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**TIME AND ORGANIZATIONAL LEARNING
IN NEW PRODUCT DEVELOPMENT PROJECTS**

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Anyone, who at some time has tried to learn a musical instrument or a new sport knows that learning takes time. Repeated practice, the repetition of various learning cycles of the type try-mistake-correction-new try require time: an objective time. Anyone, in their professional activity or in another area of work who, due to lack of time, has been obliged to restrain their creativity or has had to put off a certain experiment, which by its very nature has an unknown outcome, realises that intellectually produced worked adapts poorly to pressure created by time limits: a subjective time.

So why should collective learning be any different? Especially with regards to new product development projects where learning occurs whilst the project is being undertaken.

The evolution of competitive environment has meant that companies have pointed out their ability to develop new products both quickly and under good economic conditions - products which not only seek to satisfy the needs of clients but also bring them increased value- as a key factor of their competitiveness (Gupta & Wilemon, 1990). This reactivity puts pressure on time as a real strategic variable (Stalk & Hout, 1990). It allows the firm to respond, in an acceptable period of time to the needs of customers through specific products adapted to these needs. The specificity of products associated with brief time periods demanded by clients and imposed by competition, forces the firm to prove its ability to adapt to the changing desires of its environment. This evolution also explains why this echoes back to the theme of organizational learning and returns to the necessity for the firm to implement quick and efficient training programs (Koenig, 1994). In a context where the changing environment results in accelerated development and the launch of new products becoming an important competitive issue, it becomes crucial to master, promote and keep the knowledge learnt through R&D projects (Meyers & Wilemon, 1989).

So when managing its product development activity, the firm has to find a fine balance between two objectives which may sometimes seem contradictory; reduce the time necessary to develop new products and leave time to those working of these projects to develop ways of collective learning.

The first part of this article retraces the evolution of different methods of organising new product development projects, responding to the most important managerial criterion: the reduction of time needed to put the product on the market. The second part analyses the impact of temporal characteristics on new product development projects which determines the organizational learning taking place.

The evolution of organizational structure of new product development projects: The search for reactivity

At the beginning of the 1990s, R Rothwell (1992) noted that after more than three decades of empirical studies dedicated to identifying the characteristics of innovative companies and the factors of success or failure of innovative procedures, there was still no magic recipe for successful innovation. Despite the heterogeneity in the approaches and contents of these studies, a certain number of common factors, which characterise successful innovation processes and innovative companies, have emerged from these studies.

Thus, from this mass of research and the development of recent management models for new product development projects (Rothwell, 1992), two major managerial implications has resulted in.

Horizontal management: Towards an improvement in indirect activities

The first of these implications shows that horizontal management is a factor in improving the indirect activities of development. These activities, consisting of the control of the project, its administration and the general co-ordination of the activities of which is it composed, can, in effect, represent more than 50% of the total project time (A.D. Little, 1992). The adoption of an horizontal management style is one of the factors listed by R. Rothwell (1992) which favours the reduction in the time required to develop new products. This type of management, by favouring decision making in the lower levels, significantly reduces the time necessary to develop new products whilst improving the efficiency of so-called indirect development activities (Rothwell, 1992).

The setting up of plurifunctional teams: towards better integration

The affirmation of taking the market place and the client into greater consideration has resulted in plurifunctional teams being put into place and the resulting integration. Thus, one of the key factors of success in the process of developing new products is effective communication between the members of different functional departments; this is optimised by the setting up of plurifunctional project teams (Rothwell, 1992). Members of these projects are detached from their original functional department for a limited time.

If the search of the congruence of the developed product with the needs of the market and the final client was of major concern for a long time, the reduction in time needed to develop new products has become a primary objective in the evolution of process models for the development of new products over the last ten years (Gupta & Wilemon, 1996). The quest for greater flexibility by progressively abandoning sequential logic and breaking down barriers of time and organizational space by putting into place integrated processes are the principal traits of the changes that ways of organising new product development projects have undergone. These new models seek to find a delicate balance between, on the one hand, the need to regulate action and to obtain all information and, on the other hand, the necessity for the process to progress quickly (Cooper, 1994).

Thus, the management of new product development projects has progressively seen the sequential process, consisting of a succession of stages carried out by the various different functions of the firm, give way to plurifunctional teams which have been given increased autonomy and decision making power (Tarondeau & Wright, 1995). The areas of control and decision making, where previously information was exchanged between specialists belonging to different functions, have been replaced by simultaneous decision processes.

The emergence of the horizontal organization: Towards the prime importance of the “project” aspect

As well as reducing the time taken for new products to be put onto the market, which is still the principal preoccupation for R&D (Gupta & Wilemon, 1996), the firm must also control inherent project costs and give priority to evaluating the value brought to the client in a competitive environment where competition occurs through a continually renewed range of available products.

The dimensions (time, costs, and quality) for improving the performance of new product development projects echo back to the three defining elements of horizontal logic: by exceeding the firm’s functional barriers this horizontal logic must in effect, make it possible

to lower costs concerning service given to the client and control the overall amount of time taken “as seen by the client”.

In this new organizational context concerning the activity of developing new products, project teams centralise decision making at the project level and develop competencies in the various projects, rather than specialised knowledge in functions or activities (Tarondeau & Wright, 1995).

However, when the firm feels that this second distinctive characteristic is watering down its functional competency, it would appear to limit the development of this new form of organization.

Horizontal organization and its implied integration take precedence over functional organization, and its sequential approach of processes, when the needs of lateral co-ordination prevail over the benefits generated by the specialisation of functions and individuals. This breaking down of barriers between various activities involved in the process of developing new products by favouring an increase in information exchange right from the initial stages of the project allows for various stages, which were previously undertaken sequentially, to occur simultaneously (simultaneous development), and this would appear to be a factor in the reduction of development time (Clark & Fujimoto, 1991). This horizontality gives project members the possibility to understand and measure their contribution to collective efforts (Tarondeau & Wright, 1995). It also allows them to be informed of the value received by the client, a client who is not particularly concerned by individual involvement but rather by the overall resulting performance, nor by the sum of the different successes in the areas of competence and influence of successive functional managers, but by the quality resulting from the integration of activities in a process. So, functional territories are no longer perceived as the only areas where performance can be improved. Rather, it is cooperation and coherent action between these territories which can provide value.

For companies which have embraced this new way of organising the activity of developing new products, performance gains have been obtained in terms of cost and development, in time taken get a product on the market and the quality of the products developed (Bourgeon, 1998). This established fact confirms the merits of the original motivations to put in place an horizontal organization for new product development projects, which has resulted in an improvement in the performance of these projects.

In a complex and dynamic competitive environment, the problematic evolution of organizational methods for new product development projects arises from the search for a delicate balance between, on the one hand, the requirement to reduce development lead times for new products and, on the other hand, the necessity to guarantee conditions which favour organizational learning during projects.

New product development projects: A critical learning area

By its very nature, R&D is a learning system (Carlsson & *al.*, 1976); a learning system defined by P Shrivastava (1983, p.14) as “the mechanisms by which learning is perpetuated and institutionalised in organizations”.

So, in an R&D project, the learning systems are the formal and informal mechanisms which the project team will use in the process of developing knowledge. These mechanisms may include the methods required for detection, storage and extraction of knowledge gained (Meyers & Wilemon, 1989). The members of the project team also depend on learning systems for making decisions as well as detecting and correcting errors (Duncan & Weiss, 1979). But knowing the cause of the problem occurring (error detection) is only useful when preventative action is taken to prevent the problem from reoccurring (error correction). So, the ability to detect and correct errors in time would appear to be dependent on the efficiency of the learning system of the project team (Purser & *al.*, 1992). The project manager must therefore seek to ensure that all members of the team are involved in the realization of a learning “by participation” system (Shrivastava, 1983).

These elements make up the socio-technical culture of the project and appear (once they have been tested) to be critical factors in the success of technical complex projects (Purser & *al.*, 1992).

Because R&D projects are by their very nature knowledge-intensive places, the skills learnt through such projects can be defined as the development of a knowledge base (Purser, Pasmore & Tenkasi, 1992). But the creation of new knowledge does not come about by disregarding already acquired competencies. The learning processes, likewise the projects, are the products of the firm’s combined capabilities; the emergence of new combinations of the firm’s capabilities produce knowledge. By “combined capabilities”, B Kogus & U Zander (1992) mean the intersection of the firm’s abilities operated in the aim of exploiting its knowledge, with unexplored technological potential (technological opportunity). These new combinations are obtained through constituent trial and error sequences. The setting up of a

learning system, or conditions favouring learning, in an R&D project would therefore appear to be a critical factor in the success of a project.

The project, which by definition is voluntarily limited in both time and cost, and which has a defined organizational space, would appear as a potential place for experimenting on a reduced scale in terms of time, space and cost. At the same time it plays the part of a learning tool which enables the firm to test the validity of certain established hypotheses (Garvin, 1993). In effect, the project is precisely what modifies the setting, regenerates the system, and transforms the definition of activities (Koenig, 1994). It may be seen then as the ideal place for experimenting as defined by putting into practice new knowledge which does not concord with the rules of accepted usage (Midler, 1993). This beacon of change within organizational space limits risks and allows energy to be concentrated. And the existence of an evaluation process allows validation (or refusal) and generalization of new choices made during the project (Midler, 1993). In this perspective, the implementation of an horizontal organization for new product development projects promotes the project itself, the horizontal rather than the vertical dimension of the firm (functions), and gives preference to experimenting and learning. These projects then constitute the real test as to the capacity of the firm to succeed in crossing actions and can be used as tool to reinforce relations between functions at the same time as giving them the space necessary to improve their own expertise (Leonard-Barton & *al.*, 1995).

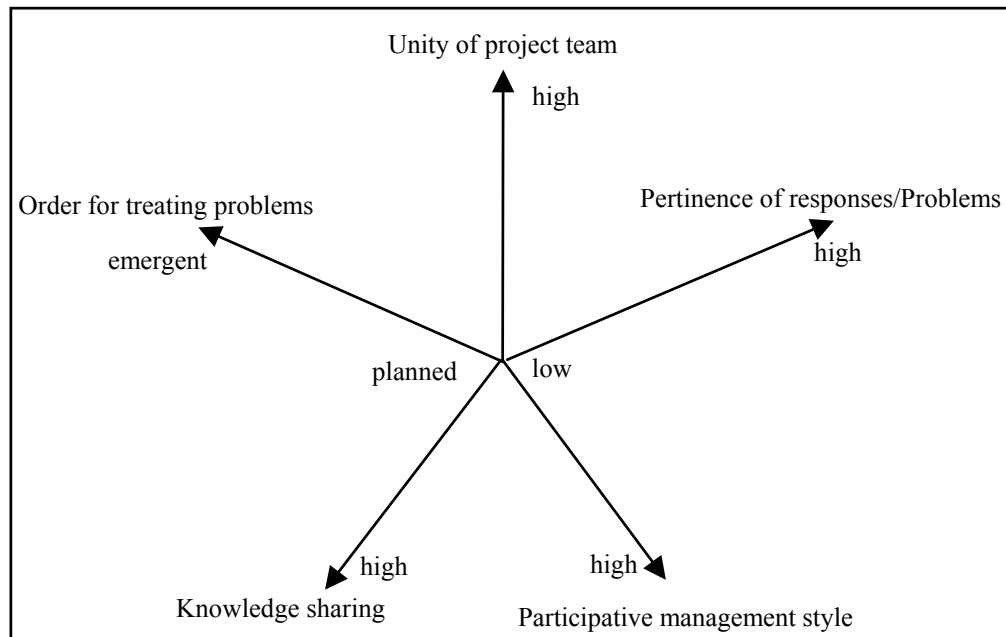
The principal dimensions of learning through projects new product development

The first stage of data analysis -data which results from a questionnaire completed for this research¹- allows the principal dimensions of learning in new product development projects to be put forward. The factor analysis carried out on the data which resulted from the tool used to measure organizational learning during new products development projects leads to five principal dimensions (or factors); these are: The unity of the project team, the pertinence of the responses brought to problems encountered during the project; the implementation of a participative style of management, the efficient knowledge sharing among project members, the order in which problems inherent to the project are treated (cf. Figure 1).

¹For a detailed presentation of the methodology used cf. Appendix 1

Figure 1

Principal dimensions of organisational learning during projects



During the second stage of data analysis (cluster analysis), the results of which are not presented here, the sample firms will be classed and regrouped in homogenous groups according to their respective position on the principal dimension of organizational learning during new product projects. These groups refer to the relative levels (low or high) of organizational learning through new product development projects.

Finally, in a third stage, an analysis of the variance is made of the values taken by the variables: “the average length of the new product development projects undertaken by the firm”, “dedication of the project-members for the entire period of the project”, “turn-over of project members during the project” and “stress related to the project-member’ perception of the time frame given to the project” according to the firm groups formed on the basis of learning conditions which characterise the projects being undertaken. The results of these analyses, the objective of which is to bring elements of validation to the hypotheses underlying this research² are presented in the following.

Project “time” : a brake on learning (?)

According to P.W. Meyers and D. Wilemon (1989), at the beginning of the project, the knowledge of the project team is said to be made up of the knowledge of its members and other available contributions. Learning by the detection and correction of errors, such errors here being understood as problems, challenges, crises and other events occurring during the development of the project, will serve to enrich this knowledge by the end of the project. The R&D project is an area of learning by doing (Maidique & Zirger, 1985). The occurrence of non-routine tasks or critical incidents during the project are, in themselves, an occasion for project-members to get involved in the processes of information research or discussions. Individuals seek to reduce the ambiguity confronting them by developing exchange and communication scheme according through which the problem is treated. Thus, discussion differentiates from the programmed decision point or revue of the project in that it encompasses informal relations established between the members in the circulation of information relating to a given subject.

During a project, non-routine tasks, characterised by a high level of complexity and uncertainty, push the teams themselves to generate processes which can deal with these problems; problems which cannot be resolved by a single player or unique function (Purser & al, 1992). In this case, the emerging deliberation is a way of dealing with the complexity of non-routine tasks; it will involve various and sometimes temporary members and will transcend the organizational limits defining the project space.

Project-members, on detachment to the project from different functional directions of the firm, acquire two types of knowledge: a first type of knowledge resulting from the information gathered during the project by the members in their respective specialised domain and from the know-how which is developed, during the project, by these same actors in order to resolve problems or accomplish tasks relevant to the speciality. The second type of knowledge gained during the project corresponds to information relating to the retention or sharing of information by the members (or the knowledge of “who knows what”) and to the relative know-how of the management of the project (Kogut & Zander).

²The proposals tested within the framework of this research are as follows: Prop. 1: the length of the project conditions the realization of collective learning during its course. The greater the length of time given for the project, the more favourable the learning conditions; Prop. 2: the dedication of the project-members (detached from their original function department) for the entire duration of the the project favours the realization of collective learning during its course; Prop. 3: turn-over of project-members during the project acts as a break on collective learning during its course. Prop. 4: stress related to project- members’ perception of the time frame assigned to the project acts as a brake on the realization of collective learning during its course.

The organization of new product development projects is a result of the setting up of plurifunctional work team in charge of managing projects which have been assigned certain objectives. The whole project is geared towards realising these delegated objectives through the optimal use of the resources, especially human resources, which have been allocated. Individuals are detached from their original functional department for a determined period of time in order to take part in the project and bring their expertise. The success of the project, through the realization of the objectives which were assigned, depends on the ability of the project manager to manage the various forms of expertise available, make individuals who are unused to working as a team work together, and thus create the desired added value through the best possible integration, and finally favours collective learning. But this success also has a prerequisite, which is that the accumulated results of different forms of knowledge, sometimes stretching back to the very beginnings of the firm, are made available through the diverse functions of the firm's high potential employees.

Project length (objective time) and organizational learning

The “time” of a project refers to different definitions of time. The first is the objective time of the project, its length or completion time measured in units of time (weeks, months or years). The project team focuses on completion of the objectives which have been assigned to it, especially as regards time, through optimal use of the allocated resources, and the development of new competencies is not a natural preoccupation in this form of action oriented logic. The length of the project thus conditions the realization of collective learning during the project. The empirical study carried out in this research confirm the link existing between the measured time of the project, its length, and the more or less favourable character of the collective learning conditions characterising the project (cf. Table 1)

Table 1
Learning and duration of projects

Mean Standard Deviation	Conditions of Organizational Learning during New Product Development Projects			
	Unfavarourable	Favourable	F	Significance
Length of projects*	2,225 0,659	2,609 0,833	5,294	0,024

*(Value taken by the variable “Length of projects” 1:<1 year; 2: from 1 to 2 years; 3: from 2 to 5 years; 4: from 5 to 10 years; 5: > 10 years)

In effect, the average length of projects would appear to differentiate more or less favourable character effecting learning conditions during these projects. The average length of new product development projects associated with the existence of favourable learning conditions during these projects is relatively greater than in those companies where these types of projects are characterised by unfavourable learning conditions. In other words, the objective time of the project tends to favour collective learning during a project. The longer the project time, the more favourable the learning conditions.

On the contrary, the relative importance of the length of the project contributes to the inertia of repeating the experience and then acts as a brake regarding the transfer of learning carried out during the project (Midler, 1993). In effect, the longer the project, the longer the time deemed necessary to judge the effects of changes introduced to general practice during a project, and thus, the inter-project capitalisation of learning resulting from it, is also slowed down, if not halted.

Length and stability of the participation of functional actors in the project and organizational learning

However, if the length of projects would appear to contribute to the emergence of favourable learning conditions during projects, the permanent availability of the project-members would also appear to play a critical role. Furthermore, an individual's participation in the project is often measured using an indicator which measures the objective time dedicated to the project and calculates the number of individuals per day units. In this perspective, it would appear of prime importance to devote members for the entire length of the project depending on personnel availability in the functional departments involved in the project and, on the other hand, avoid turn-over of project-members, paying special attention to this when enlisting their participation in the project-team. These two requirements, which are inherent to the logical setting up of project teams, contribute to the establishment of conditions which favour learning during projects.

So, it would appear that, within a firm, the logic governing the involvement of functional actors in projects developing new products discriminates to a significant extent (cf. Table 2) companies in which these types of projects are characterised by favourable learning conditions, as opposed to those where learning conditions are unfavourable.

Table 2
Learning and participation of functional actors

Mean Standard Deviation	Conditions of Organizational Learning during New Product Development Projects			
	Unfavourable	Favourable	F	Significance
Participation of functional actors *	2,799 <i>1,244</i>	3,365 <i>1,427</i>	3,608	0,0611

*(1: as needed; 5: detachment for entire duration of the projects)

The commitment of the functional actors (i.e. their detachment for the entire duration of the project) which allows new product development projects to have their own particular organizational dimension, both spacial and temporal, contributes towards the establishment of favourable learning conditions during the project. This form of approach, that is to say, the involvement of functional actors in projects developing new products is, furthermore, a characteristic of companies which have chosen to give priority to “project” dimension over “functional” dimension when organizing new product development projects by adopting a team-based organization (Bourgeon & Tarondeau, 2000).

On the contrary, the approach in which functional project members are detached on an “as needed” basis to the project according to its specific requirements, which approach corresponds to sequential management of new product development projects, would hardly appear to contribute towards establishing favourable learning conditions.

Nevertheless, it would appear that the characteristic which, to a greater or lesser extent, favours learning conditions which feature in projects undertaken by the firm, would not appear to be linked to the level of turn-over effecting the project-teams (partial renewal of the team during the project).

It would seem then that, in addition to the stability (or instability) of the functional actors involved, it is the durable character of the involvement of functional departments as well as the commitment of their managers, which is most important in establishing favourable conditions for learning during new product development projects.

Perception of time assigned to a project (subjective time) et organizational learning

But the “time” of a project is also subjective time, echoing back to the project members’ shared vision of the time restrictions which are imposed upon them. This shared vision of the project objectives by the project-members, especially in terms of the time frame, which constitutes, in the manner of understanding the purpose of the project (the technical

system to be realised) an integrating factor for the team, and also conditions the capacity of the team to develop collective learning.

By focalising on the realization of the objectives which it has been set, especially in terms of time limits, through the optimal use of resources dedicated to it, the project team is totally dedicated towards action. In this climate, which judging by appearances one could consider as hardly encouraging learning, the capacity to develop new areas of competency is largely influenced by the team members' perception of the time allowed for the project. In effect, this type of learning is time consuming, especially in the initial stages of the project (definition of the project and of the product). So, in a new product development project it is important to leave time further on in the project for experimenting and for detecting and correcting errors. These activities are, in effect, necessary so that the process for exploring "new combinations" and the acquiring of information aimed at reducing uncertainty and validating choices taken, can occur.

This latitude will guarantee rapid convergence of this process and the process of decision whereby the identity of a product progressively asserts itself, and which reduces the degrees of freedom left to the project development (Midler, 1993). Thus, the differences in terms of time allowed between the stages established during the project, reveal the levels of learning which have taken place (Meyers & Wilemon, 1989). The excessive amount of attention paid by the team to possible delays is likely to discourage not only learning efforts which rise from activities in the initial stage of the project, but also the willingness to research and incorporate previously developed learning into the project.

P.W. Myers and D. Wilemon (1989) noted that these types of "voluntary" delays, at the initial stages of a project, brought about by trying to learn more, especially regarding ratifying choices, are often perceived by exterior project observers as simply a waste of time. The "time limit" on a project would therefore appear to be unfavourable for learning. An atmosphere of urgency, which is maintained by time restrictions on new product development projects, but which does not necessarily go against intellectual production, can very quickly prove to act as a serious brake on sequence types such as "experiment-thought-decision" or "detection-correction" of errors, which are characteristic of learning in new product development projects, if the feeling of stress becomes permanent. The perceptual frontier separating stress and urgency is a matter of how the project-members perceive time restrictions: if they are judged unrealistic, they become a source of stress (Purser & *al.*, 1992).

A certain number of authors (Garvin, 1993; Meyers & Wilemon, 1989; Midler, 1995; Purser, Pasmore & Tenkasi, 1992) have observed a brake on learning occurring within a

climate of continued stress generated by time restrictions imposed on certain new product development projects. And the empirical study carried out within the framework of this research confirms this (cf. Table 3).

Table 3
Organizational learning
and stress related to perceived time restrictions assigned to the project

Mean <i>Standard Deviation</i>	Conditions of Organizational Learning during New Product Development Projects			
	Unfavourable	Favourable	F	Significance
Stress related to project time restrictions*	2,274 <i>0,816</i>	3,317 <i>0,756</i>	35,55	0,006 E-5

*(1: weakest level; 5: highest level)

It would appear that, in effect, new product development projects undertaken by teams working under high stress, which stress is generated by the shared perception that the assigned time restrictions for the projects are generally regarded as being unrealistic, are significantly characterised by unfavourable conditions for collective learning. On the other hand, companies in which the allocated time restrictions for new product development projects are not seen as a source of stress for the teams, would appear to have favourable learning conditions during these projects. The perception held by the actors involved in the projects assigned to them (or the shared vision of the time objectives assigned to the project) is a source of collective stress which conditions collective learning during these projects.

More than just the duration of the project itself (objective time), it is both the permanence of the project members involved, and their perception of the time restrictions applied (subjective time) which to a greater or lesser extent condition the favourable conditions for collective learning during a project.

This research has made it possible to show that the project's objective time (its length and the length of time the functional actors are involved) and the project's corresponding subjective time (the shared perception of the project-members of the time restrictions applied to the project) have considerable influence over the realization of collective learning during new product development projects. The "time" of a project in these two conceptions conditions the involvement of the project-actors in experimenting, detecting and correcting errors, and searching for new combinations; activities which make up organizational learning.

Further more, new product development projects are an area in which new knowledge is created within a firm. This creative activity is time consuming; it requires “(...)resources and time. The time to sit down and think. The time to be alone. The time to carry out tests. The time to have ‘on and off’ discussions with others” (Nordström & Ridderstrale, 2000, p.155). It needs communications between the actors involved in the process, or what the Japanese also call “nommunication” (the term “nommu” means drink). Nommunication is understood to mean “the time which employees spend in the bar after a day at work (and which) may be a determining factor in the development of new ideas” (Nordström & Ridderstrale, 2000, p.156).

The firm which seeks to conciliate the reduction in development time for products and the realization of favourable conditions for learning during projects may find a solution by adopting an horizontal organization structure. This form of organizational structure, which seems particularly adapted to research objectives measured in terms of time and quality of service (Tarondeau & Wright, 1995) also allows the realization of collective learning during new product development projects by giving autonomy and decision-making powers to the project teams (Bourgeon & Tarondeau, 2000).

In addition, each time a project is started, the firm using this new structure must undertake to ensure the following formula is followed: “Rather than treating each project as if it were the organization’s last, each project should be looked at as the first of many to follow” (Purser, Pasmore & Tensaki, 1992, p.23). Because learning helps one acquire the knowledge to manage time, and not the opposite.

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Appendix 1

Methodology

Sample

A random sample of 264 French industrial firms was drawn from a France-Innovation listing. A postal questionnaire was deemed to be the appropriate technique for reasons of cost efficiency and generalizability; a suitable and tested instrument was sent to the R&D manager of each firm, of which 93 were returned. Twelve of these had missing information. Thus, 81 valid responses remained, representing an effective response rate of 35,5%.

Measures

The measurement tool of organizational learning during the new product development projects was derived from the work of R.E. Purser, W.A. Pasmore and R.V. Tenkasi (1992).

The organizational learning during the new product development projects was measured by sixteen variables (lack of knowledge, failure to utilize knowledge, lack of knowledge sharing, lack of cooperation, lack of internal consulting, lack of external consulting,...); which were all identified by these authors as contributing to the creation of unfavorable conditions for organisational learning in new product development projects.

Other variables measure the various dimensions of the -objective and subjective- time of new product development projects: “The average length of the new product development projects undertaken by the firm”, “dedication of the project-members for the entire period of the project”, “turn-over of project members during the project” and “stress related to the project-member’ perception of the time frame given to the project”.

Data analysis

A three-stage analysis procedure was carried out. In the first stage, a factor analysis were used to reduce the number of variables characterising the “ phenomenon ” measured (i.e. organizational learning during projects). Thus were identified the main dimensions of this phenomenon. In the second stage, a cluster analysis were carried out to identify and to assess the underlying group structure of the sample firms in relation to this “ phenomenon ”. Finally, in a third stage, an analysis of the variance is made of the values taken by the variables relative to the project time to explain the group membership regarding organizational learning of the sample firms.