Organizational Diagnosis in Practice: A Cross-Classification Analysis Using the DEL-Technique

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Abstract

In this paper, an empirical research about organizational diagnosis in The Netherlands is presented. Organizational diagnosis is seen as a strategic activity which is determined by the idiosyncrasies of the decision maker. The main research question is whether the usage of the kind of conceptual organizational diagnosis model and computer support in diagnosing problem situations is contingent upon background characteristics of management consultants and their agencies. The DEL-technique was applied to test a number of propositions among 72 respondents of a random sample of 300 Dutch consulting agencies. This cross-classification analysis technique is especially suitable for dealing with small samples. The results indicate that size of an agency, educational specialization, and work experience are important characteristics with respect to the usage of conceptual organizational diagnosis models. Computer support was

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not found to be dependent on management consultant and agency characteristics in the specific hypothesized relationships.

1 Introduction[1]

Organizations are confronted with ever increasing turbulence and uncertainty in their external and internal environments. Organizations have to be flexible, innovative, and competitive in order to stay in business. In practice, different kinds of methods, techniques, rules, and heuristics, combined with theories and theoretical concepts are available for the recognition, diagnosis, and solution of problems in various organizational contexts. Sometimes, management is not able to either carry out organizational inquiry activities or interpret and respond to change signals. In these circumstances, managers can be supported by management consultants (MCs). MCs usually apply theories, models, and theoretical concepts to problem situations in a pragmatic way (Buchanan and Boddy, 1992). Especially, those concepts used in the context of organizational diagnosis activities of MCs are interesting, because there seems to exist a difference between the management consultant practice and the conceptual literature in this field. For instance, Wichard (1994) showed that MCs (especially turnaround and crisis managers) rely more on their previous experience than on formal models.

Organizational change usually involves a research process consisting of different stages. One of the most important stages is organizational diagnosis. Organizational diagnosis can be considered as a special branch of organizational research leading to a set of statements about design options and recommendations for change. Research in this field comprises a range of activities, from organizational assessment (Furnham & Gunter, 1993), aspect-oriented audits and diagnoses (Hofstede et al., 1990), performance measurement (Kaplan & Norton, 1996), to organizational inquiry (Argyris & Schön, 1995). In this paper, these kinds of comparable research activities are referred to as organizational diagnosis (Harrison, 1987; Weisbord, 1993; Howard et al., 1994; Burton

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& Obel, 1995). Organizational diagnosis contains a research approach leading to a statement about the functioning of the organization or a part of the organization related to the problem area of interest. Often, such a statement leads to recommendations to improve the organizational efficiency, organizational effectiveness, or flexibility. Organizational diagnosis activities are generally carried out by specialized internal or external MCs. They use the results of organizational diagnosis to initiate interventions leading to organizational change, for example reorganizations, business process redesigns, outplacements, management buy-outs, strategic alliances, or mergers. Less encompassing organizational improvements, such as internal communication improvements and reduction in absenteeism, may also result from organizational diagnosis. Finally, organizational diagnosis as a research activity contributes to change processes and to learning processes within organizations (Harrison, 1987). A diagnosis research project consists of one or more MCs who use an instrument. This can be 'off the shelf' (general instrument) or 'tailored' to a specific change situation. The instrument may vary from simple checklists to more advanced instruments, such as methods, techniques, models and databases, incorporated into computer systems.

A conceptual organizational diagnosis model[2] usually is the core of an organizational diagnosis instrument (cf. Leavitt, 1965; Weisbord, 1978; Shaw and Woodward, 1990; Gaines et al, 1993; Kaplan and Norton, 1996). The conceptual model is the most important element of an instrument, because it guides the research activities of a practitioner in certain directions. A conceptual model contains components (e.g. task, strategy, people, structure, culture, and technology) and their relationships. The components are directive for search activities. The relationships between these components can be grounded in chosen organizational theories (e.g. see Nadler and Tushman, 1990), in the experience of an MC (a MC-specific model) or a combination of both (e.g. 7-Ss model of Peters and Waterman, 1982). In this respect, a distinction can be made between standard (general) models and customized (problem specific) models (Burke, 1994). The possibilities of computers to support the change-activities of MCs have been recognized (Keen, 1981; Courtney et al., 1987; Benjamin and Scott Morton,

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[2] In the following, we use the term conceptual model in stead of conceptual organizational diagnosis model.

1988; Huber, 1990; Volonino et al., 1992; Baligh et al., 1990, 1992; Burton and Obel, 1995). In addition to existing software packages (e.g. statistical software or spreadsheets), developments in the field of information systems such as Decision Support Systems (DSS) and Knowledge Based Systems (KBS) facilitate the design and selection of diagnosis components for an MCs toolbox (see table 1 for some examples of these systems).

Information systems
OrgCon (The Organizational Consultant; Baligh et al., 1992) can be characterized as an expert system, based on several contingency theories, that operates as a management consultant.
FarSys (Flexibility Audit and Re-design System; Bouma et al., 1992) is a DSS that supports the management consultant in diagnosing organizational flexibility and, if needed, in re-designing the organization according to the FAR-methodology.
SuSyFIM (Support System for Interim Managers; Frowein and Postma, 1992) is a DSS that supports the diagnosis process of interim managers. It is developed in cooperation with an interim management agency and is aimed at small- and medium-sized industrial businesses.
LOES (Logistic Expert System) and INES (Innovation Expert System) are expert systems for supporting logistic diagnoses in manufacturing companies respectively for judging factors that stimulate or impede the innovation potential of a manufacturing company (Hundman et al., 1990).
DeS (Diagnosis Expert System; Tulp, 1992) is an expert system that is part of a research method developed for integral, preventive diagnoses of regional police units.

Table 1: Examples of existing information systems that support organizational diagnosis

Research questions

In a large number of studies,[3] the relationship between organizational diagnosis on the one hand and organizational theories and concepts and the use of computer support on the other has been discussed. Much of this literature focuses especially on theoretical aspects. Only a few studies are empirically oriented. Hardly any papers or studies deal with the actual use of diagnosis models and related computer support by MCs, and the factors which determine this use, such as the problem situation, agency characteristics and MC-characteristics. For example, only in problem situations that are characterized as

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[3] See for instance Huber, 1982; Tichy, 1983; Keen, 1987; Weisbord, 1987; Masuch & LaPotin, 1989; Huber, 1990; Gazendam, 1993; Howard et al., 1994; Burton and Obel, 1995.

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important, complex, and of a repetitive nature, researchers and MCs are prepared to invest in the development of diagnosis instruments and computer systems. In this research, we focus on the characteristics of the agency and the MC. The objective is to make an effort to bridge this perceived gap between academic research and existing management consultant practices. This paper deals with three research questions:

1. Do management consultants use conceptual organizational diagnosis model(s) and computer support in diagnosing a problem situation?

2. What kinds (type and nature) of conceptual organizational diagnosis model(s) and computer support do management consultants apply in diagnosing a problem situation?

Empirical research in related fields shows that characteristics are relevant measures for strategic choices of professionals comparable to MCs, such as accountants, marketers, and top managers (see next section). According to Wiersema and Bantel, (1992) an individual's cognitive base evolves from experience including training and background. Therefore, we expect that choices regarding conceptual models and computer support are contingent upon background characteristics of MCs and their agencies. This leads to the final research question.

3. Is the usage of the kind of conceptual organizational diagnosis model and computer support for diagnosing a problem situation contingent upon background characteristics of management consultants and their agencies?

2 Literature review

Hambrick and Mason (1984) have developed a theoretical model which has been used as a starting point in our research. Their main assumption is that managerial decisions influence organizational outcomes, in contrast to the view of the population ecologists (p. 194). In this respect (and following Child), they introduced the term 'strategic choice'. The strategic choice reflects the idiosyncrasies of decision makers and the exposure to stimuli both within and outside the organization. Analogously, the decisions of MCs to use a specific kind (type and/or nature) of conceptual model and computer support are regarded as strategic in nature. In this paper, strategic choices are determined by two

groups of factors: situational conditions and managerial characteristics. The situational conditions consist of organizational (internal) and environmental (external) stimuli. The internal stimuli are for example organization size (e.g. sales or number of consultants). The external stimuli are the type of problem situation and type of industry. In this paper, we focus on organization size (sales) and the observable managerial characteristics, following Hambrick and Mason (1984) and Wiersema and Bantel (1992). In our case, the observable MC-characteristics are: age, level of education, work experience and educational specialization. The choice for these *observable* MC-characteristics is based on research that found a link between these characteristics and the specific cognitive elements (beliefs, values and abilities) of an individual (Wiersema and Bantel, 1995: 94). As such, the observable internal characteristics can be used as indicators for these cognitive elements. However, limitations of this approach must be taken into account (cf. Norburn and Birley, 1988), such as the relative larger noise in the measurements of these demographic indicators compared to purer psychological measures (Hambrick and Mason, 1984: 196). An advantage, particularly relevant for this research, is that the observable characteristics can be used as policy instruments in the management consultant practice. The relationships between the MC-characteristics and the strategic variables (choices) are visualized in figure 1.
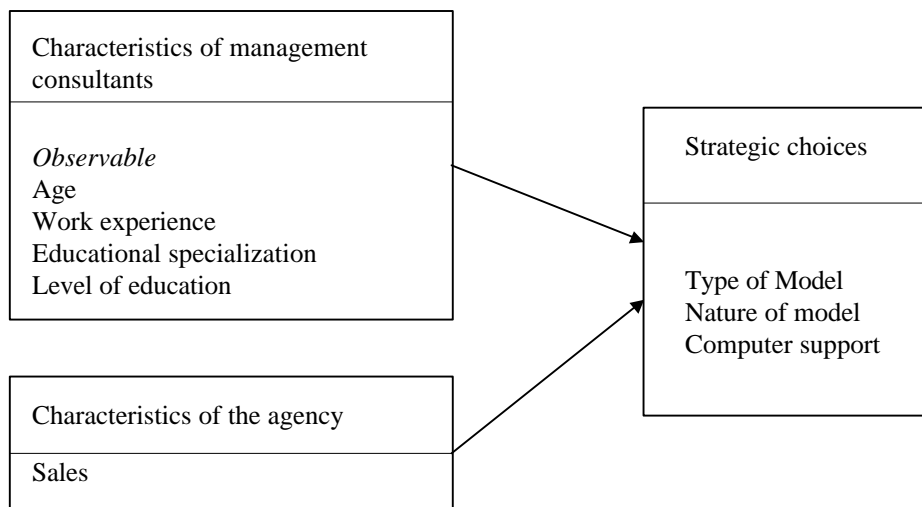

Figure 1: Adapted model based on Hambrick and Mason (1984)

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The three dependent variables in this study are: type and nature of conceptual model and computer support, they are discussed below. Five characteristics were chosen as independent variables: sales of the agency, and the following individual characteristics: age, work experience, educational specialization, level of education. The propositions reflecting the relationships between the dependent and the strategic variables are discussed in section 3.

Conceptual model

There seems to be little doubt in the literature that the conceptual model is the core of a diagnosis instrument. To satisfy a minimum required quality level of the diagnosis research, an MC should be able to articulate his/her model. This is without the regard of the findings in the literature which deal with difficulties in the use of models, due to the existence of informal approaches, intuition, soft data, and biases (Little, 1970; Bazerman, 1986; Russo & Schoemaker, 1989; Mintzberg, 1994). In the literature, no direct indications can be found concerning the relevance and prevalence of conceptual model usage by MCs. However, there are many studies available - especially in the field of marketing, strategic management, and forecasting - that report about the use of explicit formal planning techniques and a broad range of analytical tools and techniques (cf. Hooley, 1984; Mentzer and Cox, 1984; Dalrymple, 1987; Verhage and Waarts, 1988; Nicolai and Postma, 1990; Bood et al., 1994). These studies demonstrate an increasing alertness for and use of formal methods and techniques, and modeling activities in problem-solving situations by especially (top)management, marketers, and staff members of the supportive function. Two kinds of conceptual models are considered relevant in this paper[4]. The 'type of conceptual model' refers to the distinction between theoretical models/concepts and models based on insights of the MC or the agency. It has three states: 'self-made', 'textbook', and a combination of 'self-made' and 'textbook'. The 'nature of conceptual model' is based on the well-known distinction between standard models and customized models. For example, a standard model is used in various problem situations. A customized model is developed for a specific problem situation. It

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[4] There are other model classifications (see e.g. Leeflang, 1987); they are, however, not specific enough for this research.

has two states: 'standard' and 'customized'. In terms of Hambrick and Mason (1984), the specific choices of the states of these two model variables are expected to be contingent upon the five characteristics.

Computer support

Our literature research gave no explicit indications about computer use by MCs. For comparable professional/organizational groups, however, there are sources indicating the relevance and prevalence of computer support. Especially in the DSS-literature, some empirical results can be found. Sanders and Courtney (1985) performed a field study, relating organizational factors and DSS success. Their main findings were that the level of top management support, the user training, and the length of DSS use are important indicators for DSS success. This study shows that personal and organizational characteristics are important indicators for DSS success. A study conducted in 1992 on the use of software applications, planning methods and forecasting methods for strategic management in the Netherlands (Bood et al., 1994) indicated that 82 percent of the respondents used software for strategic management activities (such as net discounted value method: 47 percent; scenario-analysis, simulation, and trend analysis all 38 percent). De Jong et al. (1994) studied marketing decision support systems (MDSS) usage by top management and marketing managers (also other occupational groups were part of the study). One of the main results is that 44 percent of top management and 89 percent of marketing managers uses MDSS. The researchers also considered the impact of personal and organizational characteristics on the use of MDSS.

Furthermore, different case studies are found that report on the development, the characteristics and the usage of specific information systems (e.g. Oral, 1987; Ruohonen & Salmela, 1992). Case findings are, however, of limited value for our purpose. In general, the computer support literature suggests a certain amount of consensus about the support capabilities and potential of computers for different professional or organizational user groups. The future prospects are even better (c.f. Keen, 1987; McNurlin and Sprague, 1989).

The states for the variable 'computer usage', are non-usage, and in case of usage: 'existing software packages' only (e.g. spreadsheets) and 'existing software combined with information systems'.

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3 Development of propositions

To answer research question three, propositions were developed on the basis of theoretical plausible relationships. The following variables are considered in relation to three dependent variables: size, age, level of education, educational specialization, and work experience.

Size

Two dimensions of size are the 'quantity of available resources' and the 'organizational complexity'. With regard to 'organizational complexity', Wiersema and Bantel (1992: 100) state that "largeness should be associated with a low likelyhood of major changes in corporate strategy". This has no implication for conceptual model usage; for computer usage this may mean that larger agencies are less likely to adopt new computer support systems. The resources-argument, however, is more compelling for conceptual model usage. Analogous to medium- and small-sized enterprises, smaller agencies are expected to have less resources compared to the bigger ones (cf. Nooteboom, 1994). If size increases, it may be expected that the number of resources grows in terms of available time to perform innovative research in order to develop new diagnosis concepts, theories or instruments. Sales is chosen as indicator of the quantity of available resources (size). The proposition is that smaller agencies in terms of sales, compared to the larger ones, rely more on textbook models and less on computer support. More generally, size is associated with type of model usage (proposition 1) and computer support (proposition 2). For nature of model no support for a plausible proposition was found in the literature.

Age

Managerial age as a characteristic is expected to influence strategic variables. For instance, Norburn and Birley (1988) and Hitt and Tyler (1991) found that age as a personal characteristic influences strategic decision-making performance. Age

influences information search and processing in decision-making. Taylor (1975) reported that older decision makers seek relatively large quantities of information and process it adequately, but they tend to have difficulty to integrate it to make accurate decisions. Mental and physical capacities seem to be a function of age. Hambrick and Mason (1984) indicate another important aspect of age: "older executives have greater psychological commitment to organizational status quo" (p.198). This has also been suggested by Wiersema and Bantel (1992: 97), who argue that flexibility decreases and rigidity and resistance to change increase as people age. Both aspects of age suggest that older consultants are inclined to stick to their standard models. The proposition accordingly is that older consultants use standard models and younger consultants use customized models. As far as computer support is concerned, the following proposition was developed: older consultants in contrast to younger consultants are resistant to change and are therefore less inclined to use computer support. More generally, age is associated with nature of model usage (proposition 3) and computer support (proposition 4). For the type of model no plausible proposition could be developed.

Level of education

To a certain extent someone's educational background is indicative for a person's knowledge and skill base (Hambrick and Mason, 1984: 200). Hambrick and Mason state that: "the level of education (either of a CEO or other central actors) is positively related to receptivity of innovation", noting subsequently that we must be very careful, because of lacking controls for age in the studies they used. Also, Wiersema and Bantel indicate that: "high levels are associated with a high capacity for information processing and ability to discriminate among a variety of stimuli (1992: 99). The educational background (of leaders) has consistently been found to be related to adoption behavior (Kimberly and Evanisko, 1981: 696). These findings indicate different plausible propositions. The receptivity to and adoption of innovative developments is more related to the usage of computer support. Level of information processing and discriminating ability determine both type and nature of model usage. The proposition is that MCs with an higher level of education are more likely to use self-made models, customized models, and computer support. More

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generally, education is associated with type of model usage (proposition 5), nature of model (proposition 6), and computer support (proposition 7).

Educational specialization

Not only the level of education, but also the educational specialization is important. Educational specialization refers to the different disciplines in which the MC has been educated (such as economics/business administration, psychology/sociology, information sciences/technical sciences, and law/public administration). Hitt and Tyler (1991) indicate that the type of education influences strategic decision-making. According to Wiersema and Bantel "certain academic fields are more oriented towards change than others" (1992: 99/100). Hambrick and Mason (1984: 200) argue that a person's knowledge and skills are affected by the type of education. For instance, "a person educated in engineering can generally be expected to have a somewhat different cognitive base from someone educated in history or law". The proposition is that MCs specialized in economics, business administration, sociology and psychology (have knowledge of and therefore) use textbook or a combination of textbook and self-made models; they also use customized models, because their knowledge of the relevant models allows them to adjust them. MCs specialized in information sciences/technical sciences, and law and public administration use self-made models and use standard models. Kimberly and Evanisko (1981) indicated that they did not find a relationship between educational substance and adoption of administrative innovations. Therefore, a proposition, regarding the relationship between educational specialization and computer support, is omitted. More generally, MCs with different educational specialization make different choices regarding the type of model (proposition 8) and nature of model usage (proposition 9).

Work experience

The duration of work experience, as a management consultant, can be expected to have a significant effect on strategic variables. Kimberley and Evanisko (1981), Hambrick and Mason (1984), Norburn and Birley (1988), Zenger and Lawrence (1989), Hitt and Tyler (1991), and Wiersema and Bantel (1992) indicated experience or a related concept (such as career experience, functional track, organizational tenure) as a relevant characteristic. In this respect, the specific work experience related to the consultancy, and not to the

functional track, is considered relevant. The proposition is that MCs with less work experience use textbook models or a combination of textbook and self-made models and standard models. When they have more work experience, they can use self-made models and customized models (proposition 10 and 11). MCs with less work experience use computer support compared to more experienced MCs to compensate for the lack of knowledge (proposition 12).

4 Methodology

A survey research was conducted to empirically test the propositions. To that aim, a questionnaire was developed, tested, adapted, and subsequently sent to a sample of MC-agencies. In this chapter, the collection, description, and analysis of the data obtained from the returned questionnaires is discussed.

4.1 Data collection

In testing the propositions, a random sample of 300 MC-agencies, located in The Netherlands, was drawn from a listing of 15.000 Dutch management consultant agencies by the Dutch Chamber of Commerce (N.V. Databank). Each agency's managing partner/contact person received one questionnaire. The total number of reactions was 83 (28 percent) of which 72 (24 percent) could be used[5]. The group of respondents corresponds with a cross section of the non-response, and consequently represents the total population of Dutch MC-agencies, with respect to the dimensions spatial differentiation and sales revenues.

4.2 Data description

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[5] This difference is a result of incompletely answered questionnaires.

Table 2 displays the independent variables and the strategic (dependent) variables, which describe the research population. These variables are all categorically (nominally or ordinally) scaled.

Variables	States	Frequency/ percentage	Variables	States	Frequency/ percentage
Independent variables			Dependent (strategic) variables		
Average annual sales of the agency in DFL:	1. < 250,000 2. 250,000 - 500,000 3. 500,000 - 1,000,000 4. 1,000,000 - 5,000,000 5. 5,000,000 > in Dutch guilders (DFL)	47 67.1 14 20.0 4 5.7 4 5.7 1 1.4 -- ----- 70 100.0	Conceptual model usage	1. no model usage 2. in some cases 3. often 4. almost always 5. always	14 19.7 10 14.1 20 28.2 19 26.7 8 11.3 -- ----- 71 100.0
Level of education of MC	1. Intermediate vocational education 2. Higher vocational education 3. University education	5 6.9 28 38.9 39 54.2 -- ----- 72 100.0	Nature of model	1. standard model 2. customized model	15 60 10 40 -- ----- 25 100.0
Educational specialization of MC	1. Economics/Business Administration 2. Psychology/ Sociology 3. Information Sciences/ Technical Sciences 4. Law/Public Administration	20 33.3 11 18.3 20 33.3 9 15.0 -- ----- 60 100.0	Type of model	1. self-made model 2. combination of self-made and textbook model 3. textbook model	13 23.2 27 48.2 16 28.6 -- ----- 56 100.0
Work experience of MC in years	1. 1 - 5 years 2. 6 - 10 3. 11 - 15 4. 16 - 20 5. 21 >	37 51.4 15 20.8 7 9.7 6 8.3 7 9.7 -- ----- 72 100.0	Computer support	1. no computer support 2. existing software packages 3. existing software packages and information systems	27 38.0 36 50.7 8 11.3 -- ----- 71 100.0
Age of MC in years	1. 24 - 33 years 2. 34 - 43 3. 44 - 53 4. 54 - 63 5. 64 >	8 11.1 23 31.9 25 34.7 14 19.4 2 2.8 -- ----- 72 100.0			

Table 2 : Frequencies of the independent and the dependent variables

The sample consists of many small agencies with an average annual turnover of less than DFL 250,000. The MCs in this sample are mostly higher or university educated, are educated in different disciplines, largely have less than 10 years work experience in consulting activities, and are approximately normally distributed about

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the age categories. 80 percent of these MCs uses conceptual models for organizational diagnosis purposes. Standard versus customized conceptual model usage is almost evenly distributed and about 20 percent uses self-made models which are constructed without the use of (a part of) an explicit existing textbook model. Almost 40 percent of the MCs does not use computer support of any kind. Table 3 gives an overview of the different conceptual (textbook) models derived from literature.

Existing textbook Organization Theories/Concepts/Models (62%)		13 respondents	
Author	Theories/concepts/models	Frequency[1]:	
Blanchard et al.	Human Resources Management	1	
Bontje	Corporate Plan (Bo-plan)[2]	1	
De Sitter	Organization as Integral Model[2]		1
Handy	Culture Analysis Model	1	
Kaplan & Norton	Balanced Score Card	3	
Lievegoed	Cloverleaf Model[2]	1	
Mastenbroek	Network Model[2]		1
Mintzberg	Structural Configurations		5
Porter	5 Forces Approach	6	
Peters & Waterman	7 S-model	2	
Steiner	Three Levels Model	1	
Demarco	Structured Analysis/System Specification	1	

Table 3: Existing textbook Organization Theories/Concepts/Models

1 Number of times the theory and/or author was mentioned
2 Publication in Dutch

4.3 Data analysis

Based on the propositions of section 3, three steps were conducted. Firstly, the chi-square-technique was used to perform a cross-classification analysis in order to obtain a picture of the relationships between the variables. The chi-square-analysis showed that the rule of thumb was not met in all cross-tabulations. This rule

requires a minimum expected cell frequency of $c_{ij} \geq 5$ in at least 90 % of the cells. As a result, the Chi-square-results were not used. Secondly, as suggested by Drazin and Kazanjian (1993), the DEL-technique was used as an alternative technique, in which a relationship between the two variables a and b is considered by using a weighting scheme, taking into account the different states of the variables. In that way, patterns of association between the states of the variables could be tested (Kazanjian and Drazin, 1989; Drazin and Kazanjian, 1990).

The DEL-technique is especially suitable for analyzing bivariate data in which a dependent variable's state is predicted from an independent variable's state. Hildebrand et al. (1977) developed the DEL-technique as a statistical procedure for analyzing cross-classification data as an alternative to classical statistical approaches. They concluded that DEL *"satisfies those design criteria that pertain to the measurement of prediction success attained in a population by a bivariate proposition"* (p.104). Drazin and Kazanjian (1993, p.1380) state that the DEL-technique allows a researcher to develop an a priori customized hypothesis that can test a theory of the relationship between the states of two categorical variables. Furthermore, it is independent of sample size and robust for small samples. In this respect, the DEL-technique is superior to other test methods such as Chi-square, Lambda and Tau (Kazanjian and Drazin, 1989: 1496). The essence of the DEL-value is that it can be interpreted as the proportionate reduction in error of knowing the specific hypothesis over not knowing that rule. Drazin and Kazanjian state that DEL provides a measure of strength of association comparable with R^2 (coefficient of determination) in regression analysis and that R is comparable with the correlation coefficient between the variables. See appendix A for a more technical explanation of the DEL-technique.

A number of activities was performed in the DEL-analysis. To apply the DEL-technique and to test the general propositions involving the bivariate relationship between the variables, specific prediction rules were developed, taking into account the categorical nature of nominally scaled variables. A decision had to be made about the specific form of the relationship (prediction rule) which could be used to test the proposition. To underpin this decision, a sensitivity-analysis was performed to choose

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the feasible prediction rules within the theoretical proposition[6]. This sensitivity-analysis was also used to get insight into the DEL-technique and to refine the prediction rules. In most cases, dichotomization was needed to theoretically account for the assignment of the weight classification schemes. These prediction rules were tested in a DEL-mode. Thirdly, another chi-square-analysis was used to compare the Chi-square results with the DEL-results. Also, in this dichotomized case, the chi-square-results did not meet the cell frequency requirements.

5 Results of empirical research

The DEL-mode requires that a rule of thumb is satisfied for using the normal approximation. In this research, the analysis performed with the DEL-technique, satisfies this requirement (the formulas used to compute DEL and its significance are given in appendix A). A positive and significant DEL-value is a good predictor, and a negative DEL-value or a DEL with the value 0 means no predictive value for the proposed prediction rule (Drazin and Kazanjian, 1993).

Table 4 presents the results of the DEL-analysis. Three different weighting schemes (prediction rules) were used for the relationships involving the independent variables: sales, age, level of education, and work experience, resulting in different DEL-values. A DEL-value was calculated based on the prediction rule in which the middle state had no effect (weight of 0.5). Two adjusted DEL-values were calculated to take into account the effect of the assignment of the middle state to either the lower or the higher category. For educational specialization one weighting scheme (representing one straight forward relationship) is tested. Appendix B presents the specific prediction rules.

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[6] A specific prediction rule was developed that related the states of the two variables, to capture the richness of this variable and arrive at a meaningful proposition. Sensitivity analysis was used in the cases no theoretical argument was available to assign the middle states of the variables sales, age, work experience, and level of education to either the lower or the upper states of the same variable.

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Variables	Type of model	Nature of model	Computer support
Sales	Del 1a = 0.140	-	Del 2a = 0.042
	Del 1b = 0.281*	-	Del 2b = 0.019
	Del 1c = 0.214	-	Del 2c = 0.031
Age		Del 3a = -0.029	Del 4a = 0.019
	-	Del 3b = -0.398	Del 4b = 0.043
	-	Del 3c = -0.04	Del 4c = 0.032
Level of education	Del 5a = 0.022	Del 6a = 0.027	Del 7a = -0.031
	Del 5b = -0.015	Del 6b = 0.06	Del 7b = 0.007
	Del 5c = 0.001	Del 6c = 0.045	Del 7c = -0.014
Educational specialization	Del 8= 0.268*	Del 9 = 0.17	-
Work experience	Del 10a = 0.292*	Del 11a = 0.182	Del 12a = -0.038
	Del 10b = 0.397**	Del 11b = 0.386*	Del 12b = 0.049
	Del 10c = 0.349**	Del 11c = 0.286	Del 12c = 0.007

$* = p < 0.05$, $* * = p < 0.01$

Table 4: DEL-values of the prediction rules

Type of model

The dependent variable type of model was hypothesized to be dependent on sales, level of education, educational specialization and work experience. DEL-values of prediction rules 1b, 8 and 10a/b/c are significant which means that sales of the agency, educational specialization and work experience have an effect on the type of model used by the MC. Prediction rule 1b states that MCs working in small agencies (sales lower than DFL 500,000) apply textbook models or a combination of self-made and textbook models, compared to self-made models in larger agencies. Table 4 shows that the DEL-value of prediction rule 1b is 0.281 (truncated) which indicates that there is a reduction in error of 28 percent in knowing the hypothesis over not knowing this rule (α=0.05). The DEL-value can be compared with R^2, a measure of strength of association in regression analysis, which in this case is significant (Drazin and Kazanjian, 1993). It indicates a strong correlation of 0.53 ($\sqrt{0.28}$). Prediction rule 8 states that MCs specialized in economics, business administration, sociology and psychology use textbook models or a combination of self-made and textbook models compared to MCs specialized in information sciences, technical sciences, law, and public administration who use self-made models. This prediction rule is accepted; the DEL-value is 0.27 (α=0.05), the

correlation is 0.52. Prediction rule 10c, which states that MCs with 1-10 years of work experience use textbook models or a combination of self-made and textbook models compared to MCs with more than 16 years work experience who use self-made models, is accepted. Both prediction rules 10a and 10b are accepted as well, but the DEL-value of 10b is higher, indicating that MCs in the middle state (11-14 years of work experience) use self-made models.

Nature of model

The dependent variable, nature of model, was expected to be dependent on age, level of education, educational specialization and work experience. Only prediction rule 11b has a significant effect, which means that work experience determines the nature of model usage. MCs with 1 to 10 years of work experience use standard models compared to MCs with more than 10 years work experience who use customized models.

Computer support

The dependent variable computer support was expected to be determined by sales, age, level of education, and work experience. All these relationships, specified in the three different forms, are not significant, contrary to the effect proposed in the prediction rules.

6 Conclusion and discussion

While much research about organizational diagnosis is conceptual of nature, this study is empirically oriented. We considered conceptual model usage and computer support as strategic variables in the toolbox of the management consultants who perform organizational diagnosis. To be able to get insight into determinants of the strategic variables, we developed a research model in the tradition of Hambrick and Mason (1984).

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Research questions

With respect to the first research question of this paper regarding conceptual model usage, it can be concluded that about 80 percent of the management consultants uses these models. This practical finding is in line with the theoretical notion that the conceptual organizational diagnosis models are a core element of an organizational diagnosis research (Burke, 1994). Also, our study showed that almost 40 percent of the MCs do not use computer support in organizational diagnosis. This is due to (in order of importance): i) no need for computer support/not necessary, ii) no knowledge on/experience with computer, iii) high costs of computer equipment. The figure is, to a certain extent, comparable with the findings of Bood et al. (1994) and De Jong et al. (1994).

The second research question concerns the kinds of conceptual models and computer support used. The results show that standard versus customized conceptual model usage is almost evenly distributed and about 20 percent of the MCs uses self-made models, which are constructed without the use of (a part of) an explicit existing textbook model. With regard to computer support it can be concluded that about 50 percent uses existing software packages (such as spreadsheets, text processors, database management software, and statistical software). Only about 10 percent of the MCs also uses custom-made information systems (such as Decision Support Systems and Knowledge Based Systems).

The third research question concerns the research model. It can be concluded that patterns of association exist between type of model and the characteristics sales, educational specialization and work experience, and between nature of model and the characteristic work experience. These general relationships of the research model are confirmed. However, computer support as a dependent (strategic) variable seems not to be associated with any of the characteristics. No significant pattern of association showed up. This indicates that for the prediction rules the chosen characteristics do not differentiate for the different computer support states. This is in line with the mixed results of Dyck and Al-Awar Smither (1994) and Colley et al. (1994). To arrive at these results, it was necessary, in our opinion to consider two adjusted DEL-values. Although the DEL-method asks for a priori prediction rules to be tested, we allowed for minor variation in the prediction

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rules within the theoretical proposition. In general, it can be concluded that insignificant results do not necessarily mean that no relationship exists between two variables, however, it does mean that the specific prediction rule is rejected.

These findings implicate that size of an agency, educational specialization, and work experience are important characteristics regarding the usage of conceptual models for organizational diagnosis. Especially, educational specialization and work experience are potential policy instruments for MC-agencies. The choice of specific MCs (as model-users) and job tenure influences the way conceptual models are used. This research also underline the basic theoretical proposition of Hambrick and Mason (1984) that strategic choices reflect the idiosyncrasies of the decision maker.

Methodological remarks

Firstly, a remark can be made on both Chi-square analyses. These analyses showed that for all bivariate relations tested in the cross-tables more than 10 percent of the cells in every single cross-table has a theoretical frequency which is lower than 5. The results of the Chi-square analyses therefore, can not be considered reliable. This is a consequence of the relatively small sample. Secondly, as stated in section 4 the DEL-technique is more robust for small samples and more specific hypotheses can be tested. In general, when the null hypothesis is rejected, it may be concluded that the variables are not independent, a *specific* relationship exists. By performing a sensitivity analysis of the DEL-results (especially by varying the weighting schemes and by recoding the variables) we found that it is important to precisely formulate the relationship between the states of the variables in the hypothesis. Within the context of the propositions the variables could be recoded in varying ways to combine the different states in different ways. In most cases, the variables were dichotomized. On the one hand, this resulted to a certain extent in a loss of information. On the other hand, we were able to arrive at significant and more reliable results. By using these sensitivity analyses, however, we were able to find different theoretically plausible relations. In this way, it was possible to refine the original (general) propositions. However, a slightly different relationship resulting in a slightly different weighting scheme has implications for the strength of the proposed hypothesis and its significance. For example, the strength of the

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relationship between work experience of MCs and nature of model can be enhanced and becomes significant, by changing the weights only in a minor way (e.g. from DEL = 0.286 and p = 0.087 to DEL = 0.386 and p = 0.036). In our opinion this is a very important feature of the DEL-technique which seems to be neglected by Drazin and Kazanjian (1990; 1993). This also means that when (using a certain weighting scheme) the null hypothesis is not rejected, it can *not* be concluded that no (other) relationship exists at all between the variables (reflecting a different weighting scheme and concomitant prediction rule).

Limitations and future research

This research is based on a questionnaire that partly measures judgments of MCs. As such the obtained 'expertise' is of course subjective and personal (see Vickers, 1983). Another limitation of this kind of research is the risk that 'espoused' theory or socially accepted behavior is measured. However, we tried to reduce this by not asking any information on performance. The current study has also some limitations with respect to construct validity, internal validity, and reliability. The independent and strategic variables are all specified as stated in table 2. Their choice and different states, which are based on face validity, reflect to a certain extent some subjectivity. However, sensitivity analyses (e.g. by dichotomizing variables) were performed to minimize the problems related to the states of the variables. The research model is based on a number of direct relationships between independent and strategic variables. The internal validity of the research model as measured by these relationships needs to be established more thoroughly, for instance by gaining insight into the way the various independent variables are clustered and/or influence each other. In future research also these mutual relations between the independent variables could be taken into account. With respect to reliability, we conclude that although the DEL-method can be used and generates representative results, we would like to have more data to be able to use other methods and obtain more robust results.

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Appendix A: The DEL-technique

The formulas of DEL and its variance (Hildebrand et al., 1977) refer to the sampling condition in which neither set of marginal proportions (probabilities in the population) is known to the researcher and neither set of sample totals is fixed.
Values of DEL are calculated according to formula 1:

$$(DEL =) \; \nabla \; = \; 1 - \frac{\sum_i \sum_j w_{ij} \; f_{ij}}{\sum_i \sum_j w_{ij} \; f_{i.} \; f_{.j}}$$

where
$w_{ij} =$ Weight for i^{th} row and j^{th} column, 0 for predicted cells and 1 (or less) for error cells,
$f_{ij} =$ Cell probability for the ith row and j^{th} column,
$f_{i.} \, , f_{.j} \quad = \qquad$ Marginal probabilities for the ith row and j^{th} column, respectively.

The variance of DEL is approximated by formula 2:

$$Var \, (\nabla) \; \cong \; (n - 1 \,)^{-1} \, [\; \sum_i \sum_j (a_{ij} \,)^2 \; f_{ij} \; - \; (\; \sum_i \sum_j a_{ij} \; f_{ij} \;)^2 \,]$$

$$a_{ij} \; = \; (\; \sum_i \sum_j w_{ij} \; f_{i.} \; f_{.j} \;)^{-1} [\; w_{ij} \; - \; B \, (\boldsymbol{p}_{i.} \; + \; \boldsymbol{p}_{.j}) \,]$$

$$B \; = \; (\; \sum_i \sum_j a_{ij} \; f_{ij} \;)$$

$$\boldsymbol{p}_{i.} \; = \; \sum_j w_{ij} \; f_{.j} \qquad \boldsymbol{p}_{.j} \; = \; \sum_i w_{ij} \; f_{i.}$$

where
$n =$ Total frequency in the cross classification table.
The hypotheses are tested against the normal tables using the estimated Z statistic.
The hypotheses are: H_0: DEL = 0.0 vs H_a: DEL > 0.0

In this research the hypotheses consist of 0s and 1s which implies that the numerator of the expression of DEL has a binomial distribution. The probability distribution of DEL which is a linear function of the numerator is also binomial. A rule of thumb for using the normal approximation of the binomial distribution safely with small- or moderate-sized samples is presented by formula 3:

$$\frac{5}{n} \leq (\Sigma_i \Sigma_j \ w_{ij} \ f_{ij}) \leq 1 - \frac{5}{n}$$

To improve the quality of the normal approximation of the binomial situation a continuity correction is used. The corrected expression is represented by formula 4:

$$est.Z = \frac{\nabla^+}{[\ est.var \ (\nabla) \ ]^{1/2}}$$

$$\nabla^+ = 1 - \frac{(\Sigma_i \Sigma_j \ w_{ij} \ f_{ij}) + \dfrac{0,5}{n}}{\Sigma_i \Sigma_j \ w_{ij} \ f_{i.} \ f_{.j}}$$

Appendix B Prediction rules

Prediction rule 1a: MCs working in small agencies (sales < DFL 1,000,000) apply textbook models or a combination of self-made and textbook models, compared to self-made models in larger agencies.

Prediction rule 1b: MCs working in small agencies (sales < DFL 500,000) apply textbook models or a combination of self-made and textbook models, compared to self-made models in larger agencies.

Prediction rule 1c: MCs working in small agencies (sales < DFL 500,000) apply textbook models or a combination of self-made and textbook models, compared to self-made models in larger (sales > DFL 1,000,000) agencies. MCs working in agencies which generate sales in the category DFL 500,000 - DFL 1,000,000 could either use textbook models (or a combination) or self-made models.

Prediction rule 2a: MCs working in small agencies (sales < DFL 1,000,000) do not make use of computer support, compared to those working in larger agencies who do.

Prediction rule 2b: MCs working in small agencies (sales < DFL 500,000) do not make use of computer support, compared to those working in larger agencies who do.

Prediction rule 2c: MCs working in small agencies (sales < DFL 500,000) do not make use of computer support, compared to those working in larger agencies (sales > DFL 1,000,000) who do. MCs working in agencies which generate sales in the category DFL 500,000 - DFL 1,000,000 do either use or do not use computer support.

Prediction rule 3a: Young MCs (24-53 years) use customized models and older MCs (> 53) use standard models.

Prediction rule 3b: Young MCs (24-43 years) use customized models and older MCs (> 43) use standard models.

Prediction rule 3c: Young MCs (24-43 years) use customized models and older MCs (> 53) use standard models. MCs in the age category 44 - 53 years use either customized models or standard models.

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Prediction rule 4a: Young MCs (24-53 years) make use of computer support and older MCs (> 53) do not.

Prediction rule 4b: Young MCs (24-43 years) make use of computer support and older MCs (> 43) do not.

Prediction rule 4c: Young MCs (24-43 years) make use of computer support and older MCs (> 53) do not. MCs in the age category 44 years - 53 years either use or do not use computer support.

Prediction rule 5a: MCs with intermediate or higher vocational education use textbook models or a combination of self-made and textbook models, and MCs with university education use self-made models.

Prediction rule 5b: MCs with intermediate vocational education use textbook models or a combination of self-made and textbook models, and MCs with higher vocational education or university education use self-made models.

Prediction rule 5c: MCs with intermediate vocational education use textbook models or a combination of self-made and textbook models, and MCs with university education use self-made models. MCs with higher vocational education use either textbook models (or a combination) or self-made models.

Prediction rule 6a: MCs with intermediate or higher vocational education use standard models and MCs with a university degree use customized models.

Prediction rule 6b: MCs with intermediate vocational education use standard models and MCs with higher vocational education or university degree use customized models.

Prediction rule 6c: MCs with intermediate vocational education use standard models and MCs with university degree use customized models. MCs with higher vocational education either use standard models or customized models.

Prediction rule 7a: MCs with intermediate vocational or higher vocational education do not make use of computer support, compared to MCs with a university degree who do.

Prediction rule 7b: MCs with intermediate vocational education do not make use of computer support, compared to MCs with a higher vocational education or a university degree who do.

Prediction rule 7c: MCs with intermediate vocational education do not make use of computer support, compared to MCs with a university degree who do. MCs with higher vocational education do either use or do not use computer support.

Prediction rule 8: MCs specialized in economics, business administration, sociology and psychology use textbook models or a combination of self-made and textbook models compared to MCs specialized in information sciences, technical sciences, law, and public administration who use self-made models.

Prediction rule 9: MCs specialized in economics, business administration, sociology and psychology use customized models compared to MCs specialized in information sciences, technical sciences, law, and public administration who use standard models.

Prediction rule 10a: MCs with 1-15 years of work experience use textbook models or a combination self-made and textbook models, compared to MCs with > 15 years of work experience who use self-made models.

Prediction rule 10b: MCs with 1-10 years of work experience use textbook models or a combination self-made and textbook models, compared to MCs with > 10 years of work experience who use self-made models.

Prediction rule 10c: MCs with 1-10 years of work experience use textbook models or a combination self-made and textbook models, compared to MCs with > 15 years of work experience who use self-made models. MCs with 11 - 15 years of work experience either use textbook models (or a combination) or self-made models.

Prediction rule 11a: MCs with 1-15 years of work experience use standard models compared to MCs with > 15 years work experience who use customized models.

Prediction rule 11b: MCs with 1-10 years of work experience use standard models compared to MCs with > 10 years work experience who use customized models.

Prediction rule 11c: MCs with 1-10 years of work experience use standard models compared to MCs with > 15 years work experience who use customized models. MCs with 10 - 15 years of work experience either use standard models or customized models.

Prediction rule 12a: MCs with 1-15 years of work experience do not make use of computer support, compared to MCs with > 15 years of work experience who do not use computer support.

Prediction rule 12b: MCs with 1-10 years of work experience do not make use of computer support, compared to MCs with > 10 years of work experience who do not use computer support.

Prediction rule 12c: MCs with 1-10 years of work experience do not make use of computer support, compared to MCs with > 15 years of work experience who do not use computer support. MCs with 10-15 years of work experience do either use or do not use computer support.