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ABSTRACT

This study introduces a strategy for analysing different kinds of phenomena by building "information structures" for analysing how parts make a whole in complex systems. The strategy introduced may be of use when there is a need to understand complex systems or situations; e.g., in various studies of adult education when education is seen as closely related to individual and environmental issues. The paper introduces some areas of research where this approach could be applied; in conceptual analysis, theory building and research design, analyses of change, historical studies, decision making, innovative studies, and in educational planning and assessment. Data from an earlier study on supervisory behavior in teacher training as assessed by student teachers is used to give an example of how to build an information structure and how to use this information in building conceptual models for general and individual descriptions of a behavior. An example is also given of how to apply an information structure called Dynamic Concept Analysis in studies of change. (JD)

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RESEARCH BULLETIN 70

Seppo Kontiainen

INTEGRATING INFORMATION IN CONCEPTUAL MODELS

**Use of an information structure in building conceptual
models for behavioural studies**

888
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INTEGRATING INFORMATION IN CONCEPTUAL MODELS

Use of an information structure in building conceptual models for behavioural studies. 59 pages

ABSTRACT

The study introduces a strategy for analysing different kinds of phenomena by building 'information structures' and 'conceptual models'. In describing phenomena both linear and nonlinear relationships between concepts will be taken into consideration. The approach combines nomothetic and idiographic views: the same information structure can be used both for general and individual descriptions.

Consequently the study provides general guidelines for analysing how 'parts' make a 'whole' in complex systems. It has aspects in common with some other approaches which also aim at understanding phenomena in a holistic manner.

It is pointed out that there are altogether five ways in which two concepts can combine with each other. All these types can be identified by an information structure, and the information can be used in building conceptual models. The strategy for using information about concept relations available in an information structure is called here 'Dynamic Concept Analysis', DCA. The dynamic nature of a behaviour will be identified by conceptual models, which show simultaneously types of relationships between all the properties in question.

The analyses presented in the paper are primarily conceptual. Conceptual models can be considered as hypothetical models of actual life; reliability and validity of these analyses will be finally assessed in actual contexts.

The paper gives theoretical bases for building information structures. Data from an earlier study on supervisory behaviour in teacher training as assessed by student teachers is used for demonstration only; to give an example of how to build an information structure and how to use this information in building conceptual models for general and individual descriptions of a behaviour. A demonstration is also given of how to apply DCA in studies of change.

The strategy introduced in the paper may be of use when there is a need to understand complex systems or situations; e.g. in various studies of adult education when education is seen as closely related to individual and environmental issues.

Finally the paper introduces some areas of research where this approach could be applied; in conceptual analyses, theory building and research design, analyses of change, historical studies, decision making, innovative studies, and in educational planning and assessment.

Key words: conceptual analysis, information structure, conceptual models, systems, change, futures research, innovation, planning, assessment, theory building, research design.

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Seppo Kontiainen

1. INTRODUCTION

Development of the research strategy presented in this paper started in the early 1970's when I was doing research on interaction processes between trainers and trainees in teaching practice. I shall in this paper return to an old study 'The behaviour of supervisors assessed by student teachers' (Konttinen 1973). Referring to this study does not necessarily mean that the research results as such are of special importance. However, I have become more interested in further development of the research strategy introduced in the paper, which now serves as a source of information for demonstrations.

In studies of human behaviour we are likely to speak about individual processes and dynamics. Nevertheless, many studies of human behaviour concentrate on producing general information or new conceptions of phenomena with little or no direct connection to individuals, or on case studies with loose connections to generalisations. Nomothetic and idiographic approaches are easily accepted as being mutually exclusive; studies seek either generalisations or understanding of individual behaviour, too seldom an integration of both.

An aim of this paper is to develop a research strategy which combines nomothetic and idiographic approaches so that the same source of information could be used both for generalisations and for describing individual behaviour. In addition, the paper touches problems of describing processes and dynamics in studies of a behaviour. When accepting the dynamic nature of human behaviour, there should be ways to point this out in research into a behaviour; conceptual models in this study aim at answering to this question.

In a study of behaviour the research concepts used may be identical, parallel, overlapping or independent when compared with the concepts used in another study of the same behaviour. Each study tends to produce its own terminology or the same concept may have a different meaning in different studies. New research may sometimes cause more confusion than a new structuring in a research area. This is why there is a need to find ways of integrating research findings in a field and to develop methods for conceptual analysis in order to reduce conceptual confusion and to define key concepts for research.

One reason for the lack of relevant theories or conceptual frameworks in a field is the lack relevant of conceptual analyses. This paper gives an example of doing conceptual analyses and of producing conceptual models for theory building. An aim of this study is to demonstrate how an approach of analysing concepts could help in searching new theoretical frameworks for research in a field.

Human behaviour and a reality where an individual lives can be considered as a complex network of various processes. When trying to understand this complexity there is a need to find research methods which show the dynamic nature of a behaviour or show how relations between 'parts' make a 'whole'.

Conceptual analyses and conceptual models in this paper aim at satisfying this need.

A general aim of this study is to find more structure and to reduce the degree of subjectivity in use of information concerning human behaviour. Information derived from studies of behaviour is often used more or less haphazardly, leaving too much scope for individual, subjective interpretations of how different things are related to each other. This can be seen as a central problem when applying research findings to practice.

The approach presented in this paper could be regarded as a general guideline for behavioural and educational studies, but it may be worth applying in some other areas of research, too. Much research is still needed to find new views of understanding social and behavioural problems in a more holistic manner than present and to reduce the degree of fragmentation in research and in how the world around us is realized.

This paper introduces a strategy of using information structures in building conceptual models. Firstly, central terms of the study are defined and connections of this approach to some other orientations are investigated. Secondly, the basis of building an information structure and conceptual models are given. Finally, some remarks are made on methodological questions and on possible uses of this strategy in various kinds of research.

2. TERMINOLOGICAL DEFINITIONS

- 1) 'REALITY' refers to an entity where people live and where different things occur, and from where concepts for behavioural and other studies are derived.
- 2) 'CONCEPT' refers to any variable or quality (behavioural, social etc.) used in describing a particular state or a process.
- 3) 'INFORMATION STRUCTURE' is here a matrix of concept relations where relations of all concepts included in a study are gathered, and from where information will be taken for analyses of a behaviour both in general terms and in individual cases.
- 4) 'CONCEPTUAL MODEL' is a model of concept relations built by information available in an Information Structure.
- 5) 'DCA' = Dynamic Concept Analysis, a strategy of using information of concept relations available in an Information Structure.
- 6) 'PROCESS OF CHANGE' will be indicated here by changes in conceptual models as related to time.
- 7) 'PLANNING OF CHANGE' means here analyses of a present conceptual model and simulations on it in order to produce new relations between the concepts used or to add new elements or new concepts into conceptual analyses and conceptual models to indicate alternatives or directions for change.

- 8) 'DYNAMIC' can be understood here in two different ways:
a) referring to the dynamic nature of concept relations in a conceptual model, and b) referring to changes in conceptual models as a function of time.

3. CONNECTIONS TO OTHER ORIENTATIONS

3.1. General Orientation of This Study

David Bohm (1980, 1) writes about the fragmentation of reality: "Fragmentation is now very widespread, not only throughout society, but also in each individual; this is leading to a kind of general confusion of mind, which creates an endless series of problems and interferes with our clarity of perception so seriously as to prevent us from being able to solve most of them."

Bohm continues: .."Man's natural environment has correspondingly been seen as an aggregate of separately existent parts, to be exploited by different groups of people. Similarly each individual human being has been fragmented into a large number of separate and conflicting compartments, according to his different desires, aims, ambitions, loyalties, psychological characteristics, etc., to such an extent that it is generally accepted that some degree of neurosis is inevitable, while many individuals going beyond the 'normal' limits of fragmentation are classified as paranoid, schizoid, psychotic, etc."

In using information of psychological tests, for instance, there are difficulties in achieving a holistic view of an individual behaviour; use of information is often too dependent on experience and personal interpretations of a practitioner; on individual ways of seeing how different things may be interrelated.

Besides subjectivity involved in using information about human behaviour, fragmentation of reality, as Bohm sees it, is evident. This has partly guided thinking in this paper: a need to find more structured ways to work on information of

human behaviour to get a comprehensive or holistic view of people in their complex interactions with themselves, with others and with their environments; to achieve understanding about how the 'parts' make a 'whole'.

At the same time the dynamic nature of behaviour needs to be taken into consideration; this has led to an interest in building conceptual models which illuminate a behaviour as a complex network of concept relations.

3.2. Holistic View

The approach here stresses the importance of finding a holistic view of a behaviour taking at the same time into consideration the elements, 'parts' of a 'whole'. - A holistic view will be achieved by analyses of relations between parts with an assumption that a whole is more than a sum of its parts; this will be shown in analyses of conceptual models.

When speaking about holistic approaches, it will be realized that a holistic view of a behaviour, for instance, is rather an aim than something we can fully achieve in practice. Research concepts we are using in a study are likely to limit possibilities of getting a comprehensive picture about a reality; this will be demonstrated also in this study where only a limited number of concepts representing a reality or a phenomenon are taken into analyses.

In striving towards a more comprehensive view on a phenomenon, it is of crucial importance how covering or central are the concepts we are using. Generation of relevant concepts for a study creates necessary conditions for conceptual analyses introduced in this paper.

Fragmentation of reality, an atomistic view, has been very dominant in studies of human behaviour. Effects of the

atomistic tradition of natural sciences is still strong within the human and social sciences. In natural sciences there is now some tendency to move towards less atomistic approaches (cf. e.g. Bohm 1980, Capra 1982, 1983). Similar trends are obvious in behavioural sciences, too. A holistic view is seen as essential, in cognitive psychology (e.g. Engeström 1987), studies of world views (e.g. Neisser 1982), of human activity systems (cf. Checkland 1981) or in studies on 'wholeness' in psychology and education (e.g. Lindholm 1985, Sandelin 1985).

In general: theories, theoretical frameworks and research models (e.g. Mezirow 1981, Popkewitz 1984) aim at finding a comprehensive and a holistic view of a phenomenon.

This study shares an interest in holistic approaches with the studies mentioned above, but does not lean directly on any of them.

3.3. Systems Thinking

Checkland (1981, 3) writes in his book on 'systems thinking', about the use of a particular set of ideas in order to understand the world's complexity: "The central concept 'system' embodies the idea of a set of elements connected together which form a whole, this showing properties which are properties of the whole, rather than properties of its component parts."

This study can be seen as an example of a kind of systems thinking, which is not, however, identical to that of Checkland's. The approach introduced in this paper shows relationships between properties and uses conceptual models to illustrate a whole. Checkland follows in his analyses a certain structure.

3.4. Analyses of Change

Prigogine's theory, 'order through fluctuations' (Nicolis & Prigogine 1977; Prigogine 1980; Prigogine & Stengers 1984) gives an example of how a change occurs in metastable open systems, and reveals, too, how a temporary stage of 'disorder' is a prerequisite for promoting qualitative changes in a system. In this paper a temporary disorder might be identified in a conceptual model, and qualitative changes of a system as qualitative changes in conceptual models.

In his book 'Wholeness and the Implicate Order' Bohm (ibid., 204) writes: "...each moment of consciousness has a certain explicit content, which is a foreground, and an implicit content, which is corresponding background. We now propose that not only is immediate experience best understood in terms of the implicate order, but thought also is basically to be comprehended in this order. Here we mean not just the content of thought for which we have already begun to use the implicate order. Rather, we also mean that the actual structure, function and activity of thought is in the implicate order." In his study Bohm used the idea that consciousness can be described in terms of a series of moments, and continues: "...one moment gives rise to the next, in which content that was previously implicate is now explicate while the previous explicate content has become implicate..", and "The continuation of the above process gives an account of how change takes place from one moment to another." (ibid., 205).

A similar kind of orientation is in the background in this study when using conceptual models in describing processes of change from one moment to another.

In this approach there may also be some similarities with the thinking of Jantsch (1976, 39) on interactive processes

which define temporary structures, and which guide new processes, which in turn rise new temporary structures. Conceptual models in this paper could be regarded as temporary structures.

There seems to be much scepticism concerning the possibilities of planning a change (e.g. Goodman et al., 1984). Nevertheless, this study introduces an example of using conceptual analyses and conceptual models in planning. These analyses are close to approaches of systems thinking and futures research (e.g. Allen 1985).

3.5. Conceptual Models

Models can be regarded as simplifications of reality. Lindén (1986) discusses about different types of models: models exist on several levels of abstraction, varying from meta-physical models (metamodels) or 'paradigms' (cf. Kuhn 1970) or 'world views' to models of specific scientific theories.

How well a model describes the real world varies according to the nature of a model. Metamodels are superordinated and they cannot be proven true or false. Specific theoretical models can be concretely specified and could be empirically tested (e.g. Reese 1970).

Models are often presented either in the form of general conceptual frameworks or as statistical models. Model typologies are given in many studies (cf. Kaplan 1964, Tatsouka 1968, Bunge 1973, Hermerén 1974, Nurmi 1975, Urban 1978 and Keeves 1984). The nature of models in educational research is discussed in various publications (cf. Lindén 1986, Reese and Overton 1970, Overton and Reese 1973).

A distinction can be made between mechanistic and organismic models (e.g. Overton and Reese 1973, Murray 1984). In her

research report on behavioural development, Lindén (ibid., 7) describes these two models: "Mechanistic models focus on the analysis of elements, and development is seen as consisting of behavioral changes as additive components, which implies that later behavior is reducible to or predictable from, its antecedents. Organismic models stress the synthesis of organized complexities, and development is seen as consisting of structural change in which later states are not reducible to previous states." This is similar to a description given earlier by Hultsch and Plemons (1979). Lindén sees the human organism as an active totality, and regards it as a fundamental issue to determine principles of organization. In the organistic approach both qualitative and quantitative change is possible.

Events and elements are important, but examination of them as such is not enough to describe a phenomenon; this gives reasons to develop models, which identify complex networks of concept relations as well as to study changes in concept relations accepting both qualitative and quantitative information into the analyses.

The conceptual models introduced in this paper are based on analyses of elements (parts) resulting in models which illuminate how 'parts' make a 'whole', i.e. a conceptual model makes a synthesis of different types of concept relations. This means in practice that in building an information structure a kind of mechanistic approach may be used to show relationships between parts or elements in an information structure, but when using this information for building conceptual models, a more organismic approach will be adopted; for example in studies of structural changes in paragraph 7.

Statistical models are often built by multivariate analyses of research data. This means that research is based on a general assumption of linearity. The approach introduced in

this paper differs from statistical models; both linear and nonlinear relationships between concepts included in a model will be taken into consideration. Nevertheless, statistical analyses may be used as a way to bring information about concept relations into an information structure as shown later in 6.2.

An interesting question in this study is the question of relations between conceptual models and theories. Information structures are regarded here as theoretical frameworks from where conceptual models can be derived.

4. BUILDING AN INFORMATION STRUCTURE

The basic idea of building information structures is to bring together information and data considered central in understanding a particular phenomenon or a problem so that the structure serves as a source of information for various kinds of conceptual analysis.

A structure of concept relations (here: a matrix) can include information from one study only or it may combine information from various studies. A matrix can also be formed by hypotheses of concept relations or it can be a mixture of hypotheses and research findings. The principles of building an information structure will be presented as follows:

At first, different types of relations between two concepts will be shown in paragraph 4.1. An example of concept relations from a previous study will be given in paragraph 4.2. and building of an information structure is demonstrated in paragraph 4.3.

4.1. Different Types of Relations

In building an information structure of relations between concepts, it is essential to realize how two concepts can be related to and with each other. Five types of relations are given below with concepts A and B which describe a phenomenon.

Type 1.



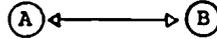
A and B (or the qualities they stand for) do not have a direct influence to each other; this may mean that they do not belong to the same entity or a group of concepts characterising a particular reality. Links between A and B could, however, be found through their relations with other concepts as shown below (types 4 and 5). In the above model A and B are nonrelated.

Type 2.



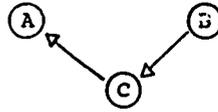
A and B may have a kind of one-way relation shown above: there is a direct influence of B on A.

Type 3.



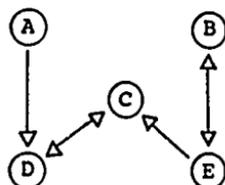
A and B have a two-way relationship with each other.

Type 4.



A and B do not have a direct relation with each other, but the relation will be found by a third concept C as in the model above.

Type 5.



The relation between A and B will be here defined via a longer chain of relations, for instance, by relations of A and B with concepts C, D and E in a way demonstrated in the model. The model actually includes three main types of relations between concepts: Type 1 (with A/B, A/C, A/E, B/D, B/C, D/E; some of these relations, e.g. A/C, becomes realised in the model as Type 4), Type 2 (with A/D, C/E) and Type 3 (with B/E, C/D).

Type 5 demonstrates how complex a network of concept relations can be when only five concepts are studied.

Types 4 and 5 are networks of concept relations. Between two concepts there are in fact three possible types of relations: Type 1, Type 2 and Type 3.

The aim in building an information structure is to produce a matrix which includes all information of the types of relations between concepts included in a study. The matrix is here called the information structure, i.e. the structure of concept relations.

4.2. An Example of Types of Concept Relations/ authoritarian' attitudes

In an earlier study (Konttinen 1973), authoritarian attitudes of supervisors were analysed in the context of teacher training. Analyses were based on assessments by student teachers of the supervisory behaviour of their trainers. The study will be introduced in more detail later, in paragraph 4.3, where building an information structure will be demonstrated.

In the following, analyses are based on use of the information structure built for analyses of supervisory behaviour. An example of 'authoritarian' attitudes and four other characteristics of the behaviour is given to demonstrate different types of relations between concepts (here: attributes or subconcepts).

This demonstration is considered as a necessary step to make it easier to understand what is meant by information structures and conceptual models later in this paper.

The following gives an example of a combination which was found to be one of most typical cases of authoritarian supervisory behaviour in the context of teacher training. The qualities are:

1. General Attitudes: 1a authoritarian
2. Role Stability: 2b unstable
3. Style of Working: 3b serious
4. Effect of Supervision: 4b negative
5. Attitudes to Individuals: 5b unsympathetic

Symbols 1a, 2b etc. are used here to specify a subconcept for each concept; a subconcept is here called an 'attribute'. All attributes are given later in Table 1 and content of each attribute is shown in Appendix 1. The procedure to

identify relation types from an information structure is shown in 4.3.2.

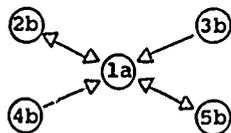
Types of relations with 'authoritarian' attitudes:

1a authoritarian 2b unstable	(1a) ← → (2b)	Type 3
1a authoritarian 3b serious	(1a) ← — (3b)	Type 2
1a authoritarian 4b negative	(1a) ← — (4b)	Type 2
1a authoritarian 5b unsympathetic	(1a) ← → (5b)	Type 3

The above relations with 'authoritarian' attitudes can be presented in a model where types of relations are shown simultaneously. Model 1 brings together the characteristics of supervisory behaviour which have a direct relation of Type 2 or Type 3 on attribute 1a:

Model 1.

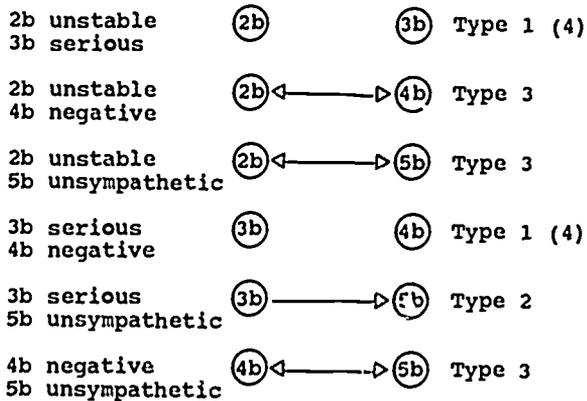
1a authoritarian
2b unstable
3b serious
4b negative
5b unsympathetic



Model 1 indicates that 'authoritarian' attitudes (1a) will be understood here by close relations (Type 3) with a supervisor's 'unstable' role (2b) and with his or her 'unsympathetic' attitudes towards individual students (5b). In addition, authoritarian attitudes can be considered as a response to a failure in supervision, 'negative' effect (4b) and his or her 'serious' style of working (3b); with 3b and 4b there is a one-way relation of Type 2, i.e. 3b and 4b have an influence on 1a, but these two are not directly influenced by authoritarian attitudes (1a).

As seen above, one aspect of a behaviour (here: authoritarian attitudes in supervisory behaviour) does not as such tell about the role this characteristic has in a wider context. The content and meaning of a characteristic will be understood better if it is put in connection with other aspects of a particular behaviour and if the types of these relations are pointed out.

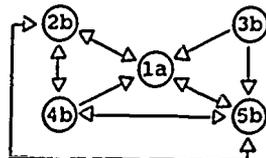
In order to understand the whole picture, it is not enough to study one aspect only in its relationships with the other. The types of relations between all aspects should be identified. In the following, the types of relations between the four other attributes of supervisory behaviour are given:



When additional information of the types of relations is added into Model 1, new information results in Model 2 where all relationships are illustrated at the same time.

Model 2.

1a authoritarian
2b unstable
3b serious
4b negative
5b unsympathetic



Model 2. demonstrates what is meant in this paper by a conceptual model; it shows types of relations between the concepts used to describe a particular behaviour or a process.

Model 2. gives relations between attributes in one the most typical combinations - when authoritarian attitudes are obviously strong as shown in the previous study. The model shows how the meaning and status of a concept will be specified by the other concepts in a certain context, in a 'whole' defined by relationships with 'parts'.

When all relations between concepts in Model 2 are taken into consideration, this case of authoritarian supervision could be interpreted in the following way:

The effect of supervision is negative (4b); this is characterized primarily by unstable role (2b) and unsympathetic attitudes (5b). Failure in supervision is likely to reflect on unstable role (2b) and to authoritarian attitudes (1a) and unsympathetic attitudes towards individuals (5b). Serious style of working (3b) is a characteristic both in general and in individual attitudes (1a and 5b), not directly in the other attributes. It was concluded in the previous study (*ibid.*, 78-79) that the major problems of this kind of authoritarian behaviour are both in the supervisor's difficulties in finding his or her identity in the role of supervisor and in difficulties in communicating with individual students.

It can be stated, that the actual content and meaning of any aspect or characteristic of a behaviour will be understood only if its relations with the other aspects of the given behaviour are known. All relations between the concepts used need to be identified in order to find a holistic picture of roles different properties play in a given behaviour. Model 2. shows the network of all relations between the attributes

in a case of supervisory behaviour with strong authoritarian attitudes as analysed in the previous study.

Although there is still scope for individual interpretations, a conceptual model gives a structure for interpretations and reduces subjectivity in seeing how different properties are related in a particular case.

In the original study of the behaviour of supervisors it was pointed out that there were 81 different ways in which authoritarian attitude may result in different conceptual models, depending on what are the other attributes of the behaviour they are combined with. A change in one characteristics only may cause a drastic change in the whole structure of a behaviour as demonstrated by conceptual models.

4.3. Information Structure

All analyses above refer to an information structure from where the information of relations between concepts is derived. Principles of building an information structure will be discussed and demonstrated in the following.

As defined earlier an information structure is a matrix of concept relations where the information needed for conceptual analysis and for constructing conceptual models is available in a coherent format.

The information of concept relations can be drawn into a matrix from various sources, for instance:

- a) from one study only; quantitative and/or qualitative data,
- b) from various studies; either by combining information from different studies (to produce a better coverage of

- concepts to describe a particular phenomenon), or using information of concept relations achieved in several studies (to test reliability of information given by one study alone);
- c) by building a matrix based on hypotheses about the nature of relationships (by a researcher or a practitioner);
 - d) by combining research findings and hypotheses in the same information structure.

It is always necessary to realize what sort of information will be gathered into a matrix of concept relations. This reflects on validity and reliability of the analyses based on a matrix. An information structure is a hypothetical structure of concept relations and relevancy of conceptual models derived from it will become finally assessed in actual contexts.

4.3.1. Concepts of Supervisory Behaviour

Principles of building a conceptual structure will be easier understood by using actual concepts available in a study. The above demonstration with authoritarian attitudes in supervisory behaviour was based on an previous study by the author (Konttinen 1973). The same study will be used in the following analyses, too. Without going into many details concerning the previous study, some information regarded as central to this paper will be given.

The study was based on a semantic differential type questionnaire by which student teachers (N=189) assessed the behaviour of their supervisors (N=32) in the context of teacher training. The assessments (altogether 1528 individual trainee-trainer interactions) were analysed by factor analysis which resulted in five factors/concepts of supervisory behaviour; these are with specifications (attributes)

given in Table 1. Qualities of each attribute are given in Appendix 1.

Tab'e 1. Concepts and attributes of the behaviour of supervisors

Factors/Concepts*	Attributes**
F1/C1 General attitudes	1a authoritarian 1n neutral ***
F2/C2 Role stability	1b non-authoritarian 2a stable 2n neutral
F3/C3 Style of working	2b unstable 3a easy-going 3n neutral
F4/C4 Effect of supervision	3b serious 4a positive 4n neutral
F5/C5 Individual attitudes	4b negative 5a sympathetic 5n neutral 5b unsympathetic

- *) 'Concept' refers here to the interpretation of the factor
- ***) 'Attribute' is a subconcept identified in the study of supervision by f-scores in a factor (a=high, n=medium, b=low).
- ***) 'neutral' refers here to attitudes which are not obviously either authoritarian or non-authoritarian.

Use of factor analysis and factor scores in specifying the attributes of a concept, as done in the study given as an example, is however, only one way to produce concepts for analyses. The technical details are not repeated in this paper. They can be found in the original report (ibid., 1-70). It is worth noting, too, that this paper does not follow the previous analysis in all respects, although the basic principles are still mostly the same.

4.3.2. Information Structure for the Supervisory Behaviour

Analysis of an authoritarian behaviour in paragraph 4.2. was based on an information structure of concept relations in the study of the behaviour of supervisors as assessed by student teachers. The information structure, the matrix of concept relations will be introduced here.

In Matrix 1. all attributes of the study are listed on the left and a row brings together the attributes among the other attributes most likely to relate to the attribute in question; i.e. qualities which together specify the content and meaning of this particular attribute in the conceptual framework of a study. Matrix 1 is a slightly modified version of the matrix given in the original study (ibid., 70).

In this study attributes for each row were identified by analysing frequency distributions of factor scores; various other techniques can be developed.

Matrix 1. Information structure of the supervisory behaviour

row	F/C	attributes	C1		C2		C3		C4		C5	
			a	n	a	n	a	n	a	n	a	n
1		1a authoritarian	a	n	a	n	a	n	a	n	a	n
2	F1/C1	1n neutral	n	b	b	n	b	n	b	n	b	n
3		1b non-authoritarian	b	n	n	n	a	n	a	n	a	n
4		2a stable	a	n	a	n	a	n	a	n	a	n
5	F2/C2	2n neutral	n	b	b	n	b	n	b	n	b	n
6		2b unstable	a	n	b	n	n	b	n	b	n	b
7		3a easy-going	a	b	n	b	a	n	n	b	a	n
8	F3/C3	3n neutral	n	b	b	n	n	n	a	n	a	n
9		3b serious	n	a	a	n	b	n	a	n	a	n
10		4a positive	n	b	a	n	b	a	n	a	n	b
11	F4/C4	4n neutral	n	n	b	n	n	n	n	n	n	n
12		4b negative	n	b	b	a	n	b	n	b	n	b
13		5a sympathetic	n	n	n	n	b	a	n	a	n	b
14	F5/C5	5n neutral	n	n	n	n	b	a	n	a	n	b
15		5b unsympathetic	a	n	b	n	b	n	b	n	b	n

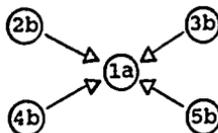
Rows in Matrix 1. show the attributes most likely to combine with each of the fifteen subconcepts or attributes in the study. A row shows those attributes which have a direct relation of Type 2 on the attribute in question. Relation of Type 2 between two attributes may change into Type 3, when information from two rows concerning these attributes is put together.

Row 1 brings together those attributes which have a relation of Type 2 on 1a 'authoritarian', i.e. the attributes which together specify the content of authoritarian attitudes in the given conceptual framework.

There are two typical cases of authoritarian behaviour as indicated in Row 1; one combined with supervisor's stable role and the other with unstable role. The latter with unstable role was introduced in paragraph 4.2. The same example will be used here, too, to make it clearer how the information structure in Matrix 1 serves as a basis to point out the types of the concept relations.

Row 1 shows in fact the attributes which have direct relation of Type 2 on 1a, 'authoritarian' attitudes. This can be illustrated by the following model, which is a part of Model 1 presented earlier:

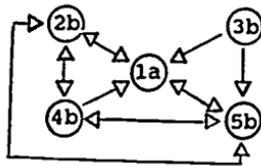
1a authoritarian
2b unstable
3b serious
4b negative
5b unsympathetic



(MODEL 1.)

To get a comprehensive picture of all relations in question, Model 2 was produced by using the information in Matrix 1. The procedure of showing the other relations is introduced in the following.

1a authoritarian
 2b unstable
 3b serious
 4b negative
 5b unsympathetic



MODEL 2.

Row 6 shows the attributes which characterize 'unstable' role in the supervisory behaviour. Among the attributes in the combination three attributes 1a (authoritarian), 4b (negative) and 5b (unsympathetic) have a direct relation of Type 2 to unstable role. Serious style (3b) does not characterize unstable role (2b), but there is an indirect relation between the two as seen in Model 2.

Row 9 gives the attributes which have a relation of Type 2 to 'serious' style of working (3b); none of the attributes in this combination has a direct relation to serious style; this indicates that serious style in this combination has a less central position. This can be recognized also in Model 2.

Row 12 gives attributes characterizing 'negative' effect (4b); only 2b (unstable) and 5b (unsympathetic) have a direct relation of Type 2 to negative effect in this attribute combination.

Row 15 gives attributes with 'unsympathetic' attitudes (5b). All the other four attributes have a direct relation of Type 2 on these attitudes. This is also seen in Model 2.

The information of concept relations concerning only the five characteristics under study can be taken from Matrix 1 into a submatrix, Matrix 1.1. which can be used for building a conceptual model; here Model 2.

Matrix 1.1.	1a	2b	3b	4b	5b
1a authoritarian		+	+	+	+
2b unstable	+		-	+	+
3b serious	-	-		-	-
4b negative	-	+	-		+
5b unsympathetic	+	+	+	+	

In the matrix '+' points out those attributes, which have a direct relation of Type 2 on the content and meaning of the attribute in question. '-' shows the attributes which do not have a direct influence, i.e. the relationship may be found by analysing other rows, other attribute qualifications (cf. Types 1, 2, 4 and 5; this eliminates only Type 3).

Similar kinds of submatrices and models can be made for all possible combinations of attributes. It was mentioned earlier in this paper that from Matrix 1 you can find altogether 81 different combinations of attributes with 'authoritarian' attitudes: i.e. more or less different ways of being an authoritarian supervisor. Matrix 1 includes information of 243 different combinations of characteristics of the behaviour of supervisors as assessed by student teachers. The number of possible combinations is dependent on the number of concepts or subconcepts included in a study.

If the concepts are divided into three subconcepts or attributes as in the example given here, the number of possible combinations varies according to the number of concepts as shown in Table 2.

Table 2. Number of different combinations of attributes as related to the number of concepts (n) included in an information matrix.

Number of concepts (n)	Total number of combinations (3^n)*	Number of combinations with one attribute (3^{n-1})*
2	9	3
3	27	9
4	81	27
5	243	81
6	729	243
7	2 187	729
8	6 561	2 187
9	19 683	6 561
10	59 049	19 683

* 3 refers here to three subconcepts or attributes for each concept

Table 2. shows that it is possible to identify almost sixty thousand different combinations and different conceptual models derived from a matrix of concept relations for ten concepts, when using the same procedure as in this study (three subconcepts for each concept).

5. GENERAL AND INDIVIDUAL DESCRIPTION

Matrix 1. makes it possible within the framework of concepts included to describe supervisory behaviour in general and altogether in 243 different individual cases.

A general description is possible when different attributes in their typical combinations with other attributes are analysed (cf. analysis of authoritarian attitudes above/Row 1). 'Subtheories' of the behaviour of supervisors can be found by building conceptual models for each attribute with typical combinations (Matrix 1; Rows 1-15).

It can be stated that Matrix 1 includes information for a theory or gives a conceptual framework of supervisory behaviour within the limits of these concepts. Nevertheless, this 'theory' cannot be spelt out so that all possible combinations and concept relations could be verbally expressed at the same time.

This also demonstrates how difficult it is to define a general theory; a conceptual model or a verbal statement is always a partial explanation of a phenomenon. Nevertheless, an information matrix, like the one given in this study, represents a general theory in a form of a general structure (cf. Matrix 1) from where substructures (cf. Matrix 1.1) can be derived for building conceptual models.

Individual substructures and models of a behaviour can be found for any combination of attributes (here 243 combinations).

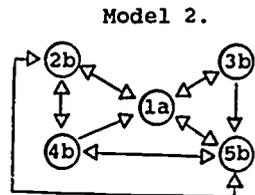
Use of the same information structure for both general and individual studies, is a way to combine nomothetic and idiographic approaches in the same study.

The following demonstrates, with some examples, how general and individual conceptual models can be found.

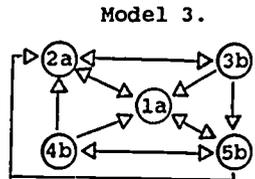
5.1. General Models

The attribute combinations for general descriptions can be found on each row in the Matrix 1. For instance, Row 1 gives two most typical ways of how authoritarian attitudes manifest in the supervisory behaviour; one combination with stable and the other with unstable role behaviour. The conceptual model with unstable role has already been given in Model 2, which will be now presented together with Model 3, with stable role, to visualize the differences between the two cases.

	1a	2b	3b	4b	5b
1a authoritarian		+	+	+	+
2b <u>unstable</u>	+		-	+	+
3b serious	-	-		-	-
4b negative	-	+	-		+
5b unsympathetic	+	+	+	+	



	1a	2a	3b	4b	5b
1a authoritarian		+	+	+	+
2a <u>stable</u>	+		+	+	+
3b serious	-	+		-	-
4b negative	-	-	-		+
5b unsympathetic	+	-	+	+	



Model 2 and Model 3 show how the 'dynamical' structures, the concept relations differ in these two cases of authoritarian behaviour when there is only one attribute different in the two models. This reflects, however, upon many other concept relations, too, as seen below when the types of relations are looked at in these two cases:

	(Model 2)	(Model 3)
1a authoritarian	2b <u>unstable</u>	2a <u>stable</u>
3b serious	Type 3	Type 3
4b negative	Type 1	Type 3
5b unsympathetic	Type 3	Type 2
	Type 3	Type 2

The types of relations are used for interpretations of these two cases of authoritarian behaviour. The differences in concept relations indicate, that Models 2 and 3 describe two quite different kinds of behaviour with authoritarian attitudes.

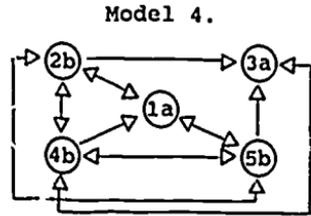
Although the above two attribute combinations stand now to characterize especially authoritarian supervisory behaviour in general they can be attribute combinations in some actual cases, too.

5.2. Individual Models

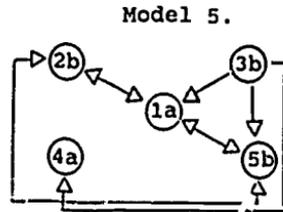
When it is accepted that individuals behave individually, there is a need to illustrate this also in conceptual models. Individual models could be seen as hypothetical models for actual behaviour; in each actual case it will be worth analysing how well a given model represents an individual behaviour.

In the following, some possible attribute combinations for individual cases are studied. Now authoritarian attitudes (1a) and unstable role (2b) are included in the combinations, but in each case one or two of the other three attributes has been changed. Matrix 1 serves still as the source of information.

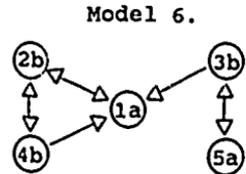
	1a	2b	3a	4b	5b
1a authoritarian		+	-	+	+
2b unstable	+		-	+	+
3a easy-going	-	+		+	+
4b negative	-	+	+		+
5b unsympathetic	+	+	-	+	



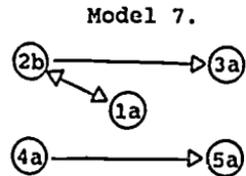
	1a	2b	3b	4a	5b
1a authoritarian		+	+	-	+
2b unstable	+		-	-	+
3b ser'ous	-	-		-	-
4a positive	-	-	+		-
5b unsympathetic	+	+	+	-	



	1a	2b	3b	4b	5a
1a authoritarian		+	+	+	-
2b unstable	+		-	+	-
3b serious	-	-		-	+
4b negative	-	+	-		-
5a sympathetic	-	-	+	-	



	1a	2b	3a	4a	5a
1a authoritarian		+	-	-	-
2b unstable	+		-	-	-
3a easy-going	-	+		-	-
4a positive	-	-	-		-
5a sympathetic	-	-	-	+	



Models 4-7 give some picture of how conceptual models may differ in individual cases. Every model could be described by its types of concept relations. Interpretation of a behaviour with five concepts only in a conceptual model is relatively easy. When the number of concepts increases, the task may be more difficult. Suitable computer programmes may help in describing more complicated models.

Models 4, 5 and 6 make a network of concepts, where each attribute is in one way or another in relation with other attributes.

Model 7 demonstrates a case where the attributes do not form an uniform model. This kind of broken model may indicate a) that the concepts used do not sufficiently cover a behaviour and the relevance of concepts have to be reconsidered, or b) that a behaviour actually is nonlogical or 'broken'.

6. BUILDING AN INFORMATION STRUCTURE; some remarks

A conceptual model gives a hypothesis of how different things are likely to become related in a real life situation or a process. Thus the analyses presented in this paper are primarily conceptual analyses which produce hypotheses of actual behaviour of supervisors. How well a model represents an actual case should be tested in practice.

An information structure can be built by observations and research, or by theoretical analyses of concepts, or by judgements of an expert and/or a practitioner or a team.

How concept relations are defined in an information structure may be effected by a structure builder's world view and values, especially if a structure is produced by personal judgements.

The following stages in building an information structure are common to all approaches:

1. Select relevant concepts for the information structure.
2. Identify the nature of the concept; use specifications if possible (cf. three attributes in the study demonstrated here).
3. Analyse in each row (or cell) of the matrix how the two concepts in question are related to each other; by using information already available in one or more studies or by constructing hypotheses of the types of relationships.
4. Build the information structure by filling in the information of concept relations into a matrix.

Selection of concepts is a crucial phase; this relates to all analyses to be done by this strategy. Therefore, it is essential to find concepts which cover well enough a phenomenon or a problem under study.

Concepts may be found from various sources. They can be derived from theories or models available or they can be research concepts of one or more studies. Concepts can also be named by one person or a team, e.g. as a part of problem solving or decision making.

It will be reasonable to work on key concepts as early as possible, although the strategy introduced here is sufficiently flexible to accept new concepts into a matrix or to take off concepts which do not appear worth keeping in a structure.

An information structure may include different kinds of concepts, characteristics or elements (semantic, dichotomic or qualities of concepts in more than two categories, e.g. three attribute categories of concepts in Matrix 1.).

Some principles of building an information structure and of analyses of producing information will be discussed in the following.

6.1. Direct and Nondirect Relations

In a matrix of concept relations, an information structure, there can be information of three types of relations: Type 1 (no direct relation between two characteristics), Type 2 (one-way relation) and Type 3 (two-way relation). Information about a type of relation between two characteristics is available in a matrix in two rows concerning these two: combining information in these rows finally defines a type of relation.

Nondirect relations of Type 4 and Type 5 become manifest in a conceptual model, where information of all relations in a given combination is given simultaneously.

6.2. Different Ways to Analyse Relations

As mentioned earlier, building the information structure of the behaviour of supervisors was based on analyses of frequency distributions of factor scores (ibid.57-70). However, it is worth emphasizing that the given approach is only one among many, and not necessarily the best; various other approaches could be developed. Some other ways of acquiring information for a matrix will be introduced here.

There are two main ways to fill a matrix with information:

1. To analyse each concept or subconcept (here: attribute) separately to produce the most typical combination(s) of this attribute with the other attributes included in a matrix. This means analyses by ROWS in a matrix.
2. To analyse relations between two concepts (e.g. here between C1 'general attitudes' and C2 'role stability') by CELLS in a matrix.

A general principle in analysing relationships between concepts was to study the qualities of supervisory behaviour there where they appear most obvious and clear. For instance, attributes in Matrix 1/ row 1 were found by analyses in two samples of interactions (N=100 and N=59) where authoritarian attitudes were strongest as indicated by high factor-scores in Factor 1. Row 1 gives the attributes of other four concepts which are most probable to join to attribute 1a 'authoritarian'(using a procedure based on quartiles and medians of factor score distributions).

An alternative to the analyses by rows is to analyse conceptual relations by cells of a matrix. This makes it possible to use information of correlational analyses, for instance, in building an information structure. Correlational analyses show, however, only linear relations between two concepts.

Finding alternative ways to define concept relations is important, especially if information from different studies is to be integrated in an information structure.

Use of correlation coefficients in defining concept relations is a practical way to bring information from various studies into the same information structure; most quantitative analyses are based on correlations. This does not exclude the use of information in qualitative analyses as well because the relationships can be expressed in the similar way with a direct attention to the qualities of two concepts, for instance: 'the more authoritarian the more unsympathetic' (cf. Matrix 1, cell C1/C5).

A statistically significant correlation between two concepts can result in a cell in one of the following ways showing a linear relationship:

significant
positive
correlation

a	
n	
	b

significant
negative
correlation

	b
n	
a	

A nonsignificant correlation or 0-correlation suggests that there is a nonlinear relation between two concepts. This can be found by analyses of rows. Information of a nonlinear relation between two concepts may appear in the following form in a cell (cf. Matrix 1, cell C1/C2):

		C2
		2a2n2b
1a	a	b
C1 1n		b
1b		n

When the relations are defined by judgements by a researcher or a practitioner or a team, it will be decided at first whether there is a linear or a nonlinear relationship between two concepts. In the case of nonlinearity, there is a need to go into more detailed discussion of the relations on the rows. Only linear relations entitle us to make decisions by cells.

6.3. Asymmetry

A matrix of concept relations is not a correlation matrix, and asymmetry in relations is accepted. Asymmetry is due to nonlinear relationships between concepts included in a matrix.

6.4. Direction of Explanation

Analyses introduced in this paper are primarily analyses of concepts and analyses of conceptual models which can be regarded as hypotheses of an actual behaviour.

Arrows in a conceptual model bring together those properties which together define or specify the content of an attribute in a particular combination.

Another question is how a conceptual model describes an actual behaviour. When a conceptual model is used to describe a behaviour in practice special attention should be paid to relations of Type 2 (one-way relation), which are in a central position to show the dynamical nature of a behaviour (e.g. Model 4, relations 1a/4b, 2b/3a and 3a/5b).

6.5. Integration of Information

An information structure may include information from different studies or other sources. Integration of information will be realized in information structures and in conceptual models when defining relationships between the concepts.

6.6. Universality of Concept Relations

In the earlier paper it was assumed (Konttinen 1973, 31), that the relations of concepts of a behaviour are common to all individuals, but the behaviour of different individuals as described by these concepts may be different. An information structure is a common structure for general and individual descriptions as demonstrated in this paper.

Although relations between concepts can be regarded as general, i.e. as common to most individuals, it does not necessarily mean that the behaviour of each individual could be equally well described by common concept relations. It was stated in the earlier paper (*ibid.*, 32-33) that the relationships between concepts can be considered logical, but the behaviour of an individual can be illogical or contradictory; this may result in a 'broken' model as illustrated in Model 7 or a behaviour may not fit into a model at all.

The principle of universality of concept relations is accepted in this paper with some reservations. There might be cultural differences, for instance, in ways to relate concepts to describe a phenomenon in different cultures. Therefore, the relevance of concepts and concept relations in an information structure should be assessed before using information in a new context.

6.7. Invariancy of Information

The context where information is used finally defines which concepts are relevant to be included in an information structure.

An information structure can be modified or rebuilt according to needs of studies in different contexts or different times. It is sufficiently flexible to accept new concepts in and to give up a concept not considered relevant.

Rebuilding information structures may be an essential task when applying this approach in historical and other analyses of change.

7. STRUCTURE, PROCESS AND CHANGE

A conceptual model shows the dynamic nature of a phenomenon at a given moment. A series of conceptual models in a given period indicate step by step how a process may proceed.

Dynamic description refers here to the use of an information structure to point out relations between concepts and to the use of conceptual models, networks of concept relations, to show the roles different properties play in a given context at a given moment.

Process and change are considered here as partly overlapping. In any change there is an element of process either before the change or as a response to change. A change can be identified here as a change in a conceptual model.

A process does not necessitate a change. It may continue as the same for a period. The dynamic nature of this kind of 'static' process can be found in concept relations of a conceptual model, which is the same throughout a process. This refers especially to processes which maintain a prevailing behaviour or circumstances.

Nevertheless, any process encounters changes in a shorter or longer period of time. An important question is how a change intervenes in a process and how a change could be forecasted or planned.

Planning of change can start from analyses of present information structure and present conceptual model. Quite often there may be a need to start analyses already before a present stage in order to understand better developmental nature of a phenomenon; this emphasizes a need to include historical analyses in planning of change.

A change can be planned by simulations with new conceptual models. Often a change brings new elements into an information structure. In planning of change relevancy of concepts in the structure will be assessed first.

The following example demonstrates how an information structure can be used in analysing possible directions for change. The example is still based on Matrix 1, the information structure of supervisory behaviour, and the analyses are reported in an earlier paper (Konttinen, 1977).

Planning of change aims at finding new directions for change and showing how a change may appear. Another question is how a change could be achieved in practice; this may be a matter of education, counselling or therapy, for instance, and necessitates different planning and various other approaches.

In Table 3 a present supervisory behaviour is described by a combination of attributes with the conceptual model (Phase 1). Then different attribute combinations are produced in order to find a conceptual model, where effects of supervision were as positive as possible. Four alternatives for change are given. Phase 5 supports best positive effect in supervision and the model shows how different elements are closely related together to result in a positive effect (4a).

Table 3 could be regarded here as an example of analysis to find directions for change, but also as a description of a process of change which has already happened.

Table 3. A Change Process/Planning of Change

Attribute combination	Model	
Phase 1. 1b non-authoritarian 2b unstable 3a easy-going 4b negative 5b unsympathetic		
Phase 2. 1b non-authoritarian 2b unstable 3a easy-going 4n neutral 5b unsympathetic		
Phase 3. 1b non-authoritarian 2b unstable 3a easy-going 4a positive 5b unsympathetic		
Phase 4. 1b non-authoritarian 2n neutral 3n neutral 4a positive 5n neutral		
Phase 5. 1b non-authoritarian 2a stable 3n neutral 4a positive 5n neutral		

If analyses in Table 3. are used to demonstrate planning of change, Phase 5 could be selected as a possible direction for changes in supervisory behaviour, because all properties of supervisory behaviour have a direct relationship with positive effect (4a). - This means in practice (compare Phase 1 and Phase 5), that a supervisor's non-authoritarian attitudes (1b) will be supported, his or her skills in supervision need development or training (change from 2b unstable towards 2a stable), the style of supervision will be developed from easy-going (3a) towards slightly more

serious (3n) and there is a need to develop some new ways to communicate with individual trainees (change from 5b to 5n).

As seen above, when an information structure and conceptual models are used in planning, it is possible to produce various alternatives or steps for defining directions for change. How a desired change will be achieved should be planned separately.

If Table 3 is used to describe a process of change which has already happened, Phases 1 to 5 show how the process has developed as indicated by structural changes in conceptual models.

In planning behavioural changes, for instance, it will be realistic to accept that some characteristics in a behaviour are difficult to change. Conceptual analyses give, however, a way to point out perhaps most 'economical' directions for change. For example: if it is considered difficult to change authoritarian attitudes in a behaviour, a change in some other characteristic may result in a behaviour, where the role of these attitudes is less central. A change in one characteristic only may reflect to the whole dynamical nature of a behaviour as shown by conceptual models.

8. POSSIBLE APPLICATIONS OF DCA

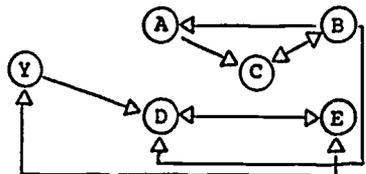
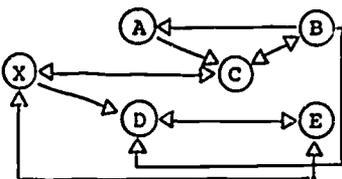
In paragraph 2, the strategy of using information available in an information structure was called Dynamic Concept Analysis, DCA. Examples of possible applications are given in the following. This is not a detailed description of how DCA could be applied, but rather an indication of those areas where it could be valuable.

8.1. Conceptual Analyses

DCA can be used to integrate information from one or more studies in an information structure and to build conceptual models as demonstrated in this paper.

8.2. Analyses of Similarities and Differences Between Concepts

Similarities or differences between two concepts can be analysed by including them in an information structure in a particular context and by comparing conceptual models. If it is argued that two concepts are identical, the relations of these concepts with the other concepts in the structure should also be identical. In the following example concepts X and Y are given in their relations with concepts A, B, C, D and E.



The above models show that there is one difference between concepts X and Y: X has a relation of Type 3 with C whereas Y has a nondirect relation with C. The other relations are identical.

This kind of 'concept laboratory' may be of use, for instance, when selecting concepts for inclusion in an information structure or when there are other reasons for understanding in more detail how two concepts differ from each other.

8.3. Theory Building and Research Design

An information structure is a theoretical framework for analysing a phenomenon. A structure includes information for theory building, i.e. key concepts and their relations. Nevertheless, it was stated earlier in paragraph 5, that a 'theory' cannot be spelt out from an information structure so that all concept relations included in it could be taken into consideration at the same time. This may be the case with theories in general: only subtheories can be specified in the form of conceptual models.

An information structure can be used in planning of research. The research concepts may be derived from theories or models describing a phenomenon or a researcher defines the concepts he is going to work with in a study. An information structure shows various possibilities to focus research. A research task may cover the whole information structure or some parts of it. In some cases it will be enough to study relations between two concepts only to acquire specific information.

An information structure can serve as a theoretical framework for a research project or a particular study. At the beginning of a study the researcher may make hypotheses of concept relations based on earlier research or on his or her

own judgements.

If the information structure is filled in at the planning stage of a study, conceptual models derived from this hypothetical structure may be used to specify a research task.

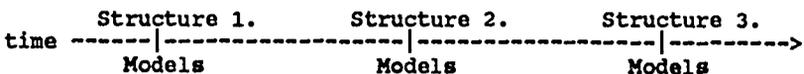
Without going into conceptual models, an information structure may help as such to define a research problem and to make hypotheses. This follows closely the ordinary procedure of planning research (e.g. use of information in previous studies, defining research questions and specifying hypotheses). This approach may, however, help to place a study into a wider framework and to point out various alternatives for research.

The approach can be used at the planning stage of a research without any further claims to apply it otherwise in a study.

8.4. Historical Studies and Analyses of Change

Information structures and conceptual models may be used in historical analyses to describe development of different phenomena in longer or shorter periods; development as indicated in changes in information structures and in conceptual models. The analyses of the process of change given in this paper are equivalent to historical analyses.

The following scheme illustrates how information structures and conceptual models make a chain throughout a period:



Changes in information structures may be caused by changes in the concepts included: new concepts can be added or old concepts taken away.

8.5. Planning of Change and Futures Research

Information structures and conceptual models can be used in describing and structuring a process of change, and in planning change or innovation, i.e. by bringing new elements into an information structure or by finding new ways to combine the present properties. Analyses of change are demonstrated in paragraph 7.

8.6. Educational Planning and Assessment

Education is closely related to the concept of change. Conceptual models can be used in analyses of a present situation or in analyses to produce various alternatives or directions for change as demonstrated in paragraph 7.

In addition, information structures and models can be used as an aid for the assessment of effects of education. This can be done by comparing a conceptual model representing a desired change with a model in a reality where changes aided by education should have appeared.

8.7. Educational Processes

Building information structures and use of conceptual models may be a part of learning and teaching processes. In this case, e.g. in adult education courses, course participants can produce an information structure and build conceptual models. This may happen in cooperation with teachers. Joint planning may be needed to decide what additional information or knowledge should be acquired during the course to achieve better understanding of a phenomenon or a problem under studies.

DCA might also be used in describing educational processes, if there is a need to find structured pictures of how a learning process proceeds.

8.8. Decision Making and Problem Solving

Analyses of change demonstrate in this paper how building an information structure and use of conceptual models might be employed in decision making and problem solving as well. The concepts for analyses will be selected and analysed by a researcher, a problem solver or a consultant.

8.9. Diagnostics

The strategy could be used in analysing complex situations, if there is a need to integrate various types of information, as in psychodiagnostics or in planning or following up psychotherapeutic processes.

8.10. Comparative Studies

The approach may find applications in comparative studies too, when there is an interest to find out, for instance, how a phenomenon exists in two different cultures. This may lead to analyses where information structures are built for both cases separately: this makes it possible to compare similarities or differences in how the 'same' phenomenon is realized in these two cases. It is also possible to study a phenomenon in one culture by conceptual structure of the other in order to understand better differences between the two.

8.11. Innovatory Approaches

To bring present properties to new relations with each other or to bring new elements in connection with the present ones.

8.12. Other Studies

DCA may be applied in various other kinds of research, whenever there is a need to analyse how parts make a whole in complex systems or situations.

9. DISCUSSION

An aim of this paper was to develop a research strategy to combine nomothetic and idiographic approaches so that the same source of information could be used to describe a given phenomenon both in general and in individual cases. An information structure is introduced here as a common basis for conceptual analyses.

Although the general principles of this approach may be accepted, a crucial question will be what are the concepts which become included in a structure and how are the relationships between concepts to be defined. This is not such a crucial question in meta-analyses or when using this approach to clarify personal judgements.

At the metalevel, building conceptual models is a kind of intellectual exercise without any urgent need to prove models true or false. In analyses based on individual judgements, subjectivity in assessments of concept relations will be accepted, and it will be up to an individual to assess information structures and conceptual models derived from them; although use of this approach may often happen with guidance by a specialist or an expert.

A more demanding task is building information structures based on empirical analyses and data, especially if information from different studies is used. This paper gives an example of using frequency distributions in building an information structure and refers to possible use of correlational studies to show linear relationships between two concepts. However, there is a need to find various other ways to define concept relations and to build information structures.

The analyses and demonstrations in this paper are primarily conceptual analyses. This theoretical paper does not go into actual contexts to assess conceptual models, which are regarded here as hypothetical models of actual behaviour, or to assess information structures used as the basis of these analyses.

The analyses given in the paper can be seen as basis for finding a general guideline for conceptual studies; more research and applications are still needed for further development of this research strategy, where an information structure has a central position in building conceptual models for various kinds of analyses as suggested in paragraph 8.

If the general principles of using an information structure for building conceptual models, as presented in this paper, is accepted, conceptual models can be considered as complex networks of concept relations, which illustrate dynamic nature of phenomena and show how a synthesis of relations between different properties may increase understanding of phenomena in a more holistic manner.

Conceptual models can be considered as structured simplifications of a reality and as hypothetical structures of actual life. When speaking about the use of conceptual models in understanding dynamical processes, for instance, it is reasonable to admit that an actual behaviour will not necessarily become sufficiently understood by conceptual models only. Nevertheless, conceptual models can be useful in finding structures which may serve as basis for deeper analyses of a behaviour or a phenomenon.

Analyses in behavioural and educational studies are often done without placing a phenomenon in a wider context; studies may concentrate on some minor details with little or no reference to the context of which they are a part. Infor-

mation structures here are regarded as frameworks for analysing behaviour more comprehensively, i.e. showing a synthesis of relations between different properties in a special context.

When using this approach, it is important to realize, who brings concepts into an information structure and who finally defines the relationships between concepts used as basis for analyses with conceptual models. In this paper the demonstrations were based on an empirical data of a study, and conceptual models were seen as hypothetical models for actual supervisory behaviour. This can be regarded as an example of applying 'theory in practice' assuming that a 'practice' finally tests a 'theory'. The demonstrations in this paper do not, however, go into actual cases. They do not therefore include assessment of the information structure or conceptual models in actual contexts, although this should often be considered as a necessary phase in a study.

In some other cases, producing concepts and defining concept relations and building an information structure may start directly from everyday experiences. This may be a reasonable way in analyses in which attention is mainly paid to structuring ongoing processes or when this approach is used, for example, in decision making and problem solving as suggested above. An information structure is now a hypothetical framework for a 'theory', and its relevance can be considered in relation to theoretical information or knowledge available. This kind of 'practical theories' can play an important role in theory building; e.g. by bringing relevant concepts into analyses.

Information structures derived from practice may as such, without reference to other information or research, help an individual to find a structure for a phenomenon or to build personal models to clarify his or her own life situation as

a complex network of various aspects to be taken into consideration at the same time.

Building an information structure and using conceptual models may be a useful technique in planning of research. An information structure can now serve as a theoretical framework for a study, including the main concepts and their relationships based on previous studies or on a researcher's own judgements.

When studying a complex phenomenon, it is unlikely that there is enough information available to identify all relationships between concepts included in an information structure. 'Empty cells' in a structure reveal what information is especially needed by new research to get a more comprehensive picture of the phenomenon in question. A researcher can, as usually, make his or her own hypotheses of these relations, and they will be taken into account in conceptual models which can be used as hypothetical models to become tested in a study.

In planning research, an information structure can give some detailed information of what kind of information will be needed to understand better a research problem. An information structure may be used as help in selecting or constructing research techniques for quantitative and qualitative analyses. Conceptual models may be used to specify research problems and hypotheses for a study as suggested earlier.

Various possible areas of applying DCA have been tentatively introduced in this paper. The approach is general by nature and it may be of use both in theoretical and empirical studies.

The approach introduced in this paper can use information acquired by different other research methods. The intention here is not to place other methods by a new one, but to find ways to integrate information produced by various methods. A most typical feature of this approach is, however, to show by conceptual models how concept relations vary in different contexts.

It is worth emphasizing once again, that in applying this approach, an information structure is the basis of all analyses. Relevance of an information structure finally determines success or failure in producing valid and reliable pictures of a reality in the form of conceptual models.

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APPENDIX 1. qualities of attributes of the supervisory behaviour

1. General Attitudes	1a authoritarian	1n*	1b non-authoritarian
- personal approach to teaching	inflexible		flexible
- involvement in student's decisions	restrictive		encouraging independence
- reaction to student's opinions	intolerant		tolerant
- moral attitudes	authoritarian		non-authoritarian
- view of teacher's tasks	narrow-ranging		wide-ranging
- personal style of working	fastidious		careless
- general tone of evaluation	negative		positive

2. Role stability	2a stable	2n	2b unstable
- clarity of instructions	clear		unclear
- certainty in making comments	confident		unsure
- relevance of evaluation	relevant		irrelevant
- impartiality of evaluation	impartial		baised

3. Style of Working	3a easy-going	3n	3b serious
- requirements for lesson plans	general		detailed
- personal style of working	careless		fastidious
- attitudes to his/her own work	easy-going		serious

4. Effect of supervision	4a positive	4n	4b negative
- on student's style of working	positive		negative
- on student's self-knowledge	positive		negative
- on student's self-confidence	positive		negative
- on ability to vary teaching methods	positive		negative

5. Attitudes to individuals	5a sympathetic	5n	5b unsympathetic
- attitudes to individual students	concerned		indifferent
- agreeableness	sympathetic		unsympathetic
- general attitudes	non-authoritarian		authoritarian

* 'n' = 'neutral' shows no particular trend towards either of the other two attributes

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