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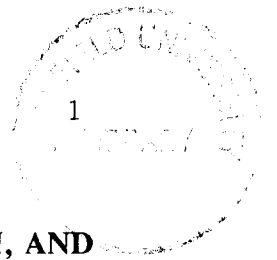Walton Hall
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COLLECTIVE FRAMES OF REFERENCE, RECOGNITION, AND
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A TEST IN TWO INDUSTRIES

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Managers draw upon sources of collective knowledge to cognitively represent strategic issues. It has also be argued that cognition is embedded in social interaction, enabling managers to recognize of others' cognitions. In two separate industries, this study found that the influences upon managers' mental models of their competitive environment include industry membership, organizational membership, and management level. The results indicate further that recognition of others' mental models may be more pronounced than cognitive similarity.

In the field of competitive strategy, Porter (1980) advocates a thorough, rational, and objective analysis of firms competing within an industry. Yet, there has been ample evidence to question the notion of analytically based managerial objectivity (Eisenhardt and Zbaracki, 1992; Fahey, 1981; Fox and Staw, 1981; Ginsberg and Venkatraman, 1992; Glazer, Steckel, & Winer 1992; Jackson and Dutton, 1988; Johnson, 1988; Mintzberg, Raisinghani, & Theoret, 1976; Noel, 1989; Pettigrew, 1985). Therefore, in order to understand more fully the processes of strategy formulation, some researchers have begun to study competitor analysis from a cognitive perspective. Within this perspective, it is considered that managers draw upon pre-existing knowledge, structured in the form of mental models (Johnson-Laird, 1989), which help their information search, and decision making (Abelson and Black, 1986; Nisbett and Ross, 1980).

Most previous cognitive studies of competition have examined how managers think of their competitors (Easton, Burrell, Rothschild, & Shearman, 1993; Gripsrud and Gronhaug, 1985; Porac, Thomas, & Baden-Fuller, 1989; Porac and Thomas, 1994; Reger and Huff, 1993; Reger and Palmer, forthcoming). This paper adds to this literature by examining the influences of collective experience upon the knowledge managers draw upon in order to understand their competitive environments. This enables the identification of some of the origins of managerial knowledge of competition; thus providing a more complete picture of the cognitive processes involved in strategy formulation (Huff, 1982).

Moreover the research design acknowledges the concern that cognitive processes need to be seen within a context of organizational interaction (Weick and Roberts, 1993). Thus, whilst managers may draw upon collective knowledge in some circumstances; it is possible that the cognitive bases of the development of competitive strategy may be accounted for by processes other than members of management teams sharing similar mental models of the competitive environment (cf. Fiol, 1994). An alternative explanation posits that managers may come to recognize each others' mental models through the processes of discourse (cf. Edwards, 1991) and arrive at strategic decisions through a

process of understanding and recognition rather than cognitive similarity. Thus an understanding of the collective influences upon managers' abilities to recognize other managers' mental models would also enhance understanding of the cognitive processes of strategy development.

These issues relating to the cognitions of competition are the themes of this paper. Specifically, its aims are to examine some of the influences upon a) the similarity of managers' mental models and b) managers ability to recognize other managers' mental models. The paper begins with a discussion of previous cognitive studies of competition; it then draws a distinction between cognitive similarity and cognitive recognition and describes the processes through which managers may be able to recognize each others' mental models. The derivation of hypotheses is described in relation to both the cognitive studies of competition and studies of cognition of other strategic issues. Tests of these hypotheses are then described within a single industry environment: this is followed by a description of a replication and extension study in a separate industry environment. The results of both studies are discussed with reference to the cognitive processes of strategy formulation.

Studies of managers' mental models of competition

Previous studies of the cognitive bases of competitor definition have been concerned with how managers decide who competes within an industry (Easton et al, 1993; Gripsrud and Gronhaug, 1985), how managers categorize competitors (Hodgkinson and Johnson, 1994; Porac et al, 1989; Reger and Huff, 1993), how managers decide with whom they are competing most closely (Porac and Thomas, 1994), and how managers conceptions of competition are related to environmental change (Reger and Palmer, forthcoming). These studies have considerably furthered understanding of the cognitive processes involved in competitive strategy formulation. The main findings of these studies can be summarized as follows:

a) Managers simplify their competitive environment by focusing upon a sub-set of firms competing within an industry (Easton et al, 1993; Gripsrud and Gronhaug, 1985).

b) Managers further simplify their competitive environment by categorizing their competitors (Porac et al, 1989; Porac and Thomas, 1990; 1994; Reger and Huff, 1993).

c) Managers define their own business in terms of the label they use to define the cognitive category in which their business is placed (Porac et al, 1989) and hence consider their firm to be competing most closely with other firms in that category (Porac and Thomas, 1994).

d) Managers conceptions of competition do not necessarily change as the competitive environment changes (Reger and Palmer, forthcoming).

That managers represent knowledge about their competitors through a process of simplification and categorization is consistent with established theories of cognition which posit the existence of cognitive configurations of concepts based on contiguity (Schacter, 1989; Schank, 1982). These configurations have been labelled variously as schemata (Bartlett, 1932), scripts (Gioia and Poole, 1984; Schank, 1982), cognitive models (Lakoff, 1987), and mental models (Johnson-Laird, 1989), the term used in this paper. These mental models help guide information search by offering heuristics that enable people to decide which information is most relevant for a given task (Anderson, 1991; Cherniak, 1984; Edwards, 1991; Rips, 1975). For instance, managers may only make detailed analyses of firms that they categorize with their own firm, since these are considered to be the closest competitors (Porac and Thomas, 1994).

An understanding of the influences on the knowledge managers draw upon in constructing their mental models may therefore allow for a fuller explanation of the cognitive processes of the choices managers make in the formulation of competitive strategy. Huff (1982) has suggested that managers draw upon multiple 'frames of reference' in constructing mental models of strategic issues; managers are thought to 'borrow' knowledge from others through processes of social interaction. Thus, to some

extent a frame of reference is a repository of collective knowledge (cf. Harris, 1994) which, it has been argued, are embodied in industry recipes (Spender, 1989), organizational paradigms (Johnson, 1987, Sheldon, 1980) and sub-cultures within organizations (Sackman, 1992).

Although none of the cognitive studies of competition cited above have directly examined the influences of differing frames of reference upon individual mental models, they do provide some clues to the collective influences on managers' mental models of competition. In their study of the Scottish knitwear industry, that Porac et al (1989) were able to form a meaningful industry wide aggregate mental model of competition indicates that there was some level of cognitive commonality across the industry. Porac and Thomas (1994) have observed that managers within an industry tend to use similar category labels when describing their own firms and major competitors; Reger and Huff (1993) have also observed that managers within an industry may categorize competitors in a similar manner to each other. Other studies indicate that managers employ exemplars in describing competitors (Easton et al, 1993; Gripsrud and Gronhaug, 1985). The results of these studies follow the same pattern, with a relatively small number of competitors being mentioned by most of the managers and a large number of competitors being mentioned by only a few managers. These findings correspond to laboratory evidence indicating that cognitive categories may be represented by concrete exemplars representing the central tendency for that category (Smith and Medin, 1981). Given the evidence, too, of industry level frames of reference or recipes (Spender, 1989), it is therefore possible to propose:

H1) Within an industry, there exist certain exemplary competitors, who will

be cited as competitors more often than other firms, by managers within that

industry.

Nevertheless, the same studies which found a level of agreement upon certain core competitors within an industry (Easton et al, 1993; Gripsrud and Gronhaug, 1985; Hodgkinson and Johnson, 1994), indicate that individual managers' mental models are also

idiosyncratic. Similarly, although Reger and Huff (1993) report commonality in how managers may categorize competitors, in an analysis of the same data, Reger (1990) indicates that there was little agreement amongst her sample on the specific bases of categorization.

This idiosyncrasy is not surprising since mental models of strategic phenomenon are thought to be constructed from individual as well as collective experience (Huff, 1982). However, it is also possible that managers draw upon frames of reference that are more specific than that at the industry level: Porac et al (1989) observed that 'variation exists from firm to firm in how managers conceptualize the details of the competitive environment' (pg 405). This may suggest that there also exists an organization wide frame of reference which influences the construction of individual mental models. Indeed, other researchers have indicated that the collective experience of the organization is encapsulated in its 'paradigm' (Johnson 1987; Pfeffer, 1981; Sheldon, 1980); a core set of beliefs and assumptions which influence the way in which managers interpret their world. On the basis of this evidence, it is possible to propose:

> *H2) There is greater similarity of mental models of competition between*
> *managers within the same organization, relative to the mental models of*
> *managers from other organizations.*

As well as industry and organizational influences upon mental models of competition, the existence of sub-cultures within organizations (Sackman, 1992) indicates that managers may draw upon frames of reference from within the organization. One such frame of reference may be provided by the focus of the function the manager performs; for instance whether the manager is primarily focused upon the external competitive environment or the internal operational environment. Some evidence suggests divergence in the mental models of managers with different functional foci (Bowman and Daniels, 1994; Dearborn and Simon, 1958; Melone, 1994; Nystrom, 1986). On this basis of this evidence, the following hypotheses may be formulated:

H3) There is greater similarity of mental models of competition between managers with the same management functional focus, relative to managers with other functional foci.

The bases of understanding others' mental models

Whilst a team of managers may be able to formulate coherent strategies through sharing aspects of their mental models in common (Johnson, 1987; Spender, 1989), since they draw upon some of the same frames of reference, it is apparent that managers may be able to reach strategy decisions through processes other than simple cognitive convergence (Fiol, 1994; Moussavi and Evans, 1993; Weick and Roberts, 1993). Recent developments in cognitive psychology have begun to highlight the role of mental models in discourse (Edwards and Potter, 1992). It is considered that cognitive categorization schemes may be particularly influential in conveying meaning during communication (Edwards, 1991). In particular, where information from the external environment is abstract, ambiguous, and incomplete, as is information from the strategic environment (Schwenk, 1984), disputes may be common about the veridicality of different persons' remembering of events: and in these situations people are most likely to make their own mental models explicit to help resolve such arguments (Edwards and Middleton, 1986). Therefore, through the processes of communication about competitors. managers may come to recognize, and at least partially understand, the logic of the mental models of others, without necessarily exhibiting similarity. The process of recognition may allow managers to be aware of how the mental models of others complement their own knowledge: Larson and Christensen (1993) refer to this as meta-knowledge. Thus, through a process of recognition, managers may be able to negotiate a coherent strategy that is not predicated upon any one individual's mental model.

It is reasonable to propose that social contact and debates about the competitive structure of an industry will be most frequent between managers with a similar functional focus, embedded within the same organization. Therefore, the greatest degree of

recognition should be found amongst managers with the same functional focus, and the same organization, relative to other managers. On the basis of these arguments, it is possible to propose:

H4) There is greater recognition of others' mental models of competition between managers in the same organization, relative to the mental models of managers from other organizations.

H5) There is greater recognition of others' mental models of competition between managers with the same functional focus in the same organizations, relative to other managers in the same organization and managers from other organizations.

STUDY 1:METHODOLOGY

Context and participants

Hypotheses 1 to 5 were tested initially in a sample drawn from the UK off-shore pumps industry. Pilot interviews revealed this industry to be tightly defined by product type and geographical scope. Studying an industry with such definite boundaries allows easy standardization of questions concerning competition. The industry is also characterized by small SBUs located at one site and many of the managers in this industry have had similar professional training in engineering.

Ten pump manufacturing organizations were approached at managing director level. These ten were selected after pilot interviews revealed each of these organizations devoted a substantial portion of their business to the UK off-shore pumps industry. Five organizations agreed to co-operate out of the ten, giving access to 24 managers (although missing data meant that between 18 and 24 managers were available for each analysis). Between three to eight managers were interviewed per organization, representing a wide range of senior management functions, such as managing director, sales and marketing director, manufacturing director, and finance director. Within these pump manufacturing organizations, there existed little overlap in terms of job titles. Therefore, it was decided

to operationalize functional focus by a simple dichotomy based on Miles and Snow's (1978) throughput and output functions. Output functions were defined as those functions where the primary focus concerns the external environment (eg. tendering, sales, and marketing, managing director was also included here). Throughput functions were defined as those functions where the primary focus is internal and operational; interviews revealed engineering, general, and finance managers to fall into this category in this industry. All the sample were male. They had been working in their present position for an average of years 5.48 (std dev = 6.16), working for their organization for an average of 11.00 years (std dev = 7.01), and had been in the industry for an average of 15.91 years (std dev = 8.44).

Mapping managers' mental models of competition

Each participant was administered a semi-structured interview, typically lasting less than half an hour, to uncover the structure of the participant's mental model of the relationships between competitors in the specified industry. In order to do this, cognitive mapping techniques were used. Cognitive mapping techniques are methods used to assess the structure and content of individuals' mental models of given issues (Axelrod, 1976). Methods were required which would allow the ideographic mapping of individual's mental models to allow a full assessment of the collective influences upon idiosyncratic mental models. Also, techniques were required which were compatible with empirically established principles of human information processing. Two empirically validated methods were thought to meet these criteria (Canter, Brown, & Groat, 1985); a simple visual card sorting technique (Daniels, de Chernatony, & Johnson, 1994a) and Kelly's repertory grid (Bannister and Mair, 1968; Kelly, 1955). Both techniques were used in this study. By using more than one mapping technique, the robustness of the results are increased (Cook and Campbell, 1976).

Both techniques first require the participant to state which organizations they perceived to be competing with their own organization in the specified industry. These

names were written on cards. On the bases of these competitors, visual card sort mapping requires the participant to arrange the cards such that those firms in close competition were placed most closely together. The participant was then asked to state why the organizations were so arranged in order to elicit the attributes of competition. Visual card sort maps are recorded by simply photographing the arrangement. Although the card sort technique can elicit multiple maps from one individual (Canter et al, 1985; Daniels et al, 1994a), reflecting the context sensitivity of categorization schemes (Barsalou, 1982), in this study only the first card sort was used, since this may be assumed to be the most salient categorization scheme.

Repertory grid technique was used to elicit the attributes of competition from detailed comparisons between sub-sets of three organizations drawn at random, until the respondent could give no more novel bases of competition; a procedure known as triading (Bannister and Mair, 1968). A few days after the mapping interview, a postal questionnaire was mailed to each of the respondents, asking him/her to rate each of his/her named competitors on each of the attributes previously elicited from that respondent (including attributes elicited by the visual card sort method). All members of the sample returned their questionnaires. In order to be consistent with previous research which has demonstrated managers categorize competitors (Porac et al, 1989), categories were derived from the questionnaires by the application of between groups average linkage cluster analysis upon squared Euclidean distances (Smith and Stewart, 1977).

Assessing the similarity and the extent of recognition of the maps

Since the maps were based on different organizations and attributes, standard statistical measures of similarity were not readily applicable to the data. Moreover, a measure of the extent to which managers recognize the logic underlying each others' maps was required. It was therefore decided to ask managers to rate the similarity of the maps to their own mental model and the extent to which they recognized the logic underlying others' maps on five point fully anchored Likert type scales (1 = 'The same as my view of

the competitive environment', 5='Not at all similar to my view of the competitive environment' for the similarity scale and 1 = 'I can easily understand the logic underlying this map', 5= 'I cannot understand any logic underlying this map' for the recognition scale).

Obtaining ratings of the similarity of two stimulus items is a common methodology in cognitive science (Bower and Clapper, 1989). Daniels, Markoczy, & de Chernatony (1994b) consider such a self-rating methodology to be suitable when: a) idiosyncratic maps are to be compared which contain no researcher standardization; b) the raters can be considered knowledgeable of the concepts being displayed in the maps; c) there are multiple raters, such that measurement accuracy is increased by averaging across these raters; d) the reliability and validity of the ratings can be demonstrated. The first three of these conditions hold *a priori* in this study, the fourth was demonstrated empirically. Validity was tested by comparing managers' ratings of random maps against their own maps: if managers rated their own maps as significantly more similar to their own mental model than the random maps, then validity could be assumed. Reliability was tested by comparing the results obtained from ratings of visual card sort maps with those from the cluster analysis maps: if there were no differences between the two sets of results, the results can be assumed to be reliable since they are triangulated from two different methods (Cook and Campbell, 1976).

Piloting had indicated that managers were able and willing to complete a rating exercise lasting up to 30 minutes. This placed an upper limit on the number of maps that could be rated by one individual. Therefore, managers were presented a random selection of maps to rate in a repeated measures design. The independent variables in the design are a) who the target map belongs to (the substantive variable of interest) and b) the type of map being rated (as a test of reliability). Each of the managers was presented with a booklet containing maps from a number of randomly selected individuals, as well as the participant's own maps and asked to rate each of these maps on the two scales described

above. By presenting randomly allocated maps, confounding due to variables not included in this study is prevented. For each individual's maps selected for inclusion in a given booklet, both the visual card sort maps and the repertory grid derived maps were included. None of these maps were identified to the participant. The maps were presented in blocks consisting of all the visual card sort maps and all the cluster analysis maps derived from repertory grid. These blocks were presented in a random order across participants. Within these blocks, the maps selected were presented in a random order. This randomization procedure circumvents any confounding due to the order of presentation.

The booklets used in the rating exercise consisted of the following maps: the participant's own maps, maps from a manager with the same functional focus in the same organization, maps from a manager with a different functional focus in the same organization, maps from a manager with the same functional focus in a different organization, maps from a manager with a different functional focus in a different organization, and random maps.

STUDY 1:RESULTS

Exemplary competitors

In the off-shore pumps industry, the mean number of competitors named by each participant was found to be 5.00 (std dev = 1.94) with no respondent naming more than 10 competitors. Table 1 shows the percentage frequency with which each competitor was named by the respondents. Application of the Kolmogorov-Smirnov test indicated that there was a significant difference between the observed distribution and the distribution expected if each competitor had an equal probability of being named ($z=2.31, p<.001$). The table shows that the majority of competitors were named by less than twenty percent of the sample but that over seventy percent of sellers named competitors A and B. These data indicate that there are small number of competitors that may be core to the mental models of managers across this industry, supporting H1.

Insert Table 1 about here

Assessing influences upon the similarity and recognition of mental models of competition

The mean similarity and recognition ratings for managers' own and random maps for each industry, for both visual card sort and cluster analysis maps, are shown in tables 2a and 2b. The validity of the rating procedure was tested by repeated measures analysis of variance (ANOVA), with two factors (own vs random map, and visual vs cluster map). These tests revealed that managers rated their own maps as being significantly more similar to their own mental models than random maps ($F = 12.16$, $df = 1/21$, $p < .005$ for similarity, $F = 8.16$, $df = 1/21$, $p < .01$ for recognition), supporting the validity of the rating procedure. All other effects in both ANOVAs were non-significant.

Insert Table 2 about here

The extent to which organizational and functional focus frames of reference influence managers' mental models of competition and managers' ability to recognize each others' mental models were assessed in separate repeated measures ANOVAs. Both ANOVAs included three factors in a fully nested design; functional focus (same vs other), organization (same vs other), and map type (visual vs cluster). The means and standard deviations for both analyses are shown in tables 2a and 2b. For both the similarity and recognition data, the map type factor had no main nor interactive significant effects. Since ratings did not vary significantly across map types, these results are indicative of the reliability of the ratings.

Organization membership was found to have a significant effect upon rated similarity ($F = 8.92$, $df = 1/17$, $p < .01$), although neither function nor the interaction between function and organization were found to be significant. The results indicate support for H2, in that table 2a shows that managers rate the cognitive maps of other managers from the same organization as more similar to their own mental models than those of managers from other organizations. The results provide no support for H3, namely that there is

greater similarity of mental models within management functions relative to other functions.

Organizational membership was also found to have a significant effect upon rated recognition $(F=7.02, df=1/17, p<.05)$. Table 2b shows that managers recognize significantly more logic in the cognitive maps of managers from the same organizations, relative to managers from other organizations, supporting H4. Like the similarity data, no evidence was found to support H5, in that neither the main nor the interactive effects of functional focus were found to be significant.

STUDY 1: SUMMARY, DISCUSSION, AND EXTENSION

The results of the first study provide support for H1, H2, and H4. These results indicate that managers in the UK off-shore pumps industry may construct their mental models of competition by drawing upon organizational and industry frames of reference and that managers in this industry may have some greater understanding of their colleagues' mental models of competition in the same organization relative to managers in other organizations. That no support was found between H3 and H5 may indicate that functional foci frames of reference do not exist at senior management level (cf.Walsh, 1988) and that senior managers communicate freely across functions, thus eliminating differential recognition of others' mental models.

However, these latter results may be peculiar to the firms in this industry given the homogeneous professional background of the managers studied and close, long standing, working relationships within organizations fostered by small SBU size. This caveat indicates some of the limitations of this first study; the reliance upon one industry context and a small sample size. Although neither are uncommon in cognitive studies of competition, it was felt a replication of the first study in a separate industry context would considerably add to the robustness of the findings. The same hypotheses were tested as in the first study; but other hypotheses were also tested in order to increase the explanatory

power of the findings. Specifically, the impact of frames of reference represented by managerial level and strategic group membership were also tested in the second study. Ireland, Hitt, Bettis, & Auld de Porras (1987) have demonstrated differences in managerial beliefs about strategic issues between managerial levels, suggesting that a managerial level frame of reference exists: and Huff (1982) suggested that a frame of reference exists at the strategic group level, since managers vicariously learn from other organizations following similar strategies. Therefore, on these bases it is possible to propose:

H6) There is greater similarity of mental models of competition between managers at the same management level, relative to the mental models of managers from other management levels.

H7) There is greater similarity of mental models of competition between managers from organizations within the same strategic group, relative to the mental models of managers from other strategic groups in the same industry.

Also, it may be expected that managers from the same management levels in the same organization are more likely to come into social contact, and therefore are more likely to engage in discourse concerning the competitive environment than with managers from different management levels. Hence, through this discourse managers may come to recognize other managers' mental models from the same level more readily than those of managers from other levels:

H8) There is greater recognition of others' mental models between managers at the same management level in the same organization, relative to other managers in the same organization and managers from other organizations.

STUDY 2:METHODOLOGY

Context and participants

In order to increase the robustness of the replication, an industry context was chosen that was considerably different from the UK off-shore pumps industry. The UK personal financial services industry was thought to meet this requirement since it is a non-

manufacturing industry, the average SBU size is greater, SBUs are located at many sites, and there is less of an institutionalized professional background of managers as is the case with the dominance of engineering in the pumps industry. Moreover, the industry has distinct strategic groups. In this study, two such groups were chosen; a) large financial service firms that offer house loans as their primary activity and are represented nationwide and b) medium sized financial service firms that offer house loans as their primary activity but are represented regionally instead of nationally. However, in order to introduce the same kind of standardization by product type as in the off-shore pumps industry, it was necessary to select a particular product type that is marketed to a distinct set of buyers. In this instance, it was decided to gather data in relation to competition for house loans for first time home buyers.

Eight financial service organizations were approached at senior management level. These eight were selected since they represented the range of organizations operating in the market for mortgages for first time buyers. Of these eight, six organizations agreed to participate. Three of these organizations belonged to the strategic group consisting of large financial services firms operating across the UK; the other three belonged to the strategic group consisting of medium sized regionally represented financial services firms. The sample consisted of 32 managers from senior and middle managers from these six financial service organizations (although missing data meant that between 29 and 32 cases were available for each analysis). Thirty of the managers were male, two were female. The managers had been working in their present position for 3.07 years (std dev = 2.88), working for their organization for an average of 9.40 years (std dev = 8.64), and in their industry for an average of 16.77 years (std dev = 9.47). Although there existed greater commonality in terms of job titles across this industry, it was still necessary to operationalize functional focus with the same dichotomy employed in the pumps manufacturing sample, since there still existed some diversity of job titles. Retaining this procedure also allows for greater comparability between the two studies reported here.

Design and procedure

The 32 managers were administered the same cognitive mapping techniques as in the first study, deriving both visual card sort maps and cluster analysis maps from repertory grid technique. All managers returned their repertory grid questionnaires. Comparisons between maps were made through ratings obtained in exactly the same manner to those described in the first study; except for some differences in design noted below. All rating exercise interviews were carried out between three and six months after the initial cognitive mapping interviews.

Managers were asked to rate maps such that each combination of the following dichotomous variables was represented: functional focus (same, other), management level (same other), organization (same other). The combination of same functional focus, same level, and same organization corresponded to the managers' own maps. It can be seen that all these variables are within subjects variables. The variable representing strategic group membership was a between subjects variable, with managers being randomly assigned to conditions where they rated either managers from different organizations in the same strategic group or in the different strategic group. Managers were also asked to rate randomly generated maps as a validity check.

STUDY 2: RESULTS

Exemplary competitors

In the financial services industry, managers named 11.53 competitors on average (std dev = 4.94). No manager named more than 22 competitors. Table 3 shows the percentage frequency with which managers named individual competitors. As with the oil pumps industry, the distribution observed differs significantly from that expected if all competitors had an equal probability of being named, as indicated by the Kolmogorov-Smirnov test (z=4.39, p<.001). The table shows that the majority of competitors were named by less than twenty percent of the sample and that one hundred percent of sellers

named competitor A, and over seventy percent named competitors B and C. Therefore, overall these data are supportive of H1.

Insert Table 3 about here

Assessing influences upon the similarity and recognition of mental models of competition

The validity of the rating procedure was tested with exactly the same procedures as those used in the first study. For both similarity and recognition data, significant effects were found for the comparison between ratings of managers own maps and random maps ($F=27.10,df=1/31,p<.001$ for similarity, $F=25.26,df=1/31,p<.001$ for recognition): Tables 4a and 4b show that managers rated their own maps as both more similar to their own mental models and more recognizable than random maps; indicative of validity. No significant main nor interactive effects were found for the map type factor.

Insert Table 4 about here

A fully nested design to test the hypotheses would involve inclusion of managers' ratings of their own maps (ie.the same functional focus, same level, same organization contingency); thus confounding hypothesis testing concerning collective frames of reference. Therefore, each of the hypotheses were tested through the application of several repeated measures ANOVAs (the means for which are shown in tables 4a and 4b), in which one of the following three contingencies were held constant; organization, functional focus, and management level. Although this procedure does not allow tests of complex higher order interactions; it does allow for rigourous testing of the hypotheses postulated. Of the five ANOVAs conducted testing the hypotheses; two revealed no significant main nor interactive effects for map type, two revealed significant main effects for map type only, and one revealed a significant interaction between map type and organization only (all $p<.05$ or lower). For those analyses where no significant effect of map type was found or where a main effect was demonstrated, reliability can be assumed, since the differences between ratings are either not significantly different or constant across all substantive contingencies. For the analysis where a significant interaction was found, the unreliability

of the ratings is controlled for by the presence of the interaction term in the estimation procedure. Nevertheless, significant effects for map type indicate that the results should be treated with some caution; these analyses are noted below.

In order to test H2 and H3, a three factor ANOVA was constructed which had two levels of each factor; map type (visual vs cluster), functional focus (same vs other), and organization (same vs other). No significant main nor interactive effects were found for map type. Management level was held constant by only analysing managers from different levels to the focal individual, the random allocation of managers to rate maps from their own or other strategic groups controlled for this variable (as with all other analyses where the effect of this variable was not tested). The results indicated a significant main effect for organization membership $(F = 5.66, df = 1/29, p < .05)$. An examination of the means in table 4a indicates support for H2. No significant main nor interactive effects were found for functional focus; providing no support for H3.

H6 was tested simultaneously with H2 by constructing an ANOVA with the following factors; management level (same vs other), organization (same vs other), and map type. Functional focus was held constant by analysing only ratings of maps belonging to managers from different functional foci. No significant main nor interactive effects were found for map type. The results indicated no significant main effects for organization; but a weak significant main effect for level $(F = 3.89, df = 1/29, p < .05$ one tailed) and a significant interaction between level and organization $(F = 6.44, df = 1/29, p < .05)$. An examination of table 4a indicates that there is generally greater rated similarity amongst managers from the same level, offering some support for H6. An analysis of the simple effects from the interaction demonstrates that there is significantly less rated similarity between maps belonging to managers from different levels and different organizations relative to maps belonging to managers from the same organization but at a different level $(t = 2.45, df = 29, p < .05)$ and maps belonging to managers from the same level but a different organization $(t = 3.66, df = 29, p < .01)$; no

other simple effects were found to be significant. These simple effects, in the presence of a weak main effect for management level, indicate that; a) there may be a slight tendency towards greater similarity within management levels, relative to other management levels, across the industry; b) although there is evidence for organizational frames of reference, cognitive differences due to differing organizational frames of reference are obviated in managers sharing the same level frame of reference.

In the final ANOVA involving the similarity data, organization was held constant by only analysing ratings of maps from outside the organization. H3, H6, and H7 were tested simultaneously by constructing an ANOVA with the following factors; functional focus, management level, map type (all within subjects factors), and strategic group (same vs other, a between subjects factor). Map type had a significant main effect on the ratings $(F=8.20, df=1/30, p<.01)$. The only substantive significant effect was found for management level $(F=6.04, df=1/30, p<.05)$. Examining table 4a, it can be seen that there is greater rated similarity within the same level, supporting H6. Support was obtained for neither H3 nor H7.

In order to test hypotheses concerning recognition, two ANOVAs were constructed; no analysis was conducted to test H5 and H8 by holding organization membership constant since both hypotheses posit interactions between function or level and organization. To test H4 and H5, the following factors were incorporated into an ANOVA; map type, functional focus, and organization; holding management level constant by including ratings of other levels only. A significant main effect was found for map type $(F=7.22, df=1/29, p<01)$. A weak significant main effect was also found for organization $(F=3.34, df=1/29, p<.05$ one tailed). The means in table 4b show that this result supports H4. No significant main nor interactive effects were found involving functional focus, providing no support for H5.

An ANOVA was constructed involving the factors map, organization, and management level, holding functional focus constant, to test H4 and H8. A significant

interaction was found between map type and organization ($F=4.68, df=1/29, p<.05$). The only substantive significant effect involved the interaction between organization and management level ($F=6.72, df=1/29, p<.05$). An analysis of the simple effects from the interaction reveals a similar pattern of significant results for the corresponding interaction with the similarity data: there is significantly less recognition of maps belonging to managers from different levels and different organizations relative to maps belonging to managers from the same organization but a different level ($t=2.62, df=29, p<.05$) and maps belonging to managers from the same level but a different organization ($t=2.17, df=29, p<.01$). These results, in the absence of a significant main effect, indicate that recognition may extend across management level and organizational boundaries, but is significantly attenuated when both level and organizational boundaries are crossed simultaneously. Thus, this analysis indicates support for H4. However, no support is obtained for H8, since within the same organization, there is no greater recognition within levels.

STUDY 2: SUMMARY AND DISCUSSION

Taken together with the results of the first study, the results of the second study provide further support for H1; indicating that managers may draw upon industry frames of reference in constructing their mental models of competition. No support was obtained for H3, H5 (replicating the first study), H7 or H8; indicating that managers may not draw upon functional focus nor strategic group based frames of reference and that recognition is not greater amongst managers with the same functional focus or the same level in the same organization.

The results do lend support to H2, H4, and H6; indicating that both organizational and management level frames of reference exist and that managers recognize significantly more logic in the cognitive maps of managers in the same organization. However, interactions between organization and management level indicate that these results need to be explained further. With the similarity data, the form of the interaction between level

and organization membership indicates that the degree of cognitive convergence is roughly equal between managers in the same organization, the same management level or both. Although these results indicate that managers can draw upon both organizational and level frames of reference, the effect does not appear to be additive, in that sharing both the same level and organization does not appear to increase similarity beyond that obtained through sharing either the same level or the same organization. The significant interaction between management level and organization upon recognition indicates that the greatest degree of recognition occurs when managers are in the same organization, the same management level or both. However, again the effect of management level and organization membership does not appear to be additive; therefore there is no greater recognition within the same level within the same organization. Although this offers support for H4, it indicates, counter to expectations, that recognition can also reach beyond organization boundaries in a manner related systematically to management level.

There are some indications of divergence in the pattern of results obtained with recognition and similarity. For instance, although management level influences recognition across organizations, there is no effect of management level upon recognition within organizations. However, there is a tendency for a management level frame of reference, influencing cognitive similarity, to permeate across the industry, both within and between organizations. This is indicated by the presence of significant main effects in both analyses involving management level upon similarity, albeit a weak effect in one analysis. Moreover, in both the pumps and the financial services industry, the effect sizes (gauged by the size of the F ratios) for the significant main effects of organization are greater for the similarity than the recognition data, indicating that cognitive similarity is more strongly related to organization membership than recognition. Taken together, these observations suggest that cognitive recognition is more widespread both within and across organizations than simple cognitive similarity.

Although the inclusion of divergence between the data obtained from the different map types was taken into account during the estimation of tests of significance; the conclusions drawn from this study have the caveat, mentioned earlier, that the results may be affected to some extent by divergence between the two methods used.

GENERAL DISCUSSION

Discussion of findings

This study, along with others, contributes to the developing understanding of strategy development at the cognitive level. It confirms that managers within an industry share aspects of mental models in common and indicates that these commonalities may be the result of managers drawing upon multiple collectives of knowledge such as industry, organization, and management level frames of reference.

At the level of the industry, there appear to be a number of named competitors and characteristics of competition which managers hold in common. As the results indicate, these are small in number; indeed in terms of any sophisticated economic analysis of an industry, they are impoverished in the extent to which they could be regarded as descriptive of industry structure. Yet in terms of competitive strategy they could be significant in that they may represent core cognitive reference points in the formulation of strategy both within the firm and across firms.

Within the firm, previous research in operations management, focusing upon the similarity of managers' mental models, has suggested that managers make decisions by sharing some aspects of their mental models in common (Langfield-Smith, 1992). The evidence here is that, managers perceive cognitive similarity with regard to the structures of competition (as represented by the maps), and this perceived commonality may be influenced by managers drawing upon organizational and/or management level frames of reference in constructing their mental models. Further, that they have the ability to recognize such structures as represented by others' mental models; and that this recognition

may transcend some cognitive barriers erected by different organizational frames of reference, provided managers belong to the same level.

The picture emerges, at least in relation to competitive strategy, of strategy developing on the basis of managers having a few common core perceptions of who the main competitors are; of managers who work in the same organization drawing on collective tacit knowledge about the structural relationships of such competitors; but also of their having the facility to understand others' cognitions where they are dissimilar to their own within organizations and within management levels. A number of observations about managerial aspects of strategy development arise.

Managers sharing core perceptions and drawing on tacit knowledge about the nature of competition may increase the speed of strategy formulation since little has to be debated in order to reach agreement. However, it is possible that discussions of strategy may then omit the sharing of unique information, which may be useful for the strategy formulation process (cf. Stasser and Titus, 1985). Therefore, teams of managers which only utilize cognitive similarity processes during strategy formulation may risk acting upon 'impoverished views of the world' (Weick, 1979, pg 68).

The ability to recognize each others' cognitions in order to negotiate a shared consensus or learn from diverse views within the management team would seem to be important in this context; and our findings show that such processes of recognition do indeed occur. Studies of strategy development processes (eg Lyles, 1981; Hickson, Butler, Cray, Mallory, & Wilson, 1986; Mintzberg et al, 1976) have shown that the awareness of strategic issues and the development of solutions are typified by canvassing of opinion, lobbying, and discussion. In cognitive terms, others have shown that managers' meta-knowledge may help them elicit information from experts within the team (Larson and Christensen, 1993), thus allowing managers a social mechanism to defer to expert knowledge and incorporate such knowledge into a negotiated view of their environment.

Moreover, experts' confidence in the accuracy of their knowledge may strengthen their ability to persuade others of their views (Hinsz, 1990). Our findings might then lend support for the benefits argued by Quinn (1980) for strategy formulation processes which are more rather than less interactive, such that dissenting and expert views are elicited: and that strategy formulation may be a more productive process in those organizations in which experts' knowledge is sought and accepted early in the strategy formulation process (Walsh, Henderson, & Deighton, 1988). The findings also show that in some circumstances, managers have the ability to infer some of the knowledge structures of competitors; and this may of course be a basis for competitive advantage, since managers in such firms may be able to pre-empt competitors' moves (Porter, 1980).

Implications for future research

Whilst the results of this research are important in so far as they indicate some possible origins of managerial mental models of competitors and advance explanations of cognitive aspects of strategy development, it is important to recognize that the research has focused upon just two industries and a small number of variables. Future research might usefully attempt to replicate and extend these findings across other industries and other contingencies. In particular, the effects of management level were tested in only one industry; clearly the results presented would benefit from replication and extension in other industry contexts. Variables not studied here which may also affect the degree to which managers draw upon similar frames of reference and recognition exhibited within an industry may include the maturity of the industry (Easton et al 1993) and nationality (Calori, Johnson, & Sarnin, 1992). In general, as demonstrated in this and another cognitive study (Thomas, Shankster, & Mathieu, 1994), researchers should attempt to use multivariate designs to assess the joint impact of influences upon cognitive processes.

Cognitive based studies of management can certainly help our understanding of strategic decision making processes by showing how managers' mental models mediate the influence of collective and individual knowledge upon organizational or group action.

However, wider social, cultural, and political aspects of the organization have been shown to play an important part in strategy development (Bartunek, 1984; Eisenhardt and Bourgeois, 1988; Johnson, 1987; Mintzberg et al, 1976; Pettigrew, 1985). The links between these dynamics and the cognitive aspects of strategy development are likely to be of significance and merit further exploration. For example, if it is the case that the surfacing of that which is taken for granted (Mason and Mitroff, 1981; Schwenk, 1982) is beneficial, it has been variously argued that the politicized context of management masks managerial differences (Johnson, 1987); or that it helps surface such differences (Bartunek, Kolb, & Lewicki, 1992).

With few notable exceptions (eg. Weick and Roberts, 1993) in the studies of the extent to which socio-political processes influence decision making, there have been few attempts to link cognition and social action; and none that we know of which have used precise measures of cognition, as in this study, or which have focused on the complex domain of strategy formulation. This is an important arena for research not least because there remains an underlying tension in our understanding of strategic decision making in organizations between notions of collective cognition and dominant ideational culture and of multiple and diverse influences upon individual cognition, self interest and political resolution of conflicting views.

A further issue which this research has revealed is the important distinction between similarity of mental models and recognition of mental models. This is not a distinction which has been pursued so far in cognitive research and, on the basis of this study, would appear to be important, especially in relation to how mental models link to organizational sense making and decision making in a socio-political context. Since recognition of others' mental models is likely to be related to understanding, and in turn to communication and discourse, (Edwards, 1991; Edwards and Potter, 1992), recognition may, itself, be a factor which facilitates investigation of the links between cognition and social action in organizational contexts.

CONCLUSIONS

Within the growing interest in cognitive studies of management, this study has built on the developing theme of how managers make sense of competition. However it has sought to place this interest in the context of intra-individual cognition by examining collective influences upon individual knowledge. It has highlighted the importance of the diverse influences upon individual mental models within firms and across firms; the patterns of similarity and recognition which nonetheless exist; the importance of industry and organizational frames of reference; and whilst no evidence was found for the influence of functional frames of reference, the potential importance of the influence of management level frames of reference. The paper has also shown that there is benefit in assessing these and other collective influences upon knowledge in multivariate studies, such that the relative influence of each variable and the importance of interactions between variables can be more accurately appraised. Moreover the study has indicated that there is both a conceptual and an empirical distinction to be made between notions of cognitive similarity and recognition; a distinction which may be useful for the study of the socio-cognitive processes involved in coordinating coherent strategic action.

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TABLE 1.

Percentage of participants who named each competitor in the off-shore pumps industry
sample (n=24)

%ge managers		%ge managers		%ge managers	
A	71	J	33	R	4
B	72*	K	4	S	4
C	43*	L	8	T	4
D	38*	M	6*	U	4
E	38	N	8	V	4
F	47*	O	13	W	4
G	21	P	4	X	4
H	46	Q	4	Y	21
I	29				

* Excludes own firm

TABLE 2.

Means and standard deviations for managers' ratings of their own and others' mental models in the off-shore pumps industry.

Map rated	a) Similarity ratings				b) Recognition ratings			
	Visual		Cluster		Visual		Cluster	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Own[*]	1.82	1.00	2.50	1.23	1.82	1.26	2.27	1.24
Random[*]	3.27	1.20	3.05	1.43	3.09	1.27	2.82	1.62
SF,SO[**]	2.22	1.00	2.94	1.00	2.22	1.00	2.78	1.22
DF,SO[**]	2.44	1.15	2.72	1.18	2.33	1.37	2.50	1.34
SF,DO[**]	3.39	1.34	3.28	0.90	3.28	1.57	3.11	1.18
DF,DO[**]	3.06	1.51	3.11	1.37	2.78	1.48	3.11	1.45

[*] n=22   [**] n=18

Key: Prefixes: S=same, D=different. Suffixes: F=functional focus, O=organization. eg. DF,SO = different functional focus, same organization.

TABLE 3.

Percentage of participants who named each competitor in the financial services industry sample (n=32).

%ge managers		%ge managers		%ge managers	
A	100*	U	16	Z15	3
B	75	V	13	Z16	3
C	72*	W	9	Z17	3
D	63	X	9	Z18	3
E	56	Y	9	Z19	3
F	53	Z	9	Z20	3
G	53	Z1	9	Z21	3
H	50	Z2	6	Z22	3
I	47	Z3	6	Z23	3*
J	44	Z4	6	Z24	3
K	44*	Z5	6	Z25	3
L	41	Z6	6	Z26	3
M	28	Z7	3	Z27	3
N	25	Z8	3	Z28	3
O	25	Z9	3	Z29	3
P	19	Z10	3	Z30	3
Q	19	Z11	3	Z31	3
R	16*	Z12	3	Z32	3
S	16	Z13	3	Z33	0*
T	16	Z14	3		

* Excludes own firm

TABLE 4.

Means and standard deviations for managers' ratings of their own and others' mental models in financial services industry.

| | a) Similarity ratings | | | | b) Recognition ratings | | | |
| Map rated | Visual | | Cluster | | Visual | | Cluster | |
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Own*	2.00	1.02	2.34	1.21	1.88	1.16	2.13	1.21
Random*	3.34	1.29	3.16	1.17	3.28	1.40	3.09	1.33
SF,DL,SO**	3.10	1.01	2.71	1.19	2.90	1.22	2.52	1.21
DF,SL,SO**	2.90	1.01	2.94	1.06	2.58	1.20	2.90	1.14
DF,DL,SO**	2.94	1.09	2.90	1.01	2.68	1.30	2.39	1.02
SF,SL,DO*	3.28	1.28	2.88	1.01	3.09	1.35	2.66	1.07
SF,DL,DO*	3.44	1.24	3.28	1.14	3.09	1.17	2.87	1.21
DF,SL,DO*	3.16	0.99	2.47	1.22	2.94	1.27	2.22	1.10
DF,DL,DO*	3.44	1.22	3.22	0.97	3.25	1.39	2.97	1.15

* n=32   ** n=31 Figures for the strategic groups between subjects variable are not shown because of non-significance.

Key: Prefixes: S=same, D=different. Suffixes: F=functional focus, L=level, O=organization. eg. DF,DL,SO = different functional focus, different level, same organization.

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