The relationship between models, methods and system development tools (i.e. case tools and 4GL).

Reference Model for System Development and Project Control

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The system development model is **independent** of the development environment, size and complexity of the project, as well as of the availability of methods and different software support.

Methods and system development tools are placed in a separate **"box"**. This makes it possible to change them and still use the model. It is also an advantage to be able to use new, modern system development methods and tools as they are available.

The "box" in the model serves as a management box and a support box. It contains policy decisions concerning such areas as ADP strategies, technology, methodology, rules and instructions which serve as management control. It is a support box in which products of the development such as project experiences, data models, glossaries and programs are collected and referenced during future development efforts.

The system development model consists of a number of **work steps**. It covers the entire development process starting with administrative development planning and proceeding through system administration and operation. It also covers generalization, distribution and local adjustment.

System development control is described in an independent project control model. A project is divided into one or more **phases**, each consisting of all work steps of the system development model. This means that the degree of control can be varied according to the extent of the project and its complexity. The phase decision points are defined as deemed necessary. Depending on the goals of each phase the refinement of the different steps will vary.

As each work step progresses, **documentation** is produced to support decisions. The precise nature of the documentation is determined by the specific phase carried out.

The reference model allows **user development of systems**. One of the common problems inherent in the introduction of new systems is that **the users do not accept the system!** They feel it does not work as they want it to, it does not do the right things, it does not have the right information and the outputs are not in the right format. However, those systems which have been developed by users gain an "automatic" **real** user acceptance.

In user driven system development it is especially important that methods and tools are easy to learn and use.

SIS-ITS has the intention to publish the reference model as a technical report. The old SIS-RAS has been withdrawn.

Introduction

The requirements for this system development model were laid out during the initial design phase:

- It should be possible to use the model for traditional centralized system development, but the main focus should be to serve as support for user development of local systems.

- It should be possible to use modern system development tools as well as traditional programming languages.

- It should be method independent - i.e. it should be possible to choose methods based on the environment in which the development will take place, while still applying the SD model.

- It should be possible for both the principal and the local users to exercise maximum influence over the system.

- It should be possible to adapt the proper level of control for each separate project.

- It should be tested in a working environment (field test completed).

The system development model is not tied to any specific method. For that reason and because all documentation is heavily method dependent, the documentation proposed in presenting the model is to be viewed **only as an example.**

The requirement that the control should be adapted to each separate project has been satisfied by making the SD model and the project control model independent of one another. This separation makes it possible to schedule frequent decision points in a large and complicated project, as well as only a few in a smaller one. This also satisfies the requirement that people at different levels, involved in a project, have the capability to influence its outcome.

The iterative approach, the design of the project organization, and the use of prototypes in the development also provide opportunities for influencing the system and the system quality.

SYSTEM DEVELOPMENT MODEL

General information

The SD model is designed to be independent of the development environment, size and complexity of the project, as well as of the availability of methods and different software support.

System development control is described in an independent project control model. It is possible to divide a project into one or more **phases**, each consisting of all **work steps** of the SD model. Depending on the goals of each phase, the refinement of the different steps will vary. For more information read the chapter entitled "Project use of the SD model."

The various work steps in the model are described in a special section. As each work step progresses, documentation is produced to support decisions. The precise nature of the documentation is determined by the specific phase carried out.

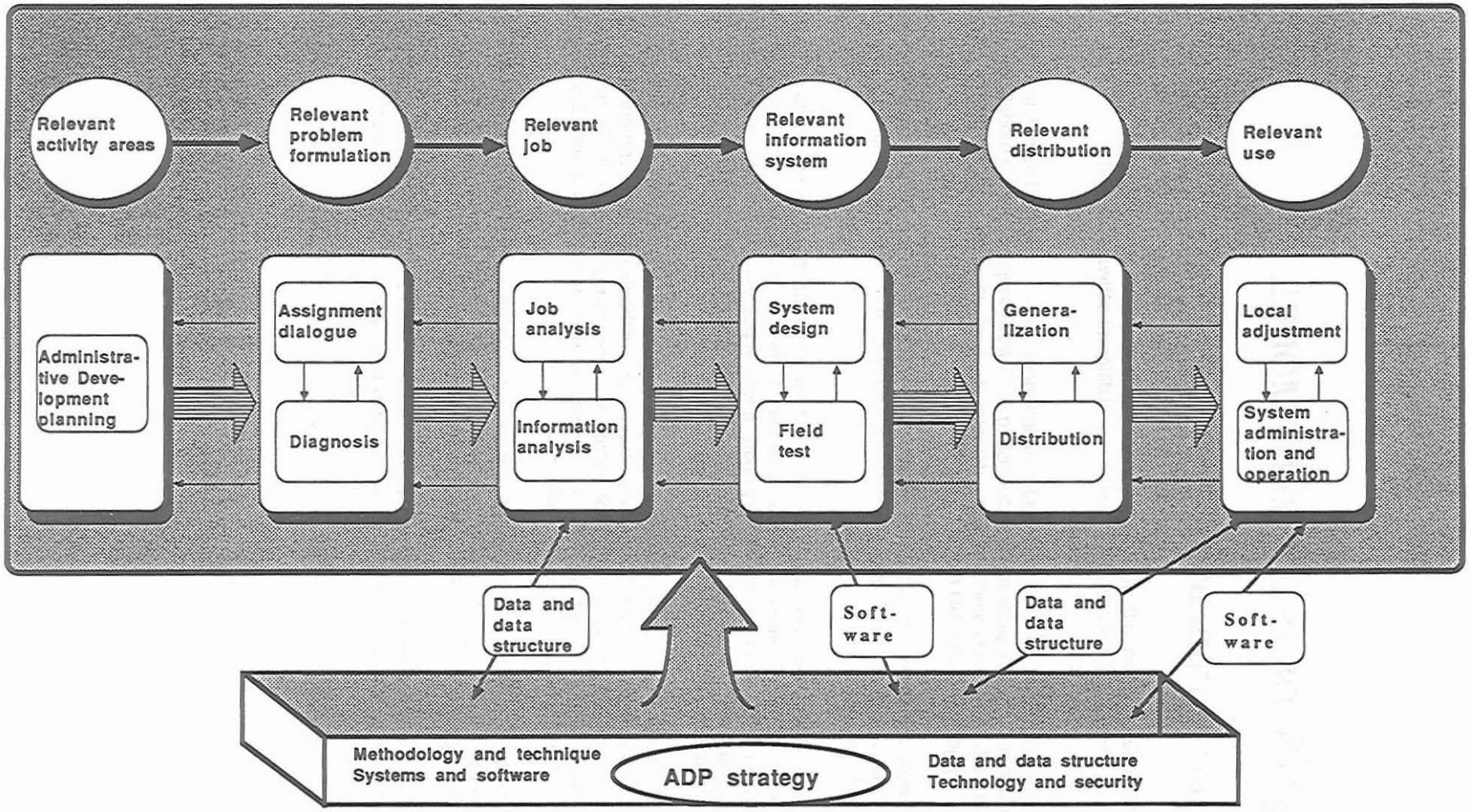
The model allows simultaneous work on several different "fronts" made up of various sub-assignments. A possible system development subject is management support. It may become obvious that one of the sub-assignments will require support very soon. It is then possible to plan the work in such a way that the computer support for the prioritized assignment can be tested (or even installed and distributed) while other sub-assignments are still involved in much earlier work steps or phases.

The **"box"** in the model serves both as a management box and a support box. It contains policy decisions concerning such areas as ADP strategies, technology, methodology, development tools, rules and instructions which serve as management control. It is also a support box in which products of the development such as project experiences, data models, glossaries and programs are collected and referenced during future development efforts.

The SD model must be viewed holistically and the various work steps must be worked through in an iterative way!
(See also "Approach" and "Project use of the SD model" .)

The SD model covers the entire development process starting with administrative development planning and proceeding through system administration and operation. It also covers generalization, distribution and local adjustment.

Reference Model for System Development



Approach

The approach is **iterative**, repeating each work step as many times as necessary to either complete the goal or satisfy the phase requirements.

The decisions in the picture (page 7) are **internal project decisions**. The results of the completed work are checked against preset conditions, level of ambition etc., ensuring that the results are in accordance with the project goals.

The project decides if the current **"cycle"** needs to be repeated or if the results are **"good enough"** to warrant moving on to the next "cycle". Parameters of such decisions are documentation, quality of work, system vulnerability and activities necessary to reach a proper reliabilty and security level.

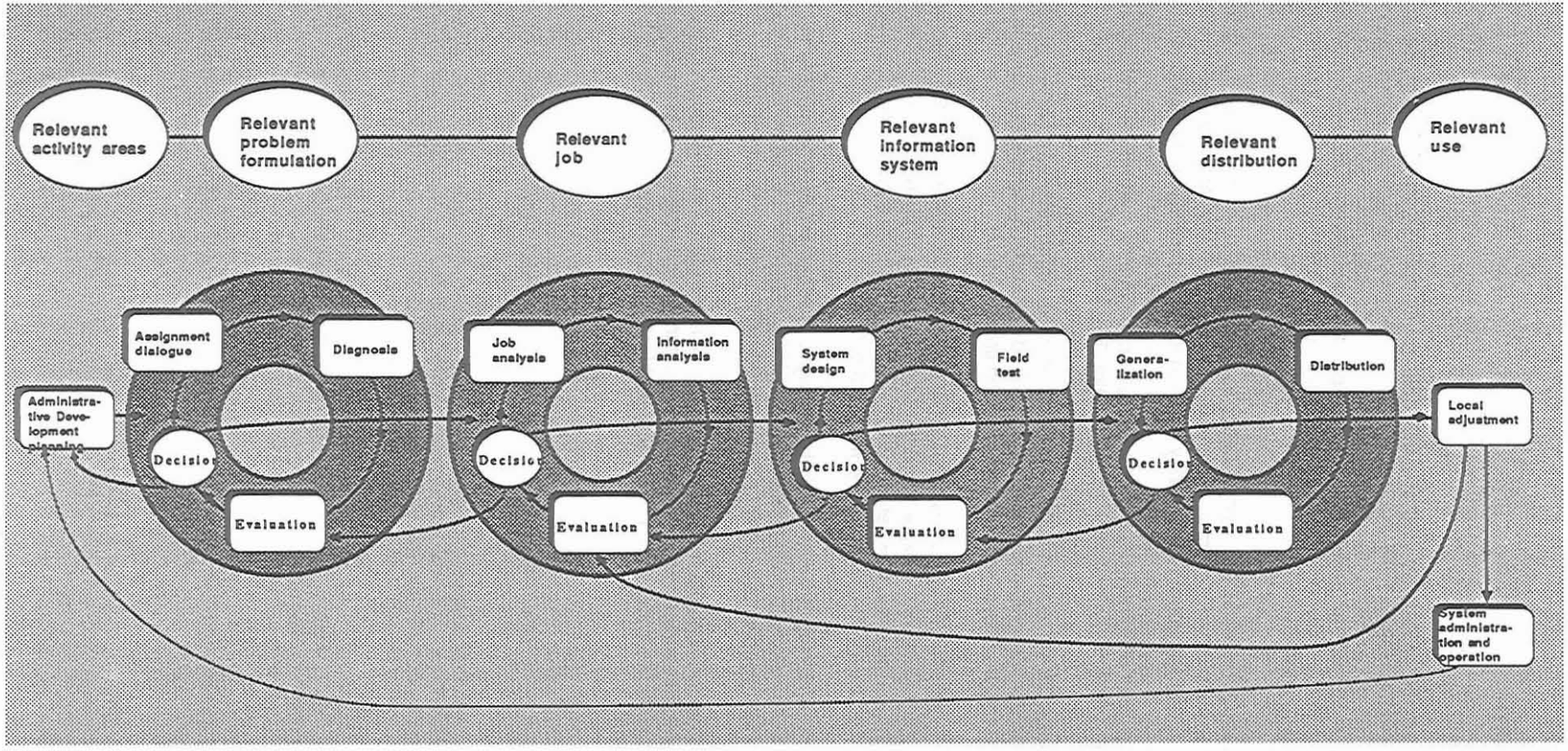
Evaluation of project documentation, system development quality, system vulnerability and security considerations are carried out at each decision point. This information, plus a cost/effect analysis which includes a resource utilization study, is required for planning the remainder of the work. In addition, it is necessary for the project to reevaluate such parameters as organizational structure (even the organization of the project), job descriptions, technology available and personnel qualifications. This is essential in order to plan any necessary training or similar activity in good time.

The concept "good enough" is somewhat of a key concept. The amount of detail required increases as the project progresses. One of the biggest problems seems to be maintaining a holistic view. This is simplified by analysing system details only when the project requires it. Such a procedure also saves time, in that break-downs and blow-ups are done only when necessary.

The goal of any work step can and should be changed if the project deems it necessary. It is better to change direction in time than to hold on to inappropriate early judgements. It is also possible during each step to return to a previous one in order to supplement or adjust the effort carried out there.

A possible scenario is that, during the prototyping, weaknesses in the information or job analyses are discovered. It is then necessary to revise those areas in order to maintain system unity or to ensure that the result is not a system which solves nonexistent problems or one which is suited to a job which does not exist in the real world.

Reference Model for System Development: Approach.



Work steps

Administrative development planning.

What is AD planning?

AD planning is carried out in order to ensure that limited resources are used efficiently, and to coordinate different development assignments.

How is it carried out?

Administrative planning is a continuous process in which the long-range plans, strategies, ideas, preferences, short-falls and problems are studied to propose development assignments. The results are documented in the form of assignment descriptions. These may involve assignments in the area of system development, as well as other types of assignments, such as organizational change, resource and competence change, efforts in organizational development, office efficiency or even change of premises. Suggestions for further development in the "system administration and operation" work step is one of several possible areas of focus.

The assignment descriptions are periodically evaluated and their priority reconsidered in light of such factors as resource utilization etc. The result of such prioritizing is an AD plan which, among other items, contains prioritized development assignments together with information concerning resource allocation and estimated time schedules.

As part of the AD planning, it is necessary to keep track of which systems are already installed, which are under development and which are planned but not yet initiated. Over time, new requirements and prerequisites may appear, but the problem area itself usually remains. In addition, work with a particular system will provide knowledge and experience which can be very valuable when working in similar activity areas. The result is circular, i.e. the follow-up regarding work on one system will relate to the AD planning process of another.

In order to receive the most benefit from this process, it is important that the different projects are not too large, complex or extensive. A project should not exceed 3 years.

What is the result?

The deliverables from AD planning include assignment descriptions and an AD plan.

Assignment dialogue

What does Assignment dialogue mean?

Before development work can begin, the tasks/assignments must be described. The Assignment dialogue contains the analysis necessary for decisions regarding assignments.

How is it carried out?

The measures, projects and activity areas found in the AD plan must be defined in a way which allows clear and complete assignments to be made. For that reason, the assignment dialogue must investigate and document such items as: goals/purpose, limitations, interested parties, division of responsibility, time and resource framework, restrictions, methodology and standards. Often this process makes it necessary to briefly carry out the diagnostic step.

It should also be clear who owns the planned system. It is customary that the principal is also the owner, but the principal can certainly assign the ownership to someone else, either at the beginning of the project or later on.

This is important since the system owner will have to take total responsibility for the system including issuing mainline orders, ensuring that the project has sufficient resources in the way of personnel, leadership and time, making necessary decisions (such as aborting a project which is not working properly), appointing the management group chairman, the system manager and the organization reponsibile for system administration and operation. Finally -- that which may be most important -- making sure the project has necessary **breathing space** between decision points.

What is the result?

The deliverables from the Assignment dialogue are proposed development tasks and development assignments.

Diagnosis

What is diagnosis?

The purpose of the diagnosis step is to determine whether developing such a system is advantagous. It is done before any actual development work is carried out, or any information is changed. Diagnosis may include changing the organization's structure, responsibility hierarchy, control methods, or any combination of these. In many situations, this gives a better result - or at least serves as a first step. In addition, diagnosis may provide the supportive documentation needed to complete the Assignment dialogue.

How is it done?

It is often necessary to carry out an overall analysis of the defined activity area in order to have sufficient supportive information to make decisions. Included in this work is an analysis of the job problems and a rough analysis of the information needs. The documentation consists of conceptual models showing the more important information objects and their internal relationships, as well as rough flow diagrams showing the work process or job handling.

What is the result?

The deliverables from the diagnosis step consist of a description and an analysis of the job problems and a definition of the goals in the areas of organization, management and general prerequisites for the development assignment.

Job analysis

What is job analysis?

In order to create the necessary conditions for the new system, a job analysis is carried out. The main purpose is to focus upon that part of the organization's tasks which the project will aim to improve. It is also desireable to clarify the relationships between different information objects and to analyse goals, symptoms, problems and reasons for problems.

How is it done?

The basic concepts of job analysis are holism, strategy and structural interrelation. The amount of detail depends on how far the development process has progressed.

Analysis of one segment can create the need for a deeper analysis of an entirely different segment. It may also be necessary to supplement or expand the job analysis once the information analysis and/or prototyping has given new perspectives and knowledge about the real world.

One possible way to start the job analysis is to study the job as it currently exists, looking at items such as organization and problems. After that, the analysis might progress to a study of possible change-oriented goals, and recommended implementation steps. During this work step it is still possible to discover that there is not enough knowledge about the current job situation, suggesting that further analysis is needed.

There are different methods for carrying out the analysis. The choice must be determined by the prerequisites already described. It is vital to choose a method that is easy to learn and produces easily understood documentation. It should be possible for individuals who have not been involved with the development work to understand the approach.

What is the result?

The deliverables from the job analysis are job descriptions, either verbally presented, graphically formatted or both. Using case tools can support this work.

Information analysis

What is information analysis?

An information analysis is carried out in order to determine what information is required for the job to function effectively. The key question to be answered is, "What data are required in order to present the necessary information?" In other words, what information must be developed in order to prepare the reports and/or displays required?

The work is based upon the concept that information is an important resource and that it is essential to develop a strategy for providing timely and proper information. None of the separate information systems can decide in isolation how to structure and store the information it uses.

Information modelling (or data modelling) is one method used to analyse and describe how this is done. The data model can be viewed as a framework on which the various terms are hung.

How is it done?

There are several different types of data models:

A conceptual data model shows the informational and physical objects and their relationship. It is not concerned with data application in any format. The model can include the entire organization or just a part of it.

A logical data model takes into account the built-in limits of the available data base manager. This model describes the paths used by the application under design, that is, how this specific system uses the conceptual model.

A physical data model describes how the physical information is stored in the specific data base. At first a model is designed which includes those information clusters which are relatively constant over time and describes their internal relationship. The data model is later expanded to include those terms the users are in

need of. (Physical data models are designed in the system design step.)

The job analysis forms a solid platform for the information analysis. Using the concepts described in the job analysis as a point of departure, it is possible to identify information clusters.

By describing the flow of information and the physical flow, it is possible to establish what support functions the job requires in order to fulfill its goals.

Once this is completed, it is possible to analyze/describe which functions the computer support must provide. The identification of terms and their definition in the glossary, which is to be developed as part of this work step, is then rather trivial. In order to make concrete discussion it may help to use a case or prototype tool to develop sketches of possible systems. (See section on "System design".)

Questions regarding data volumes, periodicity, information quality, division of responsibility and security level should also be discussed during this work step, along with the automated and manual routines.

The information analysis shall progress to the point where it is possible to begin prototyping. The activities of prototyping often makes it necessary to update the information analysis.

What is the result?

The deliverables from the information analysis are data models, a glossary of terms and descriptions of system functions.

System design

What is system design?

System design is the process by which the computer support is designed. In a traditional system development process, system design meant to make a **description** of the desired system, a demand specification which served as a drawing when the system was being built up.

However, it is very difficult for the users to get a clear picture during the initial steps of how the new system will look and function. For this reason it is very important that the details of the new system are "discovered" in close coordination with the users.

Experience has shown that users have great difficulty in understanding what a system can do and how it can be used if they only have the demand specification and system proposal to go by. As a result, many of what should be prerequisite demands are not formulated until after the installation of the ready system. At that time the only choice is to rebuild the system to satisfy the "new" demands or to force the users to accept what is to them, a poor system solution.

However, by using the new system development tools, it is possible to design a **model** of the new system in a fairly short time. This model can be altered and adapted, and best of all, the user can look at and test it.

How is it done?

In order for a system design to be successful, one basic condition must be met - an assignment must have been accepted. In other words, a customer-supplier relationship must exist with an agreed-to ambition level. This is especially important in areas where technological advances are rapid. The agreed-to ambition level must then be enforced. Above all, the project must not be allowed to have a never ending effort to reach the "best".

System sketches
Using a development tool is a way to show the users concrete suggestions of how, for example, displays or

reports might look. Starting with a preliminary description, it also illustrates one detail of the whole system. If certain parts of the system, such as information structures, instructions and man/machine interaction, are difficult to define, it is possible to build a visual model to use in the discussions. It is not necessary for the model to be **Intended** for eventual inclusion in the system under design. Rather it is possible to show reports or display layouts on the display device instead of in hard copy, or to show how a particular function button is used. System sketches are often used in the early phases of system development.

Prototyping
Using the preliminary demands defined during the analysis, and working in close cooperation with the users, a prototype of the intended system is developed. The first version takes shape gradually by using the preliminary concepts regarding information needs, handling processes and preparing system sketches. These are then refined and integrated into a useable system. This prototype is further refined as new functions are tied in after being described via system sketches, development of dialog and transaction programs.

The continued development is both quantitative (more functions) and qualitative (more display and report layouts, dialog boxes, help functions, controls and calculations).

The intent is to create enough information to make a final decision on how the functions should look and on the logical and physical data base appearance of the final system.

Development of a prototype can either use the same techniques as the production system or those which may **not** be used later.

Production system design
The development of the prototype occurs in a test situation parallel to the regular job. The aim is to identify what the users actually want the new system to do. The data base definitions develop at the same time and are formed into test data bases. The entire effort is concentrated on the logical content.

As the prototype moves toward becoming a finished production system, the data bases are given their final physical format, and real data is loaded. (See also under work step "Field test".)

It is advantagous to create an action priority schedule for the project at an early stage, keeping in mind that most system development efforts operate within very tight time and resource schedules. It is also useful for all involved parties to have available some form of documentation, showing what work has been done and that the work has been carried out according to the plan. The quality of installed functions must be evaluated in relation to the agreed-to ambition level.

In developing the prototype it is a good investment to utilize the development system tools to create a series of general functions which can be combined and formed into the desired functions. These become "building blocks" which can be used as the project progresses.

In principle, the system specification contains the same information as the demand specification. The difference is that now a prototype is available and can supplement the paper description. This means, for example, that all manual routines required by the production system should be documented.

What is the result?

The deliverables from the system design consist of a glossary, system specification, sub-system interfaces, program documentation for core programs and other functions, system documentation and training material.

Field test

What is a field test?

A field test is conducted to confirm that the system works as intended in the real world and to provide information needed for further refinement.

How is it done?

Once the production system has been designed, the completed prototype is put into operation in the daily work. The field test goals are:
- to check functionality.
- to adapt the system to actual operations by adjusting the data bases and programs to ensure that the system can handle the intended load and to optimize response and run times.
- to connect support systems to ensure the system's physical and logical reliability.
- to create production data bases and adapt the system to its environment, including operating and data base systems.

Once the field test is completed, the system moves into the system administration and operation step, and is ready for generalization.

What is the result?

The deliverables from the field test work step are further program documentation and updated documentation from the information analysis.

A system administration plan is prepared, complete with organizational structure, routines and resource budget for system administration and operation. In addition, documentation regarding security and reliability, performance and possible future development proposals is developed.

Generalization

What is generalization?

Generalization involves defining and describing the core section of the production system. This is done to get the best possible system at the lowest possible cost even for organizations which have not participated in the development process.

How is it done?

A production system can be divided into two parts:
- Its **core** section, or that part which is common to the system for that job, regardless of where the system is installed.
- Its **shell** section, or that part which reflects how the operation is carried out at a particular organization or installation. A shell can be the result of a local adjustment/addition on top of a core section.

What should be considered core as opposed to shell sections can be established in two ways and at two times.

- Prior to distribution to other organizations, using experience grown out of the development work on the test version, including prior experience of the project team members, the reference group and the like.

- Following a limited distribution to a representative group of organizations, using the local adjustment work as a basis for the decision.

Specialist organizations have an important role to play in specifying demands and in passing along experiences, especially when the limits of the generalized version are decided. Such experiences and demands should be collected as early in the development process as possible, perhaps as early as the pilot study or analysis.

What is the result?

The deliverables from the generalization are descriptions of system cores, specifications of limitations on local adjustments (modification instructions) and a distribution plan.

Distribution

What is distribution?

Distribution entails sending a version of a system to other organizations who share interest in the system, even though they did not develop it. The main purpose of distribution is to utilize resources and experience developed at one organization, to serve another organization, thereby avoiding unnecessary duplication of effort.

How is it done?

Once the system cores have been identified, and modification instructions drawn up, preparations are begun for system installation at the local organizations. A test data base is used to demonstrate the system. It is also necessary to establish a system administration organization at this time.

What is the result?

The deliverables from the distribution step are a test data base, a training plan, installation documentation and a description of the organization for system administration and operation.

Local adjustment

What is local adjustment?

Many organizations have many similar functions, but no two organizations are necessarily alike. For that reason local adjustment is carried out to ensure that each organization obtains a system which meets its own job requirements.

How is it done?

The process of adjusting and installing a system at an organization other than the one it was developed for is, in principle, the same as developing a new system. The local requirements must form the basis for the design. The difference is that the experience gained during the development of the test system can be used in the local installation. (See "Approach" illustration.)

A local job and information analysis must be carried out and a prototype designed. The test version is used as the basis for a prototype version. The local adjustment requirements are described using system sketches and the prototype is built up until it can be put into operation in the local production environment. However, often certain core sections **must not** be adjusted locally.

Experience from other local installations can simplify the adjustments and existing support systems can often be used to a great extent.

What is the result?

The deliverables from the local adjustment step are additions to the glossary and the function descriptions.

System administration and operation

What is system administration and operation?

System administration means taking responsibility for the daily care of the **system**. Operation means to handle the **computer.**

The **system administration** can cover only the generalized core sections and/or local variants of the system. It is a continuous process which involves the transfer of responsibility from the developing organization to a system administration organization, appointed by the system owner (see " Assignement" work step). It is appropriate for those who take responsibility for the system administration to be involved in the project. That prepares for a painfree system transfer.

The task is to ensure that the system supports the daily work. As no job is static over time, the support must continuously answer to new demands. It is vital to plan and coordinate the alteration requests which are received from users, operating personnel and/or computer technicians. The system owner continues to have influence.

System administration is not only debugging programs. It also includes continuous follow-up of system "behavior" in such important areas as system use, system oversight, system reliability, job descriptions, handbooks and methodology, handling of changes, monitoring of personnel competence, coordination, division of responsibility, documentation and agreements of different types.

System administration also focuses on smaller system changes falling within the budget allocations of the system administration organization. Such changes must not interfere with new development. The work shall be divided into phases etc., similar to a development project of corresponding size and complexity.

Larger changes carried out by the system administration organization fall under the heading "expansion" or are dealt with as new projects. Decisions regarding these can be made by the system owner or the system manager.

An organization with responsibility for system administration can also make proposals for expansion. These become a part of the administrative development planning as proposals for development assignments, completing the circle. Administrative plans and budgets for such proposals should be a part of the administrative development planning in order to ensure that all planning is coordinated.

The **operation** covers all parts of the system's computer handling. The operation is managed - concerning the system - by the system manager. If there are other systems with different system managers on the same computer, the local operation manager is responsible for the coordination and priority. It is advantageous for the local operation manager to be supported by a central support organization.

What is the result?

The deliverables from the system administration and operation step, are an installation plan, an operations plan, an operations report, an updated system administration plan and a list of alteration requests.

PROJECT CONTROL

Project organization

Considerable effort has been put into describing how a project should be managed, how the resources should be allocated and how a project should work. There is no reason to repeat those descriptions here.

This chapter will discuss only those experiences gained from **local system development.** As an introduction it may be useful to recapitulate and briefly comment on the generally accepted definition of projects:

- A project is a **temporary** organization, separate from, but strongly dependent on, the line organization.
- A project has set, well defined and manageable goals.
- A project has its own resources in the form of time, money, personnel, etc.

The dependence on the line organization stems from the fact that it is **personnel** from that organization who staff the project. It is important to realize that this has both positive and negative consequences. When the individuals are carrying out project activities, they report to the **project organization**, not the line organization. It is vital that the project organizations are more flexible, with less bureaucracy and less hierarchy than is the norm in line organizations. Experience has shown that such creative activities which deal with many uncertainties, are better conducted in such a structure.

The **project goals** must be completly understood and accepted by the project team members. Projects often fail because of uncertainty about project ambitions and lack of differentiation between **ambitions** and **quality of results.**

The role of the project manager is thoroughly described in the literature. However, there are several important functions which usually are forgotten. The project manager must **coordinate** between the various concerned parties and ensure that the cost/effect ratio between utilized resources and work results is kept balanced.

The project manager must also ensure that the project team can **work in peace** between decision points and reporting deadlines. If this proves impossible the reason might be unclear goals, an insufficiently defined ambition level, an unrealistic time line, decision points spaced too far apart or negotiations with the project personnel that have not resulted in **task acceptance.**

Some of the important tasks for the management group are to prioritize the right project, staff the project and provide it with sufficient resources, ensure that the project is moving on target, ensure that the ambition level is correct, ensure that the project works within the overarching ADP strategy, appoint the system manager and system administration organization and in every way **support** the project in the best manner possible. (See also the "Decisions, a summary").

Project organization (local system development)

The traditional project organization structure is seldom useful for local system development.

One of the parameters of local development is that the new system's users, helped by a support organization, are responsible for and participate actively, in the system development itself. Utilizing this structure has a number of advantages. One of the common problems inherent in the introduction of new systems is that **the users do not accept the system!** They feel it does not work as they want it to, it does not do the right things, it does not have the right information and the outputs are not in the right format.

Those systems which have been developed locally gain an "automatic" **real** user acceptance. Not only do users have extensive knowledge of the locally developed system, but they also had the opportunity to steer the development so the system works "the right way." Participation in the process also confers a better overview of the everyday work, which has a positive effect on the environment. Possible aversion toward punching buttons has disappeared and the users have obtained a realistic view of what is possible and desirable to use a computer for.

One further advantage of local development is that it helps the user find a different, and often wider, view on his/her own daily work and of his/her job's connections with all other jobs. The user must also evaluate the more or less well stated goals which are in effect. In short, the user learns **what** they do and **why** they do it.

The development work is carried out parallel to the normal work. This is advantageous for the project team members since they can benefit in one job from what they are learning in the other. The system gains as well, since it will better accomodate the everyday needs than it would otherwise. An active user participation is mandatory if a system is to function. If the users are released from normal work, they will tend to become ADP pros. Their separation, however, means they lose touch with the everyday needs, remembering only how things were before they started the development work.

This approach also has some disadvantages, but they can be avoided. Continuing to work at **both** development and normal work is a heavy work load and **should not be maintained over long periods!** (The normal work is fulltime activity in itself!) Is the solution to hire ADP specialists?

Task prioritizing varies from one employee to another. The reasons are many, but the effect is the same - for one reason or another some tasks get done before others. There will always be normal job tasks which have a higher or lower priority than the project work. **It is for those with lower priority that relief should be offered to the project team members!** Often it seems simpler just to hire some consultants to carry out the work, but this tendency must be resisted as it is this very **job knowledge** which is essential.

The reason work relief should not be offered for those tasks the team member sets high priority on, is that these are generally activities the employee does not wish to release. The result is that the relief is no relief. Another possible result could be a feeling of being exiled or extraneous. That would hardly be an attitude conducive to creativity, positive thinking, loyalty to the organization's goals, willingness to work together and communication - all characteristics which are vital to a project's progress. It is often those highly prioritized job tasks which are key tasks for the job and it is **that** job integration which is essential for the system development process.

Of course it is necessary to involve individuals with special skills and it can be assumed that this category will be represented in the project staff. But it is important to remember that **it is not possible to replace job knowledge with ADP knowledge or vice-versa**. Both types of knowledge are needed!

Another problem inherent in this way of developing systems is that the project planning becomes more difficult, less reliable and involves greater risk-taking. More or less planned situations can occur in the normal work area which make it impossible to carry out project work to the extent planned. A certain predictable overload allowance should be built into the planning, but reality very seldom follows plans.

This fact, plus the fact that it simply takes time to learn (active and internalization time) means that the project may require a lot of calender time, especially for those steps which are dominated by the line organization. If the project planning does not take this into account, and extorts documentation before it is ready, it could be the **immediate cause** of poor system quality. It ought to be self evident that the staff member who is to carry out a task should also plan the amount of time needed. Project planning and follow-up support should be supplied.

There are many advantages to developing a system within the confines of the line organization. The prerequisite is the proper support forthcoming for both ADP knowledge and off-loading of normal work loads. Planning should be done by those who will do the work and it should be expected that the process will consume more calender time than normal development. This extra time is justified because of the considerable shorter training time before and after the installation.

PROJECT USE OF THE SD MODEL

The advantage of the SD model, that it is **divorced from the project control model,** means that the degree of control can be varied according to the extent of the project and its complexity, without affecting the SD model itself.

A system development project affects and is affected by decisions on several levels. One can discuss three different decision levels.

Firstly the decisions which are taken by the principal. These decisions primarily concern longterm planning, coordination, priorities and the acquisition of project resources. These decisions are taken on the basis of development plans and status reports, which include estimates of the requirements for initiation/continuation of system development and estimates of the requirements for distribution of the system/sub-system in question.

A further decision level, which influences the system development project, contains the overall decisions or directives which apply to the demands of, for instance, models, methods, ADP strategy or the budget process. One result of the demands generated by the budget process can be that the project is expected to produce a status report at a set time, regardless of which work step in the phase is currently in progress.

Besides these decision levels is the project's own decision area. The basis for decisions here is the documentation produced in the project. Examples of the type of documentation extracted from the system development process and used as the grounds for decisions are given in connection with the descriptions of the different work steps. Since the choice of working methods has a strong effect on the documentation **the proposed documents are to be seen only as examples.**

The location of decision points in the system development model can vary according to which degree of control is judged to be applicable to the current project.

One can easily imagine a situation where the number of decision points is doubled in one project and halved in another. The larger and more complex a project is, the closer together the external decision points should lie in that project. On the following pages there are several examples of different variations on the degree of control. These are only some of the possible variations that can be applied. In the most complex projects the maxi version should be used, while for simpler projects the mini version should be ample.

For each version a number of phases has been suggested where, for every phase, every work step should be approached iteratively. Should the goal for approval of a particular step already have been reached before the work starts on that step, it can be omitted. In the examples, we have used the names for the phases which occur in other common system development models. If the phase allocation is relevant, the model can be applied even if the name of the phase used does not agree with the name chosen in the examples given.

The work steps which must be gone through very carefully are marked in **black** (high activity), **grey** indicates work steps which have to be covered less thoroughly and **white** (hollow) indicates work steps that are probably not required in the current phase.

Pay special attention to the "Assignment dialogue" work step which is indicated throughout as high activity (black). The point of this is to stress the importance of not starting any phase until there is an understanding of what is to be done, the level of ambition etc. When the phase in question is finished, a quality control procedure is performed. Up to that point the assignment/project goal must be clear so the project will not be disrupted with additions/limitations, modifications or further explanations of the level of ambition, or be forced to motivate the structure and direction of the work.

Relevant **documentation** will be produced in the work steps which are marked in black. It does not mean the documentation is "completed". The same step can be marked in black in the next phase as well.

In the case of documentation the step is decisive. As an example we can mention that the system specification (comparable to the demand specifications in traditional system development) is a product of the work step System design. The system specification, however, is not a product which comes out every time

the System design work step is performed - it only comes in the phase System requirement specification (midi A and maxi), System development (mini), Prototyping (midi B) or the equivalent.

The experience so far gained from dividing the system work into phases seems to indicate that **the entire model** should be used iteratively, i.e. the phase goal determines if the work step is reached (is "good enough") or must be further processed. It is also important to keep an eye on the work steps that follow.

The size and complexity of the project should affect the degree of control. The degree of openness, knowledge and acceptance of both the project goal and mainline directive, organization and the line organization profile are all further examples of factors which affect the number of external decision points, but there are many more.

To receive a proper level of control in a specific project, it is neccesary to decide how many phases are needed. For each phase the black (high activity), the grey (brief activity) and the white (probably not actual activity) work steps are decided and marked.

It is appropriate that the project management group's first decision should include a relevant division of the project into phases.

There is every reason to agree with what one of the great theorists of organizations once said: "If just half of the energy used today in circumventing/avoiding non-accepted management and control decisions was used to do the work the person was actually employed to do, the world would be a different place."

It is very much a case of making sure that the goals are known and accepted by all the project team members and that the degree of control used gives the best effectivity and quality in a specific project while providing the quickest way of reaching the goals.

Examples of phase allocation

To receive a proper level of control in a specific project see the discussion in the chapter entitled "Project use of the SD model."

Maxi (see picture) can represent a large and/or complex project. By large is meant making great demands on working time, by complex is meant that there are many interested parties involved, that it is intended to use new technology and/or that a new system structure will be tried.

It is important to divide the project work into units of a size which can be processed with good project security (high quality) standards. It can therefore be appropriate to divide the project into a number of sub-projects. Every sub-project is then divided into different phases.

For large projects it is also often important to judge the project ideas early with the management group, so that there are no doubts regarding, for example, the ambition level and project areas.

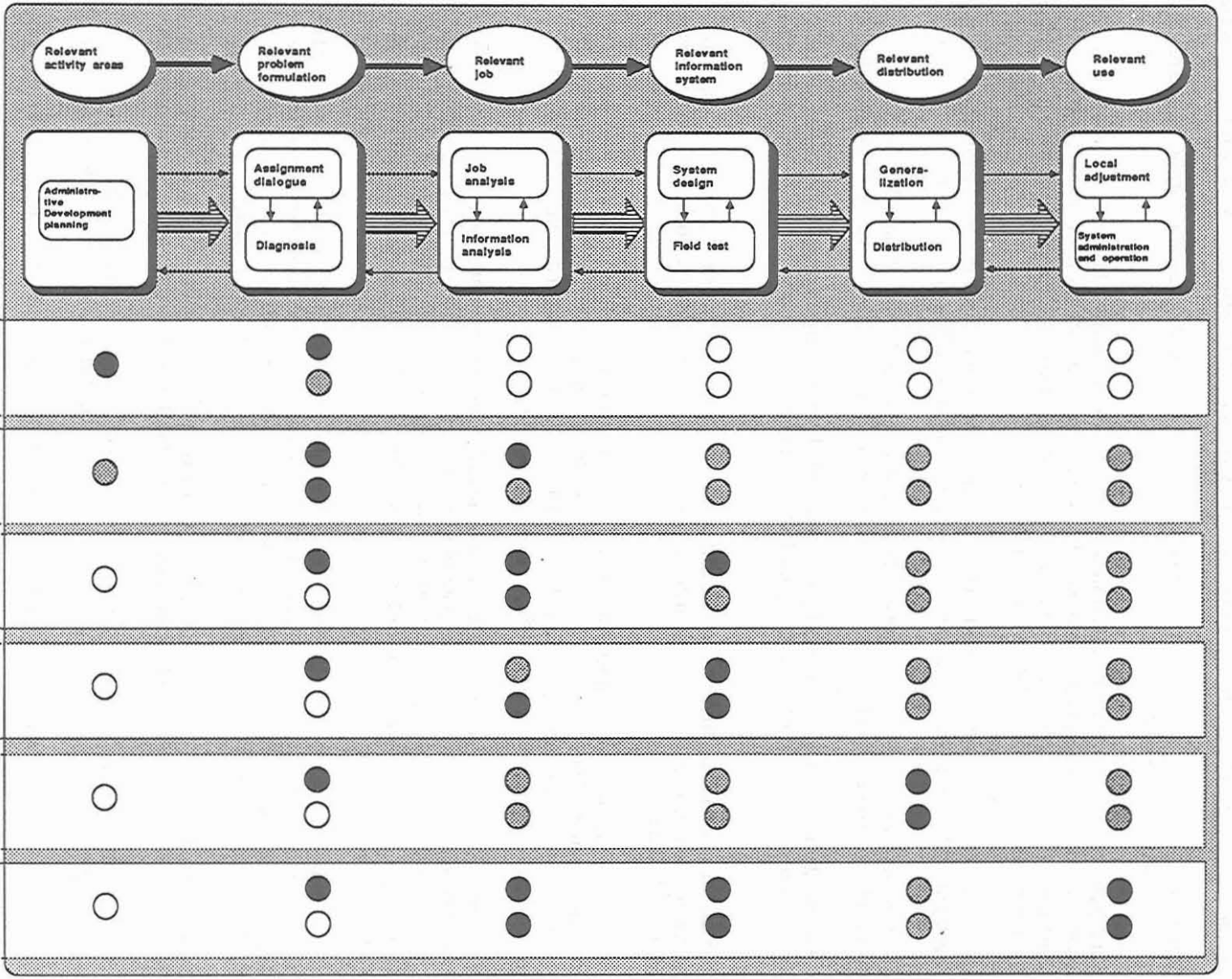
The above work is performed primarily in the Pilot study, but is also carried out at the **AD planning** phase.

A comparatively small group of people work on the **Pilot study**, preferably the best personnel available. Experienced users should work together with experienced ADP analysists or even AD analysists.

In the pilot study the work consists of reviewing all the phases in the upcoming project or projects briefly, consistent with and maintaining the required degree of quality.

The first major part of the work is to determine the correct problem formulation and whether it has been approached correctly. Questions should be asked, such as; Are ADP systems the best way to solve the problem? Should anything else be done, i.e. reorganization, changes in personnel or premises, or modifying the existing routines instead of - or before - installing a ADP system? If either answer is yes the project returns to the AD planning level. **This should not be considered a failure!**

Maxi


Relevant activity areas
Relevant problem formulation
Relevant job
Relevant information system
Relevant distribution
Relevant use
Administrative Development planning
Assignment dialogue
Diagnosis
Job analysis
Information analysis
System design
Field test
Generalization
Distribution
Local adjustment
System administration and operation
AD planning
Pilot study
System requirement specification
Construction/ Procurement and adjustment
Distribution
Local adjustment

The other major part of the work is to check if and how an ADP system can be constructed and installed. Different levels of ambition should be attempted here and a division into sub-projects and phases. The different ambition levels should be judged on the basis of cost/effect analysis as well as risk analysis etc.

If the project area is too large it results in too many sub-projects etc. If possible, it may be wise to return some of the sub-projects to the AD plan.

In the **System requirement specification** phase a system specification is produced within the ambition level set and for the project limitations defined. The system specification is comparable to what was formerly referred to as the demand specification, but it is multi-dimensional. It does not only consist of a description of the new system on paper, it also contains a prototype.

The main thrust of the work is focused on the job analysis of the daily work in detail, information analysis and development of a prototype which describes the system or sub-system to be created.

There are checks here also, to ensure that the system can be developed and installed in accordance with the intentions expressed in the pilot study. It is important that the ambition level is not changed (increased).

If the ambition level must be changed (increased) and the management group approves a new ambition level, a new pilot study must be carried out . Note that the question of ambition is not an internal project decision.

The **Construction/Procurement and adaptation** phase consists of constructing the system, or more or less adapting it to an existing system already purchased. The performance of later steps and phases are also checked here.

The decision documentation must include a relatively detailed description of how the system (sub-system) must be generalized and distributed, as well as a cost/effect analysis on the distribution. It must also include the question of the system's owner and how both the generalized system and the local variations of the system should be administered and the resources this requires.

If the system is not to be distributed, it will continue to the system administration and operation step. The project is finalized and the system responsibility passes to the line organization. It is not a bad idea to have the handover before the project is concluded. The line organization can then make demands on the remaining items in the project's work assignments, at the same time the project is released from line responsibility.

If the handover occurs too late, or for example, "when the documentation is ready", there is a great risk the project will "never" be ready and the system will "never" be handed over. Of course there is a "lowest acceptable standard" which the project has to reach. If some of those who are to administer the system participate in the project work as team members, the handover will be made easier.

If the system is to be **distributed,** the test system is generalized, training is planned and education material etc. produced. The generalized system then will be subject of system administration and operation.

Local adjustment takes place as separate projects in the local organizations which are to use the system. The local projects are then divided into phases, each one including all the steps of the entire SD model.

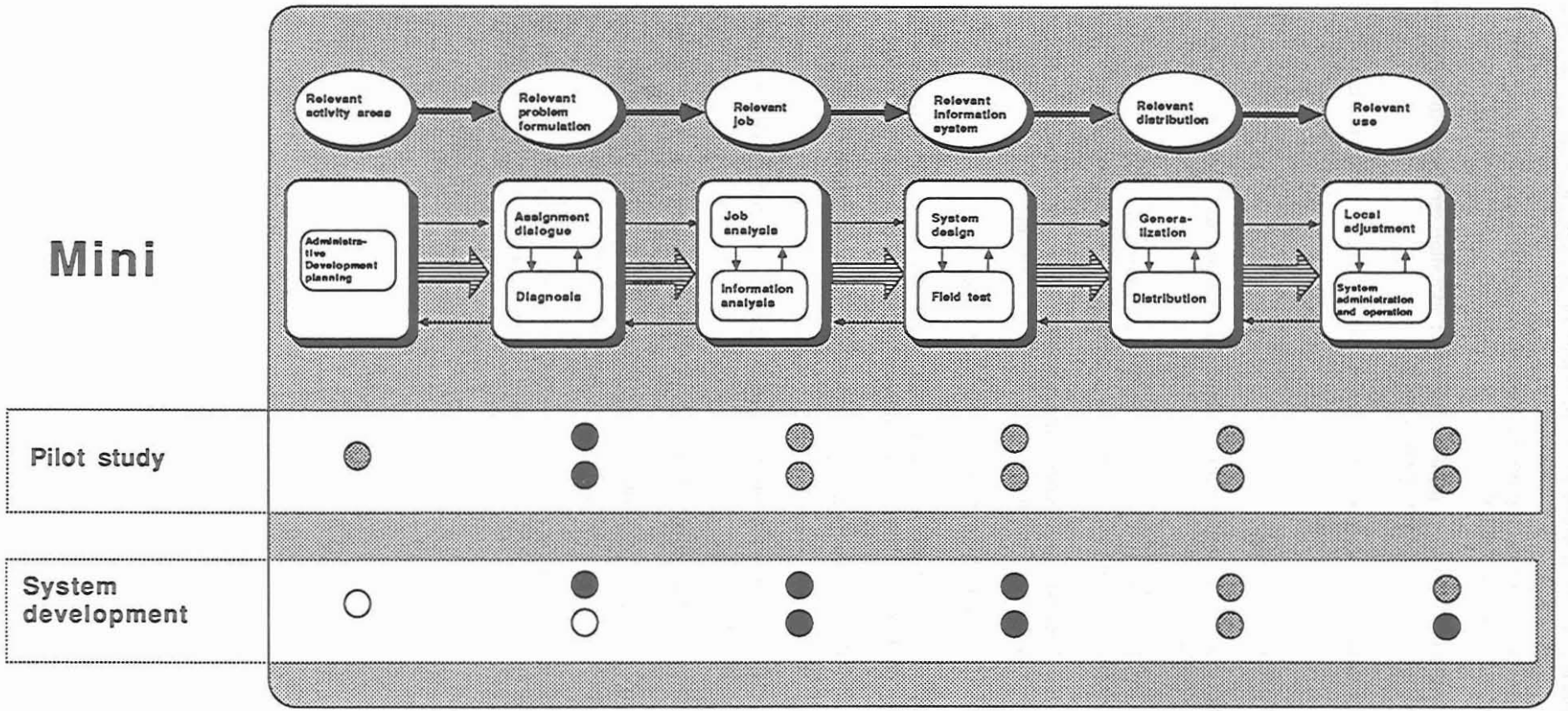
Cooperation and support from the systems manager and the system administration team for the generalized system are constantly required.

Mini. (see picture)

Mini represents a small and/or simple project.

A **pilot study** should be carried out even for a mini project. It includes all the work steps of the SD model. It results in a description of what is to be done, the ambition level, a cost/effect analysis as well as a time and resource plan for the work.

Mini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System design
Field test
Generalization
Distribution
Local adjustment
System administration and operation
Pilot study
System development

Note that this should be done even if the decision to develop a system already has been taken "in practice". This is because it will be possible to later on find out the original basis of the system.

In the **System development** phase the system is constructed or purchased and adjusted appropriately, according to the Pilot study.

After that, the system administration and operation remains. However, even here, generalization, distribution and local adjustment may be of interest.

The generalized system should be administered by an organization of professionals working in this area.

Midi (see pictures!)

Midi A and B represent two examples of division into phases where the degree of control is between maxi and mini.

In **"midi A"** a relatively exhaustive primary **Analysis** is made.
(Compared to the pilot study the analysis phase is less work intensive in the later work steps.)

In the **System requirement specification** phase, the system specification is produced and a check is made to make sure the system is possible to create.

The other phases are similar to the maxi model.

In this case no pilot study was made. If the ambition level and division into sub-systems are self-explanatory, or have been explored in the analysis phase, this can be appropriate.

In **"midi B"** the **Early analysis** reinforces the AD planning (or certain parts of the analysis work are done earlier).

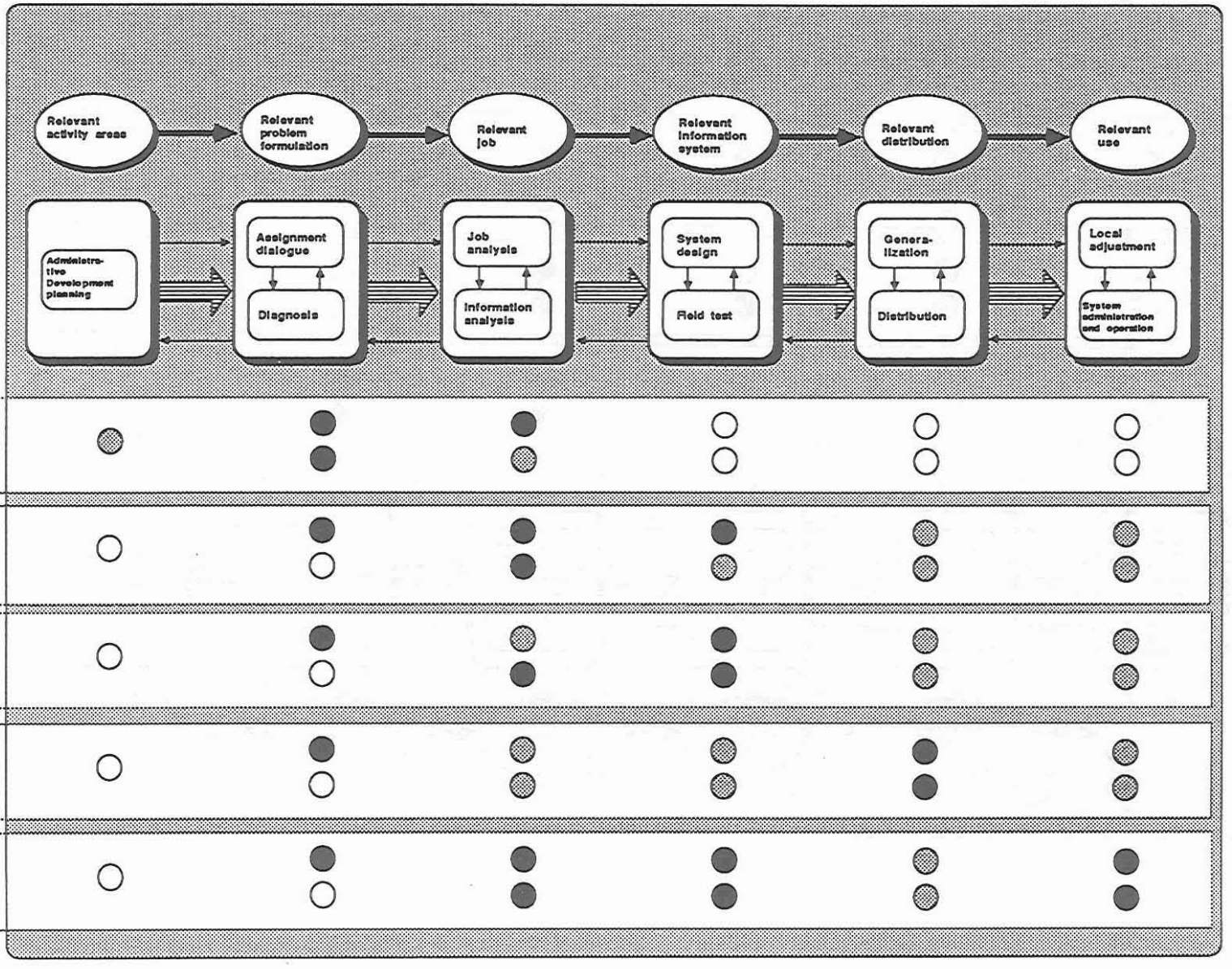
In the next phase a **Prototype** is produced directly and a check is made to ensure that the system is possible to create.

In the **Construction/Field test** phase the prototype is expanded to a production system and field tested.

In the last phase, **Distribution and Local adjustment**, the system is generalized, distributed and adjusted in a similar way as in the Maxi or Midi A examples.

This way of dividing the work can only be recommended for use in small projects where the division into sub-systems and the ambition level are clear, and the cost of the prototyping is relatively small.

Midi A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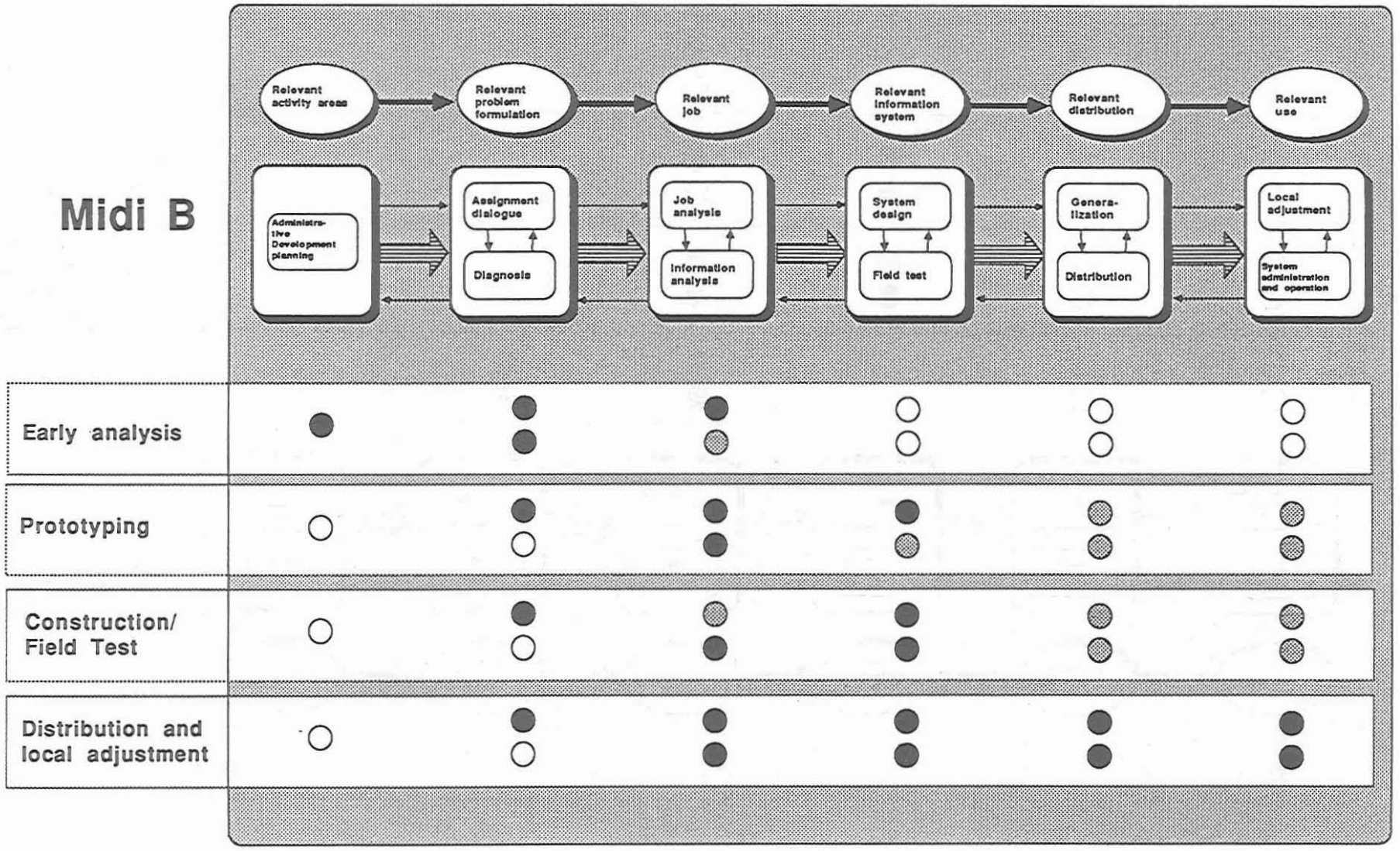
Distribution
Local adjustment
System administration and operation
Analysis
System requirement specification
Construktion/ Procurement and adjustment
Distribution
Local adjustment

Midi B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Information analysis
System design
Field test
Generalization
Distribution
Local adjustment
System administration and operation
Early analysis
Prototyping
Construction/ Field Test
Distribution and local adjustment

Decisions, a summary.

Project decisions:

Does the result obtained agree with the project goal? Is the result "good enough" to continue to the next work step?

Judging:

documentation
the quality of the system work
system vulnerability
risk analysis
cost/effect analysis
resources used
requirements for organizational changes
design of the job assignment
routine descriptions
programs
techniqal equipment
training requirements.

The project's documentation is the basis for decisions.

Management group's decision:

Is the project goal in line with the over all goal of this activity?
Is it the right project that has been prioritized?
Is the project on course/has the project reached the goal for the present phase?
Are there enough and suitable resources for the project?
How is the project manned?
What is the best way to support the project?
Does the project's ADP strategy agree with the mainline ADP strategy?
Is the ambition level correct?
Is the system's ownership cleared out?
Appoint a system manager and system administration organization!

Judging

the conditions for initiating a system development project
the conditions for continuing to the next phase
the conditions for continuing with the remaining phases.

Development plans and status reports are the basis for the decisions.

Overall decisions:

What does the mainline ADP strategy look like?
Which model/method/technique must be used?

Experience from different projects is the basis for the decisions.