

# Managing robust development process for high-tech startups through multi-project learning: The case of two European start-ups

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Received 16 May 2008; accepted 20 May 2008

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## Abstract

This paper explores the question of managing start-up development through a succession of exploration projects. Learning efficiency then appears a key success factor in this context. We propose theoretical insights as empirical material to understand the organizational mechanisms of such project-learning-based development in high-tech start-up context. On the theoretical side, we articulate three bodies of knowledge: project management, organizational learning, and entrepreneurship. The result is an analytical framework to characterize such development in term of multi-projects management and organizational settings.

On the empirical side, we analyze two contrasted case studies. The discussion helps to provide patterns to diagnose maturity level and robustness of new ventures in their development.

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**Keywords:** Entrepreneurship; Learning; Projects; Effectuation

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## 1. Introduction

The purpose of this paper is to explore the question of managing start-up development in a high-tech context through multi-project learning. Technology firms are usually founded on a product and market idea that will guide their development. The early definition, even before the firm's creation, of such idea is seen as an important success factor. Early choice, however, limits firms' flexibility; as a result, they are particularly sensitive to disruptions and turbulence that will undermine the relevance of the chosen target: every discontinuity generates erratic trajectory, if not simply death. Continuous routes from initial product-market concept to success, as exemplified by Compaq or Skype, are indeed exceptions. In many cases, the firm survives, and

maintains its development as an “old start-up” through implementing a succession of new projects that redefine and/or complete the initial concept, valuing – if possible – the initial experience of the previous trials.

Learning efficiency appears then a key success factor in this context. If the projects are just a succession of independent trials and errors, the firm will rapidly exhaust its resources and fail. On the contrary, if the learning track provides an increasing return [1] of the explorations, the firm development will grow in robustness. How can such convergent multi-project learning occur and sustain a robust development of the start-up? How is this learning process related to key choices, in terms of the internal organization of the firm and its relations with its environment? These research questions are addressed in this paper.

In the first part, we will elaborate our theoretical framework by exploring literature on organizational learning and multi-project management. This framework will enable us to characterize multi-projects startup learning on one

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side, and their organizational structuring on the other. In the second part, we will present the two cases with our theoretical framework. In the third part, in line with the inductive perspective of the research, the results of the case comparison will lead to some hypotheses concerning the organizational mechanisms of project-learning-based robust development.

## 2. Materials and methods

The paper is inductive in nature and based on the longitudinal case studies of two French startups: WSoft (a pseudonym), a firm developing wireless software, and NewPicture (also a pseudonym), a firm specialized in digital cinema.

Data were collected through a two-year full-time presence in the companies. The analysis of research data consisted of within-case analysis, cross-case analysis and expert analysis. Our primary source of data for WSoft is the founder and CEO of the firm, who is part of the research team as a reflective practitioner [2]. For NewPicture, a case study has been elaborated as a result of the research [3]. As typical in qualitative research, the validity of our insights was checked with senior executives of each firm as well as with other academic members of the research team.

We chose these firms because, as small, new players in their respective markets, they exemplify the phenomenon of interest, i.e. how an entrepreneurial firm deals with high uncertainty in its attempt to establish itself as leader in its market.

This study contributes to the integration of concepts and theories by using the extended case method, which aims to integrate and synthesize existing bodies of work. In contrast to the grounded theory approach, the primary focus of the extended case study is not to build new theory. Rather, its method is to integrate and extend existing theories through an iterative process of traveling back and forth between the data, pertinent literature and emerging theory [4].

## 3. Theoretical framework

To explore our research questions, we articulate three theoretical fields: entrepreneurship theory, project based learning, and organizational theory (Fig. 1).

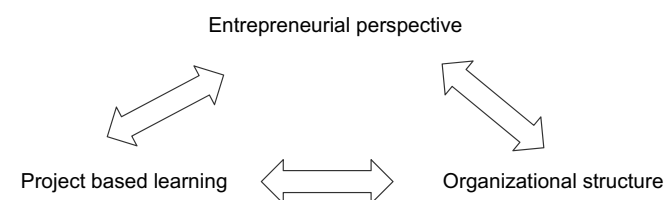


Fig. 1. Typology of organizational models, based on three dimensions [32].

### 3.1. The entrepreneurial perspective: planning vs. effectuation reasoning

Entrepreneurship theory has developed a classical, stage-based pattern for start-up development, which starts with an initial exploration stage leading to the opportunity recognition stage, where the market/product target is settled, and then thanks to a triggering event, to the exploitation phase after the firm is created [5].

In seeking to understand the key success variables for such a development, two elements have been identified as leading to a better identification of opportunities by entrepreneurs: prior knowledge and ‘alertness’ [6]. Shane [7] shows the importance of prior knowledge to find opportunities. However, he does not explain how this knowledge is acquired. Kirzner [8] uses the term ‘alertness’ to explain entrepreneurial ability to recognize opportunities, and suggests that higher alertness increases the likelihood of an opportunity being recognized. Similarly, we do not know why some entrepreneurs are more alert than others. A review of the literature shows that the relationship between opportunity identification and personality traits seems to be weak [9]. If alertness is not a trait, then it might be a condition that results from what the entrepreneur has done that others have not, rather than what he or she is, i.e., that alertness and knowledge are path-dependent. Crossan et al. [10] recognize the interactive relationship between cognition and action by remarking that understanding guides action, but action also informs understanding.

On the empirical side, many studies have demonstrated the non-linear and often chaotic profiles of start-up development. In an extensive literature review, Lichtenstein et al. [11] conclude that the stage model, linear pattern for understanding start-up development is a theoretical dead-end. They call for more complex, non-linear sequences, introducing feed-back driven patterns, unpredicted events, heavy interactions between internal and external factors, etc. But as they have a descriptive empirical capacity to map all the possible start-up trajectories, such models are too general to have fruitful operational implications for managing such trajectories.

Another stream in the entrepreneurship field has precisely studied how entrepreneurs deal with a situation of pure, Knightian [12] uncertainty. Sarasvathy [13] showed that entrepreneurs invert the principles of causal reasoning, and that the inversions together constitute a comprehensive new logic that she calls “Effectuation”. Effectuation is a sequence of non-predictive strategies in dynamic problem solving that is primarily means-driven, where goals emerge as a consequence of stakeholder commitments rather than vice versa [13]. An alternative to causal rationality (the basis of planning), effectuation suggests that “Knightian” actors succeed by taking a progressive approach to the definition of their products and markets [14]. What matters, therefore, is not which products and markets they choose ex-ante, but how, in the absence of current markets for future products, such products get created by the firm

[15] and how this process allows the firm to resolve the Knightian uncertainty.

The effectuation/planning opposition focuses on the linkages between the emergent firm and its uncertain environment (stakeholders, resources, etc.). But it does not deal with the organizational processes that can turn previous experience into emerging new strategy. Considering this problem, the project learning field appears as an interesting theoretical framework to characterize the old start-up development processes

- The learning perspective focuses on the cognitive capabilities that are emphasized as a key factor in the entrepreneurial literature.
- The multi-projects learning framework seems adapted to catch the complex and non-linear interactions between various trials and the global dynamics of the organization.

### 3.2. *Projects and organizational learning processes*

Learning by projects has long been a topic of interest by researchers, and specifically in previous IRNOP conferences and publications [16], and in the 2004 organizational studies special issue on “Project-Based Organizations” [17]. Learning within project, from project [18] and inter-project capitalization [19], has been analyzed in the context of major breakthrough projects and established mature organizations, managing innovation project portfolios.

Ben-Mahmoud-Jouini [20,21] proposed a global framework to integrate various organizational learning approaches involving projects. Her model of the “innovation design system” of the firm articulates innovation strategy, knowledge creation processes, and development projects. This model helps to map and articulate different configuration of project involvement in learning processes of the firm: exploration project generation in learning through projects approach, learning within projects, ex-ante or parallel out of project learning processes, ex-post cross project capitalization, etc. In line with this perspective, Brady and Davies [22] propose a model of “Project Capability-Building” which occurs when a firm moves into a new technology and/or market base. Whereas the studied cases are two established firms, the theoretical framework is well adapted to the situation of emerging firm. The model articulates in a dynamic sequence a bottom up project-led learning process with a top down business-led learning process which fully refines, exploits and expands the firm’s organizational capabilities and routines for a better execution performance. In that perspective, the model articulates the classical opposition between exploitation learning vs. exploration learning [23] with the firm/project categories.

Multi-project management research developed in the 1990s in various sectors. Garel et al. [24] have proposed a typology of multi-projects management based on the stra-

tegic perspective of the firm identifying three approaches: The project portfolio approach, the platform approach, and the lineage approach. How can such multi-project approaches be specified, in terms of learning processes? [25]

- The project portfolio approach. Cooper et al. [26] organize a competition between the projects in a context of shortage of resources, and contribution to strategic targets which have been formulated ex-ante. Ex-post project analysis and selection at different stages of development is the key decision process. Large pharmaceutical groups have developed this approach in risky contexts, where non dependency of projects is privileged along a hedging logic. As a project based learning approach, project portfolio can be typified as exploration through selection on one side, and exploitation of the surviving projects on the other. The cross project learning is not emphasized.
- The platform approach. Cusumano and Neoboka [27], Baldwin and Clark [28], and Gawer and Cusumano [29] organize project generation on the basis of ex-ante sharing of given architecture and/or common elements of product or process. Projects are “derivatives” from the platform, and the objective of this approach is to allow economies of scope. The platform approach is a strategy for mature domains, such as the automobile industry which is now a major proponent of this logic. No new knowledge is expected from derivative projects from the platform, which already contains all the knowledge. The platform approach is therefore not a strategy for exploration learning, but one for exploitation learning in an organization’s top down approach as per Brady and Davies [22] categories.
- The lineage approach. Chapel [30] and Le Masson [31] take a different approach in which the core driver of project generation and orientation is the learning objective, defined as knowledge expansion on a value domain. The key notion in this perspective is the “concept”, a large open value proposition that will organize the exploration, on the technology side as well as on the market side. Multi-projects management will therefore emphasize the link between project implementation and (1) the knowledge creation and capitalization within the firm, which is not emphasized in the project market approach of portfolio management, and (2) breakthrough innovative explorations, which is generally not the purpose of derivative projects platform approaches. Lineage management appears to constitute an opening of the black-box concept of exploration learning, where exploration is not just a succession of random trails which are transferred ex-post into exploitation routines if successful. Defining the leading concept from initial hazardous step appears as a key task to coordinate further exploration and structure the collective learning in terms of reuse. It allows leveraging the existing knowledge and competencies into revenue generating products

on the one hand, and prudential exploration of new markets opportunities and technology development on the other.

How does this multi-project based learning literature apply to the start-up context?

- Learning theory has extensively studied the ‘exploration to exploitation’ question, but our research question deals more specifically with the convergence of ‘exploration to exploration’ process. Lineage management appears as an appropriate framework in this perspective.
- The research on multi-project management has developed in established and big firms. Project to project and project to organization learning processes are different in the case of emerging organizations such as startups, where the structuring and identity of the firm cannot be isolated from the decisions within the projects.

### 3.3. Organizational structuring of start-ups

To address this second point, we look at organizational literature dedicated to characterization of start-up identity, and in particular to Baron and Hannan [32] model to characterize the organizational variables of the start-up. Three variables are taken into account in this model:

- Employees attachment, which can be implemented through three means: social bonds, work interest or money,
- coordination control (formal procedures, professional control or organizational culture),
- selection of employees, based on skill criteria, professional potential or value and cultural fit.

Baron and Hannan [32] identify five ideal types of organizational identities for high-tech start-ups

| Dimensions |           |                      | Employment model |
|------------|-----------|----------------------|------------------|
| Attachment | Selection | Coordination/control |                  |
| Work       | Potential | Professional         | Star             |
| Work       | Skills    | Peer/Cultural        | Engineering      |
| Love       | Fit       | Peer/Cultural        | Commitment       |
| Work       | Skills    | Formal               | Bureaucracy      |
| Money      | Skills    | Direct               | Autocracy        |

Baron and Hannan [32] do not focus on characterizing external relations of the firm with its environment, which is a key development factor as noted in the entrepreneurship literature. A recent and interesting concept in this perspective is the “effectuation” [33].

## 4. The cases: analysis of two “old startups”

In this section we analyze the trajectory of the two firms concerning their business achievements and organization.

### 4.1. Wsoft: from random trial to organized exploration

Most companies start with an initial target market or product, and WSoft is no exception. Starting in 1998, WSoft’s initial business idea was to provide IT services in the field of Web sites development. In early 2000, the firm got a contract to develop mobile phones services (using the WAP standard) for a large mobile operator, entering the mobile market for the first time. Based on this experience, and switching back to the product business, it developed a WAP simulator that was sold, with moderate success, to a few operators. In 2002, this simulator was extended and transformed into a browser, and ported to personal digital assistants (PDA). The idea was to use it to develop mobile access to corporate information systems. WSoft would work with IT services providers who would sell the product to their corporate clients. However, the market did not take off due to the lack of maturity of mobile communication at that time, and the firm exited the market. The browser was then adapted to fit onto a mobile phone, to target mobile phone manufacturers. Despite strong interest, the product was only sold to a few clients. In 2003, however, upon a client’s suggestion, it was further transformed into a user interface solution. Introduced in 2004, the new product has been successfully sold, and the firm is growing profitably.

During the period, the firm’s products and markets changed radically several times, yet the firm remains the same, with the same management and the same shareholders. The firm’s trajectory might have been purely chaotic, with markets and products being randomly tested out. Upon close examination, however, the change in markets and products clearly did not appear as random; the evolution of the firm followed an iterative, path-dependent process contingent upon (1) relationships forged by the firm, (2) the firm’s design thrust, and (3) environmental events. For instance, the WAP contract was obtained for reasons falling into these categories: The management happened to know the client’s project manager; The firm had experimented with the technology; and the client was in a hurry, such competences was scarce at the time, and larger, established service providers were too slow to react. The importance of the firm’s design thrust is exemplified by how the market for the user interface engine came about. The firm had been trying to sell its mobile phone browser with limited success for some time when a client suggested that the technology could be adapted to create a user interface engine. User interface had become a major headache for manufacturers as phones were becoming more and more sophisticated, and such an engine could well provide a solution to this growing issue. Within six months, the firm was able to transform the browser to that effect and begin



addressing this opportunity. More generally, our observations show that each product and market iteration was possible because it was in some way connected to the existing trajectory, thus leveraging cumulative learning [34].

As far as organizational identity is concerned, Wsoft can be typified in two circles based on Baron and Hannan [32] model. The core of the organization is based on the commitment model. Family ties and close friendship were the social links of the three founders of the firm. They share the same vision for the firm in its turbulent trajectory, in terms of business model and personal risk taking. Whereas, they are complementary in their competences (two creative software engineers, one business manager), they share and collectively capitalize the experiences, on the technical as well as on the market side. A second circle, more flexible in term of number of people, is closer to the engineering model, favoring the adjustment of skills to the changing requirements of the firm's development.

#### 4.2. *NewPicture: the uncertain track to the whole picture*

New picture was founded in 2001 by six people, coming either from the movie industry or from the Internet. At that time, digital technology for movie theaters had developed along two different models: the first was adopted by the Majors' and focused on quality, with sophisticated and costly solutions, through a typical sustaining innovation strategy [35]; the second was adopted by smaller players who used the rapid development of low cost and low quality digital projection equipment for emergent countries which were not yet equipped with traditional projectors.

NewPicture took a different approach, targeting mature movie market with disruptive technology, stressing picture content in the French "Art et Essai" (independent) picture network, with well developed tradition against high image quality. More precisely, the vision articulated three propositions: first, the "Art et Essai" pictures is a real market in Europe and especially in France, the bottleneck to its growth being the existing distribution system that favors Hollywood "blockbusters" products; second, that digital technologies are disruptive and give opportunities to change the rules of picture distribution; third, that digital revolution is a great opportunity to enter the very closed sector of the industry.

From this global but fuzzy vision, NewPicture engaged in a learning track implemented through three different, successive models.

The first model consisted in directly managing movie theaters that would be equipped with digital technology. NewPicture explored and negotiated with cities that wanted to develop their cultural policy by revitalizing local cinemas. The first cinema was bought in 2004, in a small French town. However, the firm rapidly understood that, due to administrative and political time pace, such business would be too slow in building, compared to their opportunity window. The firm then switched to a second model, based on a technology third-party strategy. Looking for

new financing, NewPicture applied for a grant at the French Innovation Agency, which supports high-tech ventures. When the project was accepted, the firm developed different technological solutions for movie theater equipment and tried to sell them to the independent ("Art and Essai") theater network. This strategy did not succeed either. The diversity of movie theaters meant that the firm could not benefit from scale effects to generate a profit. The shortage of money for developing more efficient solutions led the firm to abandon this model and experiment with film distribution. In 2004, NewPicture joined a European distribution network whose objective was to syndicate digital picture catalogs in order to reduce the important cost of film digitization. In 2005, NewPicture got involved in the distribution of Ingmar Bergman's latest picture, which was only distributed in digital format, at the director's explicit request. The same year, the firm bought the distribution rights of *Weather underground*, and distributed it in classical argentic format in order to generate cash. The firm is now firmly established as a distributor of independent and alternative pictures, a profitable niche but a far cry from its original vision of leading the digital movie revolution.

The evolution of the NewPicture team reflects these abrupt changes in strategy. As indicated above, the team consisted of members with different backgrounds, mostly movie industry and the Internet. Funding came from the founders themselves. The organizational identity corresponds to the "star" model as per Baron and Hannan [32] typology: founders were all cinema passionate, ready to do whatever necessary to achieve the firm's vision. However, there was not much overlap between the competencies of young high educated web engineer and older picture production veterans.

Rapidly, tensions grew among the founders, as the firm faced financing difficulties. Some quit the firm. An expert was hired to lead the technology developments, but within a year, he also quit when he realized that the technology focus was only a means to enter the movie market. Such departures had dramatic effects on the trajectory of the firm: the leading team being highly differentiated, the remaining people could not capitalize and develop the projects initiated by those who had quit. Significant knowledge was lost [22] and NewPicture's business had to almost be re-created from scratch.

Both WSoft and NewPicture have now converged towards a promising opportunity, but while NewPicture's trajectory has been chaotic, each change of direction triggering important changes to the firm and lost knowledge, WSoft's has been more progressive and has left the founding and management team intact. We characterize WSoft's development as robust in the sense that the firm evolved to a considerable extent in terms of markets and products while maintaining a high degree of stability in terms of team, technology and identity, and overall reducing the risk of its trajectory. We now need to look at how the way WSoft managed its projects served this 'robust' strategy.

## 5. Managing multi-projects learning in start-up development

In this section, we compare the start-up development through our theoretical framework: the entrepreneurial perspective, the multi-project learning approach and the organizational structuring.

### 5.1. Two examples of “old start-up” syndrome

For both firms, the way to robust development was not a one shot direct track from initial idea to its implementation as suggested by entrepreneurial models. Both firms started with a business concept, rather vague in the case of Wsoft, well defined in the case of NewPicture. Neither firm was successful initially, and both started a trajectory made of several business concepts that were tried until a successful one was found. The two trajectories can be described as a multi-project, each project corresponding to a product-market pair, and an attempt by the firm to learn about new business opportunities to address them successfully.

### 5.2. Entrepreneurial approaches: planning vs. effectuation

The two cases reveal significant differences in the firms’ way to converge to a profitable opportunity.

From the beginning, NewPicture’s trajectory was driven by a global but fuzzy vision of the strategy. The learning track appears as a succession of complementary projects supposed to progressively combine to make the fuzzy initial vision a reality. The perspective is a classical planned project view

- Decomposition of a global vision into clearly defined subprojects,
- search for resource to complete the subprojects,
- aggregation of the results to converge to the global picture.

On the contrary, Wsoft trajectory began with a precise product delivery target, but no idea of what would be the next step, and no global strategic vision. From the first market failure, the firm did enlarge the spectrum of market possibilities to be served while enhancing the efficiency of its capability to develop solutions adapted to these new target markets. Such a result can be founded on the data that, at the same time, lead time and cost to deliver a solution to answer clients’ requests was shortened, and the variety of customer base did enlarge. We note that this is a rather counterintuitive trajectory. Flexibility in market reach and efficiency in solution providing are generally thought in contradictory and trade-off terms.

### 5.3. Multi-project learning perspectives

In term of multi-project management model, NewPicture appears as projects portfolio oriented. The different

subprojects are relatively separated, driven by different actors of the firm, addressing different environmental contexts, creating their own resources to progress. Their coexistence rapidly becomes a competition for scarce internal resource and strategic orientation (for example, the technical standard fitted with the European network was not the one defended by the technical expert of the firm, who promoted the digital diffusion service orientation). The projects integration is difficult and conflicting; cross projects capitalization is rather poor. Each project is driven by its own perspectives, deeply dependant from the outside stakeholders that gave the key resources.

On the contrary, Wsoft is a typical example of lineage management [36]. The succession of projects shows how new knowledge from each trial (on market as technology) is capitalized as the base for a shared redefinition of exploration strategy for the next steps. The continuity and efficiency of learning track beyond the changing of product and market appears as the key rationality of the trajectory, as defined in lineage management [36]. Lineage management helped the firm drive the exploration in technology and customer needs on one hand, and organize value-creating reuse of acquired knowledge on the other hand [34].

## 6. Organization patterns for multi-project learning start-ups

Coming back to the organizational characterizations of the firm, we can emphasize the coherency between the organizational pattern and type of multi-project management.

In NewPicture, members are specialized resources who achieve the different projects. Tensions in the organization result from resource and time competition between the different scenarios that are explored with each project. The firm’s development appears as a combination of relatively independent ‘bricks’. This allows a rapid growth if all turns out perfectly, but can create problems if a ‘brick’ does not fit. People associated to the ‘brick’ quit, creating a dramatic void in the overall team.

In Wsoft, social fit is the cement for the core team of the firm. This involves deep collective reflection on strategy evolution, shared sense making of the situation [37], and large overlap in learning. Lineage management needs such a deep understanding of what is more complex than just technology push or market pull moves. The limit, however, is the capacity to scale up: this requires the opening of the core team to newcomers who will not necessarily share its values and will not have its experience; this will need to persuade new stakeholders, which will be difficult as most of strategic insights are tacitly shared by the members.

## 7. Conclusion

On the theoretical side, this analysis suggested new connections between the entrepreneurship field, organizational learning theory, the multi-project management domain, and organization theory. The interesting effectuation vs. planning opposition (from the entrepreneurial field) has

been related to different multi-project management models, enlarging the learning perspective from the classical exploitation to exploitation question to the less debated question of exploration to exploration convergence. Last but not least, we have connected this learning track perspective with organizational field to characterize the social and organizational aspect of these emerging firms.

On the empirical side, the two cases show entrepreneurial contexts that are characterized by complete uncertainty about products and markets. In those contexts, they confirm that the role of exploration is crucial. Developing customer and technology competences, and then exploiting them, is not enough. Envisioned markets might not come about. New products might fail. New opportunities might emerge unexpectedly. Exploration results in greater ability to adapt to changes, and thus supports future viability [4]. While exploitation provides vital short-term resources, exploration enhances the adaptation of the organization to a changing environment because it increases the variance of organizational activities [38]. The general model of startup development is that an initial period of exploration, often before the firm's creation, ends up when an opportunity is identified, after which the firm turns to exploitation based on previously capitalized knowledge on products and markets. The two cases show a different ways to handle such situation.

Both learn from projects to projects, but in different ways. We characterized their trajectory, their learning process, connected to their multi-project management approach, and their organizational patterns. A portfolio approach such as NewPicture's did not allow for cumulative learning from project to project, increasing the cost of each new strategy, and reducing its overall probability of success. With WSoft's lineage-based development strategy, on the contrary, exploration and exploitation were maintained in a simultaneous way and learning is cumulative. Thus, while not arriving immediately at a promising opportunity, the firm converges towards it, reducing the cost of each iteration, and increasing its probability of success.

Because this research was inductive in nature, this result only constitutes a first, albeit interesting insight. Future research will aim at developing this insight to better understand the interplay between projects, learning and strategy for high-tech startups to overcome the challenge of radical uncertainty.

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