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CEOs' COGNITIVE MAPS AND THE SCOPE OF THE ORGANIZATION

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In this paper, CEOs are considered as 'cognizers' charged with integrating views in the top management team; a role which should require high cognitive complexity especially in diversified multinational corporations. A methodology for studying top managers' cognitive complexity is described and then applied to a sample of 26 CEOs. The CEOs' cognitive maps of the structure and of the dynamics of their industry are analyzed in terms of their degree of complexity, in relation to the breadth of the business portfolio of the firm, its geographic scope and the links the firm has with foreign parents. The results of this exploratory test generally confirm the principle of requisite cognitive complexity, and reveal a new set of more precise hypotheses linking particular dimensions of the scope of the firm with particular dimensions of CEOs' cognitive complexity.

Strategic problems and strategic decision making are complex (Mintzberg, Raisinghani, and Theoret, 1976; Lyles and Mitroff, 1981; Mason and Mitroff, 1981; Cray *et al.*, 1991). Environments become more complex as international competition and knowledge flows develop (Porter, 1986; Melin, 1992); and the scope of some diversified multinational companies (DMNCs) adds even greater complexity (Prahalad and Doz, 1987). Firms, industries and business environments may be considered as systems and their level of complexity can be conceived of in terms of systems theory: the number of elements in the system and the number of links between elements, representing the variety of the system (Ashby, 1956, 1958; Beer, 1966). The diversity of businesses in diversified companies (Prahalad and Bettis, 1986) and the diversity of countries in multinational companies (Prahalad and Doz, 1987) create high levels of variety, that top managers have to deal with in making strategic decisions. In diversified companies there may be some synergies or sharing of resources but variety dominates: each business requires a specific strategy corresponding to specific 'rules of the game' played with specific actors. In international/multinational companies, the diversity of countries (in terms of customer behavior and management practices) requires local adaptations; there may be some global integration, but global strategy needs to be balanced with local demands (Prahalad and Doz, 1987).

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MANAGING COMPLEXITY

According to Chandler (1962) and Bower (1972) the complexity of diversified firms is resolved by means of organizational structures (such as divisionalization), and by adequate administrative mechanisms. Businesses with similar strategic characteristics are grouped into 'sectors' or 'strategic business units.' SBU managers make strategic decisions for their business. The corporate level influences the business unit level by orchestrating the organizational context. Arguably, the same kind of organizational design can be applied to multinational activities (divisions corresponding to geographic areas) in order to reduce the strategic variety that top managers have to deal with at the corporate level.

However, according to Prahalad and Bettis (1986: 496) 'Organizational structure can attenuate the intensity of strategic variety that corporate level management must deal with, but it cannot substitute for the need to handle strategic variety at the corporate level.' Prahalad and Doz (1987) also argue that while adequate organizational structures are necessary, they are not sufficient to manage diversified multinational corporations (DMNCs). In DMNCs, top managers have to cope with complexity through managing a global matrix, with a variety of management tools, but also by developing a world view or mindset (Prahalad and Doz, 1987).

Prahalad and Bettis (1986: 485) coined the terms 'dominant logic' to define the '. . . mental maps developed through experience in the core business and sometimes applied inappropriately in other businesses.' When businesses are dissimilar, top management should presumably create the capacity for multiple dominant logics to coexist and develop a 'meta-learning in which the dominant coalition learns to simultaneously conceptualize different type businesses' ((Prahalad and Bettis, 1986: 485). Ginsberg (1990) also argues that the management of diversified companies requires an adequate level of 'socio-cognitive' complexity at the level of the top management team. According to Bartlett and Ghoshal (1989) managing a 'transnational' company has more to do with developing managers than with designing structures and procedures: 'Diverse roles and dispersed operations must be held together by a management mindset that understands the need for multiple strategic capabilities, views problems and opportunities from both local and global perspectives, and is willing to interact with others openly and flexibly. The task is not to build a sophisticated structure, but to create a matrix in the minds of managers' (Bartlett and Ghoshal, 1989: 212).

'Mental maps,' 'meta-learning,' 'mindsets;' all these terms refer to the concepts of cognitive structure and cognitive complexity of the top managers. In line with the arguments summarized above, we suggest that, as well as adopting adequate administrative mechanisms, handling diversity requires high cognitive complexity from top managers in order to embrace the complexity of his or her environment. We focus on the particular case and role of the chief executive (CEO), in this respect, we propose a methodology to measure cognitive complexity, and apply it in an exploratory test of the relationships between the scope of the company and the cognitive complexity of the CEO.

THE CEO AS A 'COGNIZER'

The Chief Executive has been characterized as a decision-maker (e.g., Learned, Christensen, and Andrews, 1961), as a visionary leader (e.g, Bennis and Nanus, 1985), and as a political actor (e.g., Greiner, 1986). In their claim for more research on 'upper echelons' Hambrick and Mason (1984) argue that the strategies and the effectiveness of an organization are reflections of the values and cognitive bases of its powerful actors, among whom is the strategic leader (see also Schwenk, 1988). Strategies are abstractions in the mind of managers (Mintzberg, 1987); they emerge from sets of ideas and constructs through which problems are identified and interpreted (Hedberg and Jönsson, 1977). Although several actors may interact through social interchange to produce collective interpretations, top management is responsible for providing organizations' interpretations of their environment and strategic responses (Daft and Weick, 1984; Smircich and Stubbart, 1985). 'Indeed, the imposition of meaning on issues characterized by ambiguity has become a hallmark of the modern top manager' (Thomas, Clark, and Gioia, 1993: 240).

Decision-makers construct simplified mental models when dealing with complex problems (Simon, 1957; March and Simon, 1958; Simon,

1976). They may be subject to selective perception since they are unable to evaluate comprehensively all variables relevant to a decision (Tversky and Kahneman, 1974; Hogarth, 1980; Mason and Mitroff, 1981; Schwenk, 1988). For instance, research has identified simplifications and biases in executives' maps of their industries (Shrivastava and Lim, 1984; Stubbart and Ramaprasad, 1990). Such simplifications and heuristics are useful however. Without such cognitive structures decision-makers would become paralyzed by the need to analyze extensive ambiguous data (Weick, 1979; Daft and Weick, 1984; Hogarth, 1980; Walsh and Fahey, 1986). The simplified abstract cognitive structures developed by managers help them to cope with decision-making complexities (Kiesler and Sproull, 1982).

This duality raises the issue of the adequate level of cognitive simplicity vs. complexity in a given situation, and the question of the development of individuals' cognitive structures. Confronted with new or changing environments, managers are likely to deal with the situation within the bounds of existing cognitive structures (Johnson, 1988). It is typically after a phase of unlearning (Hedberg, 1981), perhaps prompted by threat or crises, that managers reconceive of situations outside that cognitive structure (Argyris and Schön, 1978, Grinyer and Spender, 1979). Some environmental events will be retained and included in the knowledge structure thus causing a new association to be developed (Meyer, 1982). Simple structures may therefore develop over time into complex ones by the inclusion of new experiences (Schank and Abelson, 1977; Lyles and Schwenk, 1992).

As noted by Walsh and Fahey (1986) there is no agreed terminology to denote the key construct of this theory of managerial cognition: mental maps, frames of reference, mindsets, cognitive base, beliefs, schemata, cognitive structures, cognitive maps are all mutually substitutable labels. In line with Huff (1990) we will use the term 'cognitive map' except when referring to a particular author, in which case the original term used by the author will be preferred. There is more agreement in defining individuals' cognitive complexity, according to complexity theory, the complexity of an individual conceptual system is determined by two interdependent aspects: the number of parts or dimensions of the system and the nature and extent of rules for integrating these parts (Schröder, Driver, and Streufert, 1967; Streufert, 1972, 1973; Stabell, 1978). The ability to perceive several dimensions in a stimulus array is referred to as differentiation or comprehensiveness and the development of connections among the differentiated characteristics is referred to as integration or connectedness (Bartunek, Gordon, and Weathersby, 1983).

REQUISITE COGNITIVE COMPLEXITY

Studying the relationship between the cognitive complexity of the chief executive and managerial effectiveness or firm performance raises some theoretical issues. Decisions are often taken by a top management team, going through a political process of bargaining among the members of the team and other stakeholders (Ford and Baucus, 1987). In consequence it may be more appropriate to study the socio-cognitive complexity of the team (Ginsberg, 1990), and the processes of influences within the team in trying to reach consensus. As Prahalad and Bettis (1986) argue: the variety of dominant logics that a top management team (TMT) can handle depends on the composition of the team.

However, we suggest that the CEO has a particular *integrative* function within the top management team. Whatever the level of agreement and the distribution of power in the TMT (Walsh and Fahey, 1986) the chief executive has to integrate views. High cognitive complexity and diversity among the team can be highly dysfunctional unless integration is achieved (Crossan, 1991). Particularly socio-cognitive complexity may be dysfunctional in the implementation of strategy (Ginsberg, 1990). Given his/her position in the TMT, the CEO can, then, be viewed as a cognitive integrator, the architect of a 'congregate map which must match the variety, equivocality and crypticality of the combined strategy and social system phenomena,' (Bougon, 1992: 385). In order to play this integrative role the CEO may need high cognitive complexity as suggested by the arguments developed by Bartunek *et al.* (1983: 274). People with a higher level of cognitive complexity tend to have a higher tolerance for ambiguity, assume leadership roles (Streufert, Streufert, and Castore, 1968), are more capable of taking the perspective of others (Triandis, 1977), and of

resolving conflicts cooperatively (Eiseman, 1978). In short, the tolerance for divergent perspectives may be crucial for CEOs in TMTs facing complex environments; and the leader's level of cognitive complexity should have significant effects throughout the organization (Bartunek *et al.*, 1983).

In his study among chief executives of 24 small Swedish firms involved in the construction of prefabricated houses, Häckner (1991) found that the relationship between the CEOs' cognitive complexity and the performance of the firm followed an inverted U-shaped curve. In that research the degree of complexity of the environment was kept constant across cases. However, the degree of environmental complexity may influence the degree of cognitive complexity (Hedberg and Jönsson, 1978). Thus the relationship between cognitive complexity and performance should be moderated by the degree of environmental complexity. In line with Ashby's Law of Requisite Variety (1956; 1958) and with Weick (1979), we argue that, in order to be effective, CEOs need to develop the ability to generate several interpretations of events so that the variety in their understanding matches the variety of the situation. In other words, in complex situations high cognitive complexity should lead to more accurate perception and more effective behavior (Bartunek *et al.*, 1983).

In building and testing a theory of the moderating effects of environmental complexity on the relationship between CEOs' cognitive complexity and performance, the first step is to analyze the relationship between the level of environmental complexity and the CEOs' cognitive complexity. This is the aim of our research.

The complexity of the environment of the CEO can be considered in two ways: the scope of the company, defined here as the number of businesses and the geographic scope, which determines the number of competitive systems in which the firm is involved; and the intrinsic complexity of each of these competitive systems. As it is difficult to measure the intrinsic complexity of a competitive system objectively, we measured complexity by an objective assessment of the scope of the company.

The relationship between the scope of the company and the cognitive complexity of the CEO should be twofold: a broad scope should require higher cognitive complexity, as suggested by Prahalad and Bettis (1986) and Prahalad and Doz (1987); and a broad scope should be a source of learning from diversity, as suggested by Hedberg and Jönsson (1978).

In order to demonstrate the relationships between the scope of the organization and the structure of top managers' cognitions, individual factors which could affect executives' cognitive complexity should ideally be controlled. Individual factors include: the executives' personal background (Dearborn and Simon, 1958; Martin, 1982; Fiske and Taylor, 1984; Hambrick and Mason, 1984; Haley and Stumpf, 1989; Hitt and Tyler, 1991), their cognitive style (Hurst, Rush, and White, 1989) and their personal network of social interactions (Schrank, 1978).

Both environmental circumstances and individual characteristics shape managers' cognitive maps. Whilst we recognize the importance of the individual factors, this research focuses on the link between the scope of the company (as a measure of environmental complexity for the CEO) and the cognitive complexity of the CEOs who have to cope with variety.

MEASURING COGNITIVE COMPLEXITY: INTERVIEWS AND COGNITIVE MAPPING

The first methodological choice was between content free measures of cognitive complexity (see Schröder *et al.*, 1967) and measures based on the content of the issue addressed in the research—here the CEO's understanding of the environment. We opted for the second solution considering that the interpretation of the relationships would be more instructive and that the interest manifested by the CEOs would be higher.

The CEO's understanding of his/her business environment (or industry) can be analyzed in two ways. Lenz and Engledow (1986) consider environmental analysis models in terms of 'assumptions about environmental structure' and 'origins/processes of environmental change.' Similarly, in the field of cognitive analysis, Piaget (1987) made a distinction between 'figurative structures,' which are mental representations of a structure and 'operative structures,' which are mental representations of the transformation process of a structure. We studied these two interdependent aspects: the CEO's understanding

of the structure of the environment of the firm (in terms of actors in the system and links between actors), and the CEO's understanding of the dynamics of the environment (in terms of forces and relationships between forces).

Cognitive mapping has proved to be a useful way of representing strategists' understanding of environment and industry forces (Schwenk, 1988). Huff (1990: 41) suggests that mapping managers' interpretations of the environment can help to show how 'elements of the environment are categorized and evaluated' and 'indicate how the initial definition of a situation changes over time.' Cognitive mapping has been used for instance to uncover competitive positioning as perceived by managers (Porac, Thomas, and Emme, 1987; Thomas and Porac, 1990; Reger, 1990). According to Huff and Fletcher (1990: 403–404): 'Cognitive mapping is a form of content analysis. . .(but) in cognitive mapping it is the relationship between cognitive elements that is being studied. Some cognitive maps are subject to quantitative analysis, but the central benefit of the cognitive map, is that it encourages holistic synthesis rather than reductive analysis of the actor's view of the world.'

Two aspects of a cognitive map can be analyzed (Reger, 1990; Häckner, 1991):

— the content of the map in the sense of the meaning it embodies,
— the configuration of the map, for instance in terms of cognitive complexity (Streufert and Swezey, 1986).

In this research, we are only interested in the *configuration* of the maps. Indeed maps such as those presented in Figures 1 and 2 give a direct view of the level of complexity (number of concepts and number of links). For each manager two maps could be drawn:

— a map representing the perceived structure of the environment (cf. Figure 1),
— a map representing the perceived dynamics of the environment (cf. Figure 2).

We considered several approaches to eliciting cognitive maps. Prahalad and Bettis (1986) argue that a person's theory in use cannot be obtained simply by asking for it and recommend the use of creative questionnaires and analysis procedures. Ginsberg (1989: 417) notes 'the paucity of methods suitable for operationalizing the subjective characteristics of managerial mental maps into quantitative and reproducible measures;' and proposes the use of repertory grid techniques in order to elicit and quantify top managers' cognitive maps. Repertory grid techniques (Kelly, 1955) have been used to elicit constructs and map competitors according to these constructs (Reger, 1990). Repertory grid techniques are more rigorous than in-depth open-ended interviews, but some researchers report boredom from the interviewees (Brown, 1992; Reger and Huff, 1993). The 'Self-Q' Technique developed by Bougon (1983) could be useful in analyzing top managers' understanding of the dynamics of their environment, if the number of constructs were not limited in the phase of elicitation of the relationships between constructs. Laddering techniques (Fransella and Bannister, 1977; Hinkle, 1965) could also be used in interviewing managers on cause–effect relationships describing the dynamics of their environment. But again these are lengthy procedures. In order to cover the scope of our research—perceptions of the structure (competitors, markets, other stakeholders) *and* of the dynamics of the environment—we would have had to combine these techniques. Interviews following such protocols would have been excessively long. Some CEOs may be reluctant to follow the protocols, or may shorten the interview. As acceptance by a pre-determined sample of chief executives was crucial to the purpose of this research, we opted for a more simple interview method.

We chose in-depth open-ended interviews which are less rigorous, but are well accepted by CEOs and allow the elicitation of the most salient concepts. Such interviews are widely used by researchers analyzing managers' cognitive maps (among others: Häckner, 1991; Cossette and Audet, 1992; Eden and Ackermann, 1992). In order to reduce the possible biases from in-depth loosely structured interviews several precautions can be taken (see Eden and Ackermann, 1992). These include: allowing sufficient time for discussion; controlling the skills of the interviewer; correcting biases introduced by the interviewer; controlling the coding skills of the analysts; using coders with similar skills; establishing a precise protocol for coding; defining as precisely as possible the level of analysis;

weighting concepts; checking intercoder reliability; controlling for the length of the interview; and getting feedback on the resulting map from the manager interviewed. When such precautions are taken, open-ended in-depth interviews offer a reasonable compromise between technical value and acceptability by a predetermined sample of chief executives.

HYPOPTHESES

Given the influence of the executives' cognitive structure on strategic decisions and the integrative role of the CEO in the top management team, we argue that the relationship between the CEO's cognitive complexity and the performance of the CEO, of the top management team (and possibly the organization) is moderated by the complexity of the environment. The first step in testing this proposition (and the empirical aim of this research) is to demonstrate that the cognitive complexity of the CEO is related to the level of complexity of the environment. As suggested by the literature on diversified multinational companies, the scope of the firm is a relevant first level 'objective' measure of the complexity of the environment of the CEO. Thus the general proposition is the following: the broader the scope of the firm, in terms of diversity of businesses and geographic scope, the higher the cognitive complexity of the CEO.

Concerning the diversity of businesses, the two dimensions of complexity 'comprehensiveness' (number of constructs) and 'connectedness' (density of links between constructs) need to be distinguished from each other. If the CEO simultaneously has to conceptualize different types of businesses then the number of constructs in the CEO's cognitive map should be higher (comprehensiveness). On the other hand, as the businesses are different, the CEO's cognitive map may be chunked into separated clusters of constructs corresponding to the different businesses (Baddeley, 1983; Eden and Ackermann, 1992). In this case, the level of connectedness will be lower. Thus the hypotheses relating to the degree of diversity of businesses are the following:

Hypothesis 1-1: In firms with a high diversity of businesses the CEOs' cognitive maps of the environment are more comprehensive than the ones of the CEOs of focused firms.

Hypothesis 1-2: In firms with a high diversity of businesses the CEOs' cognitive maps of the environment are less connected than the ones of the CEOs of focused firms.

Geographic diversity is an ambiguous concept. A firm may sell its products/services worldwide from a focal point established in a single country, in this case top managers will face a diversity of markets. However, a multinational (Prahalad and Doz, 1987) or a transnational firm (Bartlett and Ghoshal, 1989) has operations worldwide and top managers face both the diversity of markets and the diversity of management practices in their interactions with parent companies. Hypotheses linking CEOs' cognitive complexity with geographic scope should distinguish between these two aspects:

Hypothesis 2-1: In firms with an international geographic scope the CEOs' cognitive maps of the environment are more complex than the ones of the CEOs of firms with a national geographic scope.

Hypothesis 2-2: In firms which belong to multinational groups (i.e., have links with foreign parent companies) the CEOs' cognitive maps of the environment are more complex than those of the managers of independent firms.

The next section discusses the methodology employed for exploring these relationships.

METHODOLOGY

We selected 12 French companies and 14 British companies involved in four industries: brewing, car manufacturing, retail banking and book publishing. The industries were selected to represent a spectrum in terms of products and services, levels of concentration (from low in retail banking, to high in car manufacturing and variable by country as in brewing), the geographic scope of the market (from mainly national in retail banking, to global in the car industry) and degrees of local specificity (high in brewing in

product terms and in publishing with regard to language). Further, we sought an equal number of firms in each industry in the two countries and a split between large and small firms; and specialist vs. generalist firms. The sample is shown in Table 1.

Data on the scope of the company were collected from documentary sources (annual reports, industry studies and the business press).

The diversity of the business portfolio of a firm in the industry was evaluated by the number of products × markets, in terms of three categories: focus on one business/a few businesses/ most of the businesses of the industry.

The geographic scope of a firm was evaluated by the geographical limits of its targeted markets in the industry, according to three categories: national/national and a few foreign countries/ international (several major foreign countries).

The interactions with a parent company were evaluated according to three categories: independent company/belongs to a group from the same country/belongs to a multinational group from a foreign country.

Top managers' perceptions of the environment

The data on top managers' understanding of the business environments were collected by open ended interviews as explained earlier. Twenty-six chief executives participated (24 CEOs and 2 General Managing Directors). The interviews took place in the period from January 1990 to April 1990. The interviews were loosely structured, though grounded on two broad questions designed to surface the CEOs' strategic thinking about their industry and their firm:

(a) 'What main changes do you expect in your industry in the 90s?'
(b) 'What changes are you thinking of for your company in the 90s?'

Though both questions were about change, managers also discussed the present configuration of the industry. In this way they surfaced explanations of both structure and dynamics in terms of this research. The interviews lasted from one hour and a half to two hours and a half, and all were tape-recorded and translated into English. In general about two-thirds of each interview were concerned with the first question, though many managers mixed discussion of their company with discussion of industry and competitive forces, confirming that the conventional distinction between environmental and organizational factors is typically blurred (Dill, 1962). Many of the interviews were highly discursive in nature with managers ranging over issues they chose to emphasize. Where managers were less forthcoming two forms of prompts were employed: first, neutral conversational prompts; and second more specific prompts based on conventional framework of industry analysis: competitors, customers, suppliers, new entrants, substitute technologies, state(s) intervention(s) (Porter, 1980), and sources of competitive advan-

Table 1. Sample of companies

Scope of the company	Brewing	Car	Retail banking	Book publishing	Total
Focus on one industry segment	1	1		3	5
A few segments	3		1	1	5
All segments in the industry	5	2	6	3	16
National	3		3	2	8
National and a few foreign countries	1	1	4	3	9
International (several major foreign countries)	5	2		2	9
Independent	3		4	4	11
Belongs to a national group	3	1	3	1	8
Belongs to a multinational group	3	2		2	7
	9	3	7	7	26

tage and industry segmentation (Porter, 1985). However in order to reduce the biases created by such specific prompts, we distinguished spontaneous answers from prompted answers in the analysis, deleting all answers to prompts which did not prove to be a crucial point further in the discussion.

Content analysis

Content analysis was used to surface cognitive concepts and links beween such concepts (Holsti, 1969). The analysis of the data involved four steps.

Phase one: Surfacing first order concepts and links

Interview transcripts were analyzed according to the four broad analytical dimensions defined *ex ante*: concepts describing the industry structure, links between concepts describing structure, concepts describing the industry dynamics and links between concepts describing the industry dynamics.

As suggested by Stubbart and Ramaprasad (1990) the level of analysis (in terms of abstraction, and aggregation) is a key issue in content analysis. We only retained 'core-constructs' which were central to the reasoning of the managers (Eden and Ackermann, 1992) and we gave an overview of the cognitive map, by collapsing details into larger cognitive units (Anderson, 1983). Links may sometimes just reflect the nature of verbal argument in interview conditions, so we only retained links which were explicitly mentioned by the interviewee. For each analytical dimension *first order concepts and links* were identified *ex post* by two analysts working separately on each transcript. The first order concepts and links (or codes) were identified in terms of the exact wording used by the informants (cf. Van Maanen, 1979).

Discrimination in coding between 'structure' and 'dynamics' was undertaken according to precise conventions.

— all actors or groups of actors in the system mentioned by the manager were considered as elements of the structure of the industry; then explicit mention of links were sought for,

— all actors, groups of actors or other characteristics of the system which were explicitly associated with the notions of 'change,' 'transformation,' 'evolution,' 'development,' 'variation,' and their synonyms were considered as elements of the dynamics of the industry; then explicit mention of links between these elements were sought for.

In some cases the same concept could appear among the elements of the perceived structure and the elements of the perceived dynamics by a given manager, if, and only if, it represented an actor explicitly involved in the transformation of the industry.

The elements of Figures 1 and 2 are examples of concepts and links which emerged from the content analysis of the interviews. For instance (cf. Figure 1) for the CEO of one of the retail banks, the control by the U.K. Mergers and Monopolies Commission is one of the concepts in the structure of the industry; and the alliance between the Royal Bank of Scotland and the Bank of Santander is one of the links considered as important in the structure of the industry. For the same CEO (cf. Figure 2) the vulnerability of building societies is one of the forces he sees driving the dynamics of the industry and its positive impact on new competitors' entry on the British market is one of the links in the dynamics of the industry. Altogether the 26 interviews contained 301 different first order concepts of industry structure and 210 different first order concepts of industry dynamics.

Phase two: Weighting concepts

The importance of each concept for each manager was also assessed. Each concept was weighted according to four criteria: explicit mention of its importance by the manager; spontaneity; priority in the interview; and relative length of the discussion on the theme. This weighting is shown in Figures 1 and 2 by the use of asterisks, four asterisks meaning high on the four criteria. In further analyses we retained the concepts which scored on at least one of these criteria.

Possible biases were reduced in two ways. First it was recognized that the interviewers themselves could have introduced bias into the data by prompting a particular theme during the interviews. In order to reduce such bias, a concept mentioned after a prompt was retained

only if it scored in two of the three other criteria (explicit mention of importance by the manager, priority in the interview, and length of the discussion on the theme). In order to reduce bias in content analysis, the identification of concepts and weightings were undertaken separately by two analysts and then compared (but we did not have the opportunity to appoint a third 'candid' analyst, i.e., unaware of the hypotheses). Where weightings differed by a factor of 2 or more, the weightings were averaged. However, differences by a factor of 2 or more were only found for a total of 31 concepts across 11 of the 26 cases; and differences such as concepts identified vs. not identified were found for a total of 15 concepts across 6 of the 26 cases. Considering these levels of divergence intercoder reliability was 90.8 per cent.

Phase three: Surfacing second order categories

Second order categories were identified *ex post* from the list of first order concepts and links. The second order categories represented attempts to classify concepts at a higher level of abstraction. The following second order categories of concepts describing the industry structure emerged: the company, customers, distributors, competitors, suppliers, regulators (government, EEC, etc.) and lobbies. Five second order categories of links between concepts of industry structure were found; dependence, direct competition, pressure, cooperation, similarities and differences in behavior. Six second order categories of concepts describing the industry dynamics were found: changes in context, strategic moves of actors, changes in structure, technology, industry output and key success factors. Three second order categories emerged describing the links between concepts of industry dynamics: proximity, equivalence of concepts (similarities or differences) and causal relationships (positive or negative). The second order categories were *only used to organize* the cognitive maps in the fourth phase; the elements of the cognitive maps being the first order concepts and links.

Phase four: Cognitive mapping

Two maps were drawn for each CEO. The first map on the perceived structure of the industry corresponds to generic families 1 and 2 described by Huff (1990): 'Maps that assess attention and importance of concepts' (family 1) and 'Maps that show dimensions of categories and cognitive taxonomies' (family 2). The second map on the perceived dynamics of the industry corresponds to the generic family 3 described by Huff: 'Maps that show influence, causality and system dynamics'. Figures 1 and 2 show two cognitive maps from the 52 that were drawn. Figure 1 shows the perceptions of the *structure* of the industry from the CEO of a retail bank and Figure 2 shows the perceptions of the *dynamics* of the industry from the same CEO.

Each cognitive map was drawn using the first order concepts and links between concepts discussed by the manager and organized according to the second order categories found in phase three. For instance all the competitors (category) are positioned in a particular zone of the maps of the structure, all the regulators (other category) are positioned in another particular zone of the map of the structure. The links between concepts of the dynamics of the industry are drawn according to the following categories:

— proximity (——)
— equivalence (— = — or — ≠ —)
— causality (— + → or — − →)

The links between actors in the system are represented by lines with a mention of the type of relationship: (—O—)

Measuring complexity: Comprehensiveness and connectedness

Cognitive maps give a direct view of the complexity of the perception of a manager and allow straightforward calculations of scores of comprehensiveness and connectedness. Langfield-Smith and Lewis (1989) give a review of possible measures.

From the possible measures, we chose the best suited to a visual evaluation of maps.

- The complexity of a CEO's cognitive maps of the structure of the environment was measured by three variables:

— the comprehensiveness of a manager's map of the structure of the industry was measured by the number of elements (concepts) in the map (cf. Langfield-Smith and Lewis, 1989),

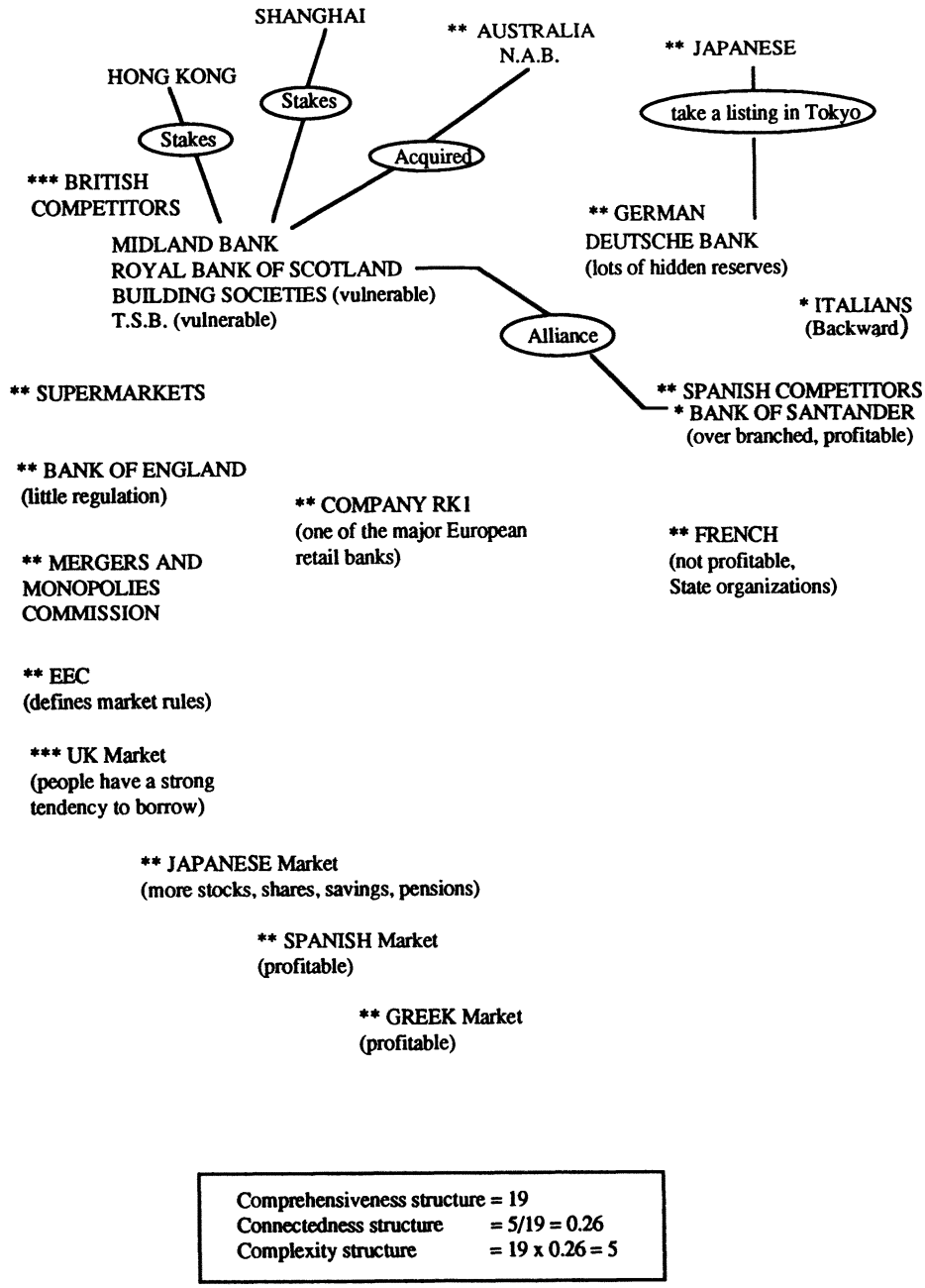

Figure 1. Cognitive map/structure (Retail banking). CEO firm RK1

— the connectedness of a manager's map of the structure of the industry was measured by the number of links between concepts divided by the total number of concepts in the map (cf. Häckner, 1991),

— we also used a combined measure of comprehensiveness and connectedness—i.e., complexity—of a manager's cognitive map of the structure of the industry: the number of links between concepts in the

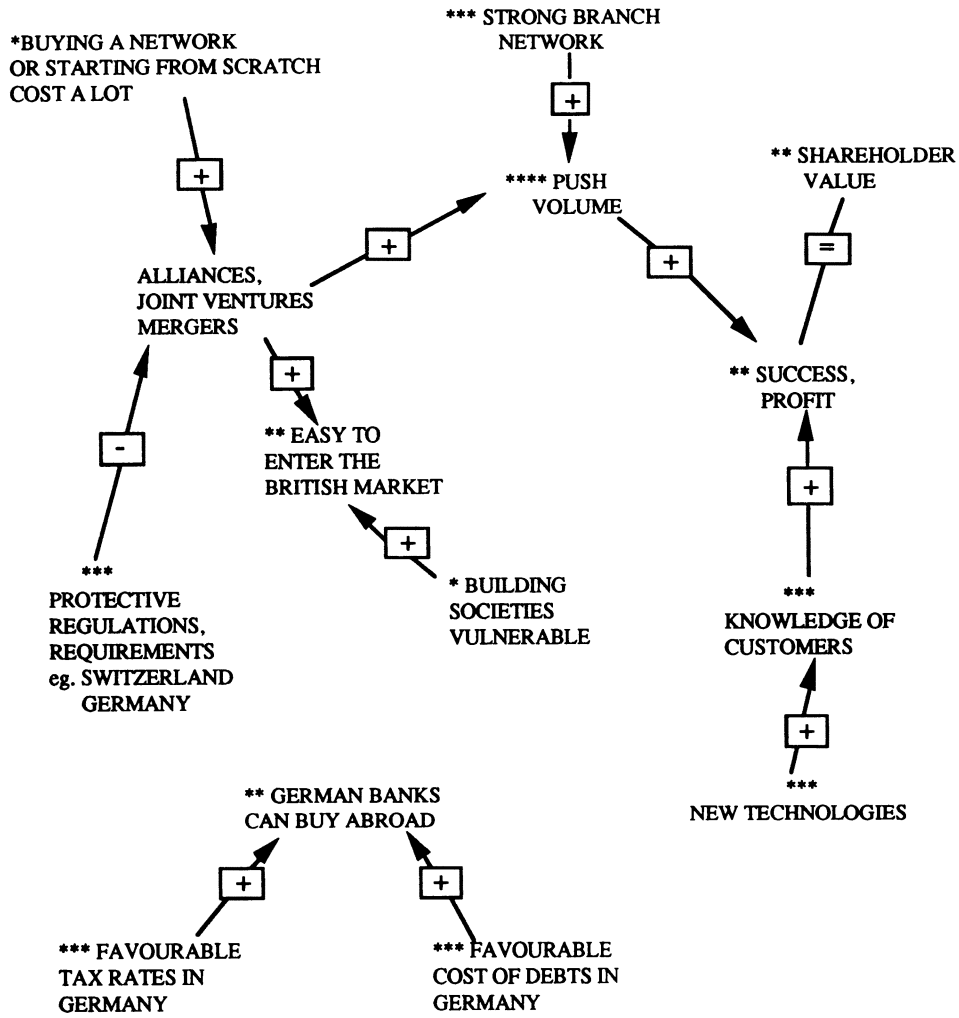

Figure 2. Cognitive map/dynamics (Retail banking). CEO firm RK1

map (i.e., the score of comprehensiveness multiplied by the score of connectedness).

- The complexity of a CEO's cognitive maps of the dynamics of the industry was measured by three variables:

— the comprehensiveness of a manager's map of the dynamics of the industry was measured by the number of concepts in the map (cf. Langfield-Smith and Lewis, 1989),

— the connectedness of a manager's map of the dynamics of the industry was measured by the number of concepts in the largest submap divided by the total number of concepts in the map (cf. Langfield-Smith and Lewis, 1989). A submap is a subset of elements of

the map (concepts) linked together directly or indirectly; the largest submap is the one which includes the most elements linked together,

— we also used a combined measure of comprehensiveness and connectedness—i.e., complexity—of a manager's map of the dynamics of the industry: the number of concepts in the largest submap (i.e., the score of comprehensiveness multiplied by the score of connectedness).

For illustrative purposes Figures 1 and 2 also give the scores on the six variables for the CEO of a retail bank.

CEOs' cognitive maps of the structure of their industry were found to include from 9 (minimum) to 34 (maximum) concepts, the average being 17.9 and the standard deviation 6.6. The number of links pointed out between actors varied from 2 (minimum) to 7 (maximum), the average being 3.5 and the standard deviation 1.1. The number of links explicitly mentioned between concepts (here actors in the system) was relatively low. This may, of course, be partly a consequence of our interview and analytical conventions given that we did not prompt on possible links between actors, or count as links the perceived similarities between the elements of a category mentioned by the interviewers: for instance, in Figure 1, the similarities between the four companies mentioned as 'British competitors.'

CEOs' cognitive maps of the dynamics of their industry included from 6 (minimum) to 16 maximum concepts, the average being 9.9 and the standard deviation 2.6. The average number of concepts included in the managers' cognitive maps of industry dynamics was similar to the numbers found by Spender (1989) or Häckner (1991). These numbers may seem low when compared with some other cognitive maps (see Eden and Ackermann, 1992); however this may be explained by the loose structure of the interviews and most of all by our decision to collapse details into core constructs for analytical purposes. Nonetheless, it seems that a limited number of core constructs is sufficient to explain the dynamics of a competitive system, at least from the point of view of a CEO. The largest submaps of the dynamics of an industry included from 3 (minimum) to 16 (maximum) concepts; the average was 7.5 and the standard deviation 3.3 (i.e., on average 7.5 concepts of the map were linked together, either directly or indirectly, in the largest submap).

In order to demonstrate the relationships between the scope of the organization and the structure of top managers' cognitions, other possible sources of cognitive complexity such as the complexity of the industry and individual factors should ideally be controlled. Here we were able to control for the complexity of the industry, but not for the managers' personal characteristics; because of the high diversity of the top managers' backgrounds and the limited number of respondents in our study. We acknowledge that our inability to control for individual factors may limit the explanatory power of our findings.

Controlling for the complexity of the industry

Industries vary in their complexity; as the top managers interviewed belonged to companies in four different industries, industry complexity had to be controlled for. For instance, in the car industry, global competition, technological issues and networks of alliances may increase the complexity of the competitive system; on the other hand the book publishing industry is still mainly domestic and relatively protected by linguistic and cultural barriers. So, in order to study the relationships between the scope of the organization and the configuration of the top managers' cognitive maps, we standardized the variables measuring comprehensiveness, connectedness and complexity. The standardization was done by dividing the original values of the variables by the average for the corresponding industry. For instance, the comprehensiveness of a manager's cognitive map of the structure of the industry 'i' is:

$$\frac{\text{number of concepts in the manager's cognitive map}}{\text{average number of concepts in the cognitive maps of the managers in industry 'i'}}$$

And so on for all the variables measuring comprehensiveness and connectedness. Standardized measures were used in all further analyses.

Controlling for the length of the interview

It was recognized that differences in the length of the interviews could bias the measurement

of comprehensiveness: the longer the interview, the more concepts in the map. Several factors could affect the length of the interview: one manager might have more to say than another (though in this case there would be no bias); the manager's agenda might have curtailed or allowed a lengthier interview; and of course the behavior of the interviewer may influence the length of the interview. The length of the interview was measured by the number of words. Actually correlations between the length of the interview and measures of comprehensiveness and connectedness only showed a significant relationship with the comprehensiveness of the maps of the dynamics ($r = 0.48^*$). The probabilities of significant relationships with the other dimensions of complexity were low. However, we decided to control for the length of the interview in all further analyses in order to produce more reliable results and to correct possible biases from the respondent and from the interviewer.

Testing relationships between dependent variables

We assumed that comprehensiveness and connectedness were not related to each other. However, in order to test for the possible relationships between comprehensiveness and connectedness we computed standardized partial correlation coefficients between the two variables after controlling for the length of the interview. The results of the multiple regressions show that the measures of comprehensiveness and connectedness are not positively correlated. The comprehensiveness and the connectedness of the maps of the structure are weakly and negatively correlated (Beta = -0.43^*); the comprehensiveness and the connectedness of the maps of the dynamics are not correlated (Beta = 0.02). On the other hand (as expected), the combined measure of complexity of the maps of dynamics (number of concepts in the largest submap) correlates with both comprehensiveness (Beta = 0.77^{***}) and connectedness (Beta = 0.66^{***}). As expected the combined measure of complexity of the maps of structure (number of links between concepts) correlates with comprehensiveness (Beta = 0.41^*) and with connectedness (Beta = 0.62^{**}).

Data analysis

The variables describing scope were all nominal level; the variables measuring standardized comprehensiveness, connectedness and complexity were ratio level. As we had to control for the length of the interviews, 18 analyses of covariance were performed (ANCOVA) with (successively) each dimension of cognitive maps by (successively) each dimension of scope, with the length of the interview as a covariate. When significant differences were found, Duncan's multiple range test was computed to compare groups.

RESULTS

The results of the analyses of covariance isolate several significant relationships between the CEOs' cognitive complexity and the scope of the organization; the presentation of the results focuses on these, and on one relationship approaching significance. The relatively low levels of variance explained probably arises from the small size of the sample and from the uncontrolled variance due to individual factors and specific firms' strategies.

Cognitive complexity and diversity of the portfolio of businesses

Table 2 summarizes the results concerning the relationships between the CEOs' maps of the dynamics of the industry and the diversity of the portfolio of businesses.

Hypothesis 1-1 is not supported, the differences in the average scores of comprehensiveness between the three categories (focused/several businesses/all the businesses in the industry) are not significant, however they seem to follow the expected pattern with high comprehensiveness in diversified firms and low comprehensiveness in focused firms. The differences between the average scores of connectedness between the three categories approach significance. In firms with a diversity of businesses the CEOs' cognitive maps of the dynamics of the industry seem to be less connected than the maps of the CEOs in focused firms, in line with Hypothesis 1-2.

The ratio measure of connectedness (number of concepts in the largest submap divided by the

Table 2. Diversity of businesses and complexity of the maps of the dynamics of the industry

Dependent variable	Standardized comprehensiveness/ dynamics			Standardized connectedness/dynamics		
Factor	Diversity of businesses in the industry			Diversity of businesses in the industry		
Covariate	Length of the interview			Length of the interview		
Main effect	$F = 0.70$		sig : 0.51	$F = 2.30$		sig : 0.12
Covariate	$F = 1.73$		sig : 0.20	$F = 0.00$		sig : 0.96
Multiple R^2		$R^2 = 0.12$			$R^2 = 0.17$	
	nb of cases	Mean	S.D.	nb of cases	Mean	S.D.
G1 : focused firms	5	0.89	0.21	5	1.19	0.22
G2 : several businesses	5	1.00	0.17	5	0.97	0.09
G3 : all businesses in the industry	16	1.03	0.27	16	0.95	0.24
Duncan's multiple range test					Group 1 > Group 3 (under the 0.10 level)	

total number of concepts) should be borne in mind. It may be that the diversity of products-markets leads to CEOs coping with such diversity through what amounts to chunking (Baddeley, 1983), leading to a number of submaps. A visual comparison of the maps in the two extreme categories (focused/diversified) confirms this finding. The existence of several submaps disconnected from each other results in a low score of overall connectedness. In the terms used by Prahalad and Bettis (1986: 498) it shows that top managers in diversified companies 'simultaneously conceptualize different type businesses,' they have in mind several coexisting logics.

Considering that the scores of comprehensiveness were not significantly higher in diversified companies, the results suggest that chief executives simplify their cognitive maps of the dynamics of each business in diversified firms. This finding also reveals a complementary measure of comprehensiveness (differentiation), which should be used in further research: namely the number of submaps (subsystems) in the manager's cognitive map.

Cognitive complexity and geographic scope

In firms with an international geographic scope the CEOs' cognitive maps of the structure of the industry are more comprehensive than those of CEOs in firms with a national scope. This finding supports Hypothesis 2-1. Table 3 gives more information on this significant relationship.

Chief executives of firms which serve an international market have more competitors and market segments to consider and the diversity of world markets leads to more strategic groups of competitors and market segments in the cognitive maps. This result might seem self-evident; we argue it is not. As the opening question of the interview was very broad, CEOs in international companies were free to simplify or reduce their views of the structure of the market as they wished. CEOs in companies with a national scope were free to widen their views of the structure of the industry to the international scene: and it is quite conceivable they might do so bearing in mind that they could be competing in their home market with international competitors or, more generally, that they may be affected by international actors (for instance the EEC, or international distributors) in a world economy. This result also shows that the experience of international operations could be a source of learning, untapped by top managers in firms with a national scope. The connectedness of the maps of the structure of the industry is not related to the geographic scope of the company (as shown in Table 3). However, the combined measure of complexity of the CEOs' cognitive maps of the structure (comprehensiveness × connectedness) is weakly related to the geographic scope of the firm (under the 0.10 level), thus supporting Hypothesis 2-1. In firms with an international geographic scope, the CEOs' cognitive maps of the structure of the industry are more complex

Table 3. Geographic scope of the firm and complexity of the maps of the structure of the industry

Dependent variable	Standardized comprehensiveness/ structure			Standardized connectedness/ structure			Standardized complexity/structure (i.e. nb of links)		
Factor	Geographic scope			Geographic scope			Geographic scope		
Covariate	Length of the interview			Length of the interview			Length of the interview		
Main effect	$F = 5.55$*		sig : 0.01	$F = 0.92$		sig : 0.41	$F = 2.79$†		sig : 0.08
Covariate	$F = 1.44$		sig : 0.24	$F = 1.10$		sig : 0.30	$F = 0.17$		sig : 0.69
Multiple R^2	$R^2 = 0.36$			$R^2 = 0.12$			$R^2 = 0.21$		
	nb of cases	Mean	S.D.	nb of cases	Mean	S.D.	nb of cases	Mean	S.D.
G1 : National (scope of the firm)	8	0.80	0.17	8	1.07	0.51	8	0.82	0.23
G2 : National and a few foreign countries	9	1.06	0.23	9	1.09	0.26	9	1.17	0.38
G3 : International (several major foreign countries)	9	1.12	0.22	9	0.86	0.22	9	1	0.22
Duncan's multiple range test	Group 3 > Group 1 Group 2 > Group 1 (under the 0.05 level)			N.S.			Group 2 > Group 1 (under the 0.05 level) Group 3 > Group 1 (under the 0.10 level)		

*Significant under the 0.05 level.
†Significant under the 0.10 level.

than the ones of the CEOs in firms with a national scope.

Cognitive complexity and links with foreign parent companies

Table 4 summarizes the results on the relationships between the CEOs' maps of the dynamics of the industry and the links the firm may have with (national/foreign) parent companies.

The comparison of the cognitive maps of the dynamics shows that the differences in the average scores of comprehensiveness between the three categories (independent/links with a parent group from the same country/links with a multinational group from a foreign country) are not significant. However, they seem to follow the expected pattern (higher in firms linked with parent companies). On the other hand, there is a significant relationship (under the 0.10 level) between the connectedness of the CEOs' cognitive maps of the dynamics and the links with an international foreign parent. In line with Hypothesis 2-2, in firms belonging to a multinational foreign group the CEOs' cognitive maps of the dynamics are more connected than the ones of the CEOs in independent firms. When the two measures are combined (comprehensivenss × connectedness) the level of cognitive complexity is significantly related to the links the firm has with foreign parents. In firms belonging to a multinational foreign group the CEOs' cognitive maps of the dynamics of the industry are more complex than the ones of the CEOs in independent firms, thus supporting Hypothesis 2-2.

Within a multinational group, the chief executive of a division or a subsidiary has to deal with relatively high complexity: through relationship with other units of the group in other countries, and relationships with the headquarters. These interactions with other managers of the group involved in different environments could also be sources of learning. The necessary bargaining with the headquarters or other units in the matrix may develop a particularly rich understanding of strategic issues concerning the dynamics of the industry.

DISCUSSION

Considering the small size of our sample, this study can be viewed as exploratory. However, it is a first empirical validation of the propositions made by Prahalad and Bettis (1986), Prahalad and Doz (1987) and Bartlett and Ghoshal (1989) concerning the requisite complexity of the CEOs' cognitive maps in diversified firms and in multinational corporations. The statistical results concerning the relationship between CEOs' cognitive complexity and business diversity did not fully support the two original hypotheses, but they are consistent enough to encourage further empirical testing. The two other hypotheses were partly supported: the top managers of firms with an international geographic scope have more complex cognitive maps of the structure of their environment than the other CEOs; and the top managers of firms related to foreign parents have more complex cognitive maps of the dynamics of the environment than the top managers of independent firms. The results confirm empirically the complexity of the task of reconciling forces of integration and forces of local adaptation, in combining product lines, geographic areas and functional specialities (Prahalad and Doz, 1987; Bartlett and Ghoshal, 1989). In such situations top managers have complex cognitive maps because they have to cope with the variety of the environment through more complex understanding and because they learn from such variety.

Further, it is important to note that the dimension of scope related to the complexity of top managers' understanding of the structure of the industry—namely geographic scope—is different from the dimension of scope related to the complexity of top managers' understanding of the dynamics of the industry—namely links with a foreign parent company. Such differences confirm the importance of a twofold analysis of managerial understanding of the environment in terms of structure and dynamics: the way managers see the world and the way managers see the world changing.

The different relationships found in this research also have more specific implications. In the case of diversified companies there is a juxtaposition of schemas in the CEOs' cognitive maps of the dynamics of the environment and a simplification of each dynamic schema specific to a business. International scope adds new actors and categories to the environment considered by the top manager, the cognitive map of the structure is enriched by new concepts but the

Table 4. Links with (foreign) 'parent' companies and complexity of the maps of the dynamics of the industry

Dependent variable	Standardized comprehensiveness/ dynamics			Standardized connectedness/ dynamics			Standardized complexity/dynamics (i.e. largest submap)		
Factor	Links with 'parent' companies			Links with 'parent' companies			Links with 'parent' companies		
Covariate	Length of the interview			Length of the interview			Length of the interview		
Main effect	$F = 1.14$		sig : 0.34	$F = 2.58$†		sig : 0.09	$F = 3.16$†		sig : 0.06
Covariate	$F = 1.79$		sig : 0.19	$F = 0.00$		sig : 0.96	$F = 0.92$		sig : 0.35
Multiple R^2	$R^2 = 0.16$			$R^2 = 0.19$			$R^2 = 0.25$		
	nb of cases	Mean	S.D.	nb of cases	Mean	S.D.	nb of cases	Mean	S.D.
G1 : Independent	11	0.91	0.21	11	0.91	0.26	11	0.81	0.29
G2 : Belongs to a group from same country	8	1.06	0.19	8	0.98	0.16	8	1.05	0.31
G3 : Belongs to a multinational (foreign country)	7	1.07	0.31	7	1.15	0.20	7	1.24	0.41
Duncan's multiple range test	N.S.			Group 3 > Group 1 (under the 0.05 level)			Group 3 > Group 1 (under the 0.05 level)		

†Significant under the 0.10 level.

complexity of the understanding of the dynamics is not affected. In Piaget's terms (Piaget, 1937) there is 'assimilation' but not necessarily 'accommodation' of the mental schemes; there is an increase in the quantity of knowledge. The interactions with other managers from foreign parent companies are sources of real confrontations of schemas of the dynamics of the environment. The quantity of knowledge may not increase much but the reasoning is enriched with new concepts and links explaining the dynamics of the business. In Piaget's terms there are 'assimilation' and 'accommodation.'

The practical implications suggested by the study underscore the importance of management development in accelerating the learning process when executives make major career changes: from a focused firm to a diversified firm, from a business unit with a national scope to one with an international scope, or from an independent company to a multinational corporation. Innovative training methods may be helpful; for instance, cognitive mapping can be used to assess individual learning over time and individual cognitive maps can be enriched by comparisons with others, thus stimulating reciprocal learning. Basically, in multinational corporations, career development should provide a variety of experience in order to develop the cognitive complexity of chief executives who are to play an integrative role within the top management team.

The results and interpretations should be taken as indicative, bearing in mind the limitations of the study already discussed; and in particular our inability to control for individual factors which may affect managers' cognition. We acknowledge that, regardless of the scope of the company, a CEO who has held positions in several countries in his or her career may have a broader view of the market, and consider more countries; or a manager with experience of multiple functions may have a more comprehensive view of the dynamics of the business in terms of markets, technologies, human and financial resources. The cognitive style of the individual may also be related to cognitive complexity: leaders ('intuitives' and 'feelers' in the terms used by Hurst *et al.*, 1989) may have less concepts in their maps than managers ('thinkers'), and may be more exclusively focused on their vision (Nöel, 1989). A study based on a larger sample of CEOs would be needed in order to control for individual factors. Such a study could also assess if some of the statistical tests which failed here gain significance in a larger sample, when controlling for individual factors.

The dilemma between technical reliability of interview procedures and acceptability by a predetermined sample of chief executives still has to be resolved. One way to resolve it would be to focus further studies on one dimension of the environment—perceptions of the structure *or* perceptions of the dynamics—, and to use simplified forms of existing techniques—for instance full context repertory grid techniques (Fransella and Bannister, 1977) could be applied in categorizing competitors and market segments in the environment.

We have not argued that more complex cognitive maps will lead CEOs to superior performance. A top manager may utilize a few concepts, but they may be the most relevant ones. Moreover, managerial work is not only thinking, it also has to do with feelings and action. We have however argued that CEOs' cognitive complexity should match the level of complexity of the environment that they are confronted with, in particular because they have to play an integrative role within the top management team. The present research has only shown relationships between the complexity of the environment mediated by the scope of the firm and the cognitive complexity of the CEO. As a first step in studying the relationships between cognitive complexity and performance, it suggests that the scope of the organization may have a moderating effect on the relationship.

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