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Summary: Building on Lars Mathiasens's notions of hierachical structure-process relationships, the authors argue that system development can be viewed as a series of *processes* (transformations) and *structures* (restrictions on process states). It can be seen as a precursor the spiral model for iterative system development introduced by Boehm in 1986.

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THE SYSTEM DEVELOPMENT PROCESS - ITS SETTING, SOME PROBLEMS AND NEEDS FOR METHODS.

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This paper relates to systems comprising people and information processing equipment (possibly also other kinds of equipment). It is further assumed that:

1) the systems may be regarded as parts of organisations interacting with a surrounding society.

2) the regular operation of the systems directly affects important aspects of the daily life of people involved.

The paper discusses various aspects of the working processes which regarded as a whole, may be named "the system development process." The paper also discusses the content of some commonly used terms.

1. SOME BASIC CONCEPTS.

Discussions on terminology are often idle, but may reflect basic differences of opinion or at least emphasis. Also terms used incorrectly may cause confusion.

In a recent book (A.Parkin,1980) the author maintains that "informatics" is a substitute term for "data processing". "Data processing" is a term denoting a process or a function, however, whereas "informatics" is the name of a science which has data processing as a subject of study.

"Informatics" is usually regarded as being a synonym of "computer science". Even so, the latter term may have a too restrictive set of connotations if we regard human and inter-human information processing as important parts of information systems.

The choice of definition of the term "informatics" is in no way trivial. Some scientists are pushing very hard for the acceptance of a definition which makes informatics a formal science in the same way as mathematics. According to such a definition, the impact of an information system upon the social structure of which it is a part, is outside informatics. Also case studies of how data processing actually is carried out in specific organisations fall outside informatics taken in this narrow sense.

In our opinion, informatics should be defined in the same way as e.g. physics, geography and botany: as a science having certain aspects of a class of phenomena as its subject of study. Our definition is as follows:

Informatics is the science which has as its subject of study the information aspects of processes and phenomena in nature and society:

- their identification and properties.
- their interaction with other aspects of reality.
- how they may be understood and described.
- how they may be designed, implemented and modified.

We feel that this wide definition is necessary if the system development process shall be properly treated as a subject of study within informatics.

The words "processes and phenomena" may be substituted by "phenomena" only. Processes are, however, phenomena of particular importance in informatics. "Information" is used as term in the definition even if this leaves us with the task of defining that term.

The next term which need consideration is "system". Many definitions are too general, making everything a system. We prefer the following definition (Holbæk-Hanssen, Håndlykken and Nygaard, 1975):

A system is a part of the world, which a person (or group of persons) during some time interval and for some reason - chooses to regard as a whole consisting of components, each component characterised by properties which are selected as being relevant and by actions which relate to these properties and those of other components.

According to this definition no part of the world is a system in itself, as an inherent quality. It may be regarded as being a system by us, if we choose to do so. But it may also be natural and useful to us not to regard that same part of our world as a system. Also, it may usefully be regarded as a system in many different ways.

Parts of the world which usually are (or initially were) thought of from a system point of view are frequently referrred to as "systems" even in other contexts. (E.g. "The news have upset his nerve system", "Scandinavian Airlines System".)

This symposium is on "Software Engineering Environment". Last week a conference was taking place in the U.S. on "Programming Environment". Are the two terms synonyms?

If there is any difference in meaning at all, it seems mainly to be in emphasis. People using the term "programming environment" will more often come from academic institutions than from applied data processing organisations. They are mostly concerned with highly advanced tools for an individual or a small team of programmers making highly sophisticated software. The management aspect of programming is seldom stressed.

Those who use the term "software engineering environment" seem to be more concerned with the development and maintenance of large programs which are run during long time spans (often a decade or more) as important parts of the information systems in organizations (enterprises, departments etc). These programs are typically produced by large teams of programmers with often high turnover rates. The management aspects are stressed and are supported by the tools developed.

Both terms refer in fact to the text which prescribes the actions of the data processing equipment:the program, the software.

In the information systems we are to implement now, a more comprehensive view is necessary than the strictly computer-oriented one.

For this reason we find it useful to talk of the "system development process", the "system" being composed of people, machines, the execution of the software involved and the data structures generated. Obviously, the notion of "software engineering environment" may be extended to include also tools useful in this wider system development process. We would, however, like to have another term, directly related to "system development".

Also we need another development environment taken into account, different from both the isolated few programmers and the huge teams in large organisations. The setting may be characterised by:

- An enterprise (organisation) of 50 to 3000 employees.
- A system department of 1 to 50 persons.
- System workers having background from:
  - The punched card machine age.
  - Manufacturers' courses.
  - Early academic educations.
  - Present academic educations.

  All being overworked.
- Managers gradually realising the impact of their information systems.
- Employees rapidly becoming scared and deeply concerned.

2. THE SYSTEMS

It is often argued that a computerised system has had little or no impact on an organisation. The argument is based on the fact that there have been few changes on the organisational chart and in the structure of positions. This view is generally based on a far too simple view of what an organisation is. To look into developement of computerised systems for use within an organisaton, it is necessary to say something about what we mean by an organisation.

A common characteristic of most organisations is that their excistence is based on some goal. If the organisation is to survive, the goal has to be fulfilled at least for some time interval and to a degree that is satisfying for the dominant interests in the organisations.

Seen from the point of view of the dominating interests in the organisation, its structure is an instrument for fulfilling the goal. The formal structure of an organisation may be read from organisational charts and instructions. The real structure of the organisation is understood by considering the tasks actually being carried out in the organisation. (Høyer, 1974).

The tasks and their connections can be studied from different points of view. An organisation may be seen to consist of:

- A system of the work tasks necessary to fulfill the goal of the organisation. Simultaneously these tasks are to give each employee a satisfactory job.

- An information system transmitting information between work tasks. The information may be orders, data for use in the work tasks or data to be stored for later use.

- A decision system. As the work is carried out a number of decisions are necessary, some being trivial and of short range, others important and of long range.

- A power system showing who are able to influence the decisions, which formally are assigned to specific persons.

- A social system of friendship, knowledge, sympathy, antipathy, dependence, expectations and experiences within the organisation.

The real organisation simultaneously comprises all these systems, and generally an organisational change affects all of them. The structures are not permanent and are created by individuals and groups, their interests and their ability to pursue their interests.
(Fjalestad, 1978).

The introduction of a computer based system in an organisation has obviously consequences for the organisation: work tasks are changed, communication structure is changed, the decision system, power system and social system may also be affected.

The consequences of a computer based system will generally vary from individual to individual and from group to group, depending on the type of work tasks carried out and the position in the systems mentioned.

In the development of computer based systems it is common to talk about those affected by the system as a group of people called "users". The term "user" is far too unprecise and general in most discussions of systems development. Statements concerning "user" participation and "user" satisfaction may have no meaning without a specification of which group within the organisation these users belong to. The groups of "users" may be classified according to different kinds of criteria:

- Kinds of work tasks carried out.
- Position within the decision system.
- Position within the power system.

Two useful approaches are, in the authors' opinion, those of interest groups and functional roles, respectively. See (Fjellheim, Håndlykken and Nygaard, 1973) and (Nygaard, 1976).

Any person may be regarded as participating as a component in a large set of systems, and her (his) relation to the production processes will have a decisive influence upon her(his) situation in life. People with the same relationship to the production processes will usually develop an understanding of common interests, group interests. They will organise themselves in "interest organisations" acting as "interested parties" to decision making in the society. Associated with an "interest point of view" is often also a more comprehensive ideology, or "picture of the world" which influences the group members attitudes to what are important properties of a system and of a system development process.

A group's interests in systems in an enterprise may relate to a number of issues, as e.g.:

- Which economic benefit will we (the group) get from the system? (As employees, middle or top management, employers.)
- To which extent may we exercise control (power) over the system?
- How will the system influence the physical and psychical working environment?
- Will the social network in the enterprise be changed to our advantage or disadvantage?
- What is the relationship between the objectives of the system and the objectives we feel should direct our society?

We get another set of relationships by considering the functions to be carried out by persons in a given system by describing the persons functional roles.

A role is then defined by a specified task or group of closely interrelated tasks, carried out by persons in the development and/or operation of a system. A person may have more than one role at a time. (Our role concept differs from that which is commonly used in social psychology where a role is described by the expectations which a person will adapt to in a given position in an organisation.)

The following list contains some important roles in relation to systems:

Rulers: control, completely or partially, the resources used in the system (and its development) and the selection of the basic objectives it is intended to fulfill.

Managers: survey and direct the development and/or operation of the system. A local representative for a ruler.

Operators: work in the system and is necessary for its proper operation. An operator may often serve as manager for a subsystem of the total system.

Customers: interact with the system from necessity or by choice. In direct contact with the system only in shorter periods of time.

Bystanders: may be influenced indirectly by the system, by its consumption of scarce resources or by other social effects.

Designers: design and describe the system's structure in cooperation with repesentatives for the ruler(s).

Programmers: work out in detail the prescriptions (programs and working procedures) used in the system. Participate in the implementation.

Teachers: teach operators and others how to use the system.

Once more we will stress the point that roles specify functions and not persons. A person within the system will usually enact more than one role, at the same or at different times.

An example: A programmer may (and in the opinion of the authors should) also act as a designer.

The eight roles indicated do not imply that we have to consider all in every situation or that those involved are to be distributed into eight disjoint groups.

The role concept is useful because it emphasises the various kinds of experience and insight needed and the demand for different kinds of system descriptions in the development process. When the management of an enterprise decides it wants "user participation", it usually means that some of the functional roles become represented in some of the bodies within the development organisation.

An employee needs one system description when he as operator shall learn how to use a terminal in his job, another when he as shop steward (interest group representative) shall understand how the terminals influence the social contact structure and the steering of the production.

The information system within an organisation is of vital importance to the organisation. The kind of information processing taking place varies from simple operations which easily are described formally and which are repeated a large number of times to complex and nonrepetitive information processing planned and executed once.

The information technology chosen by the organisation will depend on the problem to be solved: The computer is a useful tool for some of the needs, for other needs use of telephone or use of meetings is better.

Within the total information system different information processing technologies co-exist and interact. The formalised part of the information system will in general be closely integrated with parts that are not formalisable. Analysis and design of a formalised information system must therefore take into account interaction with the not formalised parts.

The computer technology has been introduced in organisations by three major stages:

- 1st stage: The large computer is installed in the "Computer Department" (or some similarly named unit). Data related to an increasing number of separate tasks are collected as input data and brought to the Computer Department, converted and entered into a task-related data bank. These results are then transferred to a set of users outside the Computer Department.

- 2nd stage: A common data base is established, instead of maintaining a set of separate data banks, each associated with a specific task. Now a common conception of the organisation, materialised in the data base, is enforced upon all users of the computer.

  The responsibility for the establishment, updating, correctness and consistency of the common data base may no longer be fragmented between users of a series of subsets of the data base. Instead generally accepted rules and assignments of authority and responsibility related to the data base must be introduced as a new, important part of the organisational structure.

- 3rd stage: The walls between the Computer Department and the rest of the organisation are penetrated by communication equipment - linking the department's equipment to local computers, electric typewriters, data displays, analog-to-digital converters etc, etc throughout the organisation. The organisation becomes a network of human beings, machines and information processing equipment, linked together by an increasing proportion of electronic communication links and a decreasing proportion of human communication links.

Most major organisations which have been using electronic information processing for more than 10 years have started in stage 1, are moving towards the common data base as described in stage 2, and have entered stage 3 for at least some important applications.

As the computer technology spreads and the systems developed become more integrated with the organisation, the integration of formal and informal information systems will have increased importance. According to (Thompson, 1967) one of the prime abilities of an organisation is that it has to cope with uncertainty and limited knowledge of the external world as well as of its internal organisation. Formalised information systems have limited ability to cope with many of these uncertainties.

The formalised information system necessary to carry out the work in an organisation is also interacting with an informal information system created by the individuals working there. This information system allows unstructured exchange of information relevant to the production, supplemented by private communications which are important to the social structure of the organisation and to the persons working there. Changes in the formalised system may also change such informal systems.

Human versus computerized information processing, an example.

LOCATION: A large furniture store, part of a chain with its main office in another city. ANDY, working in the warehouse downstairs, gets a call from LIZ, working in the store.

HUMAN COMMUNICATION:

ANDY: "Andy speaking."
LIZ: "Liz here. How is your arm?"
ANDY: "The doctor tells it will be OK in a week. You and your husband were lucky with the weather for your boat trip yesterday!"
LIZ: "Marvellous. And the most dramatic thing happened - almost. I will tell you later when business has calmed down around me."
ANDY: "It is quiet here. The others are having lunch."
LIZ: "Can you make ready a TRADITION sofa with green PRINCESS ANN material? An elderly lady named Olsen will come around and pick it up. I will send Peter down to assist you."
ANDY: "Thank you! Listen, you are lucky. She gets the last one. The main office tells us it is three months delivery time".
LIZ: "What about TRADITION in other materials?"
ANDY: "Three or four red PRINCESS ANNE and one zebra-striped. That is all we have".
LIZ: "Thank you. We'll meet at the canteen?"
ANDY: "Twelve thirty".

COMPUTERIZED COMMUNICATION:

TERMINAL:

DELIVERY ORDER
FROM CLERK NO: 12 L.ASHVILLE
INVOICE NO : 675 220 0 412
DATE SOLD : 79 - 06 - 26

QUANTITY	CODE	SPECIFICATION
1	378-303	SF TRADITION TK
	4T	MTRL PRINCESS ANNE / GREEN

Obviously it will be more difficult for LIZ to work as a data shop steward, protecting ANDY's interests under the computerized system. Also, from a management point of view, the old system creates a more "robust" organisation, more able to cope with new and unforeseen situations.

The rapid introduction of terminals relating to a common data base imply that more and more people in their work relate to a model of reality (the data base) instead of reality itself. These people have as a rule not had any influence on the selection of those aspects of their surrounding reality which are portrayed into the data base, and they may neither modify nor extend the model. Also, human communication (direct or through telephone) tends to be substituted by indirect communication by data screens. It is disturbing that these kinds of changes are implemented apparently without any concern for the possible effects upon the individuals.

The introduction of voice synthesisers combined with automated information systems creates a new set of problems for the individual. Maybe an "eleventh commandment" is needed:

> "Thou shalt not create machines in the image of Man".

or phrased in another way:

> "every citizen should always know when he is communicating with a machine and should understand its implications".

Joseph Weizenbaums' experience with the "ELIZA" program is a well known illustration.

The development of electronic information systems may also seriously influence the strength of the trade unions. (Nygaard and Bergo, 1975) and (Hennestad and Sørby, 1977). The power base of the unions is the solidarity between its members. This solidarity is founded upon a common conception of the work environment and the surrounding society. Such a common understanding may dissolve when the members become socially isolated and their direct cooperation becomes less meaningful in terms of the purpose of their work.

3. THE SYSTEM DEVELOPMENT PROCESS.

We will here primarily discuss the development of information systems which are highly integrated in an organisation, systems having serious impact on the work tasks.

The purpose of the development process is to change the organisation, and to take advantage of information processing technology. A proposed system is a planned future organisation. The plan includes people in the organisation and equipment. The system development process includes working out this plan, providing the equipment and implementing the plan.

Methods for system development are guidelines and principles to follow in the development process.

A method is in general characterised by (Mathiassen, 1980):

1. An area of application, in this case: the type of system development process.

2. A "conception (or picture) of the world" consisting of assumptions about the nature of systems, organisations, the surrounding society, and the purpose of the local organisation.

3. Principles for organising the development process, splitting it into partial tasks and assigning resources.

4. Techniques of work used in the partial tasks.

5. Tools used in the application of the techniques.

Very few methods are described by their authors according to this layout. In particular are the assumptions, attitudes and values constituting the underlying "picture of the world" very seldom stated, and they have to be deduced.

The type of system development process discussed in this paper relates to:

- systems that may be regarded as parts of organisations interacting with a surrounding society.

- systems which in regular operation directly affects important aspects of the daily life of people involved.

There are number of "schools" of organisational development. The schools are based on values and norms for guidance and control of people and for cooperation between people. The "conception of the world" embedded in some of these schools sees an employee as a passive object without own relevant interests, a person who is guided and motivated. An alternative view is to see an employee as an active subject pursuing own or collective interests (Fjalestad, 1980) and (Nygaard, 1976).

In some countries there are laws and negotiated agreements between the main working life parties, regulating the system development process. As an example in Norway the process must take into account:

- the legislation on co-determination in enterprises (1972).

- the "Agreement on Computer Based Systems" ("Data Agreement") between the Norwegian Federation of Trade Unions and the Norwegian Employers' Confederation, (1975 and 1978).

- the "Act Relating to Worker Protection and Working Environment" (1977).

- the legislation protecting information about individual citizens (effective from 1980).

The first trade union demand for a "Data Agreement" came from a local union (Askim Chemical Workers' Union) in the autumn of 1973 (Nygaard and Bergo, 1973). After long and difficult negotiations, an agreement was signed early 1974 by the union and its employer counterpart.

It was immediately realised by the Norwegian Federation of Trade Unions (LO) and the Norwegian Employers' Confederation (NAF) that a long series of similar demands would have to be negotiated in the future. The LO therefore asked for a framework agreement between LO and NAF. As a result of further negotiations, the "General Agreement on Computer Based Systems" was signed by the parties in April 1975.

The agreement, usually referred to as the "Data Agreement" was revised in 1978. Corresponding agreements between the Government and the unions of employees in government service, in local government etc, are also in effect. The agreements probably cover system development at more than 90% of workplaces employing organised blue or white collar workers.

In 1977 the new Norwegian "Act relating to Worker Protection and Working Environment" ("Working Environment Act") was put into effect. An important aspect of this Act is that it not only states which harmful factors should be removed from the working environment, but lists a number of positive factors which should be introduced. Also, in paragraph 12 it is stated that the law relates to the systems discussed in this paper.

Evaluations of systems will naturally start by discussion of system properties, in this context: the properties of the implemented system having effects on the performance and working conditions in the organisation.

It is the experience from the recent Scandinavian research projects in this area that the properties of the implemented system and those of its system development process are interdependent. It is not sufficient for an interest group to influence system specifications, it also has to influence the system development methods used and be represented in the teams involved in the development process. (Nygaard and Fjalestad, 1979).

The participation of user groups in system development is an ongoing process - not delimited to intermittent periods of activities related to specific systems. The content and design of such long range processes are discussed in the context of trade unions in (Nygaard, 1976).

The development process is usually in itself a large task commonly organised by an organisational structure that may be called specialised and hierarcic. This structure assumes that the task to be done has the following properties:

- it is decomposable into a number of smaller tasks.
- the execution each smaller task is controllable.
- coordination and control are separable from execution of a task.

(Mathiassen, 1980) argues that these assumptions generally do not apply to the system development process, and suggests other organisational forms (interdisciplinary and dynamic forms).

The development process has a number of characteristics which makes it difficult to organise and control, and which also has consequences for the production of computer software:

- It may be impossible to set up a detailed plan of the new organisation to be implemented at an early stage of the process. The final solution will depend upon experiences and knowledge gained during the process. Final specifications of the information processing equipment needed can in general not be expected until late in the process. However, equipment and software are needed during the process to gain knowledge.

- The formalised parts of the information system interacts with the informal parts. Computer technology coexists with other information technologies and human information processing. Evaluating the total information system may be very difficult until it is tried in practice.

- The development often implies integrating information models from different areas of work within the organisation. The process will thus be interdisciplinary, and will introduce new interdependencies in the organisation.

- The vast resources put into the process, means that there is a hard time pressure to implement the new organisation as soon as it is specified.

The techniques recommended in methods may relate to analysis, to design, to the activity of system description.

The tools are used in applying the techniques. The DELTA language is in this context a tool which may be used in the technique of writing system descriptions in a semiformalised English.

In the opinion of the authors, the choice of method may depend upon the case at hand and even within a given method a wide range of techniques and tools should be used. Typically, no single technique for system description is able to capture all relevant aspects of a system when both a range of functional roles and interest groups are considered. (System description in SIMULA is discussed in (Dahl and Nygaard, 1965) and in (Nygaard, 1970). System description in DELTA is discussed in (Holbæk-Hanssen, Håndlykken and Nygaard, 1975), (Håndlykken, 1977) and (Håndlykken and Nygaard, 1980)).

In the development process we are dealing with aspects relating to :

- The system's function and intended purpose.

- The development process of the system.

- The system's properties as an information system

The "ANDY and LIZ" example relates to the first of these aspects. The following two examples relate to the second and third, respectively.

(Bjerg and Nielsen, 1977) has proposed a classification of the various techniques and tools for conveying informaton about systems. The proposal illustrates the usefulness of variety of approaches to system description in the development process:

1. Information by system exposure

   1.1. Exposure to similar systems
   1.2. Exposure to partial models
        1.2.1. Static (Pictures, graphs)
        1.2.2. Dynamic (Movies, simulators)

2. Information by system description

   2.1. Static description (snapshots, dumps, invariants)
   2.2. Dynamic description
        2.2.1. Narratives (Traces etc.)
        2.2.2. Generating descriptions used by system generators
               (programs, plays, musical scores etc.)

When user groups become active in the development process, they need information about information system properties. (Andersen and Melbøe, 1980) has proposed the following classification of properties:

- Basic system properties:
  Structure (program) to which observation, addition, deletion and modification are applicable.
  Substance (objects, entities, records) to which observation, addition and deletion are applicable.
  Value to which observation and modification are applicable.

- Communication properties (between user and system).
  Input output equipment, screen lay-out etc.

- System modification properties.
  Availability of user languages,
  convenient regeneration tools etc.

4. THE TASKS OF THE SYSTEM SPECIALISTS.

Typical for departments dealing with system design, implementation and maintenance is a division of labour. Some people (usually the largest group) are applications specialists, often divided into system analysts and application programmers. These people mostly use COBOL or FORTRAN or some other language or language-like tool occasionally supplemented by sequences written in assembly. (We are not discussing "software houses" and computer manufacturers in this context.)

Other people are system programmers, implying that their responsibility is the proper functioning (including updating and adapting) of the basic support software as e.g. operating systems, compilers, editors, data base management systems, transaction handlers, etc,. etc. These people usually have no responsibility for designing, implementing and maintenance of such basic software - their task is to receive the software from some supplier (usually the mainframe manufacturer) and keep it in good shape.

The development of new operating systems and languages are generally by these people regarded as exotic and (in the case of languages) slightly dubious tasks, reserved for the relatively few at academic institutions, in manufacturers' programming departments or software houses.

This will have to change.

When the new information systems belonging to "the 3rd stage" (see above) are introduced this implies important modifications of the organisational structure. These modificatons cannot be properly designed and evaluated in terms of the modifications of the information system alone. The system development process must comprise the totality influenced by the proposed change - both people, machines and information processing and communication equipment.

If Data Agreements (Technology Agreements, or equivalent working mutual understanding) are in operation, the system specialist now has to

- communicate precisely and cooperate constructively with a number of people representing various interests and having the right to participate and negotiate in the decisions relating to system design.

- take part usefully in evaluations of a wide range of effects of the proposed system alternatives, "system" being understood in the wider sense used in this paper.

- on the basis of decisions of the total system, to deduce and implement a suitable information system supporting the accepted total system proposal.

If we examine the last point on the list in the context of "stage 3" systems mentioned earlier, the two main tasks for which the system specialist has a particular responsibility are:

- the organisation of the proper cooperation of a large and varied group of information processing and communication equipment, many operating in parallel.
  This corresponds to essential parts of implementing an operating system.

- the design of the modes of expression available in the involved peoples' interaction with the information system - from their pushing of buttons, through their use of a limited set of rigidly defined transactions to their use of a programming language. If the sum total of a particular person's modes of expression in relation to the system is called his language, then it is seen that design and implementation of languages are essential tasks.

The "operating system" now becomes an integral part of organisational structure,and should (according to e.g. agreements, laws) be designed, or at least to a very great extent be modifiable locally.

The "languages" are essential for the working situation and demands will be made to make them increasingly more flexible and powerful. Probably no "universally accepted" programming language will emerge, instead we will get "job-oriented" languages, expressing themselves in terms meaningful in the local job context.

An even better approach will be to aim at "profession-" or "craft-" oriented languages, related to skills associated with a wider range of similar jobs (as proposed by Arne Pape at the NCC). In the future the interaction with computer systems will constitute important components of the practice of most professions and crafts. The design of "profession-" and "craft- oriented languages" thus will be essential in designing professions and crafts which will be useful over longer periods.

The request for more powerful languages for the users will not only come from those representing their interests. Management may become interested in establishing situations in which their employees are able themselves to use their skills directly in the writing of programs.

The programmers also have an interest in users languages in order to relieve some of the heavy burden of maintenance work (Boehm, 1979).

Very few applications specialists or system programmers are trained for the three major tasks outlined above.

Also the tools available for these tasks are not at all sufficiently well developed. Improved language tools, concepts for organisation of information equipment, better approaches to the system development process are necessary if local system development shall be the main rule in organisations.

(Most of the material in this section is from (Nygaard, 1979).

As a final remark we want to point out that human and inter-human information processing should be built into new information systems. Today it seems to be the aim to remove as much of it as possible. The study of the properties and design of human and inter-human data processing must become an important part of informatics.

5. CONCLUSIONS

The current trend in Software Engineering (and Programming) Environments is very promising in many respects. Ingenuity combined with practical experience will no doubt result in environments offering much better working situations for the development of software.

However, we need to develop systems in which the computer based components only are subsystems, even if important ones. Also the organisational setting of the system development process will change. For these reasons we feel that the general notion of system development environments is going to be a very important and promising area also for future research.

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