.1 Appropriate legislation

The first means of social opposition pertains to laying claim for adopting appropriate legislation against the uncontrolled / unmonitored / unauthorized use of personal information. This legal framework must enjoy maximum acceptance by society members and naturally must reflect the public opinion on these issues. It should address issues such as the protection of personal information, the transparent operations of public life and the means of confronting with any "opaque" process.

1.2 Social awareness

The second means of social opposition pertains to increasing the degree of awareness of society members, so that they demand that they be informed on, consider, and take part in all structural changes, that the use of IT inflicts on human activities.

Structural changes caused by the use of IT are not limited to the realm of productive relations, but also extend to the Iteration of the composition of the social groups intervening in the establishment of the rules, according to which authority is exercised. This is realized through the alteration of the composition of the socially active population, where apart from labor unions and political parties, autonomous groups and scientific societies and leagues show themselves.

The above fact is notable, since it means that new partners are introduced to the process of establishing rules for the exercise of power. It is also notable for another reason: due to this introduction of additional partners, more effort is required in order to sort, analyze and codify their opinions,

even in environments characterized by enhanced political and social assent.

It is therefore imperative, that these groups continuously and closely cooperate, in order to exchange information and to secure that they are complementing each other, within the claiming process. This claim must definitely extend beyond the functional framework of IT and must focus on the ideological and political environment, since, after all, it is the latter which shapes the rules.

1.3 Technical procedures

The exploitation of IS's according to the procedures and rules set by the society, requires cooperation with IT scientists and professionals. They, after all, are the ones who can accurately judge whether an IS is operating within its design specifications. Besides, locating vulnerable points, establishing access rights, designing information exchange through data network schemes, protecting the users of an IS against using deficient software, etc, are among their primary responsibilities.

However, it must be noted that the development of secure IS's must only aim at the protection of those IS's, for which wide social assent has been reached, rather than to the creation of "opaque" systems.

2. THE GREEK EXPERIENCE

Greece, among other European countries, lacks a generic Data Protection Act, which would facilitate the introduction of IT into socially sensitive applications, while at the same time would ensure the immunity of personal information and consequently would guarantee observation of constitutional human rights. Existing legislation [3,4], as well as legislation proposed at times, do not seem to be able to cover the issue. Even though there exist several IS's, for which the adoption of appropriate legislation is imperative, the goal is still a generic legal framework.

Such a generic framework may certainly contain, but should not exclusively rely on "exception" clauses. Examples of IS's requiring such clauses are IS's for keeping **criminal records**, IS's for use by **mass media and the press,** IS's for use in **statistical applications,** IS's for use in **medical applications** [5], etc.

Given the fact that a legal framework is missing, one approach which could result in temporary solutions is to adopt **"internal security regulations"** for each sector of professional activity [6]. This approach is rather deficient,

since it will result in solutions reflecting the specific beliefs and interests of those forming the regulations. Moreover, any such solution will be derived under the constraints imposed by specific characteristics of the specific functional unit. Thus, this approach is ineffective, although it must be noted that its major advantage is its speed of implementation.

It has been noted in the past [7] that all relevant legislation (internationally) is mainly of a **defensive nature** and attempts to confine the use of personal information. However, efficient protection of civil rights cannot be achieved by making information inaccessible by third parties, but rather by safeguarding personal information from ourselves.

We also note that opinions have been expressed [8], whereby "keeping personal information confidential, seems sometimes to be the deed of marginal groups and idealists, who hope to change the world in a minimum time span".

Therefore, adoption of legislation requires formulation of **three sets of principles.** The first set pertains to the generic principles [8,9,10] which must govern the operation of an IS. The second set pertains to the technical procedures, which by complementing and implementing the generic principles of the first set, will guarantee secure management of personal information. Finally, the third set pertains to some "exception" clauses, which must be observed by IS's with inherent peculiarities.

3. GENERIC PRINCIPLES

In this section we propose the following generic principles which, in our opinion, should govern the operation of any manual or automated IS (see, also, Table 1):

1) **(Conformance with the constitution).** IS's exist and operate with a view towards serving citizens according to the constitutional provisions pertaining to civil rights.

2) **(Publicity).** No IS should be allowed to exist or operate, unless its existence is publicly known and its operation can be controlled and monitored by the society or its representatives.

3) **(Security).** Every IS which processes information, that may be used against citizens' rights, must be secure. The term "security" includes protection of **confidentiality, information integrity** and information **availability.**

4) **(Verification).** Procedures enabling accuracy control and verification of information, must exist.

57

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│ G E N E R I C   P R I N C I P L E S           │
│ F O R   D A T A   P R O T E C T I O N         │
├─────────────────────────────────────────────┤
│                                               │
│   #1. Conformance with the constitution       │
│                                               │
│   #2. Publicity                               │
│                                               │
│   #3. Security                                │
│                                               │
│   #4. Verification                            │
│                                               │
│   #5. Transparency                            │
│                                               │
│   #6. Minimum number of exceptions            │
│                                               │
│   #7. Objectivity                             │
│                                               │
│   #8. Qualitative evaluation                  │
│                                               │
│   #9. Social awareness                        │
│                                               │
│   #10. Anonymity                              │
│                                               │
│   #11. Monitoring                             │
│                                               │
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TABLE 1: Generic principles for data protection

5) **(Transparency).** All IS's must be designed, operated and assessed transparently and with the maximum possible participation of interested parties. Thus, every interesting party must be able to find out what information, relevant to them, is kept and how it is used.

6) **(Minimum number of exceptions).** Even though the need for some particular arrangements is apparent (criminal records, medical information), these arrangements should not establish exceptions, but rather should contribute to the security of personal information.

7) **(Objectivity).** Personal information, regarding a citizen's past, should not be allowed to influence his / her future.

8) **(Qualitative evaluation).** Evaluation of a human being should not be allowed to be made on the basis of automated data processing. Human characteristics, skills and peculiarities are qualitative attributes and should be treated as such.

9) **(Social awareness).** Care must be taken so that society be

made aware, by plain means, of the possible effects of IT on citizens' rights.

10) **(Anonymity)**. Statistical data processing must be performed in ways and by means guaranteeing anonymity of those involved.

11) **(Monitoring)**. A representative – functionally and financially independent – body, should be formed for monitoring and ensuring observation of the above principles. This body must be formed by and should account to the National Assembly.

4. TECHNICAL PROCEDURES

Some guidelines for technical procedures, implementing the generic principles, can be found in [2,11,12].

In this paper, we propose the following (see, also, Table 2):

1) **(Documentation)**. IS security procedures in force must be analytically described in writing.

2) **(Integrated design)**. Security procedures must be specified along with the IS design specifications.

T E C H N I C A L   M E A S U R E S   F O R   D A T A   P R O T E C T I O N
#1. Documentation
#2. Integrated design
#3. Access rights table
#4. Integrated technical procedures
#5. Training
#6. Continuous upgrade
#7. Restricted use
#8. Evaluation

TABLE 2: Technical measures for data protection

59

3) **(Access rights table)**. Every IS requiring security must be equipped with an access rights table (or a more general security scheme), indicating what kind of access each user has, to each type of information, file or application.

4) **(Integrated technical procedures)**. The security procedures designed for an IS, the organizational structure selected and the specialized equipment and software utilized, must [2,12,13,14]:

   - conform with the IS security goals,
   - constitute an inseparable part of the overall IS exploitation methodology,
   - optimally utilize the available resources,
   - ensure that storage and processing of data is performed in ways and by means guaranteeing accuracy of data and results and minimizing the probability of inadvertent loss or damage,
   - ensure that the reliability of the security procedures is not affected by organizational restructuring or administrative alterations,
   - ensure that any and all intervention with IS resources can be monitored and controlled (hardware maintenance, additional equipment etc),
   - ensure that a log file of system activities (especially security related activities such as use of wrong passwords, unsuccessful attempts for accessing classified system areas etc), is kept,
   - ensure that back ups are systematically made and preserved,
   - ensure that magnetic media or documents containing personal information are totally destroyed, when such a need arises,
   - ensure that personal information, exchanged through telecommunications networks, are transmitted and received safely, by using cryptographic or other suitable techniques,
   - ensure that security procedures are observed, when personal information is physically carried out of the area where the IS operates,
   - ensure that predesigned contingency planning exists,
   - enable assessment tests and reevaluation of security procedures.

5) **(Training)**. Users of IS's, handling personal information, must be systematically trained on the capabilities, the limitations and the correct use of the available equipment and the security procedures utilized.

6) **(Continuous upgrade)**. Security procedures must be updated and upgraded continuously, in order to cope with crucial technical advances (e.g computer viruses) [2].

7) **(Restricted use)**. IS's handling personal information must

not be used for training purposes. Files containing such
information should not be used for evaluating new
software.

8) **(Evaluation)**. Unified criteria for assessing security
procedures must be developed.

5. MEDICAL INFORMATION SYSTEMS (MIS) SECURITY PRINCIPLES

The generic principles and the technical guidelines described
above, should be complemented by the following specific
principles, if related with a medical information system
[5,15].

1) **(Improvement of medical services)**. All information,
pertaining to medical records stored in MIS's, should be
used solely for improving medical services.

2) **(Exchange through physicians)**. Exchange of information on
medical records, should be made only through and by
physicians.

3) **(Management by consent)**. No information may be released to
third parties, without the prior written consent of the
interested citizen(s). There exist, of course, some
exceptional cases, which must be covered by particular
arrangements (e.g the case of contiguous diseases).

4) **(Efficiency)**. Security procedures, implemented in and
utilized by MIS's, should not downgrade the quality of
medical services rendered.

6. CONCLUSIONS

The analysis of the IS security issue presented above, in
conjunction with the European model of social and
technological development, establish the necessity for
adopting a legal framework, covering the issue of protecting
citizens' rights against threats inflicted by processing
personal information.

The confidence, that this legal intervention - in order to be
effective - must be complemented by specific technical
regulations guaranteeing the protection of · personal
information, also appears through. This legal intervention
appears to be imperative in the case of MIS's; this is due
both to the inherent sensitivity of medical information, as
well as to the - currently underway - development of
automated MIS's.

We have proposed three sets of principles, on which this
legal intervention should rely. Relevant existing legislation

in force, in several European countries [11,16,17,18,19,20], constitute useful examples for assessing peculiarities and difficulties. Moreover, it constitutes an additional reminder of the imperative need for taking immediate and effective action; this stands true for several European countries, including Greece.

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Coordinated computer and network operations
Gunnar Karlström, Kommundata, Sweden

Abstract

This paper will describe the use of computers on central and local levels and their interaction by means of a nationwide communications network. The present solutions are based on a long experience and highlights the importance of a well developed communications network. By means of the network, flexible solutions that meet various customer needs can be obtained. In this network, computers will have the role of "power stations" were the location of the computers will be of less importance.

1   Background

Kommundata, Sweden, a company owned by the Swedish Association of Local Authorities and the Swedish Federation of County Councils was established in 1965. The company operates in the fields of computer services, applications software, consultany, training and hardware sells. The number of employees is about 1 500 and the total revenue about 1.2 Billion SEK (200 Million USD). Although the company competes with a number of software and hardware vendors it has a big marketshare, about 90% for computer services to local authorities (municipalities) and about 50 for county councils. There are 284 municipalities in Sweden, varying in size from 4 000 to 650 000 inhabitants, why their needs and demands are very different. The number of county councils is 24.

2   Hardware and software structure

2.1   Central computers

Historically the computer services were based on a central computer and batch systems. In the mid 70's another mainframe was installed to meet the increasing volumes and for backup. In th mid 80's a number of regional datacentres were set up to meet the demands for extended on-line services and decentralization. In all the company operated 8 datacentres a couple of years ago. During the last two years the operations have been consolidated to 4 centres.

The actual configuration are the following

Place	Configuration
Skellefteå (Northern Sweden)	IBM 3090-600J (Supercomputer)
	Unisys 2200-402
	Unisys 2200-403
Stockholm (Headoffice)	IBM 9021-580J
	Unisys 1100/93
	Unisys 2200/401
Borås (Western Sweden)	IBM 9121-260J
Lund (Southern Sweden)	IBM 9121-440J
	Unisys 1100/71

The operating systems are MVS/ESA and OS 1100 respectively.

2.2 Local computers

As mentioned the needs and demands differ very much among the customers. Therefore a number of alternatives for computers on the local level are provided. They include the following installations.

Type	Number of installations
PC networks	230
Datapoint	80
UNIX-based	51
AS/400	57

2.3 Application areas and productlines

The application systems, totally about 300 have been put together in the following application areas
- staff administration
- budget and finance
- social services
- school, culture
- GIS technique, real estate
- billing systems
- traffic, environment
- decision support, office automation
- healthcare

Some applications are provided on mainframes, others on the local environment but in many cases in a combination, which means that high volumes of datafiles and programmes have to be transferred (about 100 000 per month).

To conclude the various hardware and software alternatives a number of product lines are provided, each with as complete application portfolio as possible. Mainframe based systems however are provided either on IBM or Unisys computers.

A specification of the product lines is shown down.

Productline	Techn Eq	Products	Op systems
Sigma	Datapoint PC	Local systems	RMS MS/DOS
Omega	Datapoint PC UNIX comp	Local systems " "	UNIX v 5
Beta	AS/400	Local systems	OS 400
Delta	IBM	Servicebureau	MVS/ESA
Lambda	Unisys	Servicebureau	OS 1100

3   Trends in Local Government administration

Local Government administration in Sweden is expected to change in many ways during the 90's.

Driving force are
- internationalization
- economy
- market orientation
- age shock
- lifestyle
- environment
- deepened democracy

The trends go

From	To
Central	Decentral
Concentration	Delegation
Authority	Services
Public	Private
Sector orientation	Market orientation
Efficiency	Effectivness

4   Computer systems for the 90's

To meet the requirements of the development for the 90's there will be a need for "horizontal" use instead of "vertical". Earlier one employee most often worked with one application eg staff administration. Now and in the future the employee will require access to a great many applications. This can be illustrated as follows.

Product (sector) Oriented
Central offices

Economy   Staff   Social services

Market Oriented
(Decentralized
Multifunctional
Offices)

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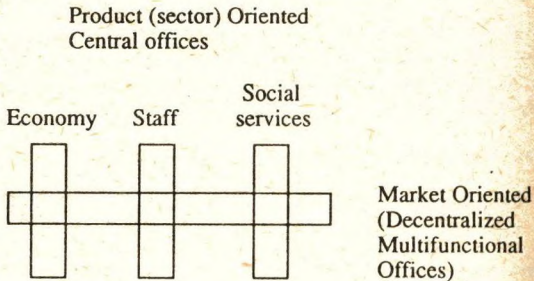
The concept for Kommundata is to provide a structure that will provide access from any PC/terminal to any system in the municipality, to the servicebureaus and to external databases, eg banks. With the great variety of applications and technical environment described above this will require some key elements.

These are
- communication
- integration
- presentation

A strategic decision has been taken to keep to standards based OSI in the above respects.

5 Communication

Covering the three basic levels in the OSI concept Kommundata can offer a communications network to its customers. It has been in operation since two years and the experience is very good.The network is based on the X.25-protocol, although at present many vendor protocols are handled (converted to X.25 in the network level) in the net such as SNA, UTS and asynchronous protocols as VT100. The ultimate target is to use attached equipment, capable to handle the X.25-protocol.

5.1 KomNET, the nationwide network

The nationwide network provided by Kommundata is called KomNET. The physical lines are 64 KB leased lines from the PTT. The network is based on Eripax nodes from Ericson, The Swedish Telecom company. The net has 4 main nodes at the 4 computer centres, 20 regional nodes and an increasing number of local nodes. The network and the attached equipment is supervised by Kommundata by means of Net Alert. To the nodes are connected Kommundata's computers, the customers local network and external databases eg banks. Out of in total 22 000 PC:s/terminals connected to the datacenters about 10 000 at present are subscribers of the KomNET services. They are charged a monthly fee that allow transmission of data regardless the volumes.

The principle of the function of KomNET is illustrated in the following picture where the net is the strategic resource.
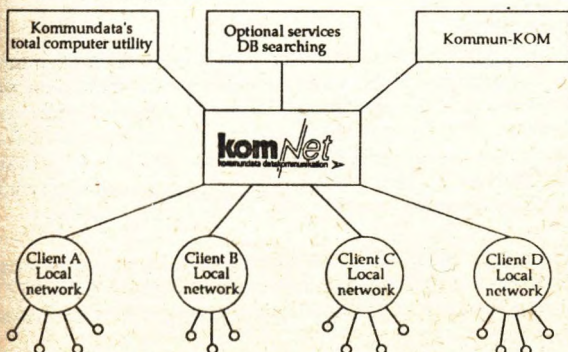
KomNET on the map of Sweden looks like this.
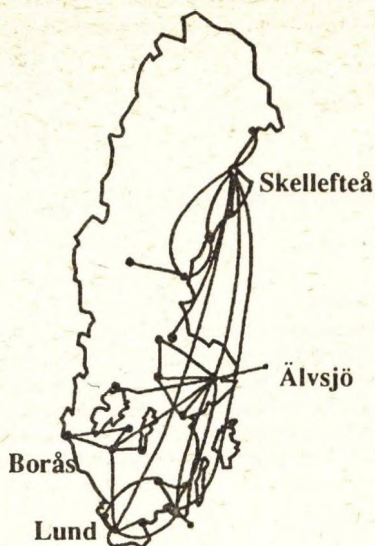
5.2 Local networks

The local nets are owned by the customers and are of various kinds, based on PC:s or PC:s/terminals connected to local computers eg AS 400. Existing network operating system is Novell based on LAN-protocols such as IEEE 802.3 (Ethernet), IEEE 802.5 (Token ring) and ARC-net (propriety Datapoint). The services of Kommundata include systems installation, training, subscription of technical support and supervision. The applications software is, as mentioned earlier, also delivered by Kommundata. The connection from the local network to the nearest KomNET nod is paid by the customer.

6 Integration

The concept "all to all" means that data from any computer environment shall be able to be transferred to any other computer environment. This will force a comprehensive need of integration (electronic exchange of information text, binary programs etc). For that reason a concept called KomLINK is under development. The concept is in true line with the efforts to keep to standards, in this case EDIFACT. Other groundstones are that transmission shall be done automatically and that the sender is responsible for the checking.

The EDI technique and the EDIFACT standard are premises for integration with external databases. The target, however, is to use the EDIFACT standard also for internal integration (for applications and databases on Kommundata's or its computers).

KomLINK (under development)

KomLINK is a màilbox system for electronic data interchange (integration) between applictions. The X.25-based communication network KomNET will be used as mainstream carrier. KomLINK will have functions for converting internal data formats to other propriety data formats or to the international standard EDIFACT. Propriety network architectures as SNA (IBM), DCA (UNISYS) can also be conneceted to KomNET.
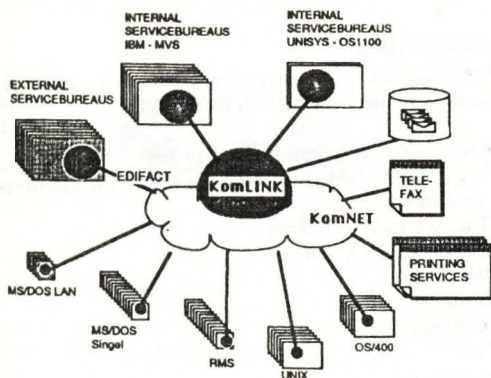
KomLINK is being developed in three phases as follows

Phase	Content	Date in operation
1	A complete "mailbox-system" with functions for handling electronic distribution of data, text and binary programfiles between applications located in different technical environments.	1991-09
2	Capability to convert internal data formats to standards as ODETTE, EDIFACT and even propriety formats for some important businesspartners.	1991-09
3	Basics för building applications in the client/server model. Support for APPC and horizontal integration between applications.	Not yet decided

69
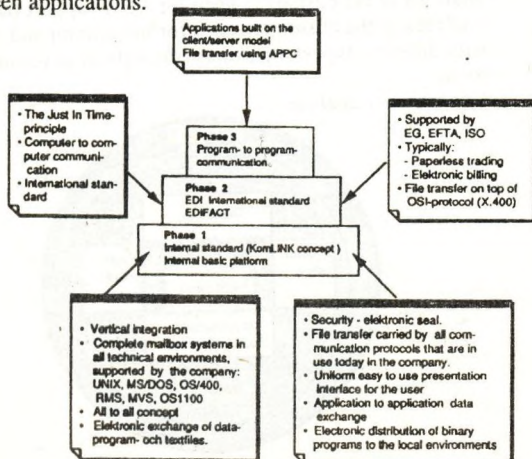
A problem in the present situation is the presence of too many file transfer protocols/products as carriers for the companys internal integration service. (3780/BSC, 3770/SNA, 3270Send/receive, NFTP, NTP, UFTP, DDP, IS5000, IS6000, NTR, NDM, UUCP, KERMIT, PCI/PCU, PC-support, LU6.2) in all 16 protocols/products. A reduction to 6 is desirable (LU6.2, FTAM, X.400, NFTP, UUCP, KERMIT). We will however keep the possibility for our businesspartners to use all these products.

7 Presentation

A vital prerequisite in the above described environment is to provide a uniform, easy to use presentation for the user.

Ingredients in our presentation concept are
- Internal standards following the SAA-concept for screen layouts colours and so on
- Touch screen technique
- Presentations Manager
- Windows 3
- Motif
- X-Windows
- PLUS
- Hypercard

8 Concepts

Kommundata has developed a concept called KAA, which contains rules and recommendations for the following basic groundstones:
- Databases (Relational with SQL-inerface)
- Presentation (See above)
- Communication (International standards as OSI, IEEE and CCITT)
- Security
- Models and methods for:
  - the development process
  - database design
  - analyses of the customers need for ADB support (activity analyse)
  - analyses of the customers need for integration and communication with different types of partners (the federal government, banks and so on).
  - Connectivity analyse.
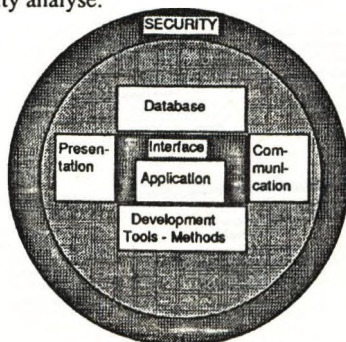
To summarize the above presented communication concepts and how they refer to the OSI model the following picture is aimed to illustrate that.

Applications

Budget and finans
School, culture
Social services
Billing systems
Traffic

Catalogue

KomLINK module

UserInterface
Database interface
KomLINK kernel
Communication interface

Logging

Mailboxes

Exchangeable depending on protocols in use

Store and forward

Communication OSI-model

| Level 7 Application |
| Level 6 Presentation |
| Level 5 Session |
| Level 4 Transport |
| Level 3 Network |
| Level 2 Link |
| Level 1 Physical |

File transfer protocols and products

KomNET

Government in the Nineties
Information - the Vital Ingredient.

By definition, a government is an instrument, or system, designed to manage and direct the affairs of a community. That community may be large or small, complex or simple; for the purposes of this discussion we will limit ourselves to the type of community in which we live, here in Europe. We have people, old and young, working and not working, in good health and bad health; we have social, economic, industrial, legal, and commercial infrastructures; if a community is to flourish and achieve its communal ambitions, then the government of that community needs access to the one common factor which is capable of sup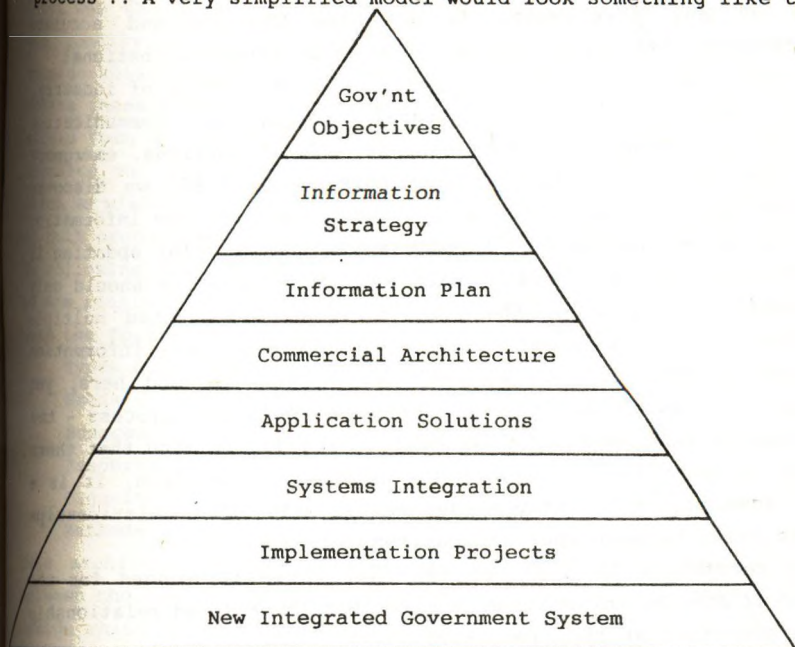porting all the diverse interests of that community - information , timely and accurate information - the vital ingredient.

Of course, we all know that there is no shortage of information as such; the problem is that much of it is irrelevant to the processes of government and that which is relevant, is frequently not available when it is needed, or some vital part of it is not up to date. Fortunately, today's technology allows us to easily store, update and retrieve vast masses of information, so the physical management of information does not really present a problem. However, if we merely facilitate the management of what we already have, the chances are that we will only be giving ourselves the ability to make mistakes faster and on a bigger scale.

What we really need to do, is to take a long hard look at the information which is really necessary to support the growth and well being of our community; we have to decide - what do we need? where does it come from? how do we get it? what will we do with it when we get it? - in short, we need to develop an information strategy.

72

Where does a strategy fit in the total decision/implementation process ?. A very simplified model would look something like this:

```
                    /\
                   /  \
                  / Gov'nt \
                 / Objectives \
                /--------------\
               /  Information   \
              /     Strategy      \
             /--------------------\
            /   Information Plan    \
           /------------------------\
          /  Commercial Architecture  \
         /----------------------------\
        /     Application Solutions      \
       /--------------------------------\
      /      Systems Integration           \
     /------------------------------------\
    /      Implementation Projects            \
   /--------------------------------------\
  /   New Integrated Government System         \
 /_____\
```

Even such a simple model can take a long time to achieve and in practice we have to recognise that a community is a living entity, time and life will not stand still while we work out all the details of a theoretically perfect model.

We have to accept that immediate, short term investments must be made to alleviate the more pressing needs of our community; however, if we are not to waste precious resources in these short term activities, then it is vital that we complete at least the first step in the overall process - define an information structure; this will enable us to take care of a very important factor in any redevlopment activity - protection of investment.

73

When setting out to define this structure, it is necessary to identify the needs that the structure will meet. Clearly the basic need of any government, is to have current and accurate information, readily available, on a whole range of "national aspects", such as - population profile, distribution of industry, scope and location of natural resources, communication capabilities, transportation networks, social services, emergency services etc.. In order to meet this basic need, we discover another layer of subsidiary needs - to be current, the information must be stored and managed in such a way that regular updating is facilitated; to be accurate, each set of information should only be held once to avoid the problem of non-integrated multiple updates; to be readily available, fast access to all information storage devices must be assured. We might well add here, yet another need which should be addressed early in the process - the information retrieved has to be useful; bearing in mind that there can be many different reasons for needing information, it is a great advantage to be able to define, at will, what relationships should exist between the various items of information to be retrieved; thus we can say that there is a need for the method of storing information to allow for any desired relationship to be specified at the time of retrieval.

. . . .

Having identified a set of needs which our information structure must address, the next step is to indentify the various sources of the information. In practice, of course, much of it already exists, in one form or another, in the various archives of government ministries, local councils, special purpose groups, educational bodies etc. and where it does not exist or is of unacceptable quality, then these are the very organisations which have to be directed to collect it, or update it. Physical identification of

74

information sources as such, is not difficult, but implicit in our quest was the need for the information to be - current, accurate and readily available and this aspect can frequently demand considerable resources. It is not the purpose of this paper to define these resources, but identification of these resources should form an integral part of the strategic model. Finally, to complete our model, we must include key pointers to the form in which we wish our information system to be organised and the method of both organising and operating the system.

By following this process to develop an information strategy, what we are really doing is creating an Information System Architecture with the following components:

    Types of information
    Needs
    Sources
    Resources
    Organisation
    Methods.

This architecture will enable us to define the relationships between the various components of the system, it will enable us to decide which existing components to retain and which to discard, it will enable us to plan our short term 'ad hoc' investments in such a way that they will retain their value during future growth and it will facilitate quick and effective response to change.

. . . .

It was suggested earlier that one of government's needs, in respect of information, was that it should be useful in terms of desired relationships. Without pre-empting any decision that might be made concerning a specific Information Architecture, it is virtually certain that this need will be met by the use of an international standard relational data base, together with standard query tools.

With this in mind, it is interesting to see how selection of such an architectural component can allow the ad hoc development of the information system, based on immediate pressing needs and availability of allocated funds, to proceed, without detracting from the basic information strategy.

In many countries, the Ministry for Home Affairs (or Ministry of the Interior), is a typical example of an 'information intensive' organisation with a need to examine information in a wide range of varying relationships. For the purposes of this discussion, let us take a quick look at three major areas of activity in such a ministry and see how selection of a relational data base, as an architectural component, can provide continuity at the same time as developmental flexibility:

```
      Civil                 Criminal               Passport &
     Registry               Justice               Immigration

  - Central Bureau     -Court Administration    - Passports
    Regional Offices   -Judiciary                 - Production
  - District Offices   -Criminal Records          - Register
                         - Base Data              - Tracking
                         - Finger printing      - Immigration
                       -Police                    - Register
                         - Administration         - Tracking
                         - Operations           - Security
                           - Liaison              - Airports
                           - Control              - Borders
```
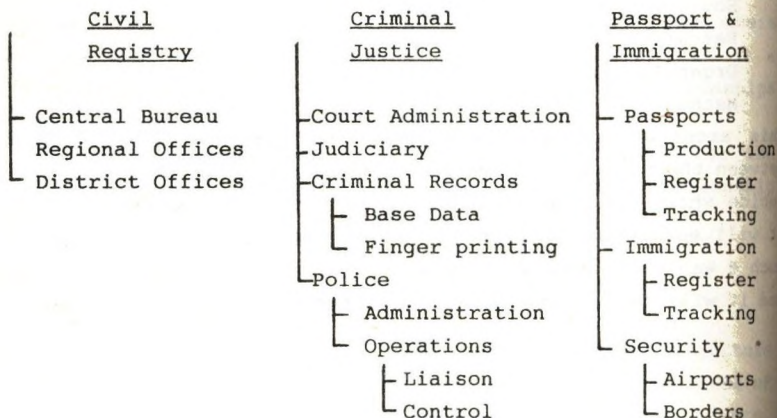
Even a cursory examination of these activity areas will show that there is a great potential for economy and improved efficiency by utilising a single source for base data on people and establishing specialised subsets as different 'relationships'. Without a

strategic model, or architecture, and without the selection of a relational data base as a basic architectural component, constructive coordination between all these activities is a monumental task and in practice, is virtually unachievable. Even with such a tool, it is a time consuming and demanding task; but the point is, that it can be done and what is perhaps even more important, it can be done in stages, as and when finance and resources are available, without endangering the investments made at each stage. An important benefit to be derived from an architectural model is that, not only does it indicate the optimum information hierarchy, but in so doing, there is an automatic indication of priority. This benefit, of having a clear indication of priority, can be used to great advantage both at the implementation decision level and in the process of building 'governmental business plans', - a vital activity where it is necessary to attract external finance in a national reconstruction program.

. . . .

In the above example, there was an implicit common link between the different areas of activity - namely, people. There is however another common link between many, apparently disparate, community activities - that is, location. This spatial attribute is, of course, present at all levels of national endeavour, but it is probably best appreciated at the 'local community' or city level where the needs of the community are more tightly meshed and interactive.

Once again, let us look at a sample of the types of services for which a typical city council is responsible:

    Transportation;   Healthcare;   Police;
    Emergency services;   Water,Gas,Electricity & Drainage;
    Housing;   Education;   Refuse collection & disposal.

It is appreciated that the city council may not actually provide all these services directly, but it is certainly responsible for ensuring that they are provided and for coordinating such provision. It is perhaps in the areas of planning and coordination that a city council can best make use of a 'spatially oriented' information system. Traditionally, this 'spatial element' has always been presented in the form of maps and indeed that is still the case today; however, it is now possible to present these maps electronically and with the advent of this possibility, has come a host of advantages which have revolutionised the process of local government. These new systems are known generically as - Geographic Information Systems, (GIS). It is beyond the scope of this paper to present all the aspects of GIS, but we can briefly discuss some of the benefits to be derived from such a system, within the context of building an Information System Architecture to meet the needs of government.

We stated earlier that the information system had to meet some very basic needs:

Information must be accurate - only stored once;

Information must be current - easily updated;

Information must be readily available - easy multiple
accesses;

Information must be useful - multiple relationships possible.

In addition to meeting all of these needs, a good GIS will offer the following beneficial features:

Total integration of all spatial and non-spatial information;

Easy access to other information systems;

Ability to handle large data volumes;

Continuous, or seamless mapping;

Ability to customise particular applications;

Interactive development language;

Extensive analytical capabilities;

Security and flexibility.

I hope that it will be obvious that GIS, with all its potential for improved efficiency, is a vital component of any government Information System Architecture. It should also be noted that acceptance of GIS as a strategic tool does not preclude phased implementation, thus meeting our previously stated objective of allowing short term implementations while protecting our investment in the long term development.

. . . .

There is one point I would like to mention here, which although it has no conection with architectural structures, does have some relevance to local government strategy. Increasingly, utility services are being provided by private companies acting under contract to local government; they can obtain significant commercial benefit from having access to a GIS; therefore, any local government which decides to invest in producing a spatial database of their area of jurisdiction, can expect to derive a considerable income from either providing a bureau service, or licencing the information to the utility companies.

. . . .

To conclude this very brief paper, I would like to go back to the simplified model of the decision/implementation process, presented at the beginning and quickly review the whole process.
We must assume that the government objectives, whatever political form they may take, include the restructuring of the fabric of government - without this, the chances of success in other areas are minimal. In this paper we have highlighted some areas that must be addressed in defining the strategy; the next step is to take that strategy and develop it into a detailed plan. Having done that, we can start to look for a commercial information architecture which matches our requirements and which can support

79

the necessary application solutions to meet the actual needs of government processes. This commercial information architecture should be sufficiently flexible to allow us to move to the next step, the integration of all government information systems, without compromising the integrity of our current investments. If the government strategic information architecture and the commercial information architecture are well structured and the structures are complementary, then the implementation process can proceed in a well ordered and cost effective manner and the government can be assured of success.

Finally, I would suggest that most governments do not possess all the resources necessary to carry out this process alone; they need an experienced partner to support and advise them. If I may be permitted a small "commercial" at such a gathering as this, I would like to say that I am proud to work for just such a partner - the Unisys Corporation.

Ivor Osgerby-Bishop
Business Manager
Central & Eastern Europe
Unisys World Trade Inc.

A NEW INTEGRATED DATA TRANSMISSION NETWORK FOR PUBLIC ADMINISTRATION IN FRIULI-VENEZIA GIULIA

by Giorgio Ribotta and Giovanni Stefanutti
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1. Introduction

In the near future the need for efficient and effective infrastructure and services will become ever more important: telecommunication services in general and data transmission network in particular, will surely have a strategic role to play. Moreover recent political events,which have completely changed the socio-economic framework in the neighbouring countries in Eastern Europe,opening new markets and offering new opportunities for economic growth,suggest further reasons to accelerate this reorganization of the communication systems for the Public Regional Administration.

"Regional" size seems to be the most suitable dimension to tackle the many and varied problems. Consequently, a plan has been drawn up by SIP (Società Italiana per l'Esercizio delle Telecomunicazioni) in order to establish a new integrated data transmission network for Public Administration in the Friuli-Venezia Giulia Region.

2. SIP and Friuli-Venezia Giulia Region

Friuli-Venezia Giulia, one of the 21 Italian Regions, located in North East Italy, has four provinces (Trieste, Udine, Gorizia and Pordenone) which in their turn are divided into 219 boroughs in all.

Important macro-economic data is shown in the table below:

Friuli-Venezia Giulia Region

area (sq.km)	7,844
no.inhabitants	1,234,000
average annual growth rate (% p.a.)	0.17
pro-capite income ($)	14,775

In Italy the telecommunications sector is particularly complex. It is managed by the following companies/administrations:

- SIP (The Italian Telecommunications Company), whose role is to manage tele-communications service on a national basis as far as local and trunk traffic is concerned;

81

- **ASST** (State Company for Telephone Services), which manages TLC services with Europe and the Mediterranean Area.

- **ITALCABLE**, responsible for international traffic with the remaining countries.

- **TELESPAZIO**, which supplies support structures for int·rnational and intercontinental connections via satellite.

The organisation of **SIP** is structured on three levels:

* **Headquarters** (located in Rome), concerned with strategy and its implementation; besides, there is one operating department responsible for long distance network within the Italian territory;

* **16 Regional Branches**, located in the main regional capitals of Italy, concerned with co-ordination;

* **101 local offices**, usually located in the provincial capitals, concerned with operational work.

The table below gives some important data regarding SIP in the Friuli-Venezia Giulia Region (as of 31.12.1990):

no.employees	2,048
no.subscriber's connections	522,554
of which business connections	103,086
no.connections/100 inhabitants	42.8
no.data transmission access points	6,798
of which on specialised networks	1,554
annual investment (millions $)	140

3. Present Status

At present as far as Public Administration is concerned in the Friuli-Venezia Giulia Region several information systems exist side by side implemented on different networks; so processing units from different suppliers, which are located on separate sites, use data transmission circuits at different speeds in order to connect workstations throughout the Region. This particularly complex situation has led to the addition of successive applications set up on separate networks in order to satisfy the growing requirements of the end-user.

The information systems now in services are the following:

- SIAR (Sistema Informativo Amministrazione Regionale/Regional Administration Information System), which connects all the offices of the Region of Friuli -Venezia Giulia and makes it possible to use unified procedures for accounting, personnel management etc.

- SISR (Sistema Informativo Sanitario Regionale/Regional Health Service Information System) which concerns all the hospitals and Local Health Authorities enabling computerised management of the health service (chemists, free beds available, admissions etc.).

- ASCOT (Automazione Comuni Minori/Computerisation of Small Boroughs) which makes it possible for all smaller boroughs grouped together to carry out procedures regarding records and public administration by means of the centralization of information technology resources;

- C-TS (Sistema Informativo del Comune di Trieste/Information System of Trieste) which computerises, for the province of Trieste alone, accounting and personnel management procedures;

- POLO (Rete Poli Provinciali/Provincial Node Network) similar to the C-TS system but aimed at the remaining Provinces in the Region.

At present, the transmission supports utilised for the networks mentioned are generally leased analogue circuits, in point-to-point or multi-point configuration, operating at various speeds (from 1,200 to 9,600 bit/s), enabling all workstations and terminals involved (roughly 1,500 in the Region) to be connected to their relative host computer. Owing to the diversity of terminals (synchronous, asynchronous, X.25) and to the presence of various proprietary communication protocols (IBM, SNA, SDLC, BSC3, BSC1) there has to be a wide range of transmission protocols.

Appendix 1 illustrates the typical layout of one of these information systems.

4. Analysis of the Present Situation

An information system based on this type of architecture shows some critical aspects which lead to rapid obsolescence or serious difficulties in managing the network itself.

The main limits of the present structure will now be examined since it is from a consideration of these points that the project for an integrated regional network took off.

83

- **Integration** : the existing information systems are in fact separate from each other, in the sense that the applications and the databases on a host may be accessed only by the workstations physically connected to it, without any possibility of network integration. This feature greatly limits the number of operations the workstations may carry out and may lead to a redundancy of resources (databases and/or workstations) with both economic and updating problems.

- **Data transmission speed**: analogue connections which generally exist today, operating at a "low" speed, are becoming a growing bottle-neck for the whole system, increasing response time.

- **Bit error rate (BER)**: analogue direct connections typically have a BER of approximately 10-5.
  Although this value may be acceptable when there is a reduced volume of data involved, on the contrary with heavy traffic it may lead to a high number of retransmission trials with a consequent serious deterioration in the quality of the network.

- **Transmission techniques**: the equipment used today is often of an analogue type (e.g. modems, FDM multiplexors etc) and so implies repeated A/D conversions of the signal and viceversa with yet again a noticeable decline in quality.

- **Transmission media**: until recently the public voice and data network has used copper cables (low frequency in urban areas and co-axial for long distances) and radio links.

- **Access to service**: the response time of the network, limited by low transmission speed and by the analogue equipment used until now is increasing as a result of an ever greater volume of traffic and in peak hours this can reach critical values.

- **Reconfiguration of the network**: in order to add extra workstations today it is necessary to reconfigure the entire multipoint connection. Moreover, in the absence of a centralised control and maintenance system, management, diagnostic and configuration procedures are particularly complex.

- **Reliability**: the present situation of analogue connections using modems and based on separate networks gives rise to some problems of reliability.

- **Traffic flow**: the existing structure does not have an optimal configuration for data transmission since it has been built on separate routes; therefore each route must be designed according to its peak traffic load as one network cannot compensate for another. Moreover, the present system is not capable of redirecting traffic if a circuit or a node fails.

84

. Costs: management of several different structures means, for equal features, higher operational and organisational costs in comparison with single integrated system.

5. The Project for a new integrated network

As a consequence of mentioned draw-backs, **SIP**, together with the Friuli-Venezia Giulia Region, has drawn up a project for a **new integrated regional network** able to meet in full the short/medium term requirements of the end users. Particular care has been taken with regard to standardisation of communication procedures and transmission protocols so as to enable interfacing with other (both national and international) data processing and information systems.

Therefore the main requirements are the following:

- **integration**: it is fundamental to the project that each workstation may have access to all or part of the information and processing resources, as well as the database of the whole of the public sector and not only the applications on the host it is connected to. Obviously in such a situation important savings may also be made in terms of databases and updating not calculated in this study.

- **Data transmission speed**: leased digital connections which support the entire primary network and a large part of the secondary network, operate at a much higher speed than existing analogue connections (up to 2.048 Mbit/s in comparison with 9,600 bit/s at present).

- **Bit error rate (BER)**: thanks to the techniques and equipment involved the BER of these connections is two orders of magnitude lower (typically $10-7$) than the present value (about $10-5$).

- **Transmission techniques**: only digital techniques (PCM) are used, leading to noticeable improvements in quality and thus avoiding A/D signal conversions which inevitably mean a serious loss of quality.

- **Transmission media**: optical fibres have gradually been coming into use replacing the present traditional cables, on the basis of the regional optical infrastructure as shown in appendix 2. As can be seen in this illustration already in 1991 all provincial capitals and major centres of the Friuli-Venezia Giulia Region will be served by optical transmission lines.

85

- **Access to service**: this network is able to cope with volumes of traffic much greater than the present system and, at the same time, it gives much lower response times thanks to a high increase in the speed of data transmission (approximately 40-50%).

- **Reconfiguration of the network**: the new control and maintenance centre permits a wide range of reconfiguration procedures required by modifications to the structure as well as monitoring the traffic situation and/or eventual anomalies.

- **Reliability**: the new network gives a much higher degree of reliability thanks mainly to the following features:

  * use of digital techniques and equipment
  * duplication of main nodes
  * the existence of a control and maintenance centre
  * links to the public data network ITAPAC (which can also provide backup routing)
  * adoption of packet switching techniques.

At this point it is worth pointing out that, merely replacing the leased analogue connections (and associated modems) with leased digital connections (and associated DCE's), a decrease in failure rate of about 30% is forecast. Moreover, the adoption of fibre optic transmission lines will further increase overall reliability (by about 10-20%).

- **Traffic flow**: the new integrated data network is able to minimise traffic delay and/or loss of the various procedures, in that their peaks, which occur at different periods, can be smoothed out.
Finally, packet switching techniques optimise the use of transmission media.

6. Project Description

The **new regional integrated network** is structured as follows (see appendix 3):

- a **primary switching level**, constituted by 5 duplicated nodes, located in each of the four provincial capitals (Trieste, Udine, Pordenone, Gorizia) and at Tolmezzo, and three mininodes (Spilimbergo, Cervignano and Monfalcone), which perform the functions of (packet) data switching, interfacing with the hosts and (in some nodes) data concentration;

- a **secondary switching level**, consisting of about 100 PAD (Packet Assembly Disassembly) and systems which access the primary network, located throughout the region;

86

- a **primary network**, using digital links (initially at 64 kbit/s) to interconnect the nodes;

- a **secondary network**, using digital lines at various speeds (initially from 2.400 to 9.600 bit/s) and base band connections;

- a **control and maintenance centre**, located with the Trieste node, which consents reconfiguration, monitoring and diagnostic operations.

For reasons of reliability, the main nodes are also connected to the national packet switching network (ITAPAC).
See appendix 4 for the main technical characteristics of the data switching and concentration units used in the network.

7. Financial Considerations

The implementation of the new regional data network requires expenditure (of 10-20%) higher than at present, owing to the numerous and significant improvements, some examples of which are:
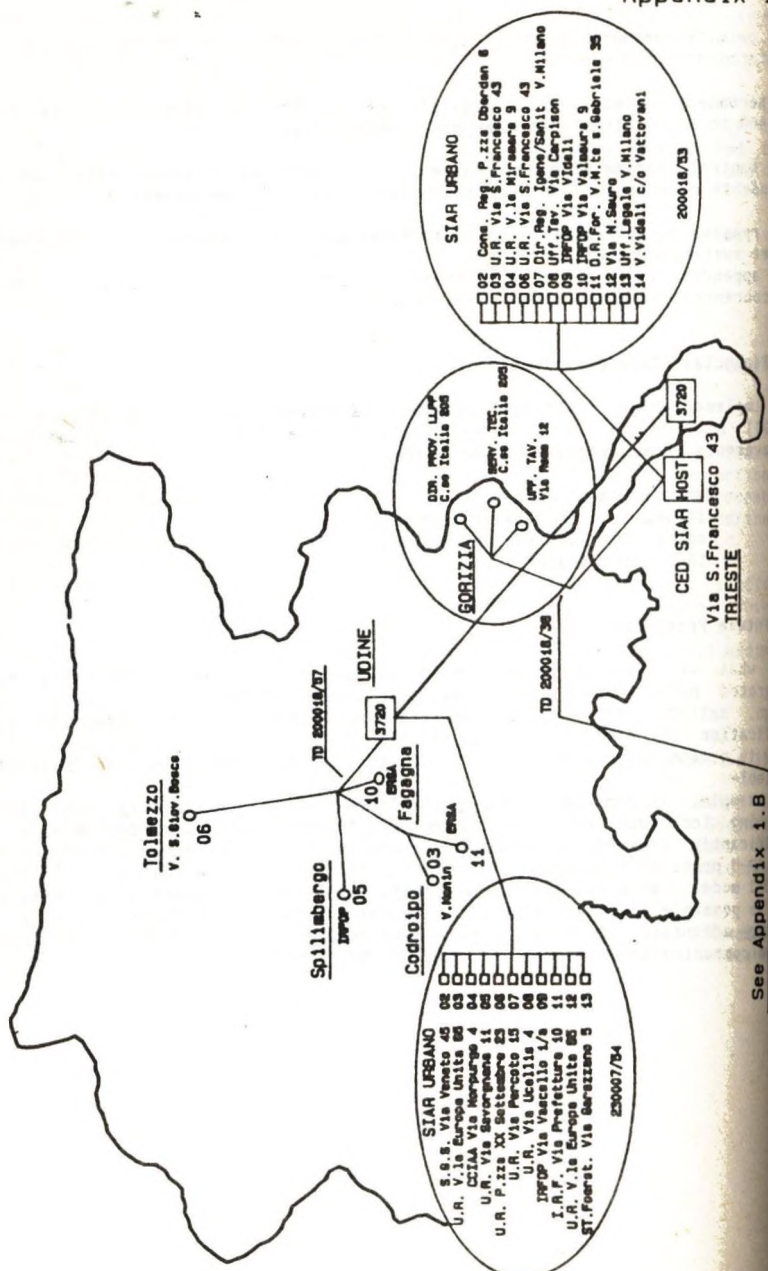
- duplication of main nodes
- higher speed of data transmission
- control and maintenance centre
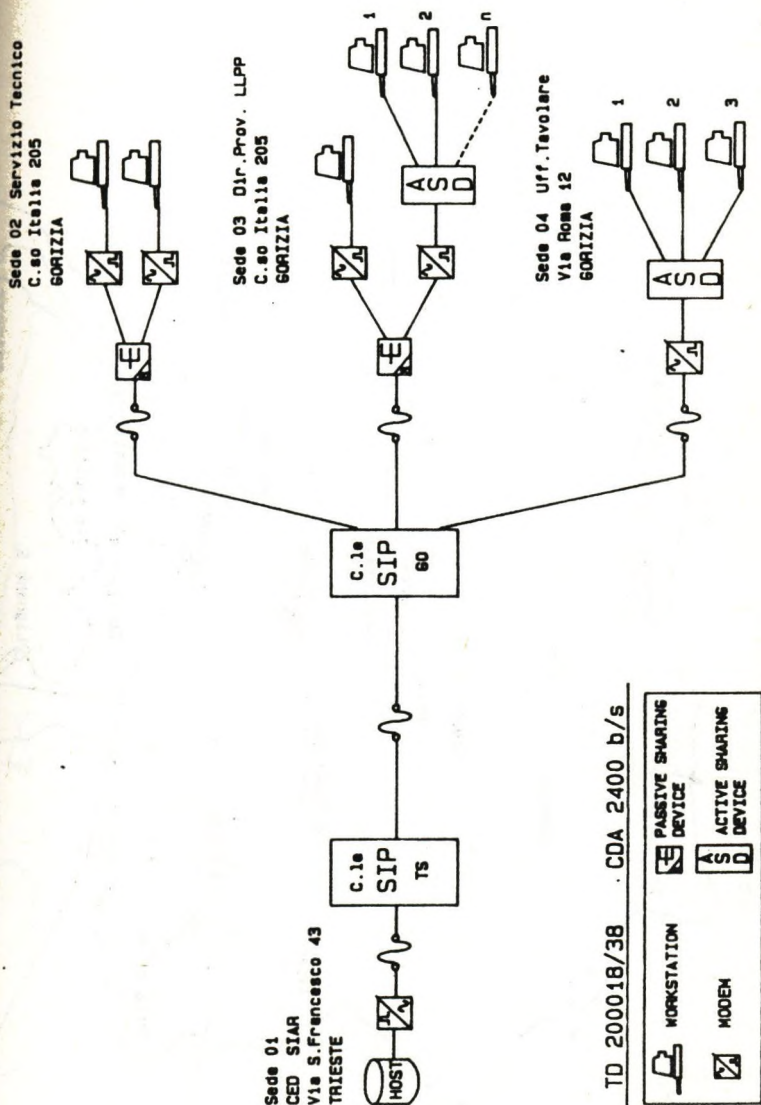- other added features

8. Future Prospects

From what we have previously said, it should be evident that this new integrated network can, by virtue of its state of the art conception and design, satisfy short and medium term demands both for the expansion and modification of existing procedures. The planned system of data switching units is potentially capable of offering more advanced services than initially available.

For example, we can remind the option "**frame relay**"; using this fast data switching technique, the transit time of a "frame" across a switching node is significantly reduced, as multiplexing and switching, performed according to the LAP-D protocol (recommendation CCITT Q.921), are carried out at level 2 of the OSI model. We would like to add that, utilising high speed data links, it will be possible to dynamically allocate the available band width. Finally, a further advantage of this option is its complete transparency to the most common communication protocols (X.25, IBM SNA, TCP-IP).
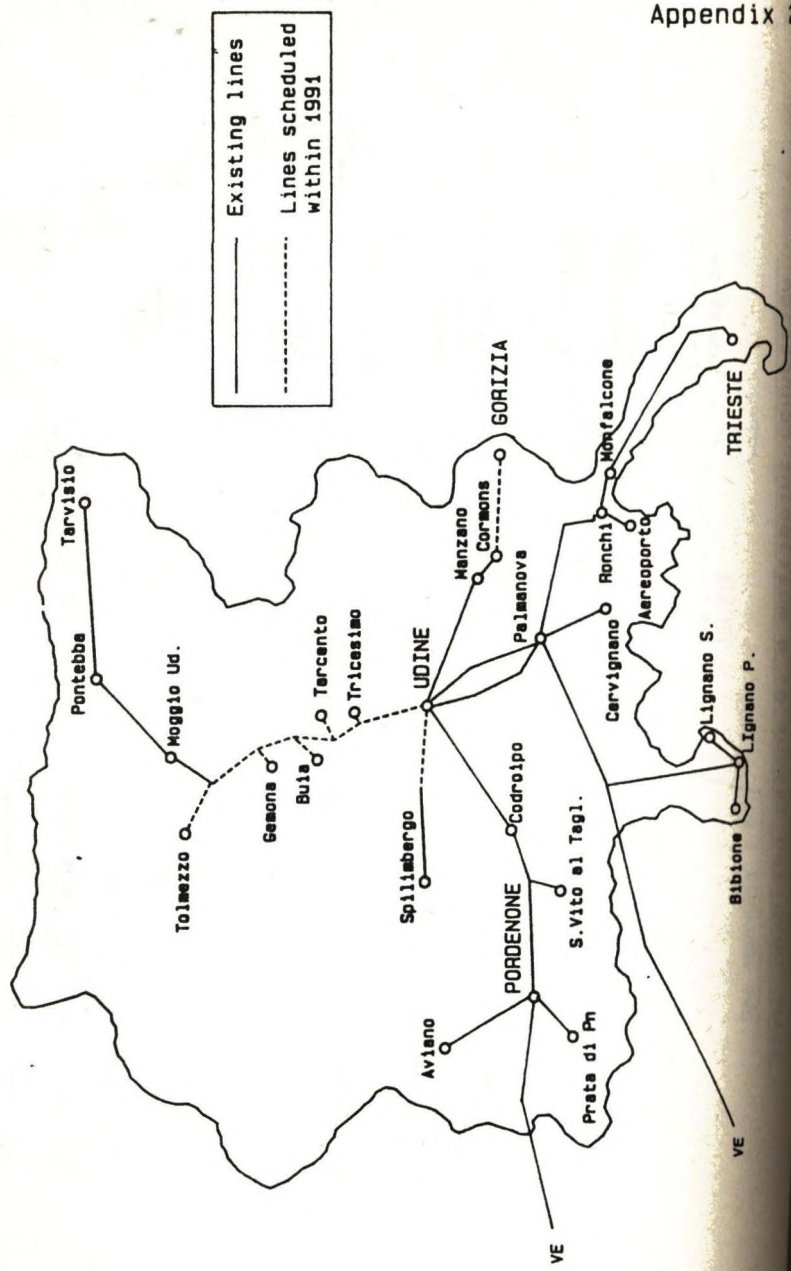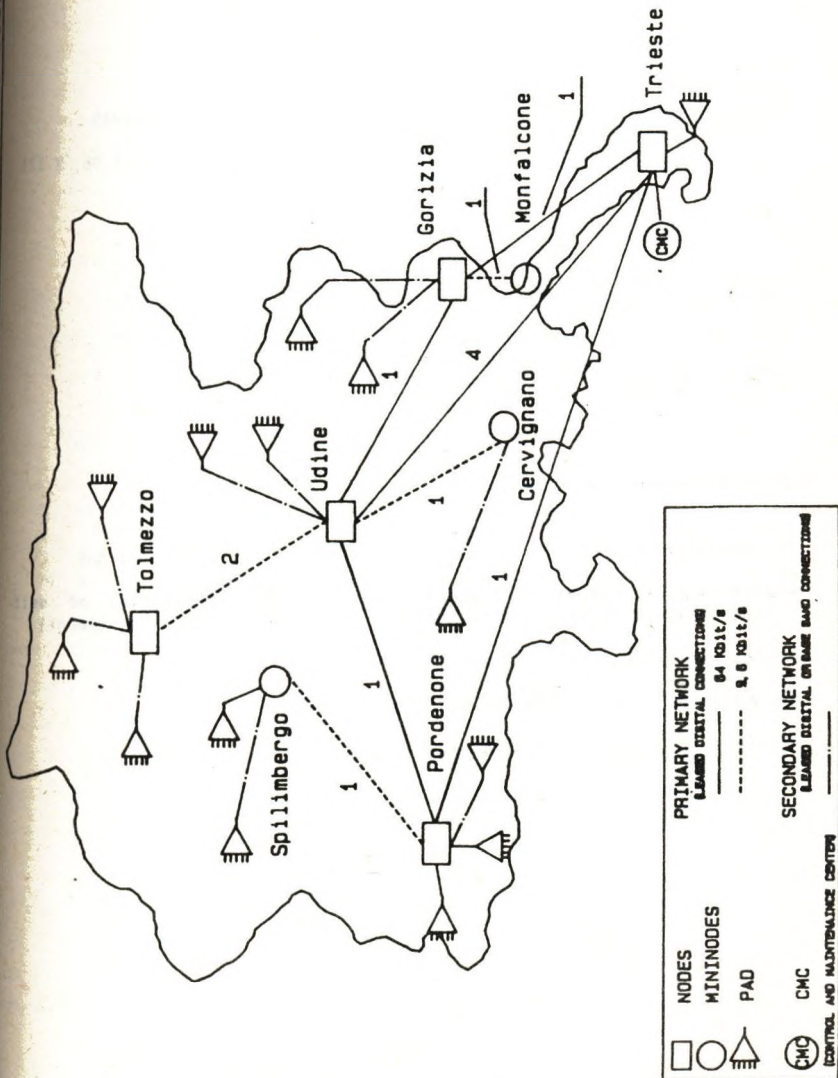
87

SIAR: Partial layout of the existing network

STAR URBANO

- 02 Cons. Reg. P.zza Oberdan 6
- 03 U.R. Via S.Francesco 43
- 04 U.R. V.le Miramare 9
- 06 U.R. Via S.Francesco 43
- 07 Uff.Ter. Via Carpison V.Milano
- 08 Dir.Reg. Igene/Sanit
- 09 IPFOP Via Vidali
- 10 IPFOP Via Valmaura 9
- 11 O.R.For. V.M.te s.Gabriele 35
- 12 Via N.Sauro
- 13 Uff.Legale V.Milano
- 14 V.Vidali c/o Vattovani

200018/113

DIR. PROV. LLPP
C.so Italia 203

SERV. TEC.
C.so Italia 203

UFF. TAV.
Via Roma 12

GORIZIA

UDINE

TD 200018/07

3720

Tolmezzo
V. S.Slav.Bosc
06

Spilimbergo
IPFOP
05

Codroipo
V.Manin
03

EMRA
10
Fagagna

EMRA
11

TD 200018/36

CED SIAR HOST 3720

Via S.Francesco 43
TRIESTE

See Appendix 1.B

STAR URBANO
- 02 U.R. S.G.S. Via Veneto 45
- 03 U.R. V.le Europa Unita 66
- 04 CCIAA Via Morpurgo 4
- 05 U.R. Via XX Settembre 11
- 06 U.R. P.zza XX Settembre 23
- 07 U.R. Via Percoto 13
- 08 U.R. Via Ucellis 4
- 09 IPFOP Via Vancello 1/a
- 10 I.R.F. Via Prefettura 10
- 11 U.R. V.le Europa Unita 66
- 12 ST.Fcrest. Via Sabbadine 5

250007/04

SIAR: Detailed layout of a multipoint connection

Sede 02 Servizio Tecnico
C.so Italia 205
GORIZIA

Sede 03 Dir.Prov. LLPP
C.so Italia 205
GORIZIA

Sede 04 Uff.Tavolare
Via Roma 12
GORIZIA

Sede 01
CED SIAR
Via S.Francesco 43
TRIESTE

C.le SIP GO

C.le SIP TS

HOST

TD 200018/38   CDA 2400 b/s

| WORKSTATION | PASSIVE SHARING DEVICE |
| MODEM | ACTIVE SHARING DEVICE |

89

Optical Fibre Infrastructure in Friuli-Venezia-Giulia

Appendix 2

Existing lines

Lines scheduled within 1991

90

New Integrated Data Transmission Network in Friuli-Venezia Giulia

	PRIMARY NETWORK	
	LEASED DIGITAL CONNECTIONS	
		64 Kbit/s
- - - - -		9.6 Kbit/s
	SECONDARY NETWORK	
	LEASED DIGITAL OR BASE BAND CONNECTIONS	

☐	NODES	
○	MININODES	
⌂	PAD	
CMC	CMC	
	CONTROL AND MAINTENANCE CENTER	

MAIN TECHNICAL FEATURES OF THE
NEW INTEGRATED DATA NETWORK

Nodes

n. of gates X.25/X.75	> 1,024
memory	64 Mbytes
throughput	> 8000 packets/s
line interface	X.21bis, RS232, V.35, V36/RS449
line protocols	X.25 X.75 X.32
CCITT recommendations	X.1, X.2, X.25, X.75, X.32, X.96, X.121
	X.150, X.300

PAD

number of synchronous gates	2,000
number of asynchronous gates	1,024
line speed	9,600 bit/s
line interface	X.21 bis, RS 232
line protocols	asynchronous, SDLC, BSC
CCITT recommandations	X.28, X.28 plus, X.29

Control and mantainance centre

Maintainance of initial configuration and successive modifications

Diagnostics (transmission of special data packets, activation of self diagnostic procedures and/or automatic shutdown of failed equipment)

Traffic measurement and statistics

Recording of traffic data for billing purposes

Creation and updating of data base

IMPORTANT ASPECTS

OF DESIGN AND IMPLEMENTATION

OF LARGE INTER-ORGANIZATIONAL INFORMATION SYSTEMS

(A population registration as an example)

P.A. Tas

1. INTRODUCTION

More and more computerized information systems are crossing
boundaries between organizations. This phenomenon is already
quite well known in the private sector, where companies link
with customers and suppliers. In recent years we can also find
more and more of these systems in a governmental environment.
We can see them within one government level, but also between
organizations on different levels and between government and
the public, public organizations and private enterprises.

In theory, these so-called inter-organizational (inter-
governmental) systems present great opportunities. In
practice, the design and implementation of such systems often
cause severe difficulties. In this contribution, an automated
population system using a large network in the Netherlands is
taken as an example to discuss some experiences with a
development process over the last 10 years. It is argued, that
the usual ways to manage projects do not suffice to solve the
problems that arise. The outlook should be broadened. The
environment in which the project is placed, is too often
neglected.

2. THE POPULATION SYSTEM IN THE NETHERLANDS

2.1. General backgrounds

The Netherlands have a population of about 15 million
inhabitants. The population registration is considered to be a

very important database for many operational and policy-preparing activities of central and municipal agencies. Examples of these activities are the issuing of passports and driving licenses, registrations for military service, social security payments, statistics and forecasts for housing, education, transport, etcetera.

Each of the approximately 700 municipalities in the Netherlands has the obligation to maintain its own population registration. The corner stone for this registration is a nationwide standardized card (the *persoonskaart*, PK), containing basic data (such as names, date of birth, address, marital status, children etc.) of each inhabitant in the municipality. The Ministry of Home Affairs issues, supported by a law, regulations and inspects regularly the quality of the registrations.

At present the basic procedures are as follows. A new PK is made for every newborn and kept in the municipal registration. Every change in the status of the inhabitant (marriage, children, moving) is recorded on the card. These changes are also sent to the municipal services which need information about the inhabitants. When someone moves to another municipality the card is sent *by mail* to the new municipality. Furthermore the municipality is obliged by law to inform a number of central government agencies (e.g. the Tax Office, the Ministry of Defense, the Central Bureau of Statistics) about the changes in their population register. These changes are also sent *by mail* (figure 1).

Apart from the card registration many municipalities also keep an automated version of the population registration. This improves the efficiency of the production, transmission and retrieval of data about the inhabitants needed for the

95

municipal services. There is a great variety in the automation
between the municipalities: there are approximately 20
different systems, from a simple and straightforward automated
equivalent of the card system to large and complex population
information systems with on-line connections to different
municipal services. These systems have been developed by
either private firms, the municipality's own computer centre
or by regional co-operations of municipalities.

2.2. Towards one automated system

In the current situation the following problems are manifest:
-      It is very inefficient for a municipality to have two
       population registrations (the obligatory card system and
       the automated system);
-      Sending all changes on forms by mail to a large number
       of central governmental agencies implies a great deal of
       paperwork for the municipalities. One change generates
       many forms.
-      The receiving agencies have problems handling the flow
       of forms coming from the 700 different municipalities.

Since the sixties everyone has become convinced that a
computerized population system presents the solution for these
inefficiencies. For approximately 10 years preparations have
been made for the development of one central automated system.
Finally, in 1982 a bill concerning this concept was discussed
in Parliament. The essence of the proposed Central Population
System was one large database with data about all Dutch
inhabitants. This database should receive its data from the
existing municipal population registrations, and should supply
data to central government agencies (and only to them). The
data could be sent on paper, on diskettes or via electronic

data communication.

Figure 1. Original concept of the population system.

The bill was not enthusiastically received by many politicians, mainly because of the privacy risks that were considered too high. The "Vereniging van Nederlandse Gemeenten" (the Union of Dutch Municipalities, VNG) was against a central population administration, because of the loss of autonomy of their members with regard to the organization of their own information systems. Another reason was, that the proposed central administration gave only a partial solution for the before mentioned problems. This system concentrated the flow of data of the municipalities to one central point, which would act as a distribution centre for all agencies. It did not eliminate the double registration system in the municipalities.

2.3.   Present concept of the system

Following the political discussions about the Central Population System and the technical developments in the field of automation and electronic data communication, the Ministry of Home Affairs intended to solve the above mentioned problems in a more fundamental and integrated way. A new concept was developed (figure 2).

Characteristics of this concept are:
-        The solution corresponds to a great extend with the existing communication structure: the mailing service will be replaced by the national datanet (DN1).
-        In all the municipalities the hand registration system will be replaced by an automated registration system. Instead of the current PK there will be an 'electronic PK' (the *persoonslijst*, PL).
-        PL's will be sent electronically from one municipality

98

to another in case of removal.

- Changes will be sent directly via DN1 to all central
  government agencies concerned. Other organizations can
  also send requests for information to all
  municipalities.
- Network standardization is necessary (address of the
  receiver, address of the sender, is the message
  received?, etcetera).
- Municipalities and organizations which receive changes
  are either connected directly to the network or via
  concentration points (computers) in regional or
  departmental computer centres.

Figure 2.   Concept of the population system, as finally
accepted by Parliament.

3.   DESIGNING THE PROJECT

The new concept was presented in 1984. After various
discussions, Parliament gave permission in 1985 to start a
project for the development of what was now to be called the
Municipal Basic Administration for Population Data
(*Gemeentelijke Basis Administratie Persoonsgegevens*, GBA).

Several major points for attention were identified:
-       A further analysis of the general concept;
-       Some organizational and political topics to attend to;
-       Financial aspects;
-       The design of a project organization.

3.1. Further analysis of the concept

With regard to the concept itself, it was clear that:
-       The GBA was going to be a large system using new
        techniques;
-       The existing systems within the municipalities had to be
        either changed or written off;
-       An important question that remained to be solved was,
        which data about inhabitants would be included in the
        system. From a users point of view probably as much as
        possible; from a privacy point of view only a restricted
        set. A question was also, which organizations would be
        allowed to have access to the network.
-       The justification for the automated population
        registration system would for a large part be based on
        the fact that it would save labour. Another
        justification was of course the improvement of the

quality of information.

Numerous discussions led to a more detailed specification of
the various elements in the new concept:
- Within each municipality we would now see
    * a subsystem for changing the database;
    * a subsystem for information retrieval;
    * a link to other municipal systems (social
      security, housing, education etc.).
- Between municipalities we would find the sending and
  receiving of the PL.
- Between central government agencies and municipalities
    * changes in data of a person would be sent to
      specified agencies;
    * agencies could make certain changes in the
      municipal database.

Furthermore, several conditions for the creation of the new
system were identified:
- All agencies must have their own database;
- In the municipal database it must be indicated (in
  lists) which agencies receive automatically certain
  changes;
- Each agency must be able to change those lists;
- The agencies must use unique administration numbers for
  each person, which are (already at present) issued by
  the Ministry of Home Affairs.

In order to develop such a system, the main question was how
to connect the 700 municipalities and the various central
agencies to the communication network in such a way, that all
necessary communication between the different systems is
possible with a minimum of central regulation. The most
centralized solution would be to design and build a uniform

municipal registration system. This system should be built and maintained under the responsibility of the Ministry of Home Affairs for a restricted number of different computer lines. This solution would be a typical example of centralized system design and decentralized information management. However, a more decentralized approach was chosen. The policy was, to issue centrally the requirements (in the form of a logical design) for the municipal registration systems and the messages that belong to the system. The municipalities and central agencies were to be free to choose a technical solution that fits their existing automation culture and the connection to other municipal systems should be relatively simple. The network however was to be centrally designed and implemented.

The minimum of central regulation in relation to the municipal system concerned:
- An obligatory minimal set of data per person;
- Strict security measures for the database;
- Clear arrangements concerning the actions from 'outside' that can lead to changes in the database;
- Arrangements about the forms to be produced by the system on behalf of the citizen;
- Agreements on incoming and outgoing messages.

The principle of the future network system would be the use of a number of 'post offices' connected to user 'mailboxes'. It was intended as a typical message switching system. The choice was made for a more of less standardized message-handling protocol X-400 within the network. An interim solution would be used, as long as X-400 is not yet implemented by every manufacturer. The question of management of this large network remains yet to be solved.

3.2. Some organizational and political aspects

The organizational structure of the new population
registration in the Netherlands would remain the same in
principle:

-       The municipalities are responsible for the automated
        registration of their own inhabitants;
-       In the automated population it is indicated which
        central agencies receive automatically certain changes;
-       The Ministry of Home Affairs issues central
        administrative, technical and security regulations for
        the registration systems in each municipality. A
        minimal set of data per person is defined.

An important aspect was the involvement of Parliament. It had
become clear, that any system of automated population
registration would be an important political issue in The
Netherlands.
First of all, there was the concern for the privacy of the
citizen, that had caused so many heated arguments already. A
complication was, that there was an ongoing discussion, but
still no new law concerning privacy protection in general.
We were to follow this discussion closely, because of the
effects it could have for our project.
Secondly, the system was to be based on new legislation. This
was to be part of the total project. The new legislation would
replace the existing law and regulations, that still required
a hand population registration, even if an automated
registration, fulfilling the requirements, was available. The
preparations and discussions that were needed would ask much
effort and take a long time.
Thirdly, there was the general (and not unjustified) fear
among politicians, that projects such as these have a tendency

to fail. Parliament wanted to be kept informed about the progress, in order to be able to make adjustments and to decide step by step about new phases.

3.3. Finance

The implementation of this complex nationwide population registration would ask a lot of financial resources. The first estimation was 25 million US dollars. In times of very restricted financial budgets it was difficult to have the necessary funds allocated. The question which part of the costs had to be paid by the municipalities (and the division between them) and which part by central government, made the financial constraints even more complicated.

3.4. Project organization

The project was started by designing a proper project organization. This included of course finding the right people.

As has already been indicated, the design of the project organization was not easy because of the number of participants (the Ministry of Home Affairs, 700 autonomous municipalities, 200 user agencies, and the Union of Dutch Municipalities). Soon it became clear that, apart from the Ministry of Home Affairs, none of these participants wanted to be responsible for the project. In the end a remarkably simple structure remained. The Director-General of Public Administration of the ministry would be the *de facto* principal of the project. He was supported by an outside consultant. The project manager was also from outside, because it was

impossible to find one within the ministry. Furthermore, most of the participants in the project group were from private firms as well. This, by the way, changed in time after a new and successful attempt to involve more members of the civil service itself.

Within the project, a number of sub projects were started:
-       A sub project for the development of a logical design of the population system, that had to produce the requirements for the technical solutions for the municipalities;
-       A sub project to prepare the required new legislation;
-       A sub project for the design of the network;
-       A sub project dedicated to the organizational implications of the new system.

4.   PROJECT MANAGEMENT

The case of the population system is taken as an example to discuss some major problems with the design and implementation of large inter-organizational systems within government. Experiences in the Netherlands have shown that these systems present some specific difficulties with regard to project design and project management. That applies to the EDP aspects (systems design, technical design including programming, hardware, software and data communication), but in particular to other aspects. In the remaining part of this contribution, we will focus on the latter.

4.1. Traditional principles of project management

A project is managed by means of a project organization that

is responsible of the products that have to be delivered.

The managing of the project is related to various resources;
-       personnel;
-       hardware, software and data communication devices;
-       finance;
-       information.
Information is not always mentioned as a separate factor, but
is of course essential, because the design is based on the
knowledge about the organization and the environment in which
the new system has to function.

Furthermore, a project has to go through several well known
phases: definition study, logical design, technical design,
implementation and the production of the system. Each of these
phases has its own products and specific problems to be dealt
with (figure 3).

Figure 3.   Traditional factors in project management

Many articles and books are produced about these principles of
project management. Handbooks like SDM (the popular Systems
Design Methodology) and various methods for network planning
for example are well known. We can quite easily relate them to
projects such as the one we are discussing. These methods can
be used to solve the problems, that are also encountered in
the GBA-project:

- *The project organization.* Because of the number of
  independent participants is was not possible to include
  them all in the project organization. At the same time
  various organizations did not want to be represented by
  other organizations. The result was a large number of
  meetings to define the requirements and create an
  atmosphere of participation. We already observed that
  nobody felt responsible, apart from the ministry!
- *Personnel.* As already mentioned most of the personnel
  came from outside, including the project manager. It was
  hard to find the right people, also because there were
  not many people in the Netherlands that had experience
  with such a large project. Furthermore, it was hard for
  the principal to keep the project in line, especially in
  the first phases, because he was not used to managing
  automation projects. During the progress of the project
  it became clear that the principal had to spend about
  three days a week on the project. This was not always
  easy to achieve.
- *Technique.* In a technical sense it was quite an
  experiment to design a network that was based on an X-
  400 protocol, that was not yet implemented by
  manufacturers. No less an experiment was the idea of a
  logical design that technically had to be implemented on
  different computers and had to satisfy all requirements
  because of the consistency of the total population
  registration and the exchange of messages.

- *Planning*. This was very difficult because of the
    complexity and length of the project, the many inter-
    related activities of various natures and because of the
    external aspects of the project.

However we found out that there are more problems to be dealt
with. All traditional methods are typically focused on the
automation part of the system. They all look at the management
aspects of projects in only a 'narrow sense', directly related
to the above mentioned resources. Other aspects, that have to
do with the environment, do not get the attention that, as we
have learned in the case of the GBA, the development of inter-
organizational information systems require. Especially these
aspects create the critical risks for the success of such
projects in the end.

4.2. Projects in a narrow sense versus projects within their environment

In practice the management of a project in a 'narrow sense' is
not enough to guarantee the success of a project, especially
in the case of inter-organizational systems as we have defined
them. There are a number of typical 'external' aspects, that
have to be looked at very carefully. The GBA-project
illustrates this, as well as numerous other projects in the
Netherlands over the last few years, like the development of a
system for student grants, a new system for issuing passports,
information systems to link police agencies and juridical
institutions, etcetera.
Figure 4 presents a general picture. The importance of an
aspect may vary with the phase the project is in. The
different 'external' aspects are:
- politics;

-    the impact on society;
-    shifts in inter-organizational relations;
-    internal organizational changes;
-    financial questions;

We will discuss each of these factors in some detail. We stress that several aspects are clearly inter-related in practice. Moreover, the GBA-project is not yet finished. We must therefore emphasize, that we present an analysis of still ongoing experiences.

Figure 4.   External influences on inter-organizational information systems.

Politics

It is quite clear that politicians - be they individual ministers, parliamentarians, etcetera - can influence an project in certain circumstances. There may be several reasons for this:

- The contents of the information system is certainly a matter of discussion if the information system is a consequence of a law, a policy paper or a special political wish;
- Politicians can influence the planning of the project for political reasons;
- If the project is publicly well known, it can easily become subject to a political discussion if something goes wrong in the project in relation to time, money and implementation;
- There can be a relation with already existing laws or regulations;
- There can be societal effects that can put pressure on a minister or on parliament;
- It can become a matter of discussion in the cabinet if ministers are not able to solve inter-organizational problems.

With regard to *the GBA-project*, different ministers in various coalition cabinets had to be kept informed about every major step. For a number of times the project has also been discussed in Parliament. After the initial permission had been given, the main issue was the chance of failure of the project. Parliament was especially careful after the failure of two large projects. In one of these cases - the so-called passport project - two ministers had to resign! Other issues were the already mentioned discussion on privacy risks for citizens, data about religious conviction and

110

security aspects. Finally, the members of the cabinet discussed a number of times the financial aspects of the system. After a few years, the original calculations appeared to be too conservative. More money was needed and the problem was, where this should come from. The Ministry of Home Affairs couldn't find the required funds. The problem was only solved after an intervention of the Prime Minister himself.

The impact on society
The main issues here are changes in the ways in which the government deals with the public or with private enterprises. More and more automated information systems will be used for service to the public and private or other organizations. The disastrous effects of ill-functioning systems were shown in the Netherlands, when a new system for student grants was introduced in the '80's.

In the case of the GBA-project so far, there have been no problems in this area, that are worth mentioning. Probably, most citizens will hardly find out that there is going to be a new population system.

Inter-organizational relations
As is well known, changes in information systems influence organizations. The introduction of inter-organizational information systems changes inter-organizational relationships. In the coming years this may lead to more efficiency and effectiveness in the government organization. However, there may also be some serious problems when disagreements between organizations are not solved.

Looking at the GBA-project, one of the important discussions with the already mentioned VNG has been the ownership of the population data and the right of each autonomous municipality

to implement its own information systems. Being a major pressure group, the VNG had already succeeded in the early '80's to convince Parliament that a central database was a bad idea. That would change the relationship between the central government and the municipalities in a way that was unacceptable to the latter.

In essence the finally chosen GBA-concept is simply a computerized version of the old system. The old postal communication is replaced by a network. In the old legislation the Minister of Home Affairs was responsible for the total population registration. As already mentioned this minister also had the responsibility to inspect the card systems of the municipality. The organizational change is that central government, if the new system is implemented, is only responsible for the changes in the law and the regulations. The management of the implemented system and the network will be the responsibility of the municipalities and the customers. Another responsibility will be the quality of the total system. This introduces an interesting phenomenon: how to organize this management as the users are autonomous organizations. The solution is still a matter of discussion.

Changes in the internal organization

This aspect deals with changes in a particular organization, as a result of the implementation of a new information system. This phenomenon is of course also well known in automation projects that are not of a truly inter-organizational nature.

The GBA-project shows clear examples of such shifts in organizational structures, procedures and even cultures. In the old hand system one could observe the changes that were made on the card. There was no real check on those. In the automated system there are new procedures to update the database and new ways to produce documents.

Totally new is the sending and receiving of messages, with additional error messages. The impression is that for a number of civil servants the new procedures are hard to grasp. This may lead to problems in the smaller municipalities, where only one or two civil servants are responsible for the population administration.

Finance

The economical and financial aspects of inter-organizational systems pose important questions. More and more the need for efficiency is stressed, especially in a time when the spending of government agencies has to be reduced. Too often, only political reasons and arguments of effectiveness are used to build a system.

One major problem is: who is going to pay for a system when there are a number of independent users, with different interests, who expect different benefits? In the case of *the GBA-project* the efficiency issue has been looked into by an auditor. The result was, that in a number of years the investments will be paid back and that after this time the system will be cheaper than the old postal system.
As already mentioned there has been quite a discussion about the participation in the investment for the design and implementation of the system. For a large part, this was due to the fact that the municipalities knew that they would have to invest in the technical realisation of their future system. Given this they didn't want to invest in the initial logical design we have discussed, nor in the network.
The result has been that the Ministry of Home Affairs has paid the first $ 25 million. The second 25 million, that was needed later on, was divided between the user departments. The cost of the production of the system is divided between the municipalities and the customers.

Normally the customer will pay for the service that is delivered. The problem in this case is, that in the old system municipalities were obliged to inform the customer without charge!

5. CONCLUSION

The different external aspects that in one way or the other influence projects like the one we have discussed, will certainly not shock many people that have a few years of experience in managing such information system projects in government. Afterwards we can all tell what went wrong. Why is it then, that we don't apply these lessons in our everyday practice?

Maybe one major problem is, that we have great difficulty in ordering the various questions we are facing. Hopefully, the analysis now given will help in that respect. Of course, more research and evaluations have to be carried out in other situations to develop the thoughts that are presented here. There will be a lot more inter-organizational information systems in the years to come. Many of these will have objectives that are not directed towards the internal processes in government. There is a tendency to use information technology especially for changing the external relations between government and the public or private enterprises. As we already indicated, the focus is no longer just on the internal efficiency, but more and more on the quality of the service, given to 'customers' of government agencies. When we try to develop information systems dedicated

114

to that purpose, we are even more dependent on a proper management of external factors.

In our introduction we implied, that the private sector is more experienced in managing inter-organizational information projects. Private enterprises have certainly a longer history in this area. They have developed more of these systems than most government organizations. In the mean time, we have no certainty whatsoever that the private sector is not facing similar problems and making the same mistakes. It is therefore our conviction, that the analysis is also relevant to them.

The Hague
April, 1991

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NETWORKS AND FLEXIBILITY FOR GOVERNMENT

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SUMMARY

Networks are one of the major technical developments for the
1990s. This paper explores the use of networks by the UK
public administration. The most important development is the
Government Data Network, a digital data communication network,
initially to be shared between four government departments,
but which now has sixteen signatories. The first section
briefly describes some features of the GDN. The second
section explores how the use of networks like the GDN
facilitates greater flexibility in the organisation of public
administration. Attention is paid to the implications both
for employees and for individuals and organisations who come
into contact with the state. Finally, the limits to
flexibility are outlined.

1. INTRODUCTION

Networks are one of the major technical developments for the
1990s, with potentially profound implications for the future
of work, the structure of the economy and, when used by
governments, for the relationship between citizens and the
state.

The most important UK development in networks for government
use, against which all other networking decisions must now be
taken, is the Government Data Network (GDN). The GDN is a
major initiative, and raises a number of very important
issues, including: individual privacy, national security,
network management, national IT and telecommunication policy,
industrial policy and technical and data standards[1]. The next
section briefly describes some relevant features of the GDN.

The main focus of this paper is to examine the types of
flexibility opened up to government through the use of
networks. Most of the flexibility literature is concerned
with manufacturing industries, and the shift, or lack thereof,
from Fordist to post-Fordist production practices. This
provides a starting point for discussion of the sorts of
flexibility that the use of IT, particularly networks, could
allow in public administration; for example, flexibility in
departmental responsibilities, policy parameters, work
location and organisation and mode of service delivery.

As in manufacturing, there may be limits on the extent to
which flexibility can be achieved. Some of these are outlined
in the final section, together with a more general warning
against the dangers of reading off new organisational and
social forms from particular technical developments.

2. THE GOVERNMENT DATA NETWORK

Historically, UK government departments developed their own
networks as the need arose. The most common scenario was for
departments' batch processing centres to develop network links
for particular applications. As a result, many departments
had several different networks, of different types which had
been installed at different times. In 1986, a small group of
senior government IT specialists began to meet together
informally and recognised that, at the very least, there were
potential economies of scale to be gained from developing a
network to be shared by different government departments.

The Government Data Network is a data communication network,
initially to be shared between four government departments -
Inland Revenue, Customs & Excise (C&E), Social Security (DSS)
and the Home Office. The CCTA (now known as the Government

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[1] Many of these developments have been discussed elsewhere.
See, for example, Wyatt (1990a,b).

Centre for Information Systems[2] - which comes under the auspices of the Treasury) was responsible for co-ordination between departments and for negotiations with suppliers.

After relatively short but certainly thorough consultation, it was decided to seek a third party to provide a data communication network <u>service</u> to be shared by government departments. It must be stressed that the government was seeking to award a contract for a service. Government does not own the equipment: Racal manages the network and owns the equipment required, excluding the lines leased from BT (British Telecom plc) and Mercury Communications plc. This arrangement marks a step on from the more conventional facilities management contract, where government would own it and Racal manage it. Government specified the level of service it required, and then evaluated the bids on price for service level and on its assessment of the ability of the company to deliver. This move to a service contract, away from the purchase of hardware or even facilities management, represents a major cultural shift, especially for people who like to 'feel, touch and love' their equipment, as one civil servant expressed it. The intention is to have a clear division of labour between Racal which provides the infrastructure and government departments which develop applications for their own use.

The GDN Steering Committee specified that the tariff be flat over time, so that initial users would not have to bear the bulk of the cost. Thus, it is in Racal's interest to get as many users as quickly as possible. The CCTA had originally intended that the initial four user departments should be the only users for the first three years. Prior to the award of the contract, some departments were told to find their own solutions rather than join the GDN. But because the pricing structure is flat over time, not over volume, Racal wants to have more departments join the GDN: it has a marketing department whose sole function is to sell the GDN to departments. Table 1 lists the departments who have signed agreements with Racal.

Pilot applications with C&E began in November 1988. By April 1989, C&E had three host computers and 180 sites on the GDN for its Project VALID (VAT Access and Local Input of Data) which, as its name suggests, allows all local VAT offices to input and gain access to all VAT data. The original target was for 85,000 terminals and 50 processing centres to be connected to the GDN by the early 1990s. However, as shall be discussed below, more departments have now joined the GDN, so this target is constantly being revised upwards. A more

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[2] The CCTA used to be known as the Central Computer and Telecommunication Agency. Since April, 1991, it has been known as the Government Centre for Information Systems. However, the original acronym has been kept, presumably because it was so well known. Government sometimes works in mysterious ways.

recent estimate is for 75,000 terminal connections by March 1990, rising to 250,000 by 1992 (Computer Weekly, 1989).

3. THE FLEXIBILITY DEBATE: IMPLICATIONS FOR PUBLIC ADMINISTRATION

There is a rapidly growing literature on the flexibility allowed by the use of new information technologies. (One of the earliest and best known examples is Piore and Sabel (1984).) This literature is primarily concerned with manufacturing industries, and the shift, or lack thereof, from Fordist to post-Fordist manufacturing production practices. David Harvey (1989) defines it in the following way:

> [Post-Fordism] is marked by a direct
> confrontation with the rigidities of
> Fordism. It rests on flexibility with
> respect to labour processes, labour
> markets, products, and patterns of
> consumption. It is characterised by the
> emergence of entirely new sectors of
> production, new ways of providing
> financial services, new markets, and,
> above all, greatly intensified rates of
> commercial, technological, and
> organizational innovation. (p.147)

Implicit in the post-Fordist literature is an assumption that these different types of flexibility are made possible by the adoption of production systems based on information technology. For example, by using flexible manufacturing systems, machines can be configured rapidly and easily to produce a variety of different products. The integration of production systems with other computer systems makes it easier to keep track of production, and stocks - so-called 'just-in-time' methods of production. The role of labour changes because these new methods of production no longer require a mass of semi-skilled machine minders, so prevalent within Fordist factories. Two types of labour flexibility have been identified. The first is the multi-skilled worker, who can perform most tasks and move between them as required. The second comes from the further fragmentation of the labour market, into a core of highly paid, permanent, skilled workers (as described in the previous sentence) and a periphery of less skilled, poorly paid, part-time workers who can move in and out of the labour market as required.

Table 2 provides a summary of the different features associated with both Fordist and post-Fordist production methods. It is more extensive than can be discussed here, but it does give a comprehensive list of the contrasts that emerge from the literature.

This provides a starting point for discussing the sorts of flexibility that the use of information technology, particularly network technology, allows in the public sector. The GDN is important because it is a shared facility, making it technically possible for changes, for example in information flows, not only within single government departments but also between different departments. Flexibility is discussed below in terms of capital, labour, policy parameters and service delivery.

3.1 Service Contracts: Flexibility in Using Capital and Labour

Government seems to have found a way of achieving greater flexibility in capital utilisation through sub-contracting. This has coincided with the use of networks, but it is not a direct result of the use of IT. Indirectly, it may be - with the rapid pace of technical change and widespread skill shortages, government users face increasing difficulty in developing and maintaining IT facilities in-house. By making greater use of facilities management and service contracts, the civil service is able to achieve a higher level of technical sophistication in its capital equipment and greater freedom from Treasury investment rules. The contract for the GDN has a 'technology refresher' clause which allows government to insist that the supplier introduce new equipment, as government deems necessary. There is no time restriction on this; it can be done as and when new products become available. Thus, civil servants are able to circumvent Treasury investment rules which require that major items of capital equipment be written off over a seven to ten year period.

The service contract for the GDN, a type of sub-contracting, is directly relevant to the notion of labour force flexibility. By using service contracts, government has access to a flexible labour force - namely Racal employees who can be made redundant relatively easily, and perhaps more important, Racal can also take on new staff very easily. The civil service, on the other hand, is characterised by a high degree of rigidity, in both hiring and firing of staff. But, contrary to what the flexibility literature would suggest, it is the workers at the periphery (in this case, Racal) who are very highly technically skilled.

3.2 Programmability: Flexibility in Policy Parameters

Chancellors of the Exchequer and Social Security Ministers have a tendency to claim that the widespread use of IT within the Inland Revenue and the DSS could allow overnight changes in the structure of taxation or benefits. While the Chancellor and the Minister for Social Services can and regularly do make adjustments to the amount of the personal allowance or child benefit, more fundamental changes would not be so straightforward; as the recent furore regarding the Community Charge or Poll Tax demonstrates. There are two reasons for this lack of flexibility. One is a result of the

121

need to change, test and fully document any changes to the
software that would be required - a time-consuming process.
The other is a result of the fact that Inland Revenue and
Social Security are huge bureaucracies, full of people who
would need to be trained in any new regulations.

3.3 Labour Force Flexibility

The major problems facing the UK public administration arise
both from staff shortages, particularly in London, and from
the sheer volume of transactions that need to be conducted.
Regarding the former, the Department of Social Security (DSS)
is attempting to separate front and back office operations for
London claims. Thus, people would go into counter-type
offices (in a similar fashion to recent changes in banking)
which may employ only a few staff, but the back office work
would be done in a part of the country with lower wages, lower
house prices and easier transport. Data communication would
be run over the GDN. In addition, people could call a London
number, and be charged at local call rates, but the call would
be routed to and dealt with in Wigan, Glasgow or Belfast.
This reinforces a very traditional form of labour market
segmentation within the UK, based on the north-south divide.

In contrast, some other departments look upon using the GDN as
a way of keeping staff where they are, for example, by
providing small, possibly geographically remote, offices with
vital information. There are considerable social and
financial costs associated with relocating staff and/or
offices. While this might appear to contradict the DSS
example, the essence of flexibility is that departments have
choices about where to locate, depending on their own
circumstances. New spatial divisions of labour can be forged,
reflecting institutional tasks and resources.

Another important area of flexibility is that which comes
through people. What has been described above is the way
networks allow the public administration to employ different
people in different locations than previously. But there are
also ways of achieving flexibility with the people who are
working for the government, wherever they are located,
including greater and more effective use of part-time and
temporary staff. More important is the development of staff
with a range of skills and understandings, which allow them to
move quickly and easily between tasks; which necessarily
accompanies the changes in service delivery, described in the
next section.

3.4 Product/Service Flexibility

The Departments of Social Security and Employment show the
greatest awareness of the potential for using networks to
change the way claims for social security and unemployment
benefits are handled. The DSS is currently implementing a
programme (called the 'Operational Strategy') which allows for
the integration different benefits, since the amount a person

receives of one (e.g. pensions) usually affects how much s/he is entitled to receive of another (e.g. income support). In the past, different benefits have been handled with different systems, and often different staff. In future, a single staff member will be able to sign onto the system and work through the different benefits available to an individual.[3]

Other advantages of an integrated system will be that once one part of the system knows somebody has died, married or had children, this information will be distributed throughout the system. This will lead to cost savings, but improvements to service quality are also noted. For instance, it will reduce distress to relatives caused by receiving forms addressed to loved ones who died six months previously. Also, at present one has to show the same piece of proof (e.g. of date of birth) to many DSS officials; in future, once will be enough because it will get recorded throughout the system. Or, in the terms used in Table 2, this is an example of a centralised information system with decentralised production. In general, it is hoped that breaking down the sequential logic which currently governs the claiming of benefits, will mean that claimants will receive a much more rapid and effective service.

With the advent of the GDN, and its potential for inter-departmental communication, there is no technical reason why the process of integration should stop at DSS benefits. The administration of unemployment benefits is currently done by the Employment Department through Unemployment Benefit Offices even though the information, technical systems and cash are provided by the DSS. Unemployed people are entitled to a fixed sum, with more or less of it coming in the form of unemployment benefit, depending on their employment history and family circumstances. The remainder comes from the DSS in the form of other benefits. While there is a certain logic in integrating the benefits available from the two departments, there are considerable vested political and departmental interests in keeping the system as it is. Departmental interests arise from civil servants within each department wishing to maintain their roles. Political interests concern the ideological basis on which income and wealth is distributed. If a combined benefits system was introduced, some people might begin to consider an integrated tax and benefit system. But that would require a major change in

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[3] The way in which computers are used in practice will affect the extent to which this is empowering for claimants. Snellen (1986) argues that more intensive use of computers could lead to further alienation if they are used to impose an order of questions and rigidify a decision-making process. Alternatively, if claimants are given an opportunity to develop competence in using the systems, greater use of computers could allow claimants to better understand the decision-making process surrounding their entitlements and the implications of their answers to the series of questions.

political thinking and seems unlikely to happen in the near, or even distant, future in the UK.

Networks also provide ways of coping with the large volumes of transactions that many government departments have with other large, private organisations, on a daily, weekly or monthly basis. It has not yet happened, but there is speculation about the possibility of direct connections between Inland Revenue and large employers to process employees' National Insurance and income tax contributions. Similarly, direct connections could be made between Customs & Excise and large companies in order to facilitate processing of VAT returns. This would reduce the current volume of transactions conducted via paper or magnetic tape.

4. CONCLUSION

Section 3 illustrates some of the ways in which networks are supporting changes in the way services are delivered by the UK public administration to the citizens. Other possibilities for changing service delivery have also been presented, which have not yet been implemented but which are being discussed within the public administration.

Parallels with some of the characteristics associated with post-Fordism (see Table 2) can be observed within the UK public administration, including the following:
* the development of a flexible, general purpose infrastructure, namely the GDN;
* the development of a core/periphery labour force, achieved both through sub-contracting and the relocation of work outside of London;
* centralised information systems together with decentralised delivery of services; and,
* possibilities for greater product/service variety, if the basis for taxation and welfare payments can be considered a service.

One of the criticisms levelled against the proponents of post-Fordism (see, for example, Callinicos, 1989) is that they imply that one can simply read off new social and organisational forms from a new technology, whether it is an information network or a flexible manufacturing system. But, technologies are a site of struggle - between workers and managers, between citizens and the state. Social relations are constantly mediating and being mediated by the ways in which new technical systems, like the GDN, are developed and implemented.

There are, of course, limits on the extent to which flexibility can be achieved. Some have been mentioned above, including political and bureaucratic vested interests wishing to maintain the status quo. Other barriers include public concern about the linking together of private companies and government departments, union resistance to relocation of

staff, technical difficulties in creating and maintaining what would be enormous databases, the lack of data standards as well as the still underdeveloped and undertested technical standards. There is a danger of seeing these as problems which are amenable to technical solutions. But they are as much political and organisational problems, requiring different sorts of solutions.

Table 1

GOVERNMENT DATA NETWORK: THE PLAYERS

Co-ordinator: Government Centre for Information Systems
                       (CCTA, part of the Treasury)

Initial   Inland Revenue
Signatories: Customs & Excise
                       Social Security
                       Home Office

Joined Later: Employment - February 1989
                       Treasury - May 1989
                       Office of Population Censuses and Surveys
                            - June 1989
                       Her Majesty's Stationery Office
                            - July 1989
                       Energy - August 1989
                       General Registry Office (Scotland)
                            - September 1989
                       Intervention Board for Agricultural Produce
                            - September 1989
                       Department of Trade and Industry
                            - November 1989
                       Welsh Office - February 1990
                       Transport - February 1990
                       Ordnance Survey - February 1990
                       Health - April 1990
                       Department for National Savings - May 1990

Supplier: Racal Data Networks, using British Telecom
                       (BT) and Mercury lines, Telematic switches

Other Bidders: ICL with Cable and Wireless
                       Computer Science Corporation (CSC) with BT

Table 2

SUMMARY TABLE OF FORDISM AND POST-FORDISM

Fordism	Post-Fordism

production/technology

Fordism	Post-Fordism
* mass production	* flexible automation
* dedicated equipment	* general purpose, adaptable equipment
* limited range of standardised products	* specialisation & product variety
* R&D discontinuous, separate	* R&D continuous, integrated
* economies of scale	* economies of scope
* cheap energy	* cheap microelectronics
* production led	* consumption led
	* design grows in importance

relations to suppliers & customers

Fordism	Post-Fordism
* manufacturers dominate customers	* manufacturers strongly influenced by retailers & markets
* mass advertising	* firm rather than product advertising
* one-way information flows	* two-way information flows
* stocks held just-in-case	* stocks held just-in-time

organisational structure

Fordism	Post-Fordism
* centralisation, with strong divisions	* centralised information & planning systems but decentralised production with use of networks

work process & skills

Fordism	Post-Fordism
* tasks fragmented & standardised	* open-ended tasks
* strict division of mental/manual	* integration of mental/manual
* semi-skilled workers paid via formalised bargaining on rates for job	* core of multiskilled workers with rising incomes, paid by results or per person through individual negotiations
	* periphery of subcontract & semi-skilled labour
	* growing use of part-time and other flexible forms of work

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SEFR - SOFTWARE ENGINEERING FRAMEWORK
Software Engineering Using the Bill-of-Material Approach

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Abstract

SEFR (Software Engineering FRamework) is a system of software
engineering guidelines covering the entire life cycle of information
system (IS) **development** and **maintenance**, including the evaluation of
existing systems. SEFR was developed by Methoda Computers Ltd. in
cooperation with the government of Israel, and has been adopted by the
government as its official procedure. The first version of SEFR was
released in December, 1989 and the second version in November, 1990.
Version 3 is due towards the end of 1991.

The distinctiveness of SEFR lies in the following areas:

A. Introduction of the **IS bill-of-material** concept.
B. The interweaving of the IS bill-of-material with the classic life
    cycle concept which yields a novel **matrix** approach to SE.
C. Application of the concept of an **open framework** which allows the
    use of a variety of techniques and tools already available for
    software engineering.
D. Use of **standards** and detailed checklists, enhancing reusability
    and reducing cost and schedule.
E. The ability to implement SEFR at any **intermediate phase** in the IS
    life cycle. For instance, IS projects that were not using **SEFR**
    at the analysis or design phases, can begin to do so at the
    testing or even at the maintenance phases.

Point D naturally complements points A and B. The fact that D does not
contradict C is an interesting innovation in itself. Standards and
detailed checklists complement an open framework. EDP professionals can
be instructed in the clearest and most detailed manner, thus avoiding
the need to "reinvent the wheel," while leaving wide margins for
individual style and particular project orientation.

In essence, SEFR is not just a "software engineering" procedure but an
"information system engineering" procedure encompassing <u>all</u> aspects of
IS. Software is indeed a central, important component in information
systems, but by no means is it the only one. Throughout the entire
process of development and maintenance, SEFR carefully considers **all**
components of an IS, including hardware, infrastructure and
organizational implications. This comprehensive approach is derived
directly from the idea of the **IS bill-of-material**.

SEFR is composed of the following items:

1. a comprehensive guidebook;
2. three template documents for the analysis, testing and maintenance phases;
3. diskettes for working interactively on a PC workstation.

These the diskettes allow the user to fill out prefabricated forms, utilize skeleton documents and work with ready-made electronic spreadsheets. Yet, this automation is intentionally partial since a complete solution can be achieved only by using Computer-Aided Software Engineering (CASE) tools suited to a shop's particular software engineering environment (SEE). In fact, SEFR diskettes can be viewed as a preCASE whose main function is to facilitate the incorporation of SEFR into one's SEE.

1. Software Engineering using the Bill-of-Material Approach

An IS can be viewed as a "product" composed of well-defined components (bill-of-material), similar to any other engineered product. The major components of the IS bill-of-material as defined in SEFR appear in Figure 1.
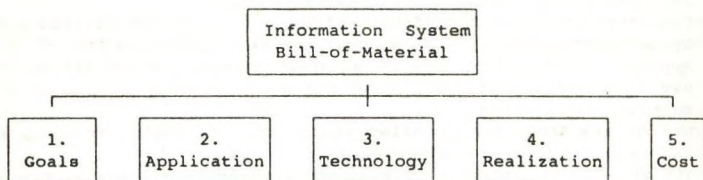

Figure 1
Components of the IS bill-of-material

Goals: The system must serve clear, achievable goals, which, in turn, serve the proper functioning of the organization. Goals are broadly defined to include problem analysis, cost/performance analysis, organizational structure, IS strategic planning and so on.

Application is the _essence_ of the system - its sub-systems, functions, data, transactions, reports, files, data items and so on. In a way, Application is a further breakdown of Goals.

Technology refers to proven off-the-shelf products. Technology implies not only hardware and communication, but also system software: computer languages, data bases, application generators, software engineering tools, and so on. Technology consists of all those components needed in order to develop, operate and maintain an IS, and which can be acquired from an external source, such as hardware vendors and software houses.

Realization is the "joining together" of the other components, mainly

Application and Technology, into an intermediate or final working solution. Realization is what "makes the IS happen" (1). It is composed of the project grand plan, the specific plan for the "next step," documentation, data conversion, testing plan, methods and organization and so on.

Cost is part of the IS bill-of-material. To use an analogy from another field, a car priced at $15,000 is distinct, qua product, from a car priced at $50,000. Under SEFR, all expenses related to the system are taken into account: installation, running, special configurations expenses, etc.

This classification is derived from viewing the IS in operation, which is certainly the ultimate target. The IS bill-of-material thus contains all the components necessary for a fully operational IS. Once this classification was determined and analyzed further, subcomponents required for individual phases of the life cycle were added.

The second level breakdown of the IS bill-of-material is as follows:

1. GOALS
   1.1 Application experts (IS sponsor)
   1.2 System objectives
   1.3 Problems requiring solutions
   1.4 Enterprise structure
   1.5 IS strategic planning - reference
   1.6 Expected benefits and savings
   1.7 Main milestones (time span)

2. APPLICATION (System essence)
   2.1 General status and main characteristics
   2.2 Users
   2.3 Sub-systems and major functions
   2.4 Operational interface: Screens and menus
   2.5 Processes
   2.6 Transactions
   2.7 Modules
   2.9 Subroutines
   2.10 Tables
   2.11 Logical files
   2.12 Physical files
   2.13 Data-items
   2.14 Glossary
   2.19 Information security
   2.20 Cross-references
   2.21 Workload and performance
   2.22 Inter-connection with other applications
   2.23 System robustness
   2.24 Special requirements

3. TECHNOLOGY
   3.1 Main hardware
   3.2 Data storage
   3.3 Peripherals (workstations)
   3.4 Special equipment
   3.9 Infrastructure (physical environment)
   3.10 Operating system
   3.11 Data base and file organization
   3.12 Data dictionary (Repository)
   3.13 CASE tools
   3.14 Query and report generators
   3.15 Operation tools
   3.16 Security tools
   3.20 End user tools
   3.30 Local area network
   3.31 Wide area network
   3.32 Public data network
   3.33 Tangent technologies

4. REALIZATION
   4.1 Working teams
   4.2 "Grand plan"
   4.3 Next step plan
   4.4 Operations
   4.5 Documentation
   4.6 Service and maintenance
   4.7 Organization and methods
   4.8 Test plan
   4.9 Incremental configurations

5. COST
   5.1 Installation costs
   5.2 Running costs (for a 5-year period)
   5.3 Configuration costs
   5.4 Item costs
   5.5 Total cost of ownership

The second level of the IS bill-of-material is SEFR's main yardstick which suits most information systems. The first step in implementing SEFR is usually the retrofitting of existing IS data to comply with SEFR's yardstick. Our experience shows that once terminological ambiguities are cleared up, all existing data can be fitted into the appropriate "slots" in the SEFR yardstick, as listed above. It is not uncommon for some slots to remain empty after this retrofitting; this usually indicates unresolved issues.

The process of retrofitting existing IS data into the SEFR yardstick has three major advantages:
   a. It can be done <u>at any point</u> in the IS life cycle.
   b. It serves as an excellent means of <u>quality assurance</u> (QA).
   c. It guarantees <u>continuity</u> and immediate passage to the next step.

Point "b" suggests that one can benefit from SEFR even when using existing methodologies. Points "a" and "c" stem directly from the fact

that the IS bill-of-material remains the same throughout the entire life cycle.

All-in-all, SEFR proposes a general IS bill-of-material model, from which individual projects derive their own specific bills-of-material. In this derivation, the complete yardstick remains stable. Tailoring of individual IS projects is done on the lower levels of the IS bill-of-material. As explained in the following section, the SEFR guidebook and template documents contain detailed "models" which allow for customization of specific projects by simply "filling in the blanks" or deleting irrelevant items from the lower levels of the IS bill-of-material.

2. Further breakdown: Standards, Customization and Reusability

A general IS bill-of-material model is possible because information systems are more alike than unlike one another. It is not surprising to find similarity of Technology components among various information systems, but it is interesting to see similarity among the Application components. Subcomponents of the Application, such as operational interface, data items, logical files, and information security needs, are often more general than unique, especially within the same organization.

This commonality becomes more apparent with further breakdowns of the IS bill-of-material into third and even fourth levels. These levels usually make reference to formal or industry EDP standards. The incorporation of current standards into subcomponents of the IS bill-of-material, such as operating systems, communications, languages, data bases and documentation, is easy and straightforward. ("Incorporation" highlights the need for standards in machine-readable format in order to facilitate their integration into documentation or CASE tools.) Where no standard is known, SEFR contains a detailed checklist as a guideline, to be replaced when either a formal or de facto standard becomes available.

Obviously, there is a limit to the degree of detail which SEFR can furnish at a general industry-wide level. Once adopted by an industry-sector, such as government, SEFR can be customized to contain regulations, standards and all kinds of "commonalities" within that sector. In the case of the Israeli government, the general SEFR model has been tailored to meet specific government needs. For instance, subcomponent 2.13 of the IS bill-of-material, the data-items dictionary, has been altered to become the government's standard data-items dictionary.

The same is true at the organization level. Businesses using SEFR, such as the Israeli Electric Company, have undergone a similar customization process, integrating their particular "culture" and regulations into SEFR's lower breakdown of the bill-of-material and life cycle.

The lowest level is that of the project. The customization of SEFR's detailed checklists at the project level is, in fact, the building of

a specific IS! Such "customization" should be checked against the organization's standard IS bill-of-material.

All these adaptations and customizations are not as ominous as they might seem because: 1) SEFR's main yardstick remains unchanged, and 2) there rarely is need for major alterations. Even at lower levels, information systems of many industry-sectors and enterprises are more similar than dissimilar. Professionals from different business sectors who use SEFR "talk the same language" due to the basic underlying IS bill-of-material. Rather than customization, SEFR users encounter the reusability of components among different information systems both at the definition and at the physical levels.

The following is a partial list of the detailed checklists or ready-made forms in SEFR. Note the numerical indentation of the checklists which relates to the IS bill-of-material:

```
2.4.1: Human-computer interface
2.13:  Standard data-items
2.19:  Information security directives
2.21:  Capacity specifications
3.10:  Operating system characteristics
3.11:  Data bases, characteristics
3.12:  Data dictionary (Repository) characteristics
3.13:  CASE tools, characteristics
3.30:  Local area networking guideline
3.31:  Wide area networking guideline
4.6:   Organization and methods considerations
4.7:   User manual layout
5.5:   Cost sum-up model
```

In addition, SEFR contains numerous professional appendices covering topics such as configuration management, project management, user participation, project reviews, executive summaries, etc.

3. The Matrix Approach

The bill-of-material concept does not replace but, rather, complements the life cycle concept. SEFR presents a complete life cycle model, very similar to standard models (2), which contains the classical phases of analysis, design, code, testing, etc. SEFR emphasizes, however, the interweaving of the bill-of-material and the life cycle, and their mutual dependence throughout the entire process of IS development and maintenance.

The interconnection between the bill-of-material and life cycle is presented in Figure 2. (The contents of the matrix constitute an example.)

IS
Bill-of-material

1. Goals
   1.1
   ....
	Estimated	Defined	Complete	Maintained	Works well

2. Application
   2.1
   ....
	Estimated	Defined	Complete	Works well	New demands

3. Technology
   3.1
   ....
	Unknown	Prototype	Complete	Continual
				adjustment
					Should be
					replaced

4. Realization
   4.1
   ....
	Unknown	Partially
		defined
			Complete	Maintained	Needs
					changes

5. Cost 5.1	Estimated	Prototype	Complete	Deviates from plan	Needs to be fixed

———————————————————//————————//——————————

Initiate   Analysis   Design ...Testing ... Maintenance

Life cycle

Figure 2   - The Matrix Model

A horizontal look at Figure 2 shows the transition of each individual component as the project progresses through the life cycle. Goals, for instance, are considered "estimated" in the Initiation phase, then become "partially defined" in the Analysis phase, and finally, reach "completion" in the Design phase. And yet, the component is always "Goals". The important thing is that the IS bill-of-material as a whole, and each component in particular, appears throughout the entire life cycle!

The vertical view depicts the contribution of each phase of the life cycle to the advancement of the IS bill-of-material. Each column shows the state of all system components at a particular phase. Each phase can be evaluated in terms of the progress of the IS components; a phase in which no component is enhanced (in a particular project) is redundant.

In recent years, much emphasis has been placed on the life cycle where each methodology professes to present a unique model. The spiral (3) and the W (4) models are two recent examples. In the long run, however, the differences between the various life cycle models are minimal. At the same time, the IS products have been given only secondary attention and are usually derived from the life cycle, resulting in inconsistencies, the need for traceability, and problems of continuity.

SEFR reverses the order, clearly giving the IS products priority by placing all IS products in the bill-of-material model. SEFR goes even further by showing how the life cycle evolves from the IS bill-of-material. The bill-of-material links the various phases in the

life cycle together, creating uniformity and compatibility between them.

4. Open Framework

SEFR joins the increasingly accepted approach in SE of using an open framework rather than a methodology. An open framework offers several distinct advantages:

1. It focuses on the major issue - the product (the "what") - rather than on the process (the "how").
2. It is relevant to a wide variety of hardware/software environments.
3. It allows for the use of diverse methodologies, techniques and CASE tools in various combinations.
4. It leaves room for "personal style" and "local culture."
5. It fits well with the concept of Open Systems.

A leading example of an open framework is DOD-2167 which clearly states: "This standard is not intended to specify or discourage the use of any particular software development method."(5)

In SEFR, the concept of an open framework and the IS bill-of-material approach complement each other to make for a powerful, productive combination. As explained above, the SEFR general IS bill-of-material model contains detailed checklists and reference to standards, but allows for expression of "personal style" and "local culture."

This combination suits the particular nature of the government sector which must adhere to formal standards and procedures, while being in itself a heterogeneous and physically scattered environment. Government policy in EDP is usually based on the following principles:

1. Diversity of hardware and software.
2. Avoidance of dependency on any single supplier.
3. Adherence to standards.
4. Centralized and unified regulations alongside decentralized implementation and operation.
5. Utilization of technological innovations, especially the more cost-effective ones.
6. Outsourcing and contracting EDP suppliers, encouraging them to utilize their own expertise and tools.

SEFR is particularly useful in realizing these principles. The combination of the bill-of-material with the life cycle, namely the matrix approach, yields a comprehensive framework with many implications, especially for the government sector. One significant implication is the ability of SEFR to serve both EDP professionals and non-EDP personnel involved in the process of IS implementation, such as comptrollers and managers at all levels. Following are specific examples demonstrating the comprehensiveness of SEFR.

5. SEFR and CASE

SEFR serves as an excellent guideline for the selection of specific CASE tools, as well as for the design of an overall software engineering environment (SEE).

The selection and implementation of an individual CASE tool, let alone a SEE, are very expensive and lengthy tasks (6), requiring a thorough examination and evaluation of various features and facilities. An abundance of technical checklists for this task is available in the professional literature (7), but a method for initial classification of CASE tools is lacking. It is first necessary to determine the overall purpose of a CASE tool: What sort of tool is it? Where in the life cycle does it fit? What is its main purpose? Only after such classification does it make sense to use the afore-mentioned checklists. It is precisely with respect to such classification that SEFR provides quick and universally applicable guidelines.

Using the matrix in Figure 2, CASE tools can be easily mapped, as seen in Figure 3.
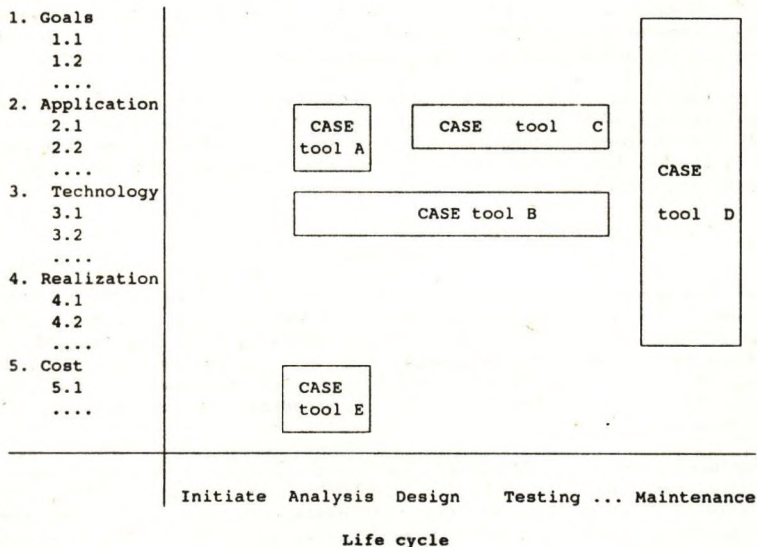
IS
Bill-of-material

Initiate Analysis Design   Testing ... Maintenance

Life cycle

Figure 3
SEFR method of classification of CASE tools

The matrix yields Xi,Yi squares which represent the relationship between subcomponent Yi of the IS bill-of-material and phase Xi of the life cycle. A CASE tool which "covers" an Xi,Yi square advances subcomponent Yi at the Xi phase. For example, tool E relates to the IS Cost at the Analysis phase. CASE tools can cover more than one square, e.g., a whole row (guiding component Yi throughout the life cycle) or a whole column (performing the Xi phase for every component of the IS bill-of-material), e.g., tool C relates to the Application component throughout the Design and Testing phases.

The matrix in Figure 3 quickly reveals that many of the Analysis tools currently on the market cover only the Application component, and additional tools are required to complete the Analysis phase. This matrix is also useful in differentiating between uppercase and lowercase tools.

6. Outsourcing and Subcontracting

Unlike most methodologies which ignore the contracting phase, SEFR fully covers the contracting (tender) phase not only as a major one-time effort, but also in terms of ongoing secondary tenders whenever subcontracting is required during the life cycle. Here again the IS bill-of-material emerges as a powerful tool. The RFP and the subsequent vendor proposals are constructed exactly according to the IS bill-of-material. In fact, the tender process becomes a simple comparison of one IS bill-of-material against another, i.e., proposal X against the RFP or proposal X against proposal Y.

Most important, SEFR shows how the RFP emerges directly from the Analysis document, while the Design document is the direct continuation of the vendors' proposals and the RFP. By adhering to the IS bill-of-material, continuity is guaranteed throughout the entire life cycle (including the tender phase).

Summary

The SEFR procedure presented in this article is based on "good old" proven techniques and yet it offers a fresh approach. The main idea behind SEFR is that of engineering through a bill-of-material. It is structured as an open framework, not as a closed methodology; it defines and arranges SE terms and concepts so that they fit together naturally and it takes advantage of standards and reusablility of information.

The harmonious combination of the three singular characteristics – bill-of-material, framework and standardization – bestows additional distinction upon SEFR in that it deals not only with software engineering alone, but with IS engineering as a whole. The approach taken by SEFR allows it to utilize existing SE techniques, CASE tools and methodologies in one broad and comprehensive framework.

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Expert Systems in Law and Public Administration
- Recent Developments and Future Prospects -

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Abstract   The aim of the paper is to give an overview of the use of expert systems in law and public administration. Based on a description of the problems connected to the support of decision making in these domains, an overview of models for representing legal knowledge and existing approaches for the design of expert systems in the domain is given.

1. Introduction

The development of expert systems in the fields of law and public administration has been going on for several years now. Astonishingly enough so far very few of the systems have become operational. A closer look at the implemented prototypes does explain why most of them were rejected by lawyers and people in administration (cf. [Susskind 1987], [Bonin 1990]). The reasons are mostly organizational, such as neglecting the need for integration with existing environments, ignoring some vital rules concerning the design of the user interfaces and neglecting the fact that rule bases have to be maintained. Altogether these problems can be put into one simple category, that of communication - the computer scientists implementing the systems did not know enough about the domain they were working in and the lawyers and administrators were unable to describe their problems in a way which the computer scientist could not misunderstand. A conclusion drawn from this situation is that the good old systems

analyst who has a vast experience in the domain he is working in, could be the right man for doing the knowledge engineering job, and projects choosing this approach have so far been successful.

Apart from the above problems, which can more or less easily be overcome by means of systems analysis and project management, there are some very interesting questions concerning the representation of legal knowledge and new approaches for the design of the user interface.

The first analysis to start with, is that of decision making in legal and administrative environments. Following this analysis we give describe some approaches which are representative for the representation of legal knowledge. Next we give an overview of the use of expert systems in the domains of law and public administration. As hypermedia can be considered as a revolutionary improvement of user interface design, we finish with giving an impression of how this new idea can affect the design of expert systems.

2. Decision making in legal and administrative environments

Decision making in legal and administrative environments has its own rules. Therefore approaches which are very successful in supporting decision making in technical and scientific domains, are not applicable. That is why it is so important to start with an analysis of decision making.

Legal as well as administrative decision making are characterized by some extremely important aspects, one of them being the fact that a decision has to be made, in administrative environments even within limited time (the maximum given in administrative law mostly is 6 months). As both groups are basically applying laws[1], lawyers and administrators decisions are largely similar. Very useful overviews of the basic steps of legal decision making are given in [Steinmüller 1976] and [Fiedler 1984]. Whereas Steinmüller's model focuses on the information processing aspect, Fiedler concentrates on legal decision making itself :

1. develop a first overview of the problem
2. first, basic overview of the laws, statutes and precedents
· 3. systematic analysis of laws, statutes and precedents
4. teleologic interpretation of laws and statutes

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[1] Art. 18 of the Austrian Constitution (B-VG) states that the administration may only become active according to the law; in other words, no action canb be taking if it is not permitted by the law.

5. detailed analysis of cases and literature
6. final interpretation of laws and statutes
7. analysis of the possible consequences of the decision
8. preparation of the decision

3. The representation of legal knowledge

Representing legal knowledge has turned out to be much more difficult than assumed by most researchers before the implementation of the first prototypes began. Modern and well structured laws and statutes can easily be decomposed into and-or-graphs. Therefore it is relatively easy to "rewrite" them in Prolog or a similar language. The real trouble begins when old, traditional laws have to be represented. Problems such as the lack of structure, continuous updates, references to other laws, the changing meaning of expressions and lots of exceptions are the toughest ones. Modern AI concepts, such as object orientation and inheritance with exception, can certainly help to overcome the worst shortcomings of traditional approaches, but one problem, that of representing analogical reasoning has so far only been solved in an insufficient way. New methods are mainly based on concepts developed in machine learning or on logic (cf. [Hall 1989] and [Baaz/Quirchmayr 1990]). Starting with L.T. McCarty's paper on Permissions and Obligations, logic has proved more and more valuable for modelling legal knowledge.

One promising approach is a combination of Multiple-valued Logic and Modal Logic. The basic assumption is that legal decision making mainly means the analysis of *situations of discourse*. Therefore the essential part of the modelling process is to build a formal representation of these situations. As basis we use the formal model described in [Baaz/Quirchmayr 1987].

To guarantee a high correspondence with legal reality, the model is based on the assumption that

1. the arguments of each source of information involved in the case (attorneys, arguments of parties, ...)are consistent, but they are not consistent with the arguments originating from other sources of information.
2. the arguments of different sources of information may differ

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3. the arguments are of different priorities.

Concerning assumption 2, there are two possibilities to achieve a solution:

1. inferences from inconsistent premises are considered
2. modal logics are used for separating contradicting premisses (this possibility is chosen by the authors).

The construction consists of a static part which is used for describing and a dynamic part which is used for deciding situations of discourse.
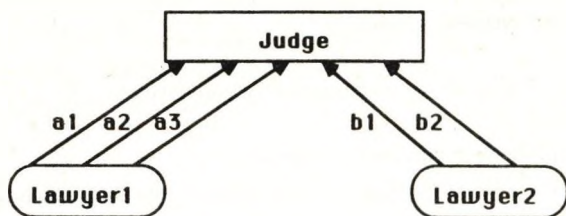
α) the static part

- the situation of discourse is represented by a Kripke-type model
- the sources of information correspond to the possible worlds, one source of information (the decision maker) is designated
- the source of information a is related to the sources of information b iff a accepts the arguments of b
- $\Box A$ is true for the source of information a iff all sources of information whose arguments are accepted by a assert A
- the different truth values of multiple valued logic assert priorities to the arguments

β) the dynamic part

- for finite situations derivations are defined by cancelling the weakest argument. This results in $\Box A$ or $\Box \neg A$ being true for each source of information, which means that the accepted arguments do uniquely determine the decision.

The use of Kripke-type models allows the model builder to divide a legally relevant situation (*situation of discourse*) into several parts which are consistent (α). To solve a case, the contradictions between these parts have to be analyzed (β).

Gerald Quirchmayr and Roland Traunmüller, Expert Systems in Law and Public Administration.

143

The arguments of lawyer1 (a_1, a_2, a_3) do contradict to the arguments of lawyer2 (b_1, b_2), but a_1, a_2 and a_3 are consistent with each other, as well as b_1 and b_2 are consistent with each other. The priorities of the arguments can be derived from natural hierarchies given defined in the laws (constitution - law - decree) or developed by custom (lex specialis derogat legi generali, lex posterior derogat legi priori). Additionally Kripke-type semantics of the well known syntactic systems of normal modal logic consist of sets of situations of discourse provide the following very useful interpretations:

| in addition to the minimal axioms and rules of normal modal logic the system is determined by	the described situations of discourse may be interpretated as
D: $\Box A \rightarrow \neg\Box\neg A$	nobody accepts inconsistent decisions
T: $\Box A \rightarrow A$	a decision for A is only accepted if A is considered to be true
4: $\Box A \rightarrow \Box\Box A$	if you accept A as an argument, you must accept the decision for A
S4 = T + 4	the acceptance of an argument is always equivalent to the acceptance of this acceptance
S5 = T + 5: $\neg\Box\neg A \rightarrow \Box\neg\Box\neg A$	each source of information accepts the arguments of each other (S5 is complete relative to Kripke- type frames, where each world is related to each other)

Logic-based models do definitely enhance the quality of models of legal decision making, but they don not solve the problem of the user interface. On the contrary, if logic formulae cannot be hidden from the user, they do normally cause enormous confusion among lawyers. How the problem of the user interface can be dealt with, is described in the following chapter.

4. Visual Representation of Legal Knowledge - Hypermedia

Hypermedia systems, mainly hypertext promise to be the key to the solution of many problems connected to the design of expert systems. The appearance of hypertext systems a few years ago has completely revolutionized the design of user interfaces. Linking words or whole sentences to background information has made it possible to allow real top down-oriented modelling and to generate help functions in a new way. The principle concept of hypertext is shown in the following figure.
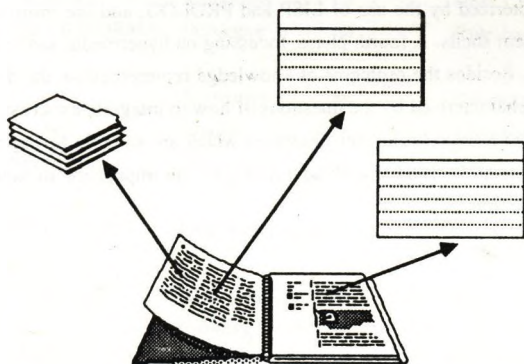
The concept of hypertext

As hypertext has proved very valuable in user interface design, it was soon expanded by additional capabilities, such as graphics, video and sound, this approach being called hypermedia.

The main advantage of hypermedia systems is that they are rather easy to handle and offer powerful toolboxes. This easiness of creating and manipulating networks of links also has its price: the user can build large, unstructured, and therefore incomprehensible networks, a situation which reminds very much of the old days of spaghetti programming (some of the systems are even based on the goto-statement). Therefore elementary principles like structured programming and modularisation are largely neglected by most of the application developers (for an overview of possible integration cf. [Quirchmayr/Kappes 1990] and [Quirchmayr 1991]).

5. Expert systems in legal environments

The development of expert systems in law can be classified in three phases, the first of them being dominated by pioneers using procedural languages such as FORTRAN or BASIC, the second phase, characterized by the use of LISP and PROLOG, and the third, which is dominated be expert system shells. A fourth phase, focussing on hypermedia and integration concepts is starting now. Besides the problems of knowledge representation, the domain of expert systems in law is characterized by the questions of how to integrate expert systems in existing environments, and how to build user interfaces which are suitable for lawyers. An overview of the state of the art in 1987 [Susskind 1987] gives an impression of how far the development is behind schedule.

Project	Language	Inference	Database	Representation
TAXMAN I	Micro-PLANNER (LISP)	Analysis	no	Semantic Network
TAXMAN II	AIMDS	Top-Down Pattern Matching	no	Frame
MIT	PSL	Analysis Deduction	no	Semantic Network
KRL	KRL	Analogy	no	Frame
RAND (LDS&SAL)	ROSIE	Forward Chaining	no	Rule-based
JUDITH	FORTRAN	Backward Chaining	no	Rule-based
ABF	ABF	Backward Chaining	no	Rule-based
LIRS	LISP	NA	yes	Semantic Network
PROLOG	PROLOG	Resolution	no	Horn Clause Logic
LEGOL/ NORMA	LEGOL/NORMA	Deductive	no	Rule-based
SARA	-	Normative Analysis	no	Discretionary Rule-based
CORPTAX	BASIC	Deduction	no	NA
ATAXIS	-	-	no	Legislative Map
POLYTEXT/ ARBIT	INTERLISP	Pattern Matching	no	Frame
ELI	INTERLISP	Backward Chaining	no	Rule-based
CCLIPS	LISP	Plausible/ Deductive Inference	no	Rule-based

Project	Language	Inference	Database	Representation
STANFORD	MACLISP	Backward	no	Rule-based
	MRS	Chaining		Transition Net
DPA	C(CRYSTAL)	Backward	no	Rule-based
		Chaining		
TAXADVISOR	LISP	Backward	no	Rule-based
	(EMYCIN)	Chaining		

As only one of the systems offers a full database integration (meanwhile some more have been developed, but the number is still well below ten), it becomes clear that an easy integration with existing office systems is impossible. As far as knowledge representation is concerned, object oriented approaches are still rare and an integration with deductive databases and hypermedia is scarce too. So isolated prototypes implemented in PROLOG or with the help of expert system shells do still play a dominant role, but the situation is gradually changing, mainly due to the introduction of hypermedia systems. Another interesting approach is the introduction of neural networks for modelling the development of decisions in criminal courts (cf. [Philipps 1990]).

6. Prospects for expert systems in legal environments

In legal professions computerization has reached the more general fields office automation adding a special law-touch by the use of legal databases but keeping off limits hard core of legal problem solving. Main hindrance for expert systems is the very narrow scope of present day systems. Nevertheless there are three promising lines for introducing decision support into the law professions main.

First, plain office functions may be upgraded with particular features containing legal knowledge in such creating better functional solutions. In that way intelligence may be added to

existing programs for different applications as filling in tax declarations, compiling documents, and drafting last wills.

Second, for above mentioned applications its possible to derive counseling systems usable for lay-persons. Even taking the case that such systems only offer coarse screening, first advice and provisional documents to be followed up by a professional finalization, they will sharply reduce the workload done by the human expert. (By the way, this might only be partly a blessing, because in the long run it might also put a major economic strain on some professionals having now a good living by invoicing high fees for legal routine acts.)

Third, searching the legal literature may be enormously enhanced by knowledge bases modules. Especially, in countries with legal systems based on case-law intelligent retrieval systems might become a professional must.

7. Prospects for expert systems in administrative environments

Expert systems in public administration do mainly face the same problems as expert systems in law. Administrators do normally have to apply rules, and these rules are stated in the forms of laws and directives. The main difference is that integration, especially with database systems, becomes even more important.

As described in [Bourcier 1989a], three levels of translation rules in law together with a result can be viewed as norm.

Legal corpus and practice	Normative dispositions
	Analysis of practice and experience (precedents)
Analysis	Resolution rules
Formalization	Production rules (Prolog)
Solution of the Problem	General decree, Assessment of individual cases

Levels of normativity

Also problems connected to data and implementation are widely underestimated, because it is only when the interesting part of the work, the design of the system is finished, that the really hard work, filling the empty shell with knowledge, starts. Testing the rules and checking out inconsistencies does even cause more headache. As knowledge is dynamic, the rule base has to be updated almost continuously, a fact which is often underestimated too. It is only then when it becomes clear that due to the enormous amount of data isolated expert systems cannot survive in public administration. These problems are clearly recognized in (cf. [Bourcier 1989b]); the advice given to project managers is as follows: Expert systems have to be properly integrated in the overall organizational flow of tasks. Organizational complexity and burocratic attitude advice very cautious procedures of implementation. It is necessary to have expert systems filled and maintained centrally that afterwards work decentrally in various copies on different sides. According to [Kuopos 89] and [Traunmüller 89] governmental computerization may be viewed as a rationalization process, a branch of the western rationalistic tradition. An overview of decision making techniques results in the following figure:

Types of Decision	Traditional	Modern
Programmed:	- Habit	- Computers
routine	- Clerical routine	- Management science
repetitive	- Organizational structure	
decisions		
Non-programmed:	- Judgement	- Heuristics
one-shot	- Intuition	- Interactive computers
ill structured	- Creativity	- Artificial Intelligence
novel, policy	- Rules-of-thumb	
decision		

Decision making techniques

The above overview does clearly show that the applicability of traditional computer science is limited to the support of routine work. As soon as real problem solving comes in, AI techniques become inevitable. Despite of these obstacles there are some bright prospects for expert systems in administrations:

There are many fields of very high specialization that look promising. In administration a system developed will meet a fairly broad market. Growing tasks for public administration turn into a high urge for rationalization.

8. Conclusion

As our paper has shown, a new phase of expert systems development in the domains of law and public administration has started. The time of experimental prototypes seems to be over and the focus shifts from theoretical aspects of knowledge representation to very practical issues such as integration and user interface design. Hypermedia has definitely brought about a revolution in the design of expert systems. Tools like Apples Hypercard help to overcome many shortages of existing expert system shells and offer the possibility of easily creating

knowledge bases. The problem is that guidelines and standards for the use of these new developers kits are still missing.

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Gerald Quirchmayr and Roland Traunmüller, Expert Systems in Law and Public Administration, .

153