

# PROTOTYPING ORGANIZATIONAL CHANGES

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## ABSTRACT

The paper describes a situation within an R&D project in the Town Planning Department of a small municipality. The situation concerns the first of three evaluations in a gradual, iterative systems development process. The evaluation provides the basis for deciding whether the prototype should be thrown away or developed further.

The questions raised are methodological. Although gradual, iterative development is well known in practice, it is not equally well known as a development model. Few proven methodologies exist, and we need to try out different techniques and methods. The challenge of this situation is to design and carry out an evaluation which will give us the information we need regarding the process and the product on the one hand, and regarding the IT system and the organization on the other hand. The situation is seen from the researchers' perspective, and the first part of the paper illustrates their reasoning before the evaluation. The last chapter reflects on some of the results.

Contrary to expectations, evaluating the prototype turned out to be the difficult part, evaluating the process the easier part. An important conclusion concerned the futility of evaluating the prototype if one wants to understand how the prototype supports the users' work. Systems in use can only be evaluated in terms of relations. An important aspect of the evaluation was its function as a search forum. Discovering new goals contributed considerably to the dynamics of the process.

## 1. PROJECT SETTING

The stage is a R&D project in a small municipality, Inderøy, in a rural part of Norway. The project is set up to develop a new IT system, DSS<sup>1</sup>, intended to support the employees working with case handling of building applications. The project should also provide a "Change Package", i.e. a "how to change your organization with IT"-book, giving advice and guidelines to other municipalities based on the experiences from three test sites.

The project is a cooperation project between the Vendor, The Research Institute, and the Town Planning Department of Inderøy. In the Town Planning Department, the four Employees who will use the DSS, are by law entitled to participate in the project. One of these is the Department Engineer who is the local project manager. The Vendor provides the System Developer, and the Research Institute two Researchers. For a more detailed description of the participants see last page. Most project meetings are held at the Vendor's office, some in the Town Planning Department and a few at the Research Institute.

The Vendor is located in the neighbouring municipality to Inderøy, half an hour drive from the Town Planning Department, while the Researchers home base is in Oslo, 500 miles from Inderøy. The project management lies with the Vendor who is in charge of the technical design and development. This also includes choice of equipment and development tools, in cooperation with the Employees in Inderøy. DSS is to be developed on a mini computer with a 4th generation tool integrated with a text processing module.

### 1.1 Different interests and objectives

The number of different actors in the project indicate a spectrum of interests and objectives. The Town Planning Department in Inderøy wants more effective case handling of building applications, in particular less time spent on paper work and reduced waiting time for the builders. DSS is, however, but one of the means to achieve these objectives. Changes in work organization and work routines and simplification of building regulations will be two other means.

The Vendor's primary objective is, like most vendors, to improve their position on the market which consists of the municipalities. They want an IT product as quickly as possible.

Our interests, i.e. the Researchers, are several. We want to try out a particular development model: gradual, iterative development of both DSS and the organization, by means of practical use of the prototype. The choice of model also has some political overtones. Few municipalities are rich, and at that time, not too many had IT experience. If the development model is successful, it could mean that the municipalities are able to carry out the change with scarce resources and at the same time reduce their dependence on the Vendor.

<sup>1</sup> DataStøttet Saksbehandling - Computer Supported Case Handling

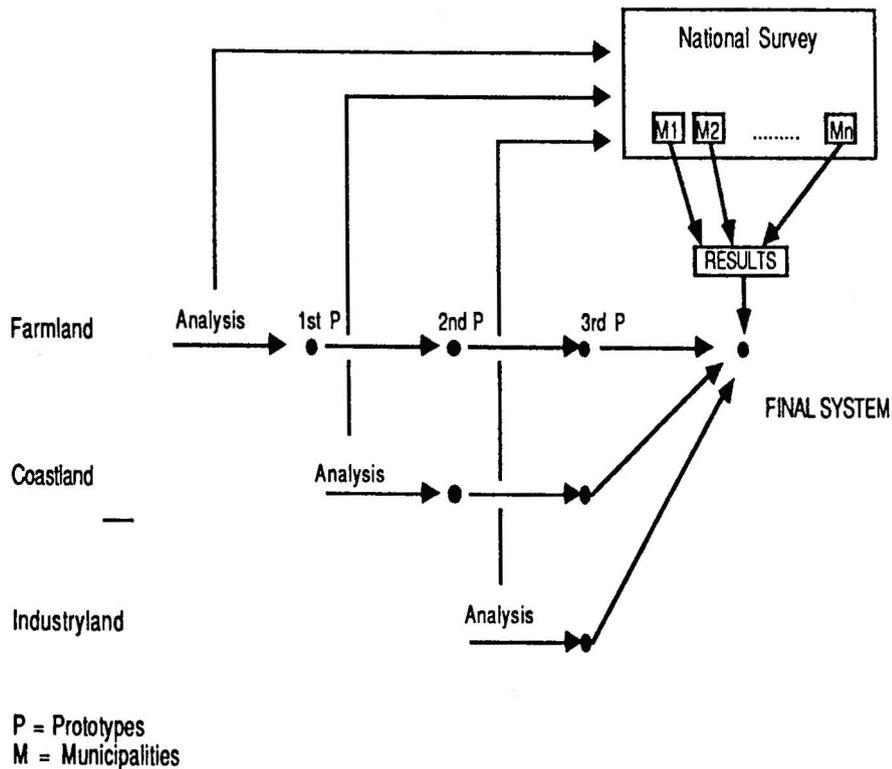
## 1.2 Some aspects of project design

However, a DSS which suits Inderøy perfectly, may be a disaster in another municipality. Even though the rules and regulations for building matters are the same all over the country, they are carried out differently in different municipalities. A DSS which does not take into account these variations may be of more hindrance than help.

The problem of Common Systems therefore needs to be addressed by the project design, to increase the possibilities for DSS to suit different municipalities.

The strategy chosen is to try out similar versions of DSS in three different municipalities, collect experiences by systematic evaluations, and feed them back to systems design and the Change Package. At the same time, a national survey shall indicate if Inderøy and the two other municipalities are reasonably representative for the Vendor's market.

Figure 1 (Pape and Thoresen, 1987) shows how the municipalities participated in different periods of time.



Inderøy is the first, trying out the 1st prototype in daily use before the 2nd municipality enters the project. The experiences from Inderøy are taken into account when the 1st prototype is redesigned to become the 2nd prototype. The 2nd prototype is tried out in practice both in Inderøy and the 2nd municipality. The experiences from both municipalities constitute the basis for redesigning the 2nd prototype

into the 3rd prototype. The 3rd municipality plays a somewhat different role. It is intended as a test of the practical usefulness of the DSS in a municipality which has not had any influence on systems design and has not had extra project resources during the organizational implementation. This is the first test of the quality of the project design with regard to the common systems problems.

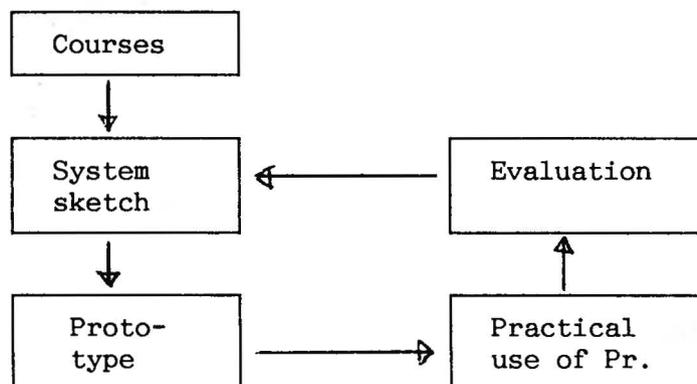
After testing the 3rd prototype in the three municipalities, the experiences are used to redesign the prototype into the pilot version of DSS, at that time supposedly ready for sale.

## 2. PROJECT PLANS

When the project started, the plans were made according to the text books: Water fall model, information analysis, requirements specification, technical implementation, acceptance tests, training, organizational development and after-the-fact evaluation. All neat and tidy, in separate phases, one after another.

We voiced our scepticism to the approach, and suggested the model based on gradual and iterative development with practical experiments and evaluation. However, it required a fair amount of work and diplomacy to persuade the Vendor. It took several months of explaining, discussing, and clearing up misunderstandings with the Vendor and the Systems Developer before the new model (Fig.2) was understood and accepted. The Employees were indifferent.

Fig.2. Development model.



The plans now looked like this:

- All potential users in the Town Planning Department of Inderøy shall take a course both in the use of the text processing module and the 4th generation tool. The courses are a necessary prerequisite for the other activities to be successful.
- The Department Engineer cooperates with the employees and the System Developer to make a preliminary system sketch. They select the parts of the system to be implemented first.

- The System Developer constructs the first prototype. Due to lack of a proper development computer in his office he will sit in the Town Planning Department while implementing the prototype.
- The prototype will be tried out in daily use at the Town Planning Department over a period of 6-8 weeks, corresponding to 2 meetings of the building council. The intentions behind the rather long testing period in practical use are twofold. We want to avoid focussing on the prototype only, and in addition focus on the work and the organizational changes. For the Employees to get a realistic impression, time is needed.
- The experiences with using the prototype and the changes in work routines will be summed up. We will carry out an evaluation, based on interviews, group discussions and demonstrations of the prototype in use.
- The participants will determine which changes are to be implemented, organizational and technical, and which new functions to be added to the prototype.

Then a new iteration will start, with construction, trying out, evaluation etc. Three iterations were planned.

The evaluation session is our responsibility, and to us it becomes a key point. The evaluation shall provide us not only with the opportunity for testing the methodology, but also with insight into the local processes. We spend our days 500 miles away from Inderøy and have little opportunity to know what is really going on. In addition, since we seldom meet the Employees, we are probably not very visible to them and the System Developer. We might easily be conceived as a project ornament or as intruders or both.

### 3. PREPARING FOR THE EVALUATION

The evaluation is limited to two main topics: a) how the prototype functions in use, b) whether the development model has functioned as planned.

The intentions are to test out the methodology and give the Town Planning Department and the project feedback on the participants' view of the prototype and the development model. The results will be documented in a report and distributed to the project and the participants only. The limited distribution is motivated by a wish to keep municipally "private" things private for some time.

There is a danger that the evaluation becomes a mock manoeuvre. This depends on several factors: Have the employees had the planned courses? Have they actually used the prototype? Are they willing to enter into a dialogue with us? The Department Engineer has been the employee representative during project meetings, with occasional visits from the other employees. We have urged the Department Engineer to invite the other employees to project meetings. The few times they have attended meetings, they have been polite but eager to leave,

excusing themselves with the work load back in the office. For all we know the Town Planning Department may be in uproar.

### 3.1 How may a prototype in use be evaluated ?

Criteria for quality control are commonly concerned with the program system, as a set of texts to be run on a computer. Such criteria may or may not be relevant for the quality of the program system in use. There is no guarantee that a high quality program system is of high quality with regard to use. Vice versa, a quality system with regard to use may be developed without fulfilling the criteria for program quality. The relationship is not clear, but the point is that the accepted criteria for program evaluation do not capture our field of interest. This may seem obvious to some, but in a setting which requires mutual understanding among the participants for the project to progress, such clarifications are necessary and take time.

As a starting point we select a number of system variables commonly recognized as important for use: operating stability, reliability, availability. We might ask if the system is "user friendly", the meaning of which is so obscure and multifaceted that we find it not suitable for our purpose. Also, "user friendliness" commonly describes the relations between a user and the system, while our interest covers the triangle of user, system, and work tasks. We choose to study how well suited the system is for supporting the work tasks it is designed to support.

The characteristics of a system in use cannot be evaluated by studying the system per se, but are related to the characteristics of the user-system-work tasks triangle. Characteristics of a system in use can neither be derived from program quality nor from "user friendliness".

Several studies have shown that office work consists of many asynchronous and loosely coupled processes which are not strongly formalized (Wynn 1979, Newman 1980, Suchman 1980). Pape (1984) suggests that two critical conditions should be fulfilled in order to facilitate effective work:

1. The individual worker and the organization need a high degree of freedom, to handle variations, non-trivial tasks and new demands from the environment.
2. Office workers must be able to utilize their information environment effectively. The information environment may be in databases or private files or in people's minds.

One way of evaluating the prototype could therefore be to study the degree to which these conditions are fulfilled.

The prototype should give opportunities to handle variations, known and unknown. E.g.:

- . changing the semantic content of variables
- . change format of fields
- . add/delete fields
- . add/delete modules
- . flexible division of work in the Town Planning Department
- . operating stability and back up routines during down periods of the prototype.

Information environments may be evaluated by studying how the Employees obtain the information they need, which actions are needed to obtain the information and whether these actions are perceived as simple or cumbersome. The Employees' opinion of the reliability of the information should also be included.

The Employees' knowledge will be an essential factor. The necessary knowledge is not just limited to the use of the system. It is equally important to know how to perform qualified work which in turn demands an understanding of the organization in question. Even so, in this first evaluation, the Employees' ability to master the prototype will be critical. We could say very little on the suitability of the prototype if they are not thoroughly familiar with using it.

### 3.2 Topics of interest when evaluating the development model

Which experiences do the participants have with the change process ?  
Have they participated actively, and have new ideas for change come up ?  
Have they discussed new tasks or new applications of the prototype ?  
How do they judge the chances for implementing new ideas ? What have they experienced as hindrances ? What kind of advice would they give to other municipalities who were about to start similar change processes ?

The background for these questions is the concept of "self sustaining processes" where changes are the result of organizational search dynamics initiated and carried out by employees and management in cooperation (which also include conflicts). The Norwegian Work Environment Act is based on philosophies of that kind, emphasizing cooperation to identify problems and find solutions (Gustavsen, 1985). Through dialogue, learning and local experiments, needs for change are identified and ways forward are determined. The organization changes gradually, in small steps or with more radical changes.

The challenge for us as researchers is to contribute, not to control. Our job is to promote the changes, stimulate the change process and augment the process management. Deciding which changes to implement is not our concern, although we feel we should voice our opinions.

Dialogue and learning is required to obtain a shared understanding, which in turn is a requirement for self sustaining organizational processes.

Another question concerns the cooperation between the System Developer and the employees. It is equally important for the System Developer to understand case handling as it is for the Employees to understand IT. What does the System Developer feel about this way of working ? Neither the tool, nor the development model nor the work situation was familiar to him when the project started. The model can hardly be termed successful if he does not find it satisfying.

Have the work routines and work organization changed ? Or is the prototype the only new thing ? So far, what is the Employees' opinion on the possible benefits from the system ?

Benefits can be planned in advance. The actual effects, however, are often found where you did not expect them.

Measuring the benefits from IT is a well known problem. Since the Town Planning Department wanted to reduce the waiting time for building licences, one could measure the time spent from when an application arrived in the Town Planning Department until the building licence was issued before and after the project. Before-figures exist, but are unreliable. Besides, this measure is of doubtful interest since the longest delays are caused by factors outside the Town Planning Department: the Natural Environment Committee, the Fire Protection Committee and others.

One could try measuring efficiency, by studying the work process for each person, "measure" each step and sum up time saved. However, how valuable would such measurements be ? After all, it is only the first prototype in a series of three. It lacks important functions and will probably create as much extra work as it saves. In addition, the introduction period is usually a time of strain, bringing forward a number of new time consuming problems to solve. Measuring in this way simply does not make sense. This is particularly so because the important point is not the time saved, but how the Town Planning Department chooses to spend the extra time.

Reducing the number of employees is not an option, there is only one person in each job category and the municipality is not under pressure. Time saved can be spent in several ways: sort and file the paper stacks from the last months, learn to program the 4th generation tool to develop new applications, or give extended guidance to the public about building matters.

We may find that changes in work routines outside the scope of DSS are more important with regard to any effects. The relation between the prototype, the change process and possible effects are complicated, and we decide on clarifying the changes before we go further.

### 3.3 Organizing the evaluation

We will use the principles of Search Conferences, a methodology developed by the Work Research Institute in Oslo in the 60'ies, rooted in the Norwegian tradition of action oriented work life research.

A Search Conference is a way of organizing company based conferences to establish a common starting point for change processes. It is intended for organizations which want to cope with changes in a democratic way, and rely heavily on different perspectives and discussions. Search Conferences are set up to bring together groups of employees who normally do not meet for discussions, in order to obtain a higher degree of shared goals and more flexible channels of communication than permitted in bureaucratic structures.

The Conference alternates between group work and plenary discussions, the groups are both functional and "horizontal". It is designed for larger companies than the Town Planning Department, so we could only use the principles, not the more detailed guidelines (Pålshaugen 1987)

Our evaluation is planned as a two day session, held at the Town Planning Department. In addition to ourselves, the participants are the Employees and a couple of other employees who are next in turn for using the computer system, the head of department (who is not a project participant) and the System Developer. We will interview them and arrange a group discussion, they will arrange a demonstration of the prototype in use. A list of interview topics and topics for the group discussion are sent to each participant in advance.

## 4. SOME RESULTS AND SOME REFLECTIONS

All the Employees had actually used the prototype. The course program was almost complete. The danger of the evaluation turning out to be a mock manoeuvre was thus considerably smaller than we feared.

### **The Employees**

The prototype was reported as a "step forward from the previous system", in particular the text processing facilities. The processing of building applications includes a fair amount of document production, and the usefulness of a good text processor is obvious.

The main problem for the Employees was the insufficient functionality of the prototype. "It can do few things, but does them well" somebody said. It is inherent in the model that this is the way it has to be, but it is still a problem for the Employees. They have to change between screen work and manual routines in ways which feel clumsy.

This also has bearing on the evaluation methodology: how much can you tell about the prototype in use? It seems likely that the evaluation will show more of the Employees' frustrations than the quality of the prototype in use.

The development model has become natural for the Town Planning Department. Somebody said that it was hard to imagine any other way to develop a system. This would not be remarkable if they knew of no

other ways, but the Town Planning Department had just ended a system development project according to traditional models when the project started.

The change process has increased the work load, which has reduced the case handling capacity during hectic periods. At the same time, the employees report with considerable enthusiasm about learning progress and successful cooperation with the System Developer.

They also reported difficulties in controlling the process (which we knew only too well from project meetings with the Vendor). Time schedules are exceeded and activities take longer and are more interwoven than planned. The activities have been heavily integrated and parallel, not like the model in Fig.2.

Does this mean that the model is inadequate, or that the project management is inadequate? Project discussions made us realize that we were about to fall in the trap of mixing together two different levels of abstraction: the model level and the action level.

<p>Management and control is different on the model level and the action level.</p>
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The model gives a good description of the process on a higher abstraction level. The action level describes the daily, practical work where the model disintegrates into parallel and integrated activities. The Employees perform their own evaluation continuously and suggest new ideas or improvements to the System Developer regularly. Since he works in their offices and have a friendly relationship with them, he does his best to implement their ideas as quickly as possible. Prototype 1 thus changes gradually into Prototype 2, not in definite steps like in the model. The activities are not only integrated, they are carried out in parallel.

The question of good or bad management can only be answered in relation to the two levels. If we had tried to force the daily work into the framework of the model, important parts of the motivation would have disappeared. The process would lose some of the dynamic which makes it self sustaining.

### **The System Developer**

The System Developer characterized his work situation as positive in some aspects, negative in others. He was young, eager and right from college, and it was all too easy to get overwhelmed by the Employees who all wanted their things implemented first and at once. At the same time, the close contact helped him to understand the Employees' work and the daily life in the Town Planning Department which was essential when he implemented the prototype.

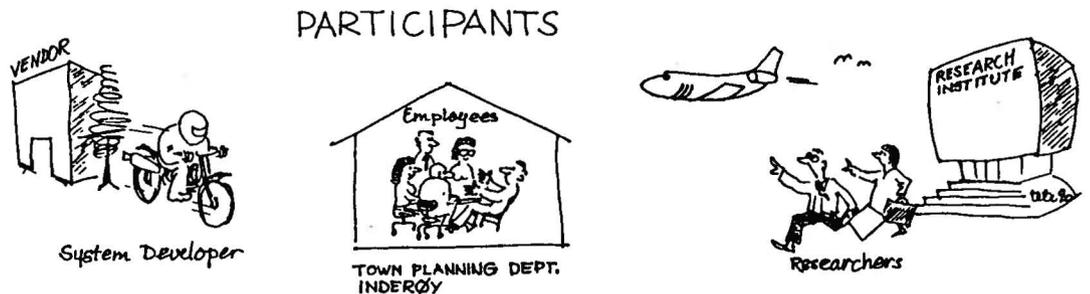
The limitations of the 4th generation tool has been one reason for not keeping the time schedule. The tool vendor has been supportive, however, and has provided new and improved versions. They have understood that the development of the tool may benefit from the feedback from the System Developer, and they see a new market.

## The Researchers

Our ambition with evaluation as a way of cooperating was to give feedback to the participants both on the prototype and the change process, seen from many perspectives. The evaluation was reasonably successful with regard to the process, but analytically and methodologically too weak with regard to the prototype.

Demonstrations show only normal use, not the unexpected, except for finger trouble. Interviews may add to the picture, but the difference between talking about work compared to talking in work is still there. Diaries and log books have not been very successful, and will probably continue to be so as long as keeping a diary merely means extra work for the Employees without getting anything in return. Looking back, we also see that we had trouble following our own definitions of a system in use. Maybe the thought of evaluating the prototype in use is a fallacy? Maybe we should concentrate on how the Employees use the prototype?

The unexpected dimension of the evaluation was its potential for resetting the development process agenda. The first evaluation showed us glimpses, and the later evaluations proved this even more clearly. The opportunity for the Employees to discuss work related matters, in particular in the group discussions with their colleagues and superiors, played an important role in bringing up new questions and objectives and laying a basis for decisions. The search aspects of the evaluation proved to be vital to the change process, while the evaluation aspect in the sense of "measuring whether pre-stated objectives have been met" played a minor role. A "Search Evaluation" would be a more appropriate term than just evaluation.



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## **Experiences with Participatory Design**

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In Norway, participation in systems design is facilitated by laws, labour agreements, negotiation procedures, and work environment councils. However, formal rights do not guarantee meaningful participation. Several other conditions should be fulfilled.

User representatives need time off from their work. Officially, this is often granted. In practice however, user representatives often find themselves trying to cope with more than one job. Systems developers, on the other hand, should be given the opportunity to follow the users in their regular work, in order to be able to understand the context in which the system will be used. Analysis of users' work is commonly carried out in meeting rooms, or often just by questionnaires, which give only a vague impression of the actual work. The systems designers should also be given the opportunity to see the results of their design. Just sitting down with someone who uses the system is a new experience to most designers.

Thus, lack of knowledge on both sides can undermine good intentions. Established models for project organization, project work, work analysis, etc. are commonly based on implicit assumptions that the necessary knowledge somehow exists, making the process of designing a system mainly a matter of extracting the knowledge from the participants, be it users or developers. More often than not, these assumptions do not hold. Therefore, development projects need to be transformed from production processes to mutual learning processes. Learning must be built into the process, by changing the ways in which project groups work together.

This is not an easy task in a setting restricted by tight time-schedules and strict resource control. However, we see a growing acceptance of the need to rethink the traditional life cycle models of software development, yielding more iterative, learning-based models. Our own experiences point to integrating development and use as a useful design approach. Feedback from real-use situations may be a slow process, but it may be one of the crucial elements to build mutual learning into the process.

My experience comes partly from building particular systems for particular work places, and partly from building more general packages in cooperation with a vendor. The project design certainly should be different when the goal is to develop

generic tools, but the principles of incorporating learning into the process are still valid.

So far the arguments that seem to have most effect, on managers in particular, are not the qualification aspects. More often the key words are "system quality", with respect to both use and "user acceptance". We need investigations to clarify the relations between systems quality with regard to use, and the benefits for the organization. Such insights might help in making participatory design more acceptable.

### Biography

Kari Thoresen has been a Research Scientist at the Norwegian Computing Center in Oslo since 1972. Her research pertains to systems development in an organizational perspective. Recent projects have been in cooperation with hospital nurses, planning departments in small municipalities, and systems developers in the Norwegian Telecommunication Administration. She is a member (85-87) of the Norwegian Advisory Council to the Government on IT policy, and a Norwegian representative to IFIP TC 9. She received a Masters degree in natural sciences from Oslo University in 1966.