

Paper for 14th IRIS (Informations system Research In
Scandinavia), Umeå 11-14 August 1991

INFORMATION SYSTEMS DESIGN AS ARGUMENTATION

- AN INVESTIGATION INTO DESIGN RATIONALE AS A CONCEPTUALIZATION OF DESIGN

by Göran Goldkuhl
MDA Group,
Dept of Computer and Information Science
University of Linköping

1 INTRODUCTION

1.1 Background

Information systems development (ISD) involves different design decisions. There are decisions concerning the application - the functioning of the system. There are other decisions concerning the technical design. How are design decisions justified? How are different design alternatives evaluated, compared and chosen? What are the reasons (the rational ground) for choosing one design option? How can the design decisions be transparent to different stake holders? These are important questions to put in an ISD process. These are important questions for researching.

Design Rationale (DR) is an approach to deal with these issues (developed by Allan MacLean et al, Xerox EuroPARC). Design Rationale consists of three basic concepts (questions, options, criteria) and a graphical "semi-formal" notation. The approach is primarily intended to be an aid in the design of user interfaces, but as the originators say it can be considered as a general design and problem solving method.

Design Rationale is an interesting and promising approach. In the research group MDA at Linköping University we are studying and developing advanced information systems for primary health care (Timpka et al, 1991). We are now working with a hypermedia based system as a knowledge and communication aid for different kinds of health care professionals.

1.2 Purpose of the paper

The design process of such an information system is complex in many ways. The DR approach seems promising and possible to use in different design situations. Our wish is to try and use and test it in different design situations in our own work with IS

development. The purpose of this paper is to report some preliminary findings.

A critical analysis of DR (concepts and notation) has been performed. Based on this analysis we are proposing some modifications and extensions to DR. We have used the extended DR in some very preliminary design situations by ourselves. I am not using or presenting these studies and design work in this paper. We are planning to present this work in a more extensive paper later. I am of course influenced by our preliminary design work but I will not use it explicitly here in my argumentation around DR as a design approach.

My main purpose of this paper is to present an analysis of Design Rationale and propose some extensions to this method. I will concentrate my analysis to the conceptual level. I leave an analysis of the DR notation to a later paper. My analysis is made from the point of view of communicative action.

2 THE IDEA OF DESIGN RATIONALE

Design Rationale is described in MacLean et al (1989) and MacLean (1990). We have also had the privilege of reading a draft paper (MacLean et al, 1990) which describes the approach more thoroughly.

I here present *my interpretation* of DR and its main properties.

2.1 Justification

Design Rationale means that a design should be well grounded. It should be a clear justification of the design. The design process should not only produce a system (the artifact), but also the reasons for choosing this design. DR also comprises alternative design options and the reasons for not choosing them. DR means building up a design space including arguments for choosing or not choosing different design alternatives. A specific design should be justified, and the specific reasons for this design should be documented and recorded for possible later use.

The DR perspective on the design process implies the process to be both *constructive* and *argumentative*. A basic value is that the design process and its record should be *transparent*.

The purpose of using this approach is to

- aid the designers in the design process to elaborate different design options and their strengths and weaknesses (i.e. perform an improved reasoning around design)
- support communication between different stake holders, e.g. users and designers
- support maintenance and re-design through providing earlier design considerations

A DR should be a co-product of the design. A short note here:

As I have understood, MacLean et al is using "DR" both for the approach itself (including concepts, heuristics and notation) and for the specific record of a design space (i.e. the produced design model). This can be confusing.

2.2 Concepts

Design Rationale consists of three basic concepts:

- Question,
- Option,
- Criterion.

An option is a proposed design alternative. It can be considered to be an answer to a specific design question. This means that there can be other answers (options) to this question. If there are different design options, which one to choose? Criteria are used for evaluating and choosing among design options.

I have put together the different concepts in a conceptual structure (figure 2.1) below.

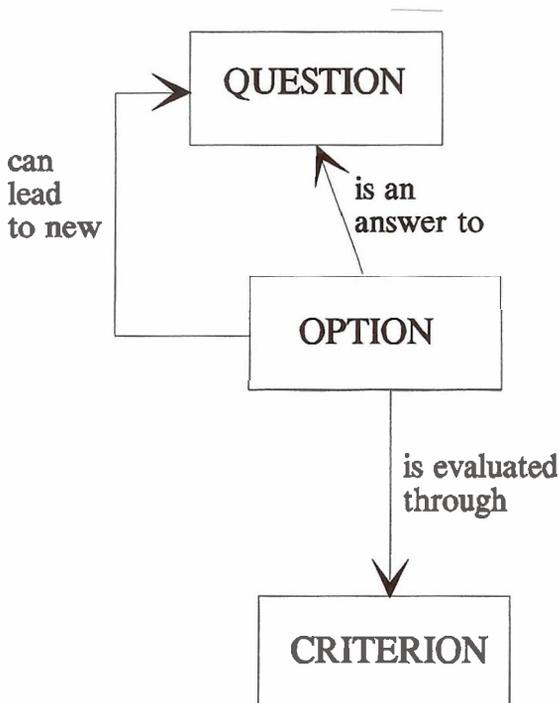


Figure 2.1 A conceptual structure of the DR concepts

2.3 Notation

Design Rationale uses a semi-formal notation as its main descriptive tool. In figure 2.2 I have indicated this form of documentation. DR uses also a matrix for options and criteria. I will not go in to further discussion concerning the notation here.

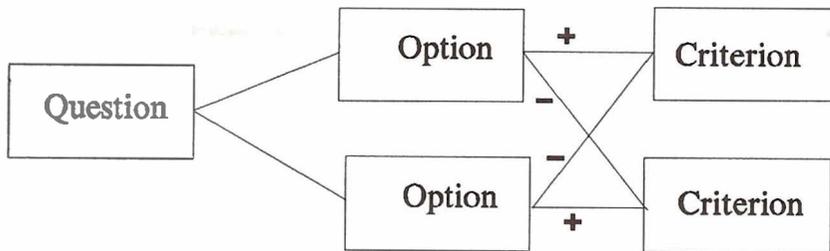


Figure 2.2 A sketch of DR notation

3 AN ARGUMENTATIVE LOOK ON THE PROCESS OF INFORMATION SYSTEMS DESIGN

3.1 The argumentative and communicative character of the design process

Information systems design can be considered (as in the DR framework) to be an argumentation process. To view it as argumentation means also to emphasize it as communication. The design process involves both oral and written communication. Designers say different things. They put forth design options. They ask "are there any more possible solutions?" They identify criteria and use criteria for evaluation of design options.

To consider IS design as argumentation and communication implies a need for such a theoretical framework for analysis. There is a need for argumentation and communication theory. In my analysis I am building on theories of speech acts and ideal communication (Searle, 1969; Apel, 1980; Habermas, 1979) and kindred theories on argumentation (Habermas, 1979; Toulmin, 1958). The use of these theories are very plausible since the claims for a good design rationale (by MacLean et al) are very much in line with the theories of ideal communication. I will not argue here further for this theoretical starting point. It has been used earlier for analysing IS development and use; see eg Goldkuhl (1984), Goldkuhl & Lyytinen (1982), Lyytinen (1986) for a more explicit argumentation.

According to Habermas (1979) every communicative act builds on (often implicit) validity claims. Eg a proposition (Searle would call it an assertion) builds on the specific validity claim of truth. If a proposition "p" is put forth and then questioned (ie the listener does not believe it immediately), this means that the speaker must raise arguments concerning why one should believe in the truth of "p". If someone makes a propositional utterance then he is expected to be able to argue for the truth of this proposition. He must show why it should be conceived as true.

A proposition is true or false. A design option is not valued in terms of truth or falseness. There are other implicit validity claims that underlie the utterance of a design proposal.

What does it mean when we say that something is a design or a design proposal? When we say that something is a design we have some implicit claims. What are the nature of these claims?

When we talk about a design it is not the case if the design is true or false. Instead we say about a design that it is good or bad. When someone puts forth a design proposal he has implicit claims that it should be good, useful and workable in some sense. When stating a design proposal we have implicit claims of quality of the design. A justification of a proposition shows in an argumentative manner how it can be true and not false. To justify a design is to state (also in an argumentative manner) the goodness of a design. The use of criteria must be understood in this context. The use of a certain criterion with respect to a design option is demonstrating the goodness of that option. It is an answer to a possible questioning of that design option.

3.2 The ideal of transparency

The argumentative raising and demonstrating of different claims leads to an open and articulated design communication. It leads to a more transparent design and decision process. The ideal of open communication has inspired our earlier works in change analysis (Goldkuhl & Röstlinger, 1984, 1988); ie the process of diagnosing and choosing systems development and/or other change actions in order to improve business activities.

I quote and translate from Goldkuhl & Röstlinger (1988):

"Change actions should be well-grounded problem solutions. It should be possible to legitimate decided changes referring to well analysed problems and goals. To legitimate is to explain and justify something; to give it a clear motivation.

A condition for both *rationality* and *participation* is that the decision process is made transparent. To make rational and informed choices among change proposals, one has to have a clear picture of the premisses. This means in this case a good picture of problems to be solved and goals to be fulfilled. To participate in an active manner in the decision process one must understand what it is all about.

A transparent decision process should be manifested in a transparent decision basis (documentation). The decision basis should form a coherent argumentation. It should be a wholeness. The conclusions (ie suggested change actions) should be understood and explained with refence to other parts of the documentation. The documentation should also form a comprehensive and *unbiased argumentation*, ie a presentation of different proposed solutions together with their advantages and disadvantages. The decision basis should be a *reconstruction of the rationality* in the decision process."

The ideal of transparency is achieved through an active reconstruction of different implicit claims behind design proposals and other communicative acts in the design process.

To reach this reconstruction one must adopt a stance characterized by critical reflection and communication. Since design to a large degree is a creative process it is important that the criticism do not destroy the necessary creativity and intuitiveness. One must try to develop a good co-existence of creativity and critique in the design process.

3.3 Argumentative design as a language game

In section 3.1 above I performed a preliminary communicative action analysis of some issues of the design process. That analysis concentrated on studying design proposal as a communicative act. I will now continue this communicative analysis by investigating not only this act and concept of design option, but also by discussing more deeply its relations to other types of acts in the design process. The question is how a design proposal (as a communicative act) is part of a larger communicative pattern, a *language game*. I view the IS design process in a language game perspective.

The concept of language game, from the later Wittgenstein (1953), has been one of the most influential metaphoric concepts in contemporary social science and philosophy. I am using this family concept here in the meaning of an institutionalized pattern of different related communicative acts. I am also inspired by Toulmin (1958) who has identified and investigated different phases of an argumentation.

I now examine design proposal as part of a language game. A design proposal (a design option) can be seen as an answer to a design issue (a design question). It is a claim for how to design a specific aspect. The answer follows the question. But this is probably not the case in all design situations. The question (the design issue) can be an implicit presupposition for the design option. Here is one of the main contributions of DR: If the design question is not stated explicitly try to formulate it! And after having formulated the question try to answer the question in different ways, ie propose several alternative design options.

If this situation is the case one can describe it in the following way: If you have stated a design proposal then consider it to be an answer to a not yet stated question. Reconstruct the question behind the design proposal and then formulate other answers to that questions that has not already been stated. As readers, acquainted with design, will understand, this will many times be an iterative process of formulating and reformulating questions and answers.

If we continue applying this kind of language game view, we can ask for arguments why something should be a good design proposal. What specific claims do you raise for a design option? If there are several design options there is an inherent need for choosing one option and not choosing the others. What does it mean raising arguments concerning goodness and badness of the design options? You claim that "this design is good since..." and then you invoke an argument. This means

that you try to justify it. To justify the proposed solution (in relation to other solutions) you state that it will have good properties and therefore meet the needs for this system. The justification can be made in several steps but must eventually reach the level of system goals.

Having several alternative proposals implies a need for comparison. What kind of language game is comparing? This kind of language game involves several different communicative acts. The alternative design options will probably have different justifications. Comparing design options means comparing their justifications. One must judge and justify the different justifications. There will be a process of stepwise asking "What is this good for?" in order to find *decisive reasons* for a choice. There will be an *hierarchy* of justifications. In comparing justifications one has to identify *conflicting* criteria and goals. One has to find ways of considering and managing these conflicts. Such an investigation can at best lead to new innovative design options and relating goals. This is another example of the iterative nature of the design process.

To make a *fair comparison* one has to use the *same standards*, i.e. the same criteria for judgement. In the process of arguing for different design options one has to find out a set of appropriate criteria to be used for evaluation of the design proposals. Finding an argument for a certain design option can be seen as the first step in constructing a criterion to be used for evaluation.

An information system as a designed product is a complex thing, which must fulfill many different goals, some conflicting. It is therefore obvious that there will be many aspects of a design proposal.

Conclusion

What have I done here? I have made a preliminary analysis of design concepts from the point of view of communicative action and language game. *The design concepts have been considered as communicative acts and consequently also as parts in a language game.* This analysis form a basis for a further analysis of the DR concepts which follows below.

4 A PROPOSAL FOR EXTENSION OF DESIGN RATIONALE

4.1 A critical look on the DR concepts

A central concept in DR is criterion. Unfortunately, through reading the DR papers, we have not got a clear picture of the meanings of this concept. This applies particularly to the relation between criterion and option. What is a designer doing when using a criterion for judging an option? In DR this evaluation is conceptually considered to be a (positive or negative) relation between option and criterion. There is no other qualification of this relation. This means that in the DR language there is no possibility expressing explicitly the

character of properties and consequences of an option in relation to a criterion. There is no explicit concept of option property or option consequence.

When designing such a complex product as an information system there will most be conflicting goals. There is very little said in DR concerning conflicting goals and criteria. Neither is the problem of justifying the criteria enough penetrated.

MacLean et al advocates for the use of DR in re-design situations. Such situations is depending on the experiences made during the use of the information system. These (sometimes negative) experiences form a background of prerequisites for the re-design situation. This problem background is not either explicitly dealt with (on a conceptual level) in DR. There is definitely a difficulty in re-design how to choose direction with respect to earlier experiences.

4.2 Conceptual extensions

In our work we have made certain conceptual extensions to DR in order to make more workable in design situations. (In our own jargon we call this extended approach DR++).

According to the discussion above we have introduced a concept of consequence (of a design option). An option has different sets of consequences, each according to a specific criterion. This enables us to explicitly qualify the options in respect to criteria. This means to elicit the meanings of consequences. It is important in design situations to distinguish between criteria and the consequences of a design option.

In a *rational reconstruction* of design justifications one must identify and judge the values and conflicts of criteria. There must be concepts (and related notational elements) for evaluation. There must be possible to relate criteria to system and activity goals in an explicit way. There must be relational concepts of goals (means, conflicts).

DR is lacking an explicit *decision* concept which also should be added.

In re-design situations one should explicitly deal with *problems* of systems use. This should include a semantic sufficiency concerning the problem concept (Goldkuhl & Röstlinger, 1988): Problem relations (causes, effects) and problem evaluation in order to conclude on important problems to resolve.

These different concepts are put together in a conceptual structure (figure 4.1). Compare this extended structure with the original structure of DR concepts (figure 2.1).

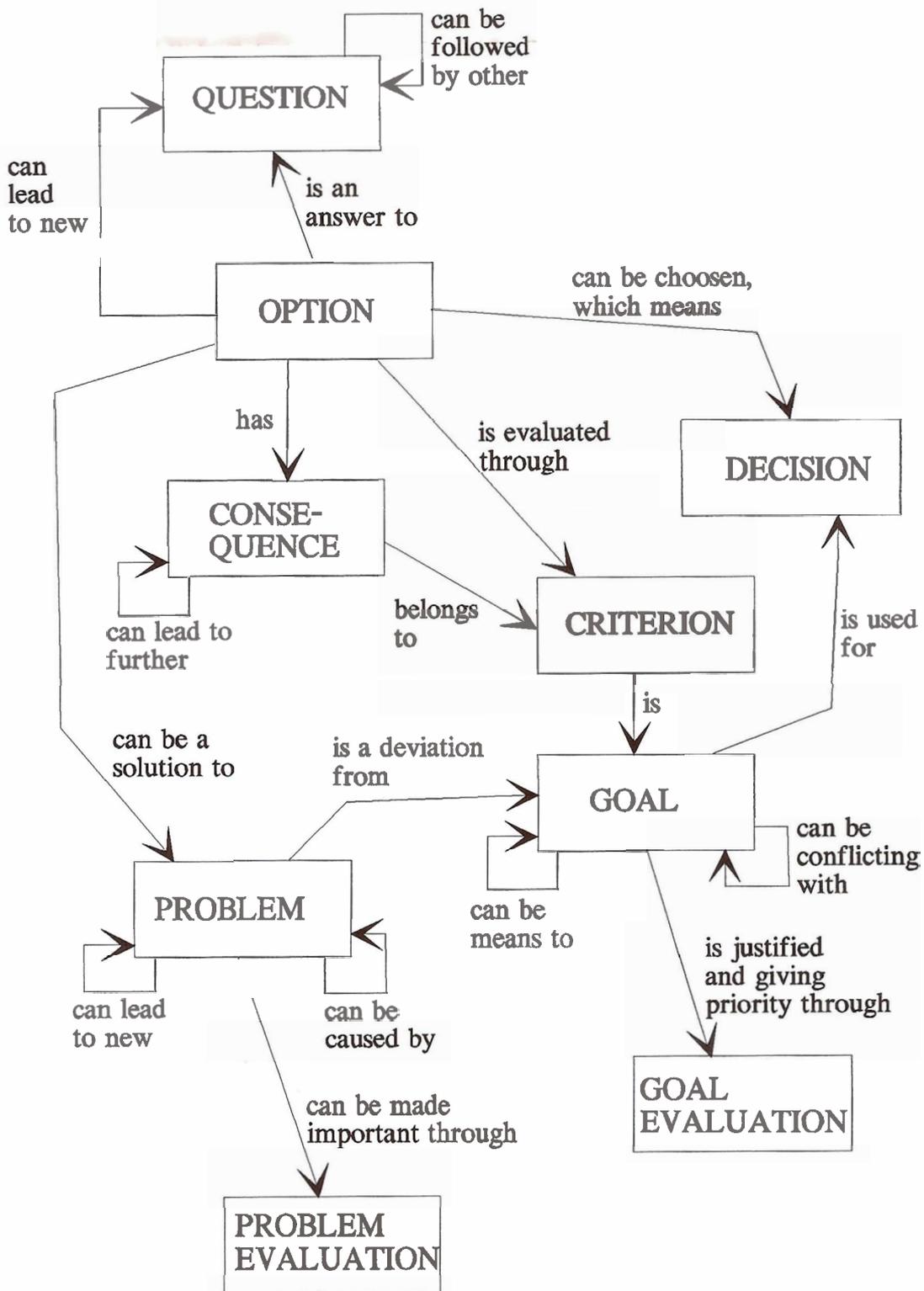


Figure 4.1 An extended conceptual structure of design concepts

4.3 Notational extensions

We have according to the conceptual extensions also made some notational modifications and extensions. The main extensions are that we are using descriptions for goals and problems. We

are here using the notation from the change analysis method (Goldkuhl & Röstlinger, 1988). Our notational development of DR++ will be described in a future paper.

5 CONCLUSIONS

Design Rationale is a very interesting approach to design work. It has however certain limitations which has been pointed out in this paper. The principle of explicit justification is very sound. Using this principle as a starting point for my analysis I have tried to create a deeper conceptual understanding of the argumentative aspects of information systems design. In this study I have used communicative action theory as an analysis tool. This theory has (to me once again) showed its fruitfulness for analysis and understanding of social phenomena.

In the analysis and proposal for methodological extensions I did also use our problem solving methodology *change analysis* (Goldkuhl & Röstlinger, 1988). I have adapted concepts and notation for development of DR++. This methodological approach is at the moment preliminary and subject to further development.

This paper represents a first step in our research on Design Rationale and argumentative design of information system. We will later present a more comprehensive paper on the extensions made to Design Rationale together with an example of design. We are also planning to study the design process more thoroughly and gather empirical material through video recordings.

Acknowledgements

This research on Design Rationale and argumentative design of information system has been conducted together with my colleagues Hans Holmgren and Cecilia Sjöberg in the MDA research group. The research in this group is funded by The National Swedish Board for Technical Development and the Swedish Work Environment Fund.

REFERENCES

- Apel K-O (1980) Towards a transformation of philosophy, Routledge & Kegan Paul, London
- Goldkuhl G (1984) Understanding computer-based information systems through communicative action analysis, presented at the symposium "Communication and contacts between people in the computerized society", Göteborgs Universitet
- Goldkuhl G, Lyytinen K (1982) A language action view of information systems, Proceedings of 3rd International Conference on information systems
- Goldkuhl G, Röstlinger A (1984) The legitimacy of information systems development - a need for change analysis. IFIP Conference Human-Computer Interaction, London

- Goldkuhl G, Röstlinger A (1988) Förändringsanalys - Arbetsmetodik och förhållningssätt för goda förändringsbeslut, Studentlitteratur, Lund (in swedish)
- Habermas J (1979) Communication and the evolution of society, Heinemann, London
- Lyytinen, K (1986) Information systems as social action: framework and critical implications, Jyväskylä University
- MacLean A, Young RM, Moran TM (1989) Design rationale: The argument behind the artifact, Proc of CHI'89, ACM Press, Austin
- MacLean A, Young RM, Belotti V, Moran TM (1990) Questions, Options, Criteria: Elements of a Design Rationale for user interfaces, Draft paper, RankXerox EuroPARC, Cambridge
- MacLean A (1990) Design Rationale: Developing a usable representation for design knowledge, AAAI Spring symposium on Knowledge-based Human-Computer Communication, Stanford University
- Searle, J.R. (1969) Speech acts. An essay in the philosophy of language, Cambridge University Press, London.
- Timpka T, Hedblom P, Holmgren H (1991) Action design: Using an object oriented environment for group process development of medical software, in Software engineering in Medical informatics, Elsevier, Amsterdam
- Toulmin S (1958) The uses of argument, Cambridge University Press, London
- Wittgenstein L (1953) Philosophical investigations, Basil Blackwell, London