TRACKING THE ROUTES OF INNOVATION MANAGEMENT ACROSS PROJECTS: A CROSS-CASES PERSPECTIVE

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ABSTRACT

Although innovation management has been extensively studied over the past decades, current literature hardly screens the current challenge for large project-based firms. For these firms, innovation management no longer deals with launching breakthrough products, but more likely with integrating innovative value propositions within a regular stream of platforms. This paper provides an analytical framework to understand this new form of challenge. We applied this framework to analyze four cases of innovation routes at two different OEMs. The article specifies the process of the innovation route and identifies key moments that stand as manageable turning points and variables.

INTRODUCTION

Time-paced competition led companies to put in place rationalized design organizations that guarantee a constant stream of new products. As a consequence, the challenge of innovation management stands as the pattern of making the stream of products evolve in a value-creating way. In this perspective, the evolution of product lines is a balanced game between regular platforms of products based on incrementally evolving knowledge, and a constellation of value propositions that challenge the dominant design of the product lines and the core competencies of the organization.

Companies adopt different strategies regarding this features/products game. In the automotive industry, Toyota dedicated a new line of products to a value proposition (hybrid engine) and then to deploy this value proposition on regular product lines. In the software industry, Microsoft makes its software platforms evolve by versioning different packages of features. Facing this renewed competitive landscape, we are still at the early stages of definition of a satisfying theoretical framework that can highlight the key challenges and provide decision making canvas for such innovation management issues.

The purpose of this paper is to provide an analytical framework that can address the main rules of the features – products interplay. To tackle this issue, we chose to study several value propositions' routes across several generations of products, and to analyze their evolution. The goal is to highlight key moments and mechanisms paving the route that goes from a brilliant idea of value to a proven and profitable innovation, deployed on several ranges of platforms, and part of the core competencies of the firm.

In the first part we base on the product development literature to delimitate the new challenges for innovation management in large project-oriented firms. We then settle the innovation route framework and explain how we use it as an analytical artefact to track innovative features across products. In the following part we review four cases of innovation routes: ACCESS and CROSS at two different global automotive OEMs. We finally underline the major findings of this experimental implementation of the analytical grid both from an academic and managerial view.

FROM PRODUCT DEVELOPMENT TO INNOVATION MANAGEMENT

The empowerment and routinization of development activities

In the 80s, the increasing competitive pressure put emphasise on the ability of industrial firms to improve the quality level, to lower the cost, to increase the pace of products launches, and, last but not least, to manage the increasing complexity of several kinds of products. This shift was addressed to numerous industries: automotive, medical devices, consumer goods, electronics, computers... A lot of attention has been paid by practitioners and researchers on the way manufacturers could meet this challenge, mainly by studying the Japanese firms (Imai and al. 1985). Pioneer researches defined concepts and organizational frameworks for effective product development: heavyweight project management teams, concurrent engineering and early supplier involvement (Clark and al. 1987; Clark and Fujimoto 1991; Midler 1993; Midler 1995). These frameworks and methodologies spread rapidly among industrial firms along the 90s.

The “fat-design” problem is a collateral effect of this overwhelming success (Fujimoto 1999). The focus on the cost-quality-timeline (CQT) indicators of a single product tends to prefer one-shot solutions that favoured the project disregarding the firm global performance. Platform strategies aim at promoting a global parts approach, by sharing components and subsystems among different products (Cusumano and Nobeoka 1998; Meyer and Lehnerd 1997). The platform approach maximizes the commonality of components among several projects and reduces the coordination burden between projects and functional departments. The platform approach manages diversity among the different products in order to save costs and improve lead-time.

Given the pressure on development performance, it is more and more difficult for firms to take risks in the context of development routines (Aggeri and Segrestin 2007). Moisdon & Weil (1998) thus show that the pressure upon project managers leads them to consider innovation as a potential danger with regards to cost, quality and delivery time. This leads to “frontload” all the problems to the pre-project phase (the "front-end" of the project). As a consequence, the pre-project phase was increasingly considered both as a product definition process (Smith & Reinertsen’s 1991; Ulrich and Eppinger 2003) but also as a risk-elimination process aimed at reducing the problem-solving effort of the development phase (Ciavaldini 1996; Cooper and Kleinschmidt 1996; Gerwin and Barrowman 2002; Thomke and Fujimoto 2000).

Innovation management in the projectified firm

Firms are now well armed to develop rapidly new products, and to lead a global parts strategy in order to manage the diversity implied by this evolution. But new product development did not explicitly refer to innovation management (Brown and Eisenhardt 1995). Researchers paid a lot of attention on the CQT factors, partly because innovation has been regarded as a micro-economical event. For several years, this shaping of the innovation topic is balanced by numerous researches in marketing, organization, and operations and management sciences. They take for common basis that the CQT criteria are only a part of the product attractiveness. Innovation management implies to complete the CQT criteria by questioning the firm's capability to embed within the stream of products enough customer value to provide product and brand attractiveness.

Building such value propositions appear to be a major challenge for project-based firms, whose organization clearly mirrors the traditional knowledge base of the firm (market and technical). This setting is likely to be reluctant to integrate value propositions that are disruptive towards this organizational structure (Galunic and Eisenhardt 2001; Henderson and Clark 1990). The projectified organizations (Midler 1995) instituted core capabilities that maximize the CQT indicators. The core capabilities developed in NPD tend to turn into core rigidities that model potential products through a stable architecture (Leonard-Barton 1992).

Innovation as an interplay between knowledge and development activities

As the development activities became empowered and autonomous, innovation management has been increasingly considered as a matter of interplay between the empowered development activities and knowledge activities. Several researches highlighted specific mechanisms of this interplay.

Iansiti's work (1998) permits to better understand the linkage between technological knowledge activities and product development activities. He shows that development projects that *"create a match between technological options and application context"* (p.21) perform better than others. In other words, knowledge creation should be oriented through the future context of integration. If Iansiti's work permits to better understand the integration of a technology within a product under development, his work focuses on the technical improvement of well defined value propositions, and leaves aside deeper reshuffling of the product hierarchy. Furthermore, the multi-product deployment of the technology remains at the background of his work.

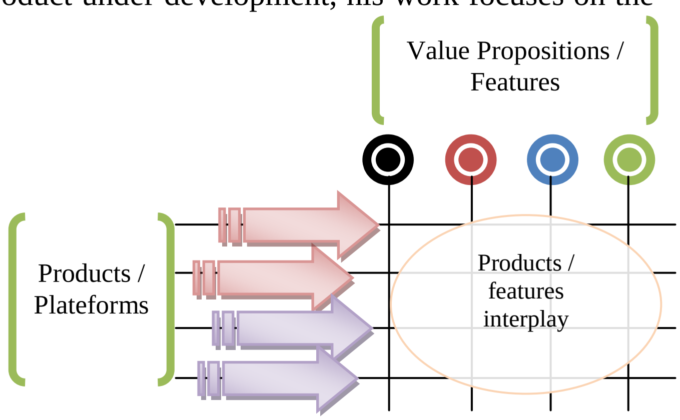


Figure 1 - The Interplay among Products Lines and Innovative Value Propositions

Cusumano & Selby (1995) describe the products / features interplay at Microsoft as a "sync-and-synchronize" process. The development teams build an increasingly reliable product by testing the integration of the different features at a day-to-day basis. Features remain relatively independent so they can change along the project from more than 30% depending on updated knowledge. On the same way as Iansiti, since the authors focus on product performance, they do not really question the deployment and capitalization issue.

Marsh and Stock settle a model of "intertemporal integration" that address this multi-products issue (Marsh and Stock 2003). By modelling the product learning cycle they aim at identifying key mechanisms of dynamic capabilities in the interplay between development activities and knowledge activities. This framework looks promising, but remains at an emerging phase and still misses some empirical insights.

FRAMEWORK & METHODOLOGY

This paper completes and enlarges the existing literature by providing a framework that can address the trajectory of an innovative feature across products. This framework is used to analyze empirical data on innovative features that are not only technological components, but more radical features that question both the regular architecture of the product, and the regular customer value.

Defining a value proposition and its evolution

We define an innovative feature as a technical solution aimed at providing a supplement of customer value that is not included in the definition of the traditional products. A value proposition tends to present a set of valuable functionalities (1) that match with the specific embedment constraints of several products contexts (2). This solution should be technically reliable - product and process (3) and bring with it a recognized advantage for the firm (4). We thus characterize a value proposition through the four following ranked criteria.

	Level 1	**Level 5**
1. Customer Value	Basic idea expected to increase the customer value	Proven strong customer value associated with a product/service.
2. Integrability	Context related constraints are not taken into account by the feature.	Multi-product integrability – A generative model to deploy it on a range of products.
3. Maturity	Underlying technology is unclear, no system test, no process.	Underlying bodies of knowledge are explicitly known.
4. Profit	Fuzzy assessment on profitability for the firm.	Defined business model, positive margin, recognized benefit.

Table 1 - Ranking of a value proposition on the four criteria

Framing the products/features interplay: the innovation route

We distinguish between knowledge related activities and development related activities. Development activities are defined as the set of investigations aimed at renewing existing lines of products based on firm's core capability. These activities encompass the investigations focused on CQT criteria and kaizen improvement of the products. We define the knowledge activities as the set of investigations aimed at exploring innovative value propositions, preparing them for the embedment in specific contexts, and capitalizing the related knowledge in the regular product-process organization.

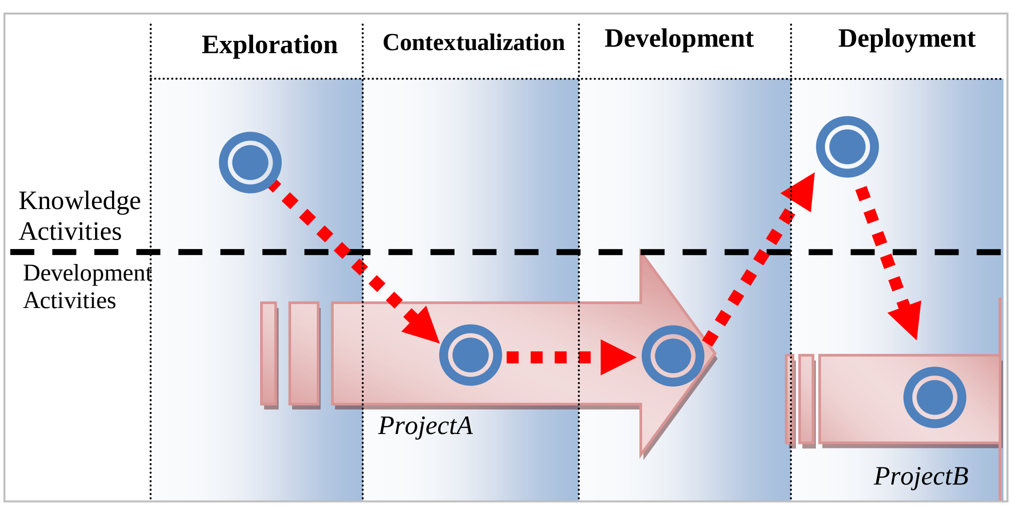


Figure 2 - The Innovation Route model of an innovative feature across products

We finally define four phases in the route of an innovative feature. These phases are delimited by the targeted contexts and by the nature of the investigations. The *exploration* phase consists in exploring and preparing an innovative feature for upcoming development projects. The *contextualization* phase consists in preparing a specific proposal to embed the feature within an ongoing pre-project. As soon as the non-return point is passed, the *development* phase consists in effectively developing the feature within the product development process. Once the first feature is marketed, the *deployment* phase consists in capitalizing on this first experience to deploy the feature on a coherent range of products. This framework will be used to analyze empirical data following a cross-cases methodology.

Methodology

We aim at better understanding the process and organizational setting that support the emergence, integration and deployment of value propositions. We are thus looking for a process theory (Mohr 1982) that includes several development and knowledge-based activities. Therefore, we chose to shift our analytical lenses from a product to a value proposition that is to be deployed on a broad range of products.

Trying to formalize emerging practices in companies, we relied on multiple exploratory case studies (Yin 2003) which provide empirical insights of the above-described ill-structured process. The two cases ACCESS and CROSS at OEM A were used to generate the initial framework. The same cases at OEM B were added to the sample as theoretical replications and extensions to challenge and refine the framework (Leonard-Barton 1990; Yin 2003).

We aim at characterizing the route of the 4 features from their early beginnings to their multi-product deployment. On each case, we tracked back the 4 above described criteria in order to identify the main shifts. This tracking process permitted to identify key milestones of the route, and to characterize the corresponding management challenges.

Data collection

We chose to investigate the automotive industry. Although it was a privileged source of learning on project management, it has been relatively neglected as a research field for innovation management. The choice of this industry was also guided by the opportunity we had to collect rich data. Top Management from two global automotive manufacturers promoted the study through financial support and time consuming involvement.

The two cases ACCESS and CROSS were selected in order to cover a contrasted scope of value propositions. The ACCESS feature is a keyless system which is very innovative towards customer use (new set of functionalities). The CROSS value proposition is a compact cockpit module which stands as an integrated system putting into question the traditional architecture of the dashboard perimeter.

On each case, we had access to key managers and in-house documentation of car manufacturers and tier-1 suppliers that were involved in the innovation process. We conducted 42 interviews of diverse manager’s profiles (project, research, purchasing, technical…) that were involved in the management of the features.

TRACKING THE ROUTES OF 4 VALUE PROPOSITIONS

Case ACCESS at OEM A

VP Preparation - In the 80s, the OEM A's Exterior Equipment Department and their supplier's counterparts had lived an exciting period: in less than ten years they passed from mechanical key controlled locks to electrical radio-controlled centralized locking system. Both OEM and suppliers thought they can do more, and studied how they could make this opening system fully automatic. In the early 90s, no one showed enough interest in the topic to continue such efforts in the Technical Departments. The topic remained active from 1992 to 1994 at the OEM's Research Centre, which was responsible to make a first draft of an ACCESS system. It finally delivered a patented functioning scheme mainly based on electronic specifications.

VP Contextualization - In June 1996, a Development Program suddenly broadcasted its need to include in the definition of the product several value propositions that could make a difference for the customer. In order to abide by the constraints of the product (parts layout, market segment, selling price…), the Vehicle Program Manager merged the pilot in-house studies and the studies of consulted suppliers, and finally proposed to the Board a mixed version of ACCESS.

VP Development - In December 1997, the Board decided that ACCESS should be included as original equipment. Another important decision was to nominate an Innovation Project Manager who was responsible to coordinate the two main contracted suppliers and the development teams impacted by the system (12 out of 26). What he put in place was an actual "development project within the development program", since he created ad hoc validation patterns and contractual engagements among people that were already contracted within the vehicle project. The ACCESS project involved numerous surprises caused by vehicle embedment, or related with customer functional mis-anticipations. The system was finally right on-time for vehicle market launch.

VP Deployment - The first version of ACCESS did not fully meet the initial Marketing Department demand. Indeed the technical incertitude took the lead and lowered the functional ambition. The Program Manager decided not only to deploy the feature on the two upcoming models, but also to enrich the functionalities in order to meet the initial customer value. Today, the ACCESS system includes all the initially wished functionalities, and is deployed on 8 models from 3 platforms. ACCESS is placed under the responsibility of a joint electronic – mechanic team, which was recently co-located.

Case ACCESS at OEM B

VP Preparation - In the early 80s, the Mechanical Division wondered how it could benefit from the generalization of electric power in cars. It launched a two year study focus on the electrification of the steering column lock. At the same time, the Exterior Equipment Division triggered a parallel study aimed at making the door locking and unlocking procedure automatic. At the end of the day, both studies were unable to show enough benefit to justify more resources, even if the auto-lock project finally sold a pilot feature as optional equipment on a luxury car.

VP Contextualization – The topic got silent until 1995, when the Board voted a customer value based strategy, which implied to add attractive features to upcoming vehicles. The dedicated steering committee nominated a taskforce responsible for introducing the ACCESS feature on the market. The members of this taskforce were the former pilots of the 2 above described studies, who had reached heavyweight positions in their respective Departments. They rapidly merged their experience to propose a coherent ACCESS system. They initially targeted the directly upcoming car project, which was a luxury one. After 6 months of study, they realized that no solution could match the cost and functional expectations. Taking advantage from this initial study, they targeted another upcoming vehicle project - a low end urban car – and managed to build a scenario that met the cost (scale effect), technical functional requirements. This was the kick-off of the ACCESS project within the traditional vehicle project.

VP Development - The early collaboration engaged among the different technical departments was identified as dramatic for the development of the ACCESS system, at least at two levels. First, this system spread among more than ten regular car perimeters, and required a tight coordination among project teams. Secondly, they had to agree on the specific requirements of the ACCESS feature, which had sometimes to take the lead in front of institutionalized vehicle validation procedures. The OEM finally launched the car on time, and widely based the marketing plan on the promotion of the ACCESS system (TV ads, show-cars). The car sales and ACCESS equipment rate reached the previsions, and allowed meeting the economic balance.

VP Deployment - Based on this successful experience, the OEM decided to deploy the feature on other from other platforms. The ACCESS topic has been promoted by the same steering committee as at the beginning of the story, which supported its development within more than a dozen of different vehicles in 5 years. They triggered ACCESS-focused cross-functional investigations that clearly stand out of the regular scope of vehicle-focused cross-functional investigations. By doing so, they were able to guarantee a persuasive balance between the customer value and the pattern of associated costs. In order to enhance the customer value, it demanded to refine functionalities in seek for the best fit with the market segment specificities.

Case CROSS at OEM A

VP Preparation – During the 1990s, the Technical Department in charge of the cockpit had great troubles in preparing innovative solutions within such an integrated perimeter. The technical teams conducted several advanced studies in order to improve the performance of their parts, but once the time to develop a vehicle came, these advanced studies did not match together in a coherent manner. That’s why the traditional parts layout survived despite the increasing importance of the “life-on-board” concept. In 2002, the Director of the Inner Design Engineering tried to bridge this paradox by triggering a new form of advanced study. He requested several suppliers to investigate an integrated cockpit solution in the context of a real ongoing vehicle program.

VP Contextualization – Several suppliers had already investigated the theme. Their proposals were promising, and the OEM decided to make them compete on the real vehicle architecture. The OEM firstly indicated a niche vehicle that would be produced by 2010. Suppliers’ proposals fitted relatively well with the specific constraints of this product, since product-process constraints were quite loose in that scale of production. After 6 months of interaction with the suppliers, the technical teams responsible for the investigations realized that they would only trigger the required in-house commitment by targeting a current platform program. In January 2004, suppliers were asked to prepare for direct interplay with the development teams of a mass selling car which start of production was programmed for 2008.

The context was evolving on a week-to-week basis, and suppliers had to keep their proposals fitted to this evolving layout. The interlocutors of the suppliers were the regular product-process technical teams of the pre-development project. Each team was evaluated on traditional kaizen performance targets. The suppliers were de facto asked to satisfy not only the global target of compactness, but also the local targets of performance on each part of the module. Six months after the beginning of this experiment, and even if their initial proposals were promising (technically validated, economically feasible…) none of them passed through the final decision. Each solution did lost appeal by adapting to vehicle related constraints (changes in the manufacturing process, need of new components that took more space…).

VP Deployment - Most surprising were the reactions of the involved teams: despite both suppliers and OEM had spent resources to develop a solution that was finally not developed or sold; all of them claimed to have benefited from the experience. The OEM benefited from this experience by promoting the CROSS topic within in-house top-tech meetings. This experience triggered technical studies focused on questions and value axis that have emerged at this occasion, both at the OEM and at the suppliers.

Case CROSS at OEM B

VP Exploration - The research department of OEM B officially considered the interior volume as a valuable innovation domain from the year 2000. In 2001, the research centre allocated resources to a study focused on cockpit module compactness.

The dedicated research team first considered a way to measure the compactness of a cockpit. It defined rough variables of performance and targets to reach. These targets included the traditional conditions of maturity of the different parts composing the cockpit module, and also specific targets of volume and broad architectural orientations. After having validated these elements with the Research Committee, it requested from a parts' supplier to tackle the issue. From 2003 to 2004, the OEM's and the supplier's research team interacted at a month-to-month basis, reviewing the results of this study.

VP Contextualization - After a 12-month period of broad technical feasibility testing and performance criteria refinement, the cooperation shifted to a more contextualized investigation. The OEM gave more precise elements of context, defining a targeted range of vehicle, and several elements of architectural context based on an existing vehicle model that had to be replaced in the next decade. From 2005 to 2006 the supplier had to reach a certain volume target abiding by the previously acquired technical validations.

In July 2006, even if the results of these investigations were promising in term of habitability and cockpit compactness, there was still no guarantee that the targeted development project would be favourable to embed this solution, or that the architectural decisions towards the architecture of this product will fit with the hypothesis made during this investigation.

RESULTS & IMPLICATIONS

The experimental implementation of the innovation route grid makes visible dramatic mechanisms of the process that allow a brilliant idea of feature to be deployed on a range of products. We regarded the features' related sequence of events as a cumulative process aiming at this target. We observe that the route of a value proposition reveals important variations both in the 4 indicators under evaluation and in the organizational settings that support this evolution.

The forms of early explorations

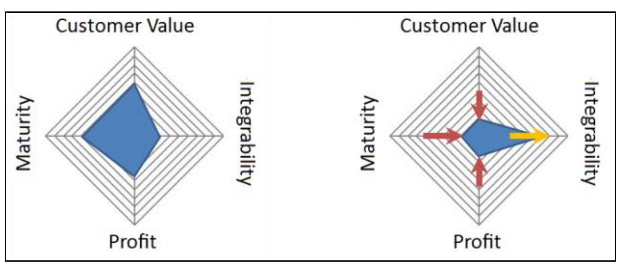
The exploration phase appears as dramatic and particularly difficult to manage. Whereas it is common language for development projects to call for "proven technologies", the cases show that there is an unavoidable space between what the development projects are likely to embed directly, and what the research activities are able to deliver even with consequent resources. On the four cases, no value proposition could be embedded without demanding tremendous further investigations. On the ACCESS A case, even two years of investigations on the keyless entry topic were not sufficient to provide a functioning system.

The case provide evidence that the organization of exploration activities (following technical domains of expertise) and advanced activities (following regular product architecture) act as a major canvas for feature preparation. The ACCESS A research team was specialized in electronics, and disregarded industrialization constraints or functional requirements. We can also observe this phenomenon when the investigations are led by technical product-process departments: the compactness had been studied by different product-process departments in the past, unsuccessfully. The upfront organization orients the early studies towards mono-expertise roadmaps instead of an integrated effort pulled by the seeking for customer value. On the same way, CROSS shows the difficulty to study and develop an architectural value proposition within the regular development organization. Advanced studies were led by different technical departments which failed to coordinate on a valuable parts' setting.

The limits of "off-the-shelves" solutions

The second main insight provided here follows Iansiti's conclusions and directly questions the notion of "proven technology": the exploratory investigations are context dependant. What has been validated out of context can be put into question just by modifying a tight element of the value proposition. On each case, the sudden appearance of specific context related constraints interrogated several hypotheses that have been guiding the investigations so far.

On the CROSS A case, the suppliers made early investigations based on a generic context of embedment that fitted relatively well with a specific niche product. As the targeted product changed, numerous interferences appeared. The adaptation process (scheme 3) putted into question the previously envisaged technical solutions (maturity 3->1), the economic balance because the new technical solutions were much more expensive (profit 2->1). The customer value of the cockpit module was also questioned (3->1) since the new layout demanded volume consuming parts in order to keep abiding by the regular specifications.



Scheme 3 - "CROSS A" indicators before and after contextualization (source: our research)

The innovative solution is "shelved", "validated" or "proven" in a given functional / technical configuration that is very dependent on the context of embedment. So we can only underline the critical role of the embedment process. The two CROSS cases provide insights from two different choices of contextualization process. Let us have a closer look at the positive and negative aspects of these two settings.

Various track of value proposition *contextualization*

Whereas OEM A envisaged the embedment process of the CROSS solution within the product development process, OEM B chose to investigate the embedment out of the product development cycle. The table 2 shows a brief synthesis of the characteristics of these two processes.

	CROSS A	**CROSS B**
Major advantages	The proximity to the product sales provides great incentives for OEM and suppliers	Step-by-step investigations that account a progressively representative context.
Major disadvantages	VP product and process validations are placed under the same validation regimes than robust traditional parts	Uncertainty towards the context hypothesis and the upcoming valorisation

Table 2 - Advantages and disadvantages observed of both patterns of contextualization

One could imagine a hybrid form of embedment between these two specific settings. We currently carry out further research in order to define the settings of a contextualization process that could maximize namely the context matching, the maturation pace and the incentive effect.

Shaping the innovation routes

We cannot understand the decisions made during case if we limit our scope of evaluation to the performance of the current development project. CROSS was not developed yet but the CROSS's route benefited from the created knowledge for both OEM and suppliers. Several decisions aim not only at increasing the value of the upcoming product, but also to nurture and solidify value proposition related knowledge fields (Hatchuel and al. 2004) in order to make the future features embedment more likely and profitable (Lenfle and Midler 2001).

In this "rebound" perspective, the cases provide evidence that firms can choose different patterns of learning. These are summarized in Figure 4. OEM A privileged a more customer-value-oriented innovation route. In spite of poor exploratory technical studies, it defined quite rapidly valuable functionalities and brought the feature on the market through a mass selling product. This shift triggered an incentive to learn the missing technical knowledge. The OEM B led a more iterative and technical-oriented innovation route that used several development projects as learning support. The successive trials led to define a relevant set of functionalities and a profitable feature.

The ACCESS case shows extensively how innovative value propositions need different coordination process than the product development routines: they tend to fade the coherence of the innovative value proposition behind the regular validation patterns. At OEM A the lead came from the project management, and needed heavyweight management in order to coordinate the technical teams that were not strongly committed. After the first development, the technical departments formalized written design rules and dedicated a technical team. At OEM B, the lead came from technical departments that

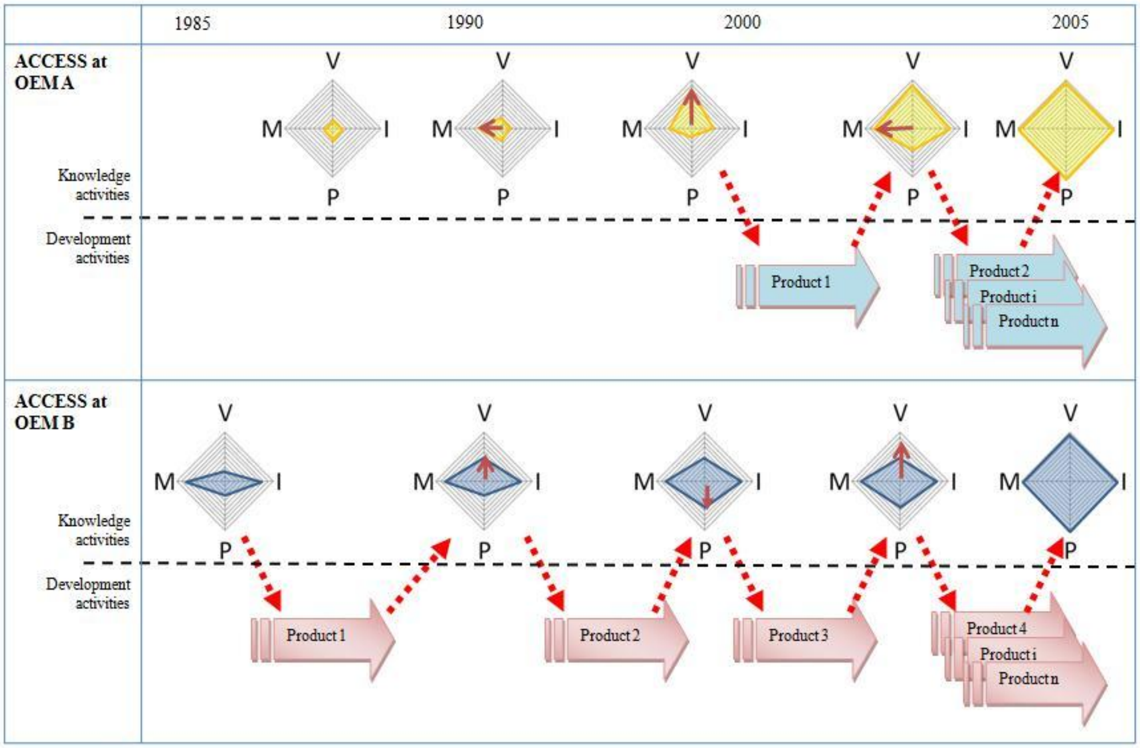


Figure 4 - Two contrasted innovation routes for the same features; ACCES A and B (source: our research)

had already worked together on the topic. They acted as heavyweight coordinators for in-house technical teams and suppliers. These roles are still unchanged today.

The multi-products learning perspective enables to regard the improvement of the four criteria on the scale of different products. The cases highlight the need to consider the four criteria at a multi-products scale. Project-oriented organizations (like OEM A) tend to focus on the cost related to the first embedment and disregard the consequences of these early choices towards upcoming embedment efforts. We face here another fat-design problem: a decision could be rationally justified at the level of project performance, but could represent an over-design cost when considering the integration problem at a multi-context scale.

Further researches

The multi-case approach we adopted here was relevant to build accurate analytical lenses but we still miss a more systematic approach to isolate key levers for the management of this kind of innovation routes. We currently define a quantitative approach to correlate management practices of the innovation routes with differences in the performance of these routes. This framework will be part of the first round of an international benchmark on innovation of the International Motor Vehicle Program.

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