Co-evolution of strategy, learning and organizational structuring.

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Introduction

In the literature on learning and innovation a substantial amount of theorizing on the combination of exploration and exploitation has been done (March 1991; Nooteboom 2001, Volberda and Lewin, 2002). However the conceptual and theoretical development outpaced the empirical research so far. (e.g. the volume of Dierkes et. al. on Organizational Learning). There is an old, but profound literature on innovation and structure (Hage 1980, 1998; Alter and Hage 1993; Damanpour and Gopalakrishnan1998). Until recently these literatures on learning and structuring are rather detached. Only some researchers (Boisot, 1998; Nooteboom 2001; Volberda 1998, and Volberda and Lewin ( 2002) aimed at a synthesis, nevertheless the empirical part remains underdeveloped.

In this paper we purport a synthesis of the old Chandlerian structure follows strategy notion and the literature on innovation and learning. Our research question is as follows:

To what extent does the level of strategic activity in innovation affect the external and internal structuring directly and to what extent is this effect mediated by learning and innovation processes?

Empirically the starting point of this study lies in findings of Pettigrew et. al . (2000). In a four-year period 1992-1996 substantial structural dynamics in European firms are reported.

Table 1  Aspects of Structural Dynamics in European companies between 1992-1996 (Pettigrew et.al 2000: 264)

<table>
<thead>
<tr>
<th>Aspects of structural dynamics</th>
<th>1992</th>
<th>1996</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Structures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean number of Layers</td>
<td>3.5%</td>
<td>3.2%</td>
</tr>
<tr>
<td>Median</td>
<td>3.0%</td>
<td>3.0%</td>
</tr>
<tr>
<td>Project form</td>
<td>19.6%</td>
<td>41.6%</td>
</tr>
<tr>
<td>Operational decentralization</td>
<td>40.7%</td>
<td>61.0%</td>
</tr>
<tr>
<td>Strategic decentralization</td>
<td>15.3%</td>
<td>18.9%</td>
</tr>
<tr>
<td><strong>Processes</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vertical linkages</td>
<td>10.3%</td>
<td>31.8%</td>
</tr>
<tr>
<td>Horizontal linkages</td>
<td>10.8%</td>
<td>25.6%</td>
</tr>
<tr>
<td>Information technology</td>
<td>7.2%</td>
<td>38.8%</td>
</tr>
<tr>
<td>New HR practices</td>
<td>Not asked</td>
<td>34.9%</td>
</tr>
<tr>
<td><strong>Boundaries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategic alliances</td>
<td>10.2%</td>
<td>31.1%</td>
</tr>
<tr>
<td>Downscooping: single core business</td>
<td>34.3%</td>
<td>23.7%</td>
</tr>
<tr>
<td>Dominant core business</td>
<td>25.4%</td>
<td>34.3%</td>
</tr>
<tr>
<td>Set of related businesses</td>
<td>25.6%</td>
<td>29.9%</td>
</tr>
<tr>
<td>Wide range of businesses</td>
<td>14.7%</td>
<td>12.1%</td>
</tr>
</tbody>
</table>

Of course this asks for an explanation. Why do these structural dynamics occur? Unfortunately Pettigrew et. al. do not give an empirical analysis. A number of factors that potentially account for his findings are suggested by Pettigrew et. al. (2000). Some of which are taken on board in this paper. First of all we take the old Chandlerian perspective – ‘structure follows strategy’. We concentrate on a specific part of strategy namely the innovation strategy. This restriction is important because especially in innovation strategy specific learning goals are defined, and to achieve these goals, structures must be reconsidered.

Second we consider the mediating effect of learning between strategy and structure? Recently several authors (Wolf and Egelhof 2002; West 1999) recouped the Chandlerian ‘structure follows strategy’ discussion advancing an information processing perspective. As in the debate on the M-form (Freeland, 19??) and the A-form versus the J-form (Aoki, 19??), the organization of R&D (West 19??) changes in the intensity of information processing account for the adaptation of intraorganizational organizational structures. An important restriction in
this literature is that the external organization is somewhat ignored. In our theoretical model external structure is included, because of the emergence of the networked organization and the growth of the number of strategic alliances (see Table 1).

The second part of our research question about the mediating effect of learning is based on a conceptual issue as to the notion of organizational learning. In his seminal 1991 paper James G. March introduced the dichotomy of exploration – exploitation in organization learning. In this dichotomy two types of adaptive processes were conceptualised. Exploration includes things captured by terms such as variation, risk taking, experimentation, play, flexibility, discovery and innovation. Exploitation includes refinements, choice, production, efficiency, selection, implementation or execution. March presents the problem related to this dichotomy as a trade-off (1991, p. 71).

‘Organizations engaging in exploration to the detriment of exploitation are likely to find that they suffer the costs of experimentation without gaining many of its benefits. They exhibit too many undeveloped new ideas and too little distinctive competence. Conversely, systems that engage in exploitation to the exclusion of exploration are likely to find themselves trapped in suboptimal stable equilibria. As a result, maintaining an appropriate balance between exploration and exploitation is a primary factor in system survival and prosperity.’

One of the problems related to the use of this dichotomy is that it is pretty unspecified. Both the definition of exploration and exploitation are broad, and in a sense vague. This is caused on the one hand by the fact that the problem definition is derived from four distinct bodies of knowledge: rational models of choice esp. theory of rational search, theories of limited rationality, studies of organizational learning, and finally from evolutionary models of organizational forms and technologies. These theories tell the same story in many forms: the story about resource allocation between competing behavioural alternatives.

Another problem is more of a conceptual nature. Drazin and Sandelands (1992) claim that organization science is flooded with so called achievement verbs like choice, selection, and change.

‘If it is asked how environments or managers determine organization, the answer usually given is that they “select” or “choose” one that is appropriate. However, to say that organization is “selected”, or “chosen” only incorporates the fact to be explained in the verb that does the explaining. The verbs “to select” and “to choose” do not refer to definite activities, but rather to consequences that unspecified activities might have. They present an appearance of process that only seems to explain organization.’ (1992, 231).

In the empirical literature one will find a wide variety of types of transformation processes, and outcomes that could, but not necessarily have an empirical relation. To us it seems that this also applies to the concept of learning. In most definitions of learning the transformation process over a time period, as well as its outcomes are taken together. In the innovation literature it is stressed to take this problem serious. Dosi (1988: 227) emphasizes that it is important to distinguish between factors, which induce, stimulate or constrain technical change, from the outcomes of the changes themselves. Inducement mechanisms may involve a broad set of factors, including: technological bottlenecks in interrelated activities, input scarcity or abundance, changes in demand, levels and changes of prices etcetera. We think that this also applies to organizational change, and learning.

Our theoretical starting point is derived from this brief discussion on the concept of learning. In the analysis of learning one should avoid the conflation of outcome, activities of many kinds and distinct types of change. Furthermore we concentrate on a specific type of outcome: relative differences in organizational structures, in companies with relative higher earning efforts. To us it seems that this is not only important to be able to develop more
analytical accounts of organizational behaviour, besides that it also opens up possibilities for a more differentiated set of interventions enabling successful learning.

Another important issue is whether one should treat exploration and exploitation as more or less exclusive whereas many companies probably combine both exploratory and exploitative learning strategies. From an empirical point of view this is important because in terms of resource allocation the two types of adaptive processes are exclusive, whereas it cannot be set aside that the exploratory part feeds the exploitative part of organizational learning. So an additional question is: to what extents do exploratory and exploitative learning affect each other?

The contribution of this paper is threefold: first, it tries to refine the rather linear and simplified discussion on the strategy – structure nexus by introducing mediating variables of a process nature; second it tries to extend the structure debate by including the external structuring besides the internal structuring; third it is one of the first papers to analyze empirically the interrelatedness of distinct learning strategies.

**Toward a research model**

Why do new organizational structures emerge? To what extent is the emergence of new structures a direct effect of strategy, and to what extent do learning process mediate the strategy effect on structure? This question has not been asked many times in this way. Many answers have been given on parts of this research question and therefore we will come up with partial accounts for the issue at hand.

**Environmental dynamics**

In the environment - organisation literature changes in organizational structures (often labelled as organizational innovation, but not to be confused with technological product- or process innovation) is considered as an outcome of strategic responses to environmental pressures. Especially in the resource dependency theory a la Salaçık and Pfeffer (1976?) companies confronted with conflicting demands are inclined to create new organizational devices be it departments, rules, positions, or a new organizing principle like for instance a divisional structure. In this way environmental pressures are transformed in structural devices. In general the environmental pressures vary between market pressures, technological change, regulatory changes and the like. The mechanism that explains this environmental effect is mostly left to the reader. Khandwallah (1972) and Duncan (1972) were among the few researchers that made explicit the theoretical mechanism linking environment and structure; uncertainty or unpredictability of future performance given high velocity or conflicting demands.

Gopalakrishnan and Damanpour (1998: 12-13, 16) state, ‘as the external impetus for change is weak, the organization’s main concern is operation, not innovation…. The organization’s focus is internal and its long-term concern is stability, predictability and efficiency – the characteristics that reflect a hierarchy. In a high-velocity or a hyper competitive environment the environment changes frequently and irregularly; thus the rate of innovation is high and the speed of adoption is fast. …The organization has an adhocracy form, is committed to experimentation and innovation.’

Unfortunately Gopalakrishnan and Damanpour did not test their enormous set of propositions empirically. Building on Duncan’s typology of environmental dynamics and uncertainty, Meeus & Oerlemans (1993) and Oerlemans (1996 p. 223-241) confirmed the uncertainty effect when reporting significantly higher levels of organizational adaptations if dynamics in supply markets and output markets were higher.

P1 Higher environmental dynamics induce higher levels of strategic activity.
Higher environmental dynamics induce higher rate and speeds of innovation.
Higher environmental dynamics induce higher levels of adaptation in organizational structures.

Past Performance
In the strategy literature, new or adapted structures are considered as the outcome of past performance of the firms (Miller, 1999). Miller & Friesen (1977, 1982, 1984) have extensively researched the self-reinforcing consequences of success. From the late seventies on he has been refining an initially rather rough taxonomy of successful and unsuccessful firms. Their initial findings were that the less successful were simpler and more extreme: For example among bureaucracies the unsuccessful type was more bureaucratic. Second less information processing took place within the unsuccessful types – less scanning of the environment, less careful analysis in decision-making. Miller and Friesen (1984) report in a longitudinal study that different types of companies evolved in different ways – bureaucracies tended to become more bureaucratic, whereas entrepreneurial enterprises became more entrepreneurial. This “momentum” was especially was especially common among companies that were doing well. Such firms extended their current practices whenever these appeared to pay off. In short, success may have major effects on the way organizations evolved.

March (1991) and the scholars he published with (Levinthal and March 1993; Levitt and March 1988, March and Olsen 1975), took a broader perspective, and related learning to success and failure. Their main conclusion is that both success and failure are potential learning traps. Success creates temporal and spatial myopia, success blocks learning when existing competences are exploited at the expense of exploring new ideas. Organizations can get caught in a failure trap when one idea after another is tried out and then abandoned before enough experience has been accumulated for it to be used successfully.

In our own research (Meeus & Oerlemans 1993) we found that companies adapting organizational structures either had been less successful over a five-year period, or had an above average past performance. The firms with stable performance turned out to significantly less active in adapting structures. This finding applied both if we used the achieved profit rates and the changes in strategic position.

Past performance either impedes or fosters adapting organizational structures.
Past performance either impedes or fosters organizational learning.

Structure and innovation
In the structural theories of innovation (Gopalakrishnan and Damanpour 1998; Hage, 1999) the main goal is to specify organizational design characteristics leading to innovation. Over time this strand of theorizing has evolved gradually specifying the nature of innovation as well as the phases of the innovation process. The founding fathers – Hage, Pierce and Delbecq, Damanpour – defined a number of structural variables that hampered or fostered organizational innovation. Professionalism affects innovation positively because it increases boundary-spanning activities, self-confidence and a commitment to move beyond status quo. Vertical differentiation affects innovation negatively because it increases links in communication channels, making communication between levels more difficult and inhibiting the flow of innovative ideas. The main conclusion of these studies has been that more bureaucratic control hampers organizational innovation, whereas structural features allowing a higher complexity of activities foster innovation.

The main argument one can derive from these studies is structural features of organizations can be barriers for innovation. The inverse argument is that effective learning is conditional
upon organizational structuring. Unfortunately, again the authors do not pay attention to external organizational structures.

P6 If effective learning is conditional upon organizational structuring, than higher levels of learning will induce changes in organizational structures.

Structure and learning
In the literature on learning structures are given a pivotal role. Several authors have reported results on structures as barriers to organizational learning. Fiol and Lyles (1985: 805), Hage (1999), Pawlowsky (1992: 223) suggested that centralised structures block learning because ‘a centralized, mechanistic structure tends to reinforce past behaviors, whereas an organic more decentralized structure tends to allow shifts of beliefs and actions’. Others like Berthoin Antal, Dierkes and Marz (1999) found contrasting evidence of effective and long-term learning in centralized and hierarchical structures as well as in decentralized structures. In this literature the role of external organizational structures is downplayed. In our research (Meeus, Oerlemans, Hage 2001a/b; Oerlemans and Meeus 2001; Meeus, Oerlemans and Hage 2002) we have shown that external linkages are certainly affected by the complexity of innovative activities. Although we analyzed the formation of external linkages both within the value chain (customers and suppliers) as well as within the knowledge infrastructure.

P7 Higher levels of learning activity are associated with more decentralized as well as with more centralized structures.

P8 A higher levels of innovative activities induces the formation of external linkages.

An exploratory theoretical model
The reviewed literature does not suggest any hypotheses on the intermediary effects of learning in the relation between past performance, and organizational change. Therefore a full-fledged approach of learning in terms of explaining the relation of past performance, innovation strategy - learning (activity) – adapted structure (outcome) cannot be based on this literature.

Central in learning is on the one hand the information and knowledge processing capabilities, on the other hand the external monitoring capabilities. The more firms move toward a combination of exploration and exploitation, the more they have to structure themselves in such a way that they can easily process and distribute knowledge and information. Hence they must decentralize, and simultaneously they have to create supporting linking devices facilitating the learning process. Another underlying idea is that patterns of embeddedness - the external structuring of firms - have to be aligned with its learning processes. The firms low on exploitation, high on exploration probably have stronger relations with firms in the value chain, whereas firms with a predominantly exploratory strategy should have stronger relations in the innovation system.

Of course we should be aware of the fact that these alignment processes are partially induced by dynamics in business environments. Organization researchers have found that imitative forces in populations of firms are very strong, and also contribute to the distribution of behaviours and structures (Haunschild and Miner 1999, Pettigrew et. al. 2000). For instance the two-way interaction between users and producers seems to be so widespread that a strong embeddedness in the value chain is likely to be found for any combination of exploration and exploration. In that case the embeddedness in the innovation system – with the weak ties so to speak – might be the discriminating factor in the alignment process. The
same applies to the assumed differentiation in organizational structuring (Pettigrew et al. 2000). Therefore it is necessary to control for factors that counteract these co-evolutionary patterns of learning and innovation strategies and organizational structuring.

Level of Exploratory learning

| Internal: centralized mechanical structures (CMS), few linking devices (LD) | I CMS < DMS ➞ many LD |
| ES low in VC, but high in IS |

| Internal: decentralized organical structures (DMS), many linking devices | I CMS = DMS ➞ few LD |
| External (ES): strongly embedded in value chain, and innovation system (IS) |

| Internal: centralized mechanical structures (CMS), few linking devices (LD) | I CMS = DMS ➞ few LD |
| ES high in VC, but low in IS |

| External: strong in value chain (VC) |

Level of Exploitative learning

**Figure 1:** Some hypotheses on Exploitation/Exploration and the internal/external structuring of organizations

In Figure 1 we summarized the hypotheses we explore in this paper. These hypotheses are based on aforementioned research. Foremost we build on the idea that structure follows strategy, but we add to this that these alignment processes are also affected in a complex way by past performance. In this paper we concentrate not on strategic in the broadest meaning but more specifically on innovation strategy, because that is a special knowledge intensifying area. That is also the basic mechanism that links strategy with structure (Wolf and Egelhoff, 2000).

P1 If the level of strategic activity increases the information processing capabilities have to be adapted, and hence internal structures are probably more decentralized and the external embeddedness is stronger.

The reviewed literature suggests several types of structural adaptations from which we selected two. The first one is the level of decentralization (Hage, 1980; Hage 1999; Gopalakrishnan and Damanapour, 1998; Pettigrew et al. 2000), which is a device for more commitment, self-confidence and openness and hence enables information exchange. The growth of operational decentralization is also one of the most significant structural dynamics among the European companies in 1992-1996 (Pettigrew et al. 2000). A second aspect of structural adaptation regards the external structure. Empirical research (Meewes, Oerlemans & Hage, 2001a/b; 2002) and theoretical considerations (Lundvall 1992; Nooteboom 1999) on the nature of innovation has shown that more complex innovative activities induce the monitoring and utilization of external knowledge resources, due to input and output uncertainty. Hence we expect that if strategic activity is augmented that first of all the linkages in the value chain are strengthened and additionally that the linkages with the knowledge infrastructure accrue. As to past performance the story is slightly complicated because the findings are more or less contradictory. This implies that we can both find negative and positive effects of past performance on the level of adapting structures.

As to the indirect effects we consider two challenging issues: first, the extent into which exploratory and exploitative learning affect each other. March (1991) suggests that in
terms of resource allocation there is a problem of balancing between the short-term benefits of exploitation and the more long-term benefits of exploration. However, if seemingly exclusive behavioural alternatives would turn out to have a positive effect on each other, this could imply that these behavioural alternatives are complementary. For instance, a positive effect of exploration on exploitation would mean that companies investing in radical new technologies, obviously daring to experiment heavily, systematically accrue companies’ capabilities of improving their existing products and processes. The point is that in that case the whole idea of balancing boils down to building these learning capabilities in organizational structures. The choice issue is then defined at the level of organization design and budget allocation, and not at the level of which type of activity to carry out. Strictly speaking we cannot make a proposition here, hence we describe how to interpret the sign of the structural coefficients between exploratory and exploitative learning.

P2a If the structural coefficient is positive this implies that exploratory learning amplifies exploitative learning.

P2b If the structural coefficient is negative this implies that exploratory learning has a detrimental effect on exploitative learning.

The next issue is the mediating effect of learning in the relation of innovation strategy and structure. We propose:

P3 Relatively higher levels of strategic goals in the field of innovation cannot be achieved without learning, and since learning implies more intense information processing this would demand for specific internal and external organizational structure enabling intensified information and knowledge processing.

The mediating effect of learning in the relation between past performance and internal and external structuring is less obvious. The general idea of Miller (1999) that success has a self-reinforcing effect. In line with this argument relatively high innovation targets are the products of the past. This means that previous behaviours are intensified unidirectional or as Sull (Dierkes) puts it, companies will show active inertia. If they were rather hierarchical and centralized, the change of innovation targets, and hence their innovation strategy, would give learning processes that reinforce these centralized structures. In the same way initially decentralized organization would become even more decentralized. This implies that more successful firms are inclined to routinize instead of experiment, or at the utmost routinize experimentation. In terms or structures this would yield a prediction that strategies and structures co-evolve in a literal sense.

P4a The higher the past performance, the higher the intensity of learning activities, the more decentralized internal structures, the stronger the external embeddedness.

To make the picture even more complex Nooteboom suggests that the effects of learning on organizational structure are bifurcated along the lines drawn in March’s exploration – exploitation dichotomy. Organizations consist of parts supporting exploitation and parts facilitating exploration. Exploration is expected to be associated with relatively integrated structures meaning process, change, and autonomy-oriented structures. Exploitation is associated with bureaucracy, standards, stability, and preservation of boundaries (Nooteboom, 2001: 262-3). Nor the suggestions of Nooteboom, neither these of Miller can be tested with our data. Besides that their ideas do not address both the internal and external structure. Nooteboom’s suggestions require data at the department level, whereas Miller’s predictions demand longitudinal data. As we do not have such data we’ll reformulate their ideas in such a way that their claims are visible, but also testable with our cross-sectional data. Our proposition is:

P4b If past performance positively affects exploratory learning this yields more decentralized internal structures.
If past performance positively affects exploitative learning this yields more centralized internal structures.

In our inductive search for backing of these ideas proposition 1 to 4 form the basis of our analysis and tries to reveal the direct effects of innovation strategies on internal and external structures of companies. In addition we explored all possible indirect relations between the included variables in our model. The hypotheses in this section indicate our interest in the existence of both direct effects and indirect effects indicating the intermediate function of learning in the effects of strategy on structure.

**Table 2 An overview of hypotheses**

<table>
<thead>
<tr>
<th>Type of effects</th>
<th>Mechanism</th>
<th>Type of effect (pos/neg)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Direct effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP → Explr</td>
<td>Myopia, self-reinforcing effect of success</td>
<td>+/-</td>
</tr>
<tr>
<td>PP → ExpLt</td>
<td>Active inertia, short sighted experimentation</td>
<td>+/-</td>
</tr>
<tr>
<td>PP → IS</td>
<td>Monitoring effect</td>
<td>+</td>
</tr>
<tr>
<td>PP → ES</td>
<td>Efficiency effect</td>
<td>+</td>
</tr>
<tr>
<td>IS → Explr</td>
<td>Information processing effect</td>
<td>+</td>
</tr>
<tr>
<td>IS → ExpLt</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>IS → IS</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td>IS → ES</td>
<td></td>
<td>+</td>
</tr>
<tr>
<td><strong>Indirect effects</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PP → Explor → Exploit → IS → ES</td>
<td>The expected signs as well as the effective mechanism are identical as in the case of the direct effects</td>
<td></td>
</tr>
<tr>
<td>IS → Explor → Exploit → IS → ES</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Method**

In this paper we want to develop these hypotheses further and develop a structural equational model to answer the following research question: To what extent do combinations of exploratory and exploitative learning and innovation strategies induce distinct patterns of internal and external structuring, and how far are these patterns affected by past performance, and imitation effects.
The research model

Figure 2 An exploratory model of strategy, learning and structuring

PP = Past Performance measured as the change in turnover, employment rate, profit between 1992-1996
IS = Innovation Strategy is a compound variable measuring the relative importance of strategic targets between 1992-1996. Seven separate indicators were: more attention for product innovation, more attention for process innovations, shortening of time-to-market, quality mark-up, customization, specialization, customer selection. Answers: 1 very unimportant – 5 very important. The variable was included in the analysis on the basis of an exploratory factor analysis. Higher scores on this variable mean that companies have relatively broader and more ambitious innovation targets in their innovation strategy.
Explor = Level of Exploratory Learning is measured as a compound variable of with two indicators: a) the percentage of turnover invested in radical new technologies applied in existing products in 1992 - 1996, and b) the percentage of turnover invested in radical new products with new functions and new technologies in 1992-1996.
Exploi = Level of Exploitative Learning is measured as a compound variable with two indicators in terms of the percentage of turnover invested between 1992-1996 in product innovations that are: a) incremental improvements of existing products without functional or technological changes, b) redesigned products with additional features or functions, with the same technology.
ISt = Internal structure measures centralization – decentralisation with three indicators. They measure the number of employees engaged in: a) cross-functional teams, b) quality circles or groups; and c) and planned roulation of workers on the basis of mutual consent of workers and management. Higher scores mean that companies have a more decentralized operational structure.
ES = External Structure measures the external embeddedness of companies in the value chain (customers, and suppliers of equipment and raw materials), and in the knowledge infrastructure (knowledge institutions within 20 km, and knowledge institutions outside the region) in terms of their importance for the acquisition of knowledge and methods in seven areas: state of process technology; application of technologies; development of new or improved products; organization structure; finance; marketing; HRM. The companies were asked to indicate the relative importance of these actors in all these areas using a 5-point Likert scale ranging between 1 = very unimportant, to 5 = very important. Higher scores on this variable mean that they utilize the value chain and on top of that the knowledge infrastructure relatively more.
**Sample**

In 1997 a survey was distributed among 2200 Dutch companies. The response was 13.6% and the dataset contains survey results of some 300 Dutch firms. The survey was developed especially to show how organizational structures evolved over a five-year period 1992-1996. The population has been described extensively in Oerlemans & Meeus (1998).

**Tabel 3: The size distribution of the population (n=256).**

<table>
<thead>
<tr>
<th>Number of employees</th>
<th>LPO</th>
<th>HPO</th>
<th>LKI</th>
<th>HKI</th>
<th>SHPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20</td>
<td>1.8%</td>
<td>0.0%</td>
<td>1.4%</td>
<td>1.9%</td>
<td>0.0%</td>
</tr>
<tr>
<td>20 - &lt; 100</td>
<td>49.1%</td>
<td>49.2%</td>
<td>63.4%</td>
<td>43.4%</td>
<td>46.7%</td>
</tr>
<tr>
<td>≥100</td>
<td>49.1%</td>
<td>50.8%</td>
<td>35.2%</td>
<td>54.7%</td>
<td>53.3%</td>
</tr>
</tbody>
</table>

Legenda: LPO = Low performance organization, HPO = High performance organization, LKI = Low Knowledge Intensity, HKI = High Knowledge Intensity, SHPO = Super High Performance Organizations.

**Table 4 Sectoral distribution of companies (n=256)**

<table>
<thead>
<tr>
<th>Sector</th>
<th>LPO</th>
<th>HPO</th>
<th>LKI</th>
<th>HKI</th>
<th>SHPO</th>
</tr>
</thead>
<tbody>
<tr>
<td>Industry</td>
<td>59.6%</td>
<td>48.3%</td>
<td>47.1%</td>
<td>34.0%</td>
<td>41.4%</td>
</tr>
<tr>
<td>Service</td>
<td>19.3%</td>
<td>32.8%</td>
<td>24.3%</td>
<td>47.2%</td>
<td>34.5%</td>
</tr>
<tr>
<td>Trade</td>
<td>10.5%</td>
<td>6.9%</td>
<td>15.7%</td>
<td>17.0%</td>
<td>3.4%</td>
</tr>
<tr>
<td>Other</td>
<td>10.5%</td>
<td>12.1%</td>
<td>12.9%</td>
<td>1.9%</td>
<td>20.7%</td>
</tr>
</tbody>
</table>

Legenda: LPO = Low performance organization, HPO = High performance organization, LKI = Low Knowledge Intensity, HKI = High Knowledge Intensity, SHPO = Super High Performance Organizations.

**Analysis**

The structural relationships between the variables IS, PP, Explor, Exploi, ISt and ES have been estimated and statistically tested for by means of the LISREL 8™ computer program (cf. Jöreskog and Sörbom, 1993). LISREL is well suited for this purpose because it is designed for the simultaneous estimation of all unknown but constant parameters in linear structural equation models of latent variables, which are specified to be measured in factor analysis models on a priori specified sets of observable variables, by means of the maximum likelihood (ML) method.

For reasons of brevity we do not go in detail of the technical details of our measurement model.

**Results**

Unfortunately the effects of Past Performance did not find any support at all in our data set. Hence this variable has been removed from the analysis. It also implies that findings about P4 are not reported.

P1 was supported by our findings. Relatively higher innovation targets are positively associated with relatively more decentralization ($\beta = .222$, p. < .06) as well as with a stronger external embeddedness ($\beta = .260$, p. < .06).

P2a was supported by our findings, whereas P2b has been rejected. Our findings suggest that higher levels of exploratory learning induce higher levels of exploitative learning ($\beta = .746$, p. < .04).
P3 hypothesized an intermediate effect of learning activities in the relation of innovation strategy and organizational structure. This effect indeed occurs. However, the association between the distinct learning strategies is much stronger than the association with innovation strategy. Important is that innovation strategy is unrelated to exploitative learning and only affects the exploratory efforts. Another interesting result displayed in Figure 3 is that exploratory learning seems to foster centralization slightly, whereas exploitative learning has an opposite effect, and seems to induce decentralization. Furthermore it is remarkable that the learning efforts do not directly affect the external embeddedness of the company. The learning effect on external embeddedness goes via internal structures.

**Figure 3 Structural coefficients in the SEM (n=276)**

![Figure 3](image)

Goodness of fit statistics of the estimated model:
- Goodness of Fit Index (GFI) = 0.74
- Adjusted Goodness of Fit index = 0.64

The goodness-of-fit measures GFI and AGFI of Jöreskog & Sörbom (1989) (cf., Tanaka & Huba, 1985) do not depend on sample size explicitly and measure how much better the model fits as compared to no model at all. Both GFI and AGFI vary between 0 and 1.

Legenda:
- Significance levels: d = p < .001, c = p <.01, b = p < .05, a = p < .10

**Discussion and conclusions**

The main conclusion is that the direct effect of innovation strategy on structures is stronger, and broader than the indirect effects via learning. Companies with relatively higher innovation targets turned out to be relatively more decentralized, and had more extensive and intense external relation in the value chain and the knowledge infrastructure. The learning efforts did not have a direct effect on external embeddedness, and proved to be mediated by internal structures. Chandlers (1962) main proposition turns out to be valid also in case one specifies ‘strategy’ as innovation strategy. It turns out that Cyert and March’s (1963) assumption that a search for better problem solutions is stimulated as soon as existing strategic targets are relatively outdated and no longer guarantee the achievement of organization’s goals.

The recent upsurge of the information-processing perspective (Wolf and Egelhoff, 2002) stresses that specifically activities intensifying the importance of knowledge and information exchange bear on organizational distance, openness, and permeability of boundaries hence on decentralization and external ties. Even after the millennium this implies a dramatic change for many companies, not to be underestimated in a sector that has been
socialized in terms of hierarchy, profit and competition, resulting in N-Learning (Boisot, 1998). N-learning is the neo-classical learning of building first mover advantages, based on protection of R&D investments by means of IPR, and trust in own competence. Our main finding as to the mediating effect of learning is that relatively broader and more ambitious innovation strategies induce exploratory learning, which on its turn boosts exploitative learning. There is no direct significant effect of innovation strategy on exploitative learning. The subsequent effect on internal and external structure is twofold and to some extent counterintuitive. Firstly, higher levels of exploratory learning have a direct negative effect on internal structure, which means that it pushes towards centralization. Secondly, higher levels of exploitative learning push organizational structures in the opposite direction and increase decentralization. This is contradictory to expectations of Nooteboom (2001). Furthermore, neither exploratory learning, nor exploitative learning proved to affect the external embeddedness. The effects of learning on external structures turned out to be contingent on the level of decentralization, which is consistent with earlier findings. In three papers (Meeus, Oerlemans and Hage 2001a/b, 2002) we have reported that internal structures foster interaction with external actors.

In sum these findings as to the mediating effect of learning between strategy and structure yield interesting additional explanations for the emergence of networks and decentralized structures. However for a substantial part these findings are contrary to our expectations and expectations in the literature. An exception should be made for the link between internal and external structure.

In general the effects in our model are moderate or even weak. Why? First of all, nor the data, nor the measurement model has been polished. So, this is a WYSIWYG model that can be refined and adapted in many ways. Of course this is not a decisive argument at all. From a theoretical point of view we would be very suspicious of very strong structural effects of strategy and learning. After all, structures are the pillars on which the organizational fabric rests, they stabilize and ascertain longevity. This temporal invariance of organizational structures should not be underestimated. Besides this general notion of structural inertia – it is clear that learning efforts only have to be assimilated partially in a structural sense, because for the larger part they should precipitate in new products and processes. The implication of our main findings is that the co-evolutionary part of our argument a la Miller and Friesen – although not on the basis of past performance – has to be adapted slightly. Learning efforts – that is to say the operationalization of innovation strategies – materialize partially in a structural way as far as procedures and rules are involved, but for the larger part they yield repertoires, and to an even larger extent new product and processes. Furthermore our findings support the existence of a sort of cumulative (Colombo and Mosconi 1995) and self-reinforcing effect of strategy, learning and structuring at the level of the firm in which exploration and exploitation seemingly have counteracting effects on decentralization, and in tandem generate stronger external embeddedness.
References
Meeus, M. T.H.; Oerlemans, Leon A.G., 1993, 


