

Laboratoire d'Economie Appliquée de Grenoble

PROJECT MANAGEMENT :

LEARNING BY BREAKING THE RULES

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ABSTRACT

The paper explores project management in action in a large public research organisation – NLAT which decided to change its internal organisation from team-based to project-based organisation a few years ago. A systematic and comparative analysis of 8 projects reveals that adherence to the ISO 9000's standardized rules of project management - specific staffing and project leaders, definition of milestones ex ante, procedure manuals, and formalized learning accumulation mechanisms - had little to do with the organisations success over recent years: Looking for explanations for this success, the paper focuses on the process of transferring from one project to another, enhancing organisational learning through rules breaking. We identify three elements which encourage the accumulation of knowledge and competencies, as organisational learning: low project core staffing levels which stimulates the circulation of engineers and researchers between projects and blurs project boundaries, implementing and managing thematic projects which build on specific competencies developed in dedicated projects and encouraging 'bricolage' to hybridise project management with traditional hierarchical management practices.

Keywords: project management, R&D, high tech, management practices

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'Eppur si muove (but still it moves)'. What Galileo is supposed to have said during his trial in Roma in June 1633 could be a relevant summary of what has happened at the French National Laboratory of Advanced Technologies (NLAT) over the last few years. It hasn't done what it said it would – but still, it works.

In 1998, NLAT decided to change its internal organisation from team-based to project-based, adopting standardized project management practices designed to develop new technologies quickly and under favourable economic conditions [1]. All activities were to be labelled as projects, and managed as such. NLAT adopted ISO 9000's standardized rules of project management: identification of project, specific staffing and project leaders, *ex ante* definition of milestones, manuals of procedures, and formalized learning accumulation mechanisms [2]. But an analysis of NLAT project management practices shows that basic project management rules were systematically broken or ignored. And yet, at the same time, NLAT has exhibited tremendous success. The paper explores the new practices at NLAT after the introduction of project based organisation, analysing how the organisation plays the inherent tensions between project based organising - focused on meeting short term project task objectives - and the long term organisational learning processes [3].

Because it focuses on the realisation of a particular set of tasks for a specific client, project management practices are oriented towards optimising the process of providing clients with answers and solutions (problem solving approach). While there is a significant amount of learning within projects, Prencipe and Tell [4] stress the difficulty of sharing such knowledge across projects and within the organisation. There are few mechanisms through which the learning accumulated from projects can be assimilated as organisational knowledge, *i.e.* knowledge which can be mobilised by the organisation for other projects. Inspired by Scarbrough *et al.* [5], who analyse project based learning from the comparison of two cases, the

paper builds on previous analyses to identify knowledge transfer mechanisms in project based organisations. The particular focus of this paper is how the process of transferring learning from one project to another, thus enhancing organisational learning, involves breaking project management rules.

The paper is structured as follows. In the next section, a targeted review of literature suggests that the transformation from team-based organisation to project based organisation leads to a fragmentation of the organisation which slows down and reduces learning opportunities. Cases from one large R&D organisation are examined to show how the circulation and accumulation of knowledge is based on breaking project management rules. The final section discusses managerial and theoretical implications.

1. FROM TEAM BASED ORGANISATION TO PROJECT BASED ORGANISATION

During the late 80s most R&D organisations, whether in firms like large pharmaceutical firms [6] or large, dispersed multinationals [7], in universities, academic organisations or in public research organisations [8] faced fundamental challenges of longer development times, tremendous increases in R&D expenditures, a multiplication of scientific and technological approaches and the entry of new actors into research arenas. In this challenging environmental context, research organisations started to rejuvenate themselves by implementing up-to-date technologies, transforming organisational forms and developing both cooperative and competitive strategies. Hamel [9] argued that these organisations were not only racing for innovation, but also for learning, especially within collaborations, in order to become more effective competitors.

As part of this change, most R&D organisations shifted from team-based organisation, structured by scientific fields or technological competencies, to project based organisational structures, focused on the realisation of specific sets of tasks to solve particular problems. The

notion of projects epitomizes a shift of the locus of knowledge creation from the traditional institutional framework to knowledge creation in the context of its application. As "one-off" activities, projects tend to sit outside mainstream organisation structures and control mechanisms. This suggests that the transfer of knowledge and learning generated within projects, be it managerial or technological, does not happen either smoothly or directly [5]. There are few mechanisms through which the learning accumulated from projects can be assimilated as organisational knowledge and resources.

Ibert [10] defines three different meanings of organisational learning: *memory* i.e. storage of knowledge; *experience* i.e. organisations' ability to learn from accumulated events and *reflection* i.e. the ability to detect and correct deviations from predicted norms or experiences. Just as firms are perennial organisations, research labs (teams of researchers following the same scientific goal) have specific existence as hierarchical entities, and are usually conceptualised as "repositories of knowledge" [11]. Organisations play a critical role in creating and accumulating knowledge, in the protection of valuable knowledge and in managing knowledge to make it redeployable and reusable over time and for different projects. Through the creation of specific routines to solve problems, organisations develop unique and intrinsic capabilities to innovate, based on their accumulated learning. Accumulated knowledge and tacit "how to do it" knowledge are embedded into organisational routines, organisation charts, circulation of information, architecture, management staff and other organisational devices such as managerial procedures, assessment methods etc.. As the organisations shift from teams-based to project based organisation, tradition methods of learning and accumulating scientific, technological and managerial competencies can be called into question.

While some authors see project teams as the new economic form at the macro level [12], most research on project management looks only at the management of single projects [13]. This

paper offers a view at a level above this, by comparing different projects. Sydow and Staber [14] define a project as a temporally limited set of interrelated tasks. Grabher [3] underlines how project management practices have witnessed standardization and certification efforts which have made project management a well diffused mode of organising. The main principles (rules) of project management can be summarised in five keywords: *task, interdependence, power, deadlines and learning mechanisms*. Thus:

- The first principle is that projects are focused towards the realisation of a particular set of **tasks**, which can be more or less complex, implying a contextualised and pragmatic approach which is focussed on action.

- The second principle is that the different tasks performed for the project are **interdependent**. Thus the pacing of concentrated efforts, and planning, optimising and scheduling are crucial: parameters have to be met, goals have to be accomplished according to a grand scheme which is responsive to the competitive environment [15]. Girard and Stark [16] note that the fact that the projects are done not *for* a client but *with* a client increases the strength of these interdependencies, and also underlines the necessity of bringing the project to closure.

- The third rule is the **importance of project management,** carried out by a project leader in whom trust and authority is focused. Project leaders embody the management of the project, and must manage the project's interdependencies within its boundaries. They must have effective power to manage the budget, negotiate technical allocation or re-allocation and be responsible for meeting the deadlines and delivering results to the clients. (Grabher notes that the role of the independent contractor as project leader is increasing.) Project management also requires a specific project team which is clearly identified and dedicated to the project.

- Fourth, **meeting milestones and deadlines** are main criteria for evaluating the performance of the temporary project organisation, and also appear to be the main coordination mechanism to help participants and organisations avoid distractions and remain focussed on the problem solving process [17]. The project schedule preserves the professional and organisational cultures of the different members as the project time-span is defined *ex ante*. In that sense, knowledge is valued according its usefulness to solve the specific project task, rather than to the authority of its disciplinary or departmental origin. The project schedule is also used to time financing needs and staged payments, and allows venture capital funding to be linked with deliverables, which may be especially pertinent in such research-driven contexts.

- Finally, project management rules involve formalized **learning accumulation and dispersal mechanisms** (final review, articles in internal magazines, etc) to help both to preserve accumulated knowledge and competencies for the project, and to share them between projects and throughout the organisation.

Many scholars underline the difficulty of transferring learning between projects and from project to organisation as the main bottleneck of project organisation. The essential temporal limitation of any transient organisational form provides a major obstruction against useful knowledge 'sedimenting' and being retained beyond the project time-span. Knowledge accumulated in the course of the project is in danger of being lost as soon as the project team is dissolved and members are assigned to new project or task, within a new team and focusing on new deadlines. If projects, viewed as singular ventures, combine different knowledge effectively, they apparently also tend to forget quickly. The syndrome of such "organisational amnesia" from the singular venture to the wider social context in which the project is embedded has drawn increasing attention. Project based organisation practices and organisational R&D goals may be difficult to reconcile: projects are essentially focused on

one client with specific deliverables, while research organisations emphasise not only the development of a specific application as a response to demand, but also the construction of ways to generalise the methodology or results which have been discovered. The assessment of project managers is based on the meeting deadlines *i.e.* giving the most satisfactory answer to the client within a given limited time, while research is driven by competition amongst teams and quality of results. Finally, in research organisations learning aimed at accumulating reusable competencies is a crucial by-product of the research process, but this may be limited in project-based organisations. Nevertheless, whether in academic organisations, national labs or in firms, most research organisations utilize project management rules. But how do they work in practice?

There are inevitable tensions between the objectives of project based organising, focused on meeting short term project task deliverables, and those of the long term organisational learning process [3]. Because it focuses on the realisation of a particular set of tasks for a specific client, project management practices are oriented towards the optimisation of the process of providing the clients with answers. While there is a significant amount of learning within projects, Prencipe and Tell [4] have stressed the difficulty of sharing such knowledge across projects and within the organisation. This paper analyses the on-going practices of project management at NLAT. The cases describe how a specific organisation manages the balance between project- and lab-based organisation requirements, focussing on the breaching or adaptation of project management rules as a method of enhancing learning transfer beyond specific project boundaries.

2. PROJECTS UNDER REVIEW: BREAKING THE RULES

Our study draws on a single subject organisation, the National Lab for Advanced Technologies (NLAT) which undertakes technological research bridging between academic

research and industrial development. NLAT has been recognised as one of the worldwide leaders in developing collaborations with the main leaders in microelectronics, optronics and semiconductors. In addition, it has won several national and international competitive calls for tenders (National competitions for Centres of Excellence; and leading different integrated projects and Network of Excellence initiatives in the 6th EC framework programme). NLAT is a public organisation which employed about 8,000 scientists in France in 2004, with about 50% of its budget coming from public authorities, and the remainder from private firms via agencies or industrial contracts (2004 figures).[2]

Our analysis focuses on projects developed at one NLAT site, in the high tech city of Doetown in south-eastern France. This specific branch of NLAT employs about 800 scientists and 2,000 employees in *Doetown*. During the early 1980s, NLAT and Thomson Semiconductor (a national leader at the time) allied with local Universities to develop research and development capabilities in micro-electronics, allowing it to design and produce wafers of 100mm, miniaturise batteries, produce low energy devices and matching optics, materials, software and microelectronics. During the 1990s, the consortium was enlarged to include France Telecom Research Centre (also at Doetown) and to build larger research facilities dedicated to silicon applications, optronics labs and software security (cryptography). Doetown has continued to expand, and now dedicated research and training facilities belonging to different public research organisations (NLAT, local Universities and other national research centres) are spread out within the 'scientific polygon', a small area about a mile in perimeter in the city centre. *(NLAT and Doetown are, of course, pseudonyms)*

The research team was appointed by NLAT to study project management in action, with a mission to analyse the extent to which it had been a success and to identify any significant problems. Before the first meeting, a list of projects, both on-going and achieved, all of which were managed according to ISO9000 procedures, had been chosen by the head of

NLAT. The different projects were selected to maximise the research outputs by exploring variations around similar features. The projects had similar (2-3 years) timescales, but focused on different technological developments and involved different NLAT teams. They also varied significantly as to their level of strategic priority, the structure of their partnership, and the resultant learning effects.

In-depth semi-structured interviews were conducted in each case with internal project stakeholders, including project managers and project team members. More than 60 interviews were conducted over a period of two years by 5 researchers and 2 assistants to gather data on how project practices and project-based learning developed. Interviews were conducted on site while projects were still in progress, based on a pre-designed interview guideline. Table 1 displays the characteristics of the projects and the nature of the investigations.

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Insert Table 1 about here

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Interviews were conducted with project leaders, project stakeholders, researchers and engineers so as to identify the project management practices in action at NLAT. The interviews focused on the constitution, life and dissolution of project team; the different phases, main events and day to day organisation of work during the project realisation; the respective responsibilities and tasks of team leaders and project leaders; formal and informal lessons; and the management and accumulation of knowledge from the project, identifying the transfer of capabilities from one project to another and the repositories of scientific, technical and managerial knowledge in the project.

The following paragraphs describe each project and analyse it in terms of its rule breaking practices. Projects have been analysed on a systematic mode. The paper describes

only parts of the project to exemplify the use and misuse of R&D project management tools at NLAT.

DIAKIT and TECPLAT: Two unlimited projects with fuzzy goals

DIAKIT and TECPLAT are projects whose purpose is to make research, development and testing facilities available to project participants. The projects are collaborative agreements on enabling tools, their aims defined as providing the partners with favourable environments in which to innovate. DIAKIT is a bilateral project between NLAT and a pharmaceutical company which bridges two different competencies: microtechnologies/microsystems and *in-vitro* diagnostics. The project aims to enhance capabilities to develop miniaturised systems for biological analysis. The two partners agreed to build a common platform of equipment and competencies as a basis for developing further projects and programmes. The project is managed by a project leader and a steering committee. TECPLAT is a multilateral project involving NLAT and four large microelectronic companies which aims at building a technological facility to design and develop prototypes of large surface electronics devices. As with DIAKIT, TECPLAT is an enabling project which provides partners with additional capabilities to design and develop new products.

DIAKIT and TECPLAT are breaking three rules: tasks, interdependencies/closure and *ex ante* definition of deadlines. Both projects cover two steps; the development of the facilities and the subsequent running of their day-to-day activities. The latter stage does not focus on the realisation of a specific task, and thus cannot lead to closure. As a set of enabling tools, the technological facility will remain open for the partners' engineers and teams to

perform development and microchip characterisation[1]. DIAKIT and TECPLAT represent a mission rather than a set of tasks for the delivery of a specific device, and thus there is, *per se*, no time limitation. The projects will end when the development facility is out of date or obsolete, or when one of the partners decides to withdraw. When running their facilities' day-to-day activities, DIAKIT and TECPLAT have to deal with the partners' projects, meeting deadlines and realising sets of task in cooperation with their partners. Partners' knowledge increases as they accumulate experience which is stored and embedded in the technical devices and facilities as well as engineers and technicians running these facilities. DIAKIT and TECPLAT cannot be characterised as projects according the ISO definition, although, as specific activities run with outside partners, they are managed as projects within NLAT. In these cases, temporary management structures based on project management rules are being used to manage permanent equipment facilities.

NMT: Aut Caesar, aut nihil (Either you are Caesar, or you are nothing.)

NMT project is a bilateral project between NLAT and a large microelectronics firm to explore, design prototypes and test new materials for transistors. It has been designed to run for 2 years, with milestones and assessment procedures. NMT's project leader, originally from industry, is also the head of the lab, and argues that it is impossible to manage a project properly without also being a team or lab leader as well.

In fact, while project leaders in NLAT are responsible for their project's scientific and technological achievements and quality, they do not have the managerial tools to fulfil these responsibilities properly. They do not manage the project budget or its human resources, and

[1] Characterisation represents a specific stage of microchip design.

have no *official* means to influence priorities to gain access to specific facilities such as clean rooms or microchip characterisation tools. However, team or lab leaders are on the hierarchical line, and thus have hierarchical power to manage such allocations of internal resources. They also manage the relationships and negotiate milestones, achievements and budgets with the clients. Only those leaders who combine project and hierarchical status have full powers to design a specific organisation for their project and manage its budget, assign or withdraw technicians or engineers to or from specific projects and negotiate priorities and delays with other labs or departments. Project leaders lacking such additional hierarchical authority are advised to follow the standardised project guidelines and procedure manuals. They have only a technical role in the project, which is actually managed by the hierarchy. "Aut Caesar, aut nihil."

OSTEO: Project memory loss

OSTEO is a bilateral project between NLAT and a SME aimed at developing a new medical device (coupling scanner and specific software) to detect osteoporosis. A project leader together with one NLAT engineer and one technician were allocated full time to the project for its expected time length of 18 months. However, after 9 months, the engineer died in an accident, and it took NLAT about 3 months to find a replacement. The developments already completed had been documented, but in a rather specific and non standardised way, and it took about 6 months for the new engineer to be fully operational, as he had to re-run some of the experiments. By that time, the original 18-month time-span for the project had run out, and the project technician was due on another strategic project.

The OSTEO project had been a perfect example of project management: the tasks to be achieved were precise and well defined; a specific team had been allocated, deadlines and milestones had been identified. However, the project was understaffed. NLAT policy is to

limit the number of employees dedicated to a project as much as possible, and rely on the additional competencies of employees who participate on the project tasks occasionally. OSTEO also illustrates a situation where projects are ‘memory less’. As the project leader only manages the technical aspects of the project, the memory of the project is embodied in the few staff dedicated to the project. Projects have no organisational memory as organisational features are similar whatever the project’s characteristics. The circulation of individuals between projects and the understaffing of project-dedicated employees limits the sharing of the knowledge within the project. Because of this, and because project boundaries tend to remain fuzzy due to project leaders’ lack of power (see NMT case), there is no learning mechanisms intra projects and inter projects.

RADIN, LEB and VLB: Project or umbrella

RADIN, LEB and VLB are three thematic/generic projects which group different sister/brother projects focused on specific clients, aiming to shape building blocks of knowledge, and develop general and reusable competencies over on-going projects. Basically, they build on different specific projects to make generalization gains in scientific and technical competencies and thus make individual projects’ knowledge creation redeployable. The goal of these projects is not to find a solution to a specific problem for a client via a set of focused tasks, but rather to enrich the project partners’ technological capabilities to develop further projects. By enhancing partners’ scientific knowledge and technological awareness, these umbrella projects improve the capacities of the project team to generate new focused projects. As in DIAKIT and TECPLAT, the projects aims are to build dynamic capabilities for the project team. But where, in those two projects, the resulting dynamics capabilities were embedded in technological installation and equipment, in RADIN, LEB and VLB they are embodied in the project participants. In the case of the VLB project, the ambiguity about

the repository of knowledge remains. Does the accumulated knowledge belong to the project, or to the partner organisations? And will it still be accessible when the project team is dissolved?

SOITI: Forgetting a non strategic client

SOITI is a bilateral project with a new partner, a large US microelectronics firm. After having initially given the project a high priority, NLAT subsequently developed a collaborative project with another firm, and the SOITI project appeared to drop lower in NLAT priorities. Project members could no longer access the clean-room to design and realise Silicon-On-Insulator materials without prior notification. The project has been delayed for about 2 years because of the clean-room bottleneck. The projects timescale has had to be adjusted without consideration for the original timetable. Without power to mobilise other resources, delays become the only variable, as the only project management option. As NLAT's organisation is all project based, the flexibility to reorganise and restaff projects is reduced, and when something happens to delay a project no corrective action can be taken, and the project timing appears to become of secondary importance.

Conclusions on project management practices

Despite the fact that NLAT has been seen as a successful organisation, it clearly did not manage these projects according to the book. Has NLAT's success been due to its newly adopted project management organisation, or has it rather followed from its practice of breaking the rules of this new organisational system? Table 2 presents a list of the main rules which have been broken and their effects on learning. Our in-depth analysis of 8 projects highlights that all the project management rules were systemically broken or ignored:

- Any R&D project involving at least two people working on a given issue (or object) was

defined as a project and managed as such, whatever its size, its budget or the number of partners;

- Project leaders were not involved in the definition of the project from the very start of operations. Project leaders had only technical liability and involvement but they could not control and manage project resources *i.e.* budget, human resources, and clean rooms access or priority;
- All the projects were delayed, leading to systemic crises with partners. Project managers had no tools to manage delays, and clients were not notified of the possibility of delays until they became actual;
- While error detection mechanisms worked, no corrective actions were applied, and project leaders had to rely on their own ability to improvise. Although formal reports were written, they did not always reflect what actually happened in the project, and project leaders managed as best they could by designing easier and better-adapted tools (in effect, a 'bricolage' – a temporary software 'lash-up'), mainly in the area of technological developments. As these tools were not "official", little cumulative managerial learning took place.

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Insert Table 2 about here

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The gap between what NLAT claims in terms of its new status as an ISO standardised project based organisation and its actual project management practices raises questions as to why the hierarchy does not reinforce these practices. In fact, NLAT hierarchy did not really implement project management rules: rather, they adapted them to their previous team based organisation, and this process of adaptation between project management principles and the

lab-based hierarchical organisation seem to be what sustains organisational learning at NLAT. Knowledge and know-how are still embodied in individuals and in equipment, and thus learning remains stored in labs.

NLAT did not design specific storage methods for knowledge produced during the projects. The formal tools for accumulating experience from the project, such as formalised learning mechanisms (record of procedures, final review) tended not to be used in practice. The OSTEO project illustrates this facet: when individual memory was lost, the whole project 'lost its memory'. The repository of knowledge produced during individual projects remained at the NLAT lab level where experience was accumulated and shared between labs. Even the two technological platform projects DIAKIT and TECPLAT were stable organisations, and in effect had all the characteristics of labs, with their repository of knowledge embodied in technicians and engineers and embedded in technological equipment. Finally, the reflection tools, which should have given NLAT the ability to detect and correct deviations from the predicted norms, were not used: adjustments when things went wrong mostly took the form of delays and crises.

We have seen that NLAT's 1998 implementation of project management did not include implementation of the relevant learning mechanisms which should accompany project-based organisation. But was NLAT dysfunctional - or was it rather adapting irrelevant project management rules to produce efficient organisational learning practices?

LESSONS FROM PROJECT MANAGEMENT RULE BREAKING

A systematic and comparative analysis of our 8 examples of what NLAT defines as R&D projects reveals that adherence to its adopted strategy for managing such initiatives has little to do with NLAT's success. Looking for more accurate explanations as to its success - and bearing in mind the list of 'failures' we have itemized as far as project management is

concerned - we identify three elements: low project core staffing levels, which leads to the circulation of engineers and researchers around different projects; the building and managing of thematic projects; and the encouragement of 'bricolage' as part of project management practices.

1. Core project members and circulation of human resources

All projects are staffed by two categories of workers: engineers and technicians. The project is staffed by a core team which manages the project during its life, and tends to remain stable. As and when required, the hierarchy may allocate additional personnel and competencies to the project. Thus engineers and technicians circulate among different projects, stimulating the circulation of knowledge [18], as well as the tacit knowledge of who can do what, throughout the organisation. This organisational structure questions the observation of Scarbrough et al.'s (2004) definition of learning boundaries for intra-project, inter-project and intra-organisational learning as a way of conceptualising the tension between learning at project level and changes in mainstream organisational practices. The circulation of individual from one project to another, and from one context to another, may reduce the effect such boundaries.

The circulation of engineers amongst projects changes projects' organisational and temporal boundaries. The idea is not to transfer "captured" learning directly from one project to another, but rather to transfer and hybridize practice-based learning, embodied in individual who adapt their existing routines, into other contexts. Most NLAT engineers and technicians are not in fact allocated to a specific project full time, but are supposed to move from one project to another, and this circulation of individuals communalises project management practices within the organisation. It is a powerful tool to share practices from one project to another. However, it may destroy or dissolve an individual project's tacit knowledge (as in the

OSTEO case), and if changes are too frequent the realisation of the project can be slowed and the learning process dissolved. Thus NLAT's policy of 'understaffing' projects stimulates inter-project learning process and increases the distribution of shared knowledge across the organisation: but it can also reduce the efficiency of project realisation.

2. Thematic project structures

NLAT defines a 'project' as an administrative entity, with scientific and technological objectives, a starting point and a name to put in financial and activity reports. However the same word 'project' in fact covers two different realities: **specific projects** (targeted scientific or technological work in a problem solving perspective) and **thematic/generic projects**, aimed at identifying, acquiring and accumulating competencies in particular scientific and technological fields. A thematic project may include, or be nurtured by, an agglomeration of specific projects but, as Brady and Davies (2004) point out, they aim at building capabilities rather than solving specific problems.

The motivation behind a thematic project stems from a strategic decision at the organisational level, resulting from NLAT scientific leaders' anticipation in identifying a relevant science or technology in which to invest the labs time, energy and resources. Such projects are intended to nurture the knowledge base of the organisation for the technological developments that will take place in 5-7 years. Our definitions do not completely match the two dimensions Brady and Davies highlight of projects as explorative or exploitative. Thematic projects are not directly linked to a specific client or user, as they are designed to enrich the future supply of technologies rather than solving an existing problem of clients or partners. They tend to be open-ended, and while they have clearly identified starting and meeting points, the project's end and its assessment criteria are far less well defined. Such projects are mainly learning processes, enabling the development of future projects with

partners and clients, and thus form the building blocks that NLAT combines to define its strategic offer [19]. In that sense, they reinforce the exploration competencies of the organisation. Exploration is also performed within specific projects, and thematic projects build on knowledge gained in specific projects to generalise and decontextualise it, transforming it into reusable and redeployable learning.

From an organisational point of view, specific projects aim at minimising costs and at developing problem-solving approaches as quickly as possible, through the creation of contextualised knowledge. Thematic projects appear to be a proto-institutionalisation of NLAT's basic organisational structure of labs [20]. Indeed, the aim is to develop learning from one project to another, and to accumulate scientific and technological knowledge which is more generalised and less contextualised, which is actually the aim of all scientific activities [21]. At NLAT, the memory and repository of that knowledge is in the labs, which have a perennial existence. While the focus on a specific project creates borders around the project to allow it to be effectively managed, learning from project experience is developed in thematic projects and stored in labs. It also means that there is a strategic decision that learning should be undertaken: NLAT decides which knowledge is relevant to be stored, and the act of storing it shapes it into generalised, decontextualised knowledge. The final repository of organisational storage or memory is the labs, which have permanent existence within the organisations, and can thus collect and store learning from time-limited projects. NLAT thus creates building blocks and architectural competences which are not context dependent, and which can be reused as such. Both exploration- and exploitation-oriented projects can nurture the knowledge base of the NLAT. Individual competences are developed as projects explore specific fields, but one of the key competences of a large research laboratory is to combine different sets of competences which may have been developed in different places, in different projects. The renewal of the knowledge base is crucial to be able to develop new problem-

solving projects, and this demands the successful management of thematic and learning processes.

3. Bricolage as organisational arrangement

Thematic and specific projects are given contrasting leadership, and while there is no administrative or semantic distinction between specific and thematic project leaders, they enjoy very different status in reality. While all projects are led by engineers, most thematic project leaders have hierarchical positions within the Lab, such as team leader, manager or department director, which mean they are involved in the strategic decision process in NLAT, and can control resource allocation. While all project leaders can define the technical direction of their projects, thematic leaders also have the ability to allocate budgets, to manage priorities and to influence human resources allocations to their projects. Their participation in senior management meetings allows them to signal and notify any problems and then to negotiate with the hierarchy for additional resources. NLAT plays on this ambiguity of project management roles to give hierarchical priority to its thematic projects. Despite the strong organisational rhetoric espousing its use of project management tools, these have been designed to manage specific targeted projects, while NLAT prioritises an orientation concerned with its desire to build blocks of competencies over that of problem solving driven by client logic [22]. Thus its primary strategic focus is on thematic projects for designing the future [23]; but project management tools are essentially unsuitable for such purposes.

While project management tools have been designed to manage specific projects, the fact that they are not adapted to the management of thematic projects – as well as the fact that project management tools are not supported by top management – may explain why they are broken all the time. NLAT is continually adapting project management rules and practices in

a sort of permanent trial and error process we have termed ‘bricolage’. The huge diversity of projects leads to the definition of generic tools which are not accurately adapted for any particularly kind of projects: large or small, client oriented or internal, research focused or technological.

However, such project management ambiguities, about definition of the project, responsibilities of project leader etc., may induce risks [24]. Constant delays and inadequacy of project leaders’ answers to managerial problems appears to have produced a style of management by crisis. Project managers with no managerial power have to wait for problems to become apparent before they can report their project implementation difficulties and negotiate higher resource allocation priorities.

CONCLUSION

“Eppur si muove.” But still – it works! Should we view NLAT as an obscurantist institution which obliges its project leaders to break the rules to run their projects? That would hardly explain their continuing success. The reality is that NLAT has never really implement project management rules; rather the whole institution systemically breaks the standardised ISO practices in order to create, accumulate and then redeploy knowledge. Our comparison between principles and actual practice underlines NLAT’s ambiguity in implementing the project management rules. It appears that NLAT hybridises project management rules with the old lab hierarchies to stimulate learning amongst projects, and blurs project boundaries so as to accumulate learning and assemble building blocks of knowledge in specific thematic areas. It uses thematic projects as proto-institutionalisations of the basic organisational structure of labs.

A collective reflection on the “what for” of project management is needed in such contexts to gain a better understanding of the conditions and situations under which its rules

should be applied, modified or ignored. Strategic project leaders need replacement or complementary practices which allow them to develop their range of project leading skills and experience, rather than to have to break non-adapted rules. This is surely the most important challenge for R&D centres, and requires consideration of the anticipative practices and abilities of top managers, of the identification and choice of strategic options, and of the opportunities to continually integrate and upgrade new competencies from external organizations which can offer appropriate knowledge and skills management rules.

The limits and the sustainability of the existing organization and its procedures, which systematically lead to crisis management, must be questioned. Crisis management may have interesting impacts on clients and partners, showing their ability to react quickly and change priorities in favour of a specific project to give partners the feeling of being important. But questions can surely be raised about on the potential for damage to the lab's reputation, which might lead to the loss of strategic contracts, as well as about its ability to handle multiple parallel projects without the crisis management pattern producing a snowballing fragmentation which might be fatal to some of them. And at the very least, such crisis patterns must demand extraordinary expenses of energy and resources: hardly a positive indicator of competitiveness.

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Table 1: The characteristics of the projects

Project ID	Project aims	Project characteristics	Investigation
DIAKIT	Development of capabilities and tools to enhance the conception of diagnostic kits based on the convergence of biotech and microelectronics	Long term collaboration between two teams, one in NLAT and one in industry	4 interviews with project manager 3 interviews with researchers
OSTEO	Development of new protocol to diagnose osteoporoses	Bilateral collaboration between NLAT and one SME	5 interviews with project leader 3 interviews with other researchers 2 interviews within the SME
VLB	Knowledge and learning process to accumulate capabilities	Generic project with long term partner	5 interviews with project leader 3 interviews with engineers
LEB	Project to develop low energy battery	Internal NLAT project involving different departments	5 interviews with project leader 3 interviews with engineers
TECPLAT	Shared research facility between NLAT and 3 firms	Multilateral collaboration. Shared facility	6 Interviews with different (and successive) project leaders)
SOITI	Design of Metal Oxide semi-conductor	One-off collaboration with a large US based firm	5 interviews with project leader 3 interviews with different project partners
NMT	Design, analyse and test of new materials (metallic oxide) for transistors (front end)	Internal project to Investigate a new scientific and technological field to enhance technological capabilities. Supported by public funding.	4 interviews with project leader 2 interviews with engineers
RADIN	Development of a-synchronic logic for new generation of transistors	Internal NLAT project involving different departments. Supported by public funding.	4 interviews with project leader

Table 2: The characteristics of the breach of the project management rules

Project rules broken	Main example	Other Projects concerned	Breach modalities	Learning effects
Task focused	DIAKIT & TECPLAT	VLB, LEB, , NMT and RADIN	DIAKIT and TECPLAT are platform activity projects. No milestones are defined. The aim is to make up-to-date technological platforms available for the partners LEB, VLB and RADIN are thematic projects aimed at accumulating knowledge and know how	The organisation is breaching this rule by managing a permanent organisation (technological platform) with tools design for a temporary organisation. The thematic project aims at accumulating competencies, embodied in NLAT engineers.
Project memory and documentation	OSTEO	OSTEO, SOITI, TECPLAT	The projects respect the formal rules of filling in documentation. However, they do not preserve the memory of the research which has been performed. The documentation format seems irrelevant for engineers	Non-adapted tools destroy learning within projects and from one project to another. - A net loss for an organisation which manages organisational memory by designing thematic project and stores it in labs.
Delays – milestones	SOITI	All	Time and delays are the main adjustment variable. NLAT waits until there is a crisis with its client before taking corrective actions.	As projects are late, project members and project managers never take time for the final reviews and to draw lessons from what happens during the project.
Identification of project boundaries	NMT,	LEB, RADIN	Thematic projects erase project boundaries to organise the accumulation of knowledge, know how and competencies.	The main question remains the locus of the accumulation of knowledge. There is no a tool or repository within which knowledge is accumulated except individuals, teams or labs.
Specific staffing of the project	OSTEO	SOITI, RADIN	Dedicated staffing is limited for each project. Project managers have to rely on additional staff and competencies to achieve the project goals. But staffing decision depend on hierarchical decisions	As projects are under-staffed, individuals are not really involved in project. They circulate from one project to another. While this allows knowledge to circulate from one project to the other, individuals remain the main repository of knowledge and over circulation amongst projects does not allow organisational knowledge accumulation
Project leader	NMT	SOITI, OSTEO	Project leaders have no decision power unless they are also in hierarchical position	There is no management learning within project and no connexion between project management and clients.

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