Projects as temporary trading zones: a theoretical proposal

Paper submitted to the IRNOP Conference, London, 2015

Sylvain Lenfle
University of Cergy-Pontoise & Ecole Polytechnique, France
slenfle@hotmail.com

Jonas Söderlund
BI Norwegian Business School, Oslo, Norway

Abstract

There is a growing body of research in the field of project management discussing the ontology of projects and more specifically what projects are. This paper draws upon the work of P. Galison (1997) to introduce the idea of viewing projects as trading zones. This concept offers a novel way of looking upon projects that reflects their processual nature and emphasizes the ongoing creation of an interlanguage unique for each project. The paper presents an analytical framework that builds on this idea by particularly focusing on four elements of project organizing: organizational devices, project management tools, artefacts, and language.

Projects as temporary trading zones: a theoretical proposal

Introduction

There is a growing body of research in the field of project management discussing the ontology of projects (Cicmil & Hodgson, 2006), and more specifically what projects are. This particular inquiry raises the very issue of why projects exist and how we should understand projects as social phenomena. In many ways this is a refreshing discussion and debate since mainstream literature on projects and the management of projects has treated projects simplistically – as a rational tool implemented to develop and implement a new product or process. Of course, projects are efforts to implement change. But projects are so much more than that. Hence, there is a need for a more elaborate discussion about what projects are and the theories that are needed to understand why projects exist and how they behave.

Thus, the matters associated with the ontology of projects are critical for the advancement of better theories of projects and the management of projects. So far, writers have argued that there is a lack of theoretical awareness and development in the field of project management and that that this situation has turned into a deadlock where it becomes difficult for researchers to draw on each other's' findings because of lack of coherent linkages across studies and theoretical conversations (Koskela and Ballard, 2006; Winch, 2006; Williams, 2005). There are many musicians playing but too few seem to listen to what the others' are playing. One possible route to get out of this deadlock is to develop a more elaborate research agenda and bolder theoretical efforts. This is the overall and important aim of the present paper – to offer an example and discussion of how such theoretical efforts may look like and discuss the general insights that may result from such efforts.

A promising strategy for this advancement, this paper argues, would be to borrow theory from neighboring disciplines. However, such borrowing of theory must rest upon the awareness that the social context to which the theory is transferred has unique characteristics that might be downplayed by an ignorant and blind transfer of theoretical ideas (Markoszy, 2009). Hence, borrowing should be done wisely and humbly.

This paper seeks to take part in the development of new concepts and theories by offering a theoretical framing of projects as temporary trading zones – a framing that is quite different from much of extant theorization in the domain of project management. We believe this framing offers novel answers to fundamental theoretical questions, including why projects exist, why they differ, and how they behave – all fundamental and important

questions for anyone interested in developing stronger theories of projects and the management of projects (Söderlund, 2004).

Indeed the field of project management has long been dominated by a strongly rationalistic and instrumental approach (Packendorff, 1995). This is perhaps particularly obvious in the normative tradition of writings, which to a great extent is rooted in the growth of the practical application of decision sciences after World War II (see Erickson et al. 2013). This "Management Science" approach had a major impact, particularly in the practice of project management, namely how managers talked about project management and how people generally conceived of what project management really was. In this tradition of project management writing, project management is first and foremost seen as a scheduling problem of complex endeavor. The Polaris project became emblematic of the success of this rational approach which gave birth to the "optimization school" of project management (Söderlund, 2011). In this perspective projects represent a temporary organizational setting which aims to reach a clearly defined goal within budget, time and quality constraints. A defined toolbox exists to optimize the organizational effort. This view is now widely criticized. One of the most influential contributions critiquing the normative and instrumental tradition of project management writing is the book edited by Hodgson and Cicmil, *Making projects critical* (2006). The book leads to a reopening of the ontology of projects. The contributors analyze the roots of the rationalistic model in a genealogical perspective and suggest a postmodern approach to projects. In this perspective projects are first and foremost conceived as processes. They are gradually constructed through social interaction, practices and language creation. Projects are "emergent spaces" that become enacted through nested sensemaking processes. A second and more recent critical remark points to the irrelevance of the normative/instrumental tradition of project management. For instance, Hällgren et al. (2012) argue that « *the* [relevance] *problem occurs when simplified, rationalistic and deterministic models (or ontologies) are mistakenly considered to be accurate views of reality. (…) It could be argued, therefore, that PM research is not only an immature field of research, it is also unsubstantial in terms of understanding what is going on in projects* » (p. 462).

The present paper is in line with this novel framing of projects. More specifically, we are interested in the exploration of the processes that are specific to projects. Indeed, with the exception of the above mentioned work, projects have been defined mainly by their temporariness (Lundin & Söderholm, 1990), their difference from operations (Declerck & al. 1983) or routine activities (Obstfeld, 2012), and their goal-oriented/teleological nature (see for example Morris, 2013). But we still need to address what happens specifically within projects

that are different from the routine work, especially grasping the process characteristics of projects. As many writers have said before us, we believe there is a need for a more elaborate theory of projects and project management. We also believe that theoretical attempts should be more frequent and make use of writings in other areas of social science. In addition, we believe that theoretical attempts should make use of the salient characteristics of projects as social phenomena. We also believe that such theories must acknowledge the dynamic and processual nature of projects. We believe that the theoretical framework presented to some extent does all this – it builds on extant research in social science, it draws on process theory, and it addresses several of the most salient characteristics of projects as social phenomena. The paper argues that research into projects need to become more interested in process and in the becoming elements of project management. Projects are born and nurtured. Projects are equally made to live and made to die. Theoretical attempts that fail to address these processual features of projects, we believe, miss a great deal of the organizational challenges that many contemporary projects are facing.

It should be pointed out that the framework presented here focuses on the coordination problem of projects and that it draws on the influential work by the historian and philosopher of science Peter Galison. It should also be pointed out that it builds on the idea that a theory of projects and project management need to rest on five key questions, namely: why projects exist, why projects differ, how projects behave, what the value is that the project management unit is adding, and, what determines the success and failure of projects (Söderlund, 2004). These questions are far from novel when it comes to the theorization of organizations and firms, however, they have received surprisingly modest interest among project scholars. We believe this is problematic, especially in times when scholars are calling for more bold theoretical attempts and stronger theoretical foundations for the further development of the field of project management.

The ultimate matter is to build a more robust theoretical foundation to be able to describe and analyze the process of projects. To achieve this we begin by analyzing the rich literature on coordination and communication across boundaries in innovation management. We argue that this theoretical framing is relevant to understand several of the most salient process features of projects. We base our theory on the metaphor of the “trading zone” which was originally developed by Gallison in his book *Image & Logic* (1997). Indeed, we believe that the “trading zone” concept, with its emphasis on language creation as a condition of coordination, can be fruitful to describe the nature of the processes at stake in many different

kinds of projects. This leads us to discuss the implications of the framing of projects as temporary trading zones. The last section presents a few suggestions for future research

The problem of coordination

In our view, we believe that the theory of project management must initially be made through a distinction between two kinds of organizational problems. One relates to the cooperation problem, the other with the coordination problem. The cooperation problem typically seek to discuss how actors come to agree on a conflicting goal, how actors are able to reach agreement, how actors create a social exchange that works for all parties involved. Typically these kinds of theoretical attempts make use of stakeholder theory, economic theory, and goal setting theory (see for instance, Söderlund, 2013). However, as for the second problem – the coordination problem – other theories are relied upon. Here analysts are more interested in explaining how actors with diverse background come to integrate and unite their distinct experience and their respective activities to reach a common goal. In that respect, the coordination problems may be unsurmountable even though the cooperation problems have been solved (Grant, 1996). Therefore, this paper is primarily interested in the coordination problems of projects and project management.

To arrive at a relevant conceptualization of the coordination problem, we have to rely on other literature than PM. This question is particularly significant in innovation management since, as stated by van de ven (1986), "*managing part-whole relationship*" is a central problem in the management of innovation. In this perspective working across boundaries (internal and/or external) is a central concern. Two research streams lead to important insights: the literature on integration and on boundary-spanning mechanisms.

One classical concept used in the literature is that of Integration which was used in much early work on projects, for instance in Lawrence and Lorsch's (1967) landmark contribution. In this perspective projects constitute an integrating mechanism that helps the different functions of the organization to work together in order to achieve complex tasks like new product development. However, Lawrence and Lorsch define integration very broadly as "*the process of achieving unity of effort among the various subsystem in the accomplishment of the organization's task*" (1967, p. 4). They do not offer a micro-oriented analysis of the ongoing processes within a specific project. A more sophisticated use of the concept of integration is provided by the Harvard studies on new product development projects (Clark & Fujimoto, 1991; Wheelwright & Clark, 1992; Iansiti & Clark, 1994). For them integration constitutes a dynamic capability. Its essence is "*the generation, fusion and accumulation of*

knowledge: the capacity to merge new knowledge about the impact of possibilities with deep accumulated knowledge of the complex existing capability base of the organization" (Iansiti & Clark, p. 602). In this sense, they insist, integration is more than communication and coordination across functional boundaries since it entails the "*proactive generation of new knowledge*" (ibid.). Their research provides an insightful description of internal and external integration mechanisms which corresponds *de facto* to the characteristics of heavyweight development teams that practices *integrated problem solving* (see Clark & Fujimoto, 1991). However, in our view, they did not provide a description of how integration unfolds within project teams, what are the practices associated with this integration process.

Another and complementary line of research focuses on coordination mechanisms across boundaries in organization. This is a vast domain starting already with the work of Allen (1977) and our objective here is not to make a literature review. This might very well be needed but it is beyond the scope of this paper. We consider the work of Paul Carlile (2002; 2004) to be particularly representative of this research stream. Studying new product development efforts, but not mentioning the term project or the project management literature per se, Carlile provides an in-depth study of the processes involved for managing knowledge across boundaries. He proposes an integrative framework which distinguishes three processes: transferring, translating and transforming. These processes correspond to increasingly complex situations in which novelty and diverging interests between actors complicate the coordination process. Kellog et al (2006) have completed this framework by an insightful in-depth study of the practices of cross-boundary coordination in the projects of a web agency. According to their findings (table 4 p. 40), display (rendering work visible to others), representation (rendering work legible through us of projects genres like power-point presentation or documents) and assembly (juxtaposing work through modification and recomposition) are the three practices that enable cross-boundary coordination. In so doing the authors provide a landmark description of the coordination processes at stake in projects. However, and we think this constitutes an important limitation their work, they completely ignore the literature on project management and the setting-up of projects as a way to enhance coordination. The authors thus fail to recognize the value of project organizing and for that matter the effects that organizing coordination by projects may cause.

These two research streams provide invaluable contributions to our understanding of coordination processes in teams involved in new product development. But their goal is not to develop a theory of what a project is, even if they describe some of the very essential

processes at play in complex projects. Thus, we think that we are still missing an overarching framework that could integrate these works into an ontology of projects.

Inside the "trading zone"

In our quest for a relevant conceptualization of the processes at play in projects we suggest a framework that draws on the work of philosopher and historian of science Peter Galison. In *Image & Logic* (1997), Galison analyzes the evolution of the practices of scientists working in the field of microphysics (i.e. atomic physics). More precisely he focuses on the question, central for our topic, of coordination between the three cultures of physics: theorists, experimenters and instrument builders. *Image & Logic* is a fascinating description of the evolution of modern physics from a "workshop" type of science in early twentieth century to the huge post-1945 "factory of physics" at prestigious institutes of technology, such as the MIT. The increasing scope of the laboratory made the question of coordination (present since the beginning of microphysics) increasingly salient. To describe the processes at play in coordination Galison introduces the idea of a *trading zone* i.e. "*an intermediate domain in which procedures could be coordinated locally even when broader meaning clashed*" (p. 46). Indeed, as Galison demonstrates, there are often profound divergences (even paradigmatic ones) between the different cultures of physics or between scientists and engineers. However, he shows how, despite these disagreements, "*there can be exchanges (coordination), worked out in exquisite local detail, without global agreement*" (p. 46). To develop the notion of trading zone, Galison relies on anthropological linguistic work showing how different groups with radically different cultures and languages succeed in exchanging goods. According to him "*the work that goes into creating, contesting and sustaining local exchanges is (…) at the core of how local knowledge becomes widely accepted*" (p. 47). Borrowing from linguistics, he insists on the process of language creation in the trading zone, contesting the notion of translation, so common in sociology of science (Callon, 1986). Therefore "*rather than depicting the movement across boundaries as one of translation (from theory to experiment, from military to civilian science, or from one theory to another), it will prove useful to think of boundary work as the establishment of local languages – pidgin or creoles – that grow and sometimes dies in the interstices*" (p. 47). This emphasis of local language creation (referred to as *interlanguages*) as the core element of coordination is, in our view, the fundamental contribution of the trading zone. It is all the more relevant for our purpose that the notion of "language" is in fact broad in Galison's framework. As he notes, "*I intend the term "trading zone" to be taken seriously, as a social,*

material and intellectual mortar binding together the disunified traditions of experimenting, theorizing and instrument building" (p. 803). He is very clear on this question in a 2010 reflection on the trading zone concept (Galison, 2010): "*the language of science does read, quite literally, as language: propositions, statements, observations, hypotheses and conditionals are all recognizably linguistic even if technical in scope. But at other times practices do not necessarily form linguistic objects, in a strict sense. Diagrams and symbols, for example, have their own combinatorial logic. (…) I'm interested in language in an expanded sense that would embrace such symbol language – whether computer codes, abstract algebra, formal logic, or the calculations of quantum physics. Each carries with it its own form of syntax, its own rules of simplification, generalization and composition. Similar (…) are languages formulated in ways that make use directly of spatial or topological relationships – electronic schematics, group-theoretical dynkin diagrams* [and so on]" (p. 43). It is also clear from his writing and the subsequent paper that objects constitutes a form of language. It leads Galison to speak of "wordless pidgin" or "wordless creole" to name material or symbolic objects that are also a form of language (p. 43-44) Therefore, as he explains, "*Images, symbol systems, calculational and diagrammatic schemes – even complex objects – could be part of a generalized notion of language that is far from "just words". Indeed, language, as I want to use it, is a regular yet flexible apparatus that may take many forms, from the recognized, everyday "natural world languages", to the myriad, systematic registers in which we communicate*" (p. 44). Thus Galison, even if criticizing the notion of "translation", recognizes his closeness with Star and Griesmer's research on "boundary objects" (1989). We believe these standpoints and suggestions have important implications for how we should frame the coordination power of projects and the role of project management.

Projects as temporary trading zones: a framework

Our chief argument is that a project might be viewed as a "trading zone". Actors from different functional units /firms/cultures have to coordinate under time and budget constraints. The basic coordination process is local language creation through words, symbols, and objects. Indeed the fundamental question, which is often emphasized but little theorized in the project management literature, is how communication among people involved in a project unfolds. The most frequent answers as we have seen points to: 1) the role of team creation, co-location or the project manager to foster cooperation (e.g. Clark & Fujimoto, 1991); 2) to the cross-boundary coordination processes like in Carlile's and Kellog et al.'s writings. This

is unquestionably true, but it misses the question of local language *creation* and, furthermore, it does not discuss the ontology of projects. We believe that the concept of the trading zone provides a fruitful lens for the study of this process. We thus propose to extend the trading zone concept, also discussed by Kellog et al. (2006) in their exploratory study of cross-boundary coordination, to the domain of project organizing.

In this framing it is interesting to note that in Galison's writing the important role played by project management methods in the wide sense (tools and organization) in the fostering of trading zones between the different actors involved, specifically scientists and engineers. It is evident in his analysis that the major projects of the Second World War play a central role in the development of new collaborative practices, new forms of trading zones in which the creation of these interlanguages are fostered by the emergence of "*new visible structural arrangements – both physical and social – in which action can proceed*" (Vaughan, 1999, p. 922). Galison's analysis of the functioning of large war projects and laboratories is crystal clear on this matter. He describes how the creation of new types of laboratory, like the MIT Radiation Lab and Los Alamos, foster coordination between different disciplines. Bringing them together under the same roof leads to new types of relations in these "interactive zones" (p. 830, see also chapter 4). Moreover he shows how, especially in very complex projects, project management methods like PERT, phased planning, task partitioning and the designation of system engineers and project managers also contribute to this development of new modes of coordination.

More broadly, approaching projects as trading zones should lead researchers to look more closely at how actors communicate and interact, how they create their own language, what roles are being played by objects in this process, etc. (the "material culture" of project management to paraphrase Galison). In fact, these questions are emerging in project management research. Several authors have quite recently addressed how PM tools, such as schedules are playing the role of boundary objects (Yakura, 2002; Chang et al, 2013); how project management constructs a new language to foster coordination (Linehan & Kavenagh, 2006); how boundary objects constitute a way to resolve conflicts in projects (Ioro & Taylor, 2014), etc. However, we still miss an overarching framework presenting a more coherent theory of projects taking these aspects into account. In addition, this literature, in our view, is excessively focused on project management tools, whether as language, processes or boundary objects. This is again unquestionably true, but we cannot restrict language creation in projects to project management tools. Indeed one of the fundamental roles of the project team is to design, negotiate and implement the concept that justifies the project (see Clark &

Fujimoto, 1991; Wheelwright & Clark, 1992; Midler, 1996) – this is much more than just simply laying out the tasks to implement the project. Instead, this demonstrates the need for project management to re-invent the concept as such, telling the story about the future state to which the project will contribute. This is truly a language creation process, a simple indication of this being the difficulty, experienced by all researchers working with project teams, to understand what people are saying during project meetings.

This condensed overview of the literature shows that we actually know a lot of things about what is going on in projects. The problem is that the innovation management and boundary spanning literature for the most part never talks about project management and project management literature typically fails to draw on the innovation literature. To lead the way for more interesting questions into the ontology and the processes of projects, we suggest a more elaborate use of the idea of projects as temporary trading zones. This leads us to the following proposition concerning the nature of projects and the processes involved:

A project is a process that is enacted as a temporary trading zone. We thus follow Cicmil and Hodgson's emphasis on projects as processes and Kellog et al's description of the coordination processes in cross-boundary work. Furthermore, the aforementioned literature allows us to identify four underlying elements that foster coordination in the trading zone, namely organizational devices, project management tools, artefacts and linguistic representations. Therefore the trading zone concept allows us to bring together the contributions from two fields of inquiry: project organizing and innovation management. We argue that the following elements are particularly pertinent for the analysis of projects as temporary trading zones:

1. ***Organizational devices***. It is striking to note that the structuration of project per se is almost never mentioned as an important element of coordination. Indeed most the innovation management or boundary spanning literature rarely talks about projects (Lenfle, 2008; Davies, 2013). Kellog et al, for example consider projects as taken for granted, using the word dozens of times in their paper but completely ignoring the project management literature. However from Polaris's Special Projects Office (Sapolsky, 1972) to Clark & Fujimoto's Heavyweight development teams (1991), project management research has demonstrated the fundamental role of the setting-up of dedicated teams, co-location, projects reviews, etc. to overcome coordination

problems between boundaries. This dimension is probably a precondition for an effective coordination among members of a project, although not sufficient in itself (Engwall, 2003). It is present in Galison's work and in Vaughan's (1999) discussion of the trading zone but here again without any reference to project management research.

2. ***PM tools***. Typically scheduling tools such as PERT and CPM constitute the second element fostering coordination. If the dominant model emphasizes the role of PM tools as aid for rational decision making, recent literature on project management helps to deepen our understanding of their role in projects. Indeed, contemporary research recognizes the role played by PM tools in the coordination process (note that this role is already present, though not theorized, in Brooks' classic treatise on software engineering, 1995). They are boundary objects that help coordination between the different departments. Moreover, the PM toolbox represents a kind of language to enhance coordination, as noted by Galison (chap. 7). We therefore agree with Engwall (2012) when he explains that they play three different, and equally important, roles a) « *As a boundary object for technical coordination of actions and expectations*; b) *As a political feature for legitimacy and trust building; c)As a cognitive means for the social construction of a predictable future* » (p. 611)

3. ***Artefacts***: There is now an important literature on the fundamental role of artefacts (what Seidel & O'Mahony call *material representations*), be they prototypes, numerical simulations, objects, etc. in the innovation process. The role of artefacts as boundary objects to foster coordination between experts with different background is now well documented. It helps to overcome the problem eloquently summarized by Weick: "*How can I know what I think, until I see what I say*" (1979, P. 133). Our goal is not to contribute to this research stream, but to mention its importance for our understanding of coordination. The works of Henderson (1999) and, more recently, of Jouini & Midler (2014) provide a fitting analysis of their different role in the design process.

4. ***Language*** in the strict sense i.e. *linguistic representation*. This dimension, which is central in Galison, is fundamental. If it has recently received more attention in innovation management literature, we think in particular to the work of Seidel which

discusses at length the process of concept creation and the role that language plays in the process of concept creation (see Seidel & O'Mahony, 2014), it has older roots. We think in particular of the landmark contribution of Nonaka (1994 & 1995 with Takeuchi) and its knowledge creating process. It demonstrates the role played by what he called "figurative language" (1995, p. 13), such as metaphor and analogy, in the knowledge creating process and the development of innovative concepts. It is evident from Nonaka, Clark & Fujimoto, Midler and Seidel & O'Mahony that the creation of a "project-specific" language constitutes a fundamental characteristic of (successful?) projects. To consider a recent case, one may consider the Renault Logan project (Jullien et al, 2013) to understand how difficult and important it is to progressively define what an "entry" vehicle is (which is different from just being "low-cost") in a company that has never built such cars and think, for a large part, that it's impossible. The Logan case is even more interesting that it subsequently expand into a new product line at Renault (Midler, 2013)[1]. In the same vein, we can probably argue, following here the work of S. Johnson (2002), that the reliance of large military and space projects on the tools and language of systems management, respond to this need of a new language to manage the interfaces between components and disciplines. Therefore we believe that PM research should take into account advance in other fields that are most relevant to understand processes at stakes in a trading zone.

Table 1 summarizes the main elements of the trading zone framework. It also presents a few examples of theoretical sources that we believe are particularly important for each element.

[1] We thank Christophe Midler for this example.

Elements	References	Primary mechanisms
Organizational devices	Lawrence & Lorsch , Clark & Fujimoto , Allen	PM as 1) integrating mechanism across functions and 2) integration as generation of knowledge. Key role of heavyweight project management and teams in this process. Co-location or people.
PM Tools	Brooks, Yakura, Chang & al, Engwall, Galison (chap. 7)	PM toolbox as a central coordination mechanism in project. PM tools as boundary objects.
Artefacts	Wheelwright & Clark, Nonaka & Takeuchi, Henderson, Carlile, Ioro &, Seidel & O'Mahony	Artefacts (prototype, simulation tools, drawings, etc.) as boundary objects that foster the knowledge translation/transformation process (Carlile). Artefacts as central coordination mechanisms
Language	Nonaka & Takeuchi, Carlile, Seidel & O'Mahony, Galison	Role of figurative language (metaphor and analogies) in the knowledge creation process (Nonaka and Takeuchi). Foundational role of "common lexicon". (Carlile). Role of linguistic representations (stories, metaphors, etc.). Creation of inter-language (pidgin) that are more than just translation and in fact allows coordination. Language as comprising both words and material/symbolic objects (Galison).

Table 1. The trading zone framework: central elements of project organizing

The above framework is, of course, a tentative one. It has to be used and discussed in future research on the management and organization of projects. We believe it to be a fruitful avenue for PM research for two reasons

1. it emphasizes the process nature of projects,
2. it is grounded in solid literature and would thus offer an example of "borrowing theory" that could offer a lens to look at projects and the management of projects that complementing existing theories and perspectives.

Towards a theory of projects as trading zones

This paper introduces the idea of viewing projects as trading zones. The paper presents an analytical framework for the study of projects that builds on this idea by particularly focusing on four elements of project organizing: organizational devices, project management tools, artefacts, and language. The paper draws upon the work of Galison (1997). We argue that this writing offers a novel way of looking upon projects that reflects the some of the unique and salient features of projects. In particular, we stress the processual nature of projects and the ongoing creation of language for unique projects. We illustrate this with example from research on innovation projects.

As discussed initially, we believe at least five primary questions would need to be addressed for the future development of theories of projects and project management. How does our idea of projects as temporary trading zones answer these questions? This will of course deserve further research and our goal here is just to outline direction for future works. First, as for the question of why projects exist, our proposal points out that a fundamental reason for creating a project in the first place relate to the need for establishing an interlanguage, that the local languages that need to be integrated are specialized to the extent that communicating without the aid of project management would be extremely difficult. Following this idea, projects could also be expected to differ with regards to the kinds of interlanguages created and the number of local languages involved. The third question relates to the behavior of projects, or perhaps even more accurately the process of projects. We have suggested that projects could be seen as moving along four different dimensions: organizational devices, tools, artefacts, and language. The behavior of projects would thus be related to these four elements. Considering the success and failure of projects would not only be a matter of ensuring the creation of an interlanguage but equally so the establishment of the necessary devices, tools, and artefacts for such language to be developed. The success and failure are also associated with these issues – the creation of interlanguage is again underlined as a critical element. These are all hypothesis that would have to be explored in future research.

References

Allen, T. J. 1977. *Managing the Flow of Technology*. Cambridge, MA: The MIT Press.

Ben Mahmoud-Jouini, S.; C. Midler; V Cruz and N Gaudron. 2013. "Creative Artefacts: How Stimulators, Demonstrators and Prototypes Contribute to the Creative Processes ?," *20th International Product Development Management Conference.* Paris:

Brooks, F. 1995. *The Mythical Man-Month. Essays on Software Engineering.* Boston: Addison-Wesley

Callon, M. 1986. "Eléments Pour Une Sociologie De La Traduction. La Domestication Des Coquilles Saint-Jacques Et Des Marins-Pêcheurs Dans La Baie De Saint-Brieuc." *L'Année sociologique,* 36, pp. 169-208.

Carlile, P. 2004. "Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge across Boundaries." *Organization Science*, 15(5), pp. 555-68.

Carlile, P. 2002. "A Pragmatic View of Knowledge and Boundaries : Boundary Objects in New Product Development." *Organization Science,* 13(4), pp. 442-55.

Chang, A.; C Hatcher and J Kim. 2103. "Temporal Boundary Objects in Megaprojects: Mapping the System with the Integrated Master Schedule." *International Journal of Project Management*, 31, pp. 323-32.

Clark, K. and T. Fujimoto. 1991. *Product Development Performance. Strategy, Organization and Management in the World Auto Industry*. Boston, MA.: Harvard Business School Press.

Clark, K. and S. Wheelwright. 1992. "Organizing and Leading Heavyweight Development Teams." *California Management Review*, 34(3), pp.9-28.

Declerck, R.; J.P. Debourse and C. Navarre. 1983. *Méthode De Direction Générale : Le Management Stratégique De L'entreprise*. Paris: Dunod.

Duncan, W. . 1996. *A Guide to the Project Management Body of Knowledge*. PMI Publishing Division.

Engwall, M. 2003. "No Project Is an Island:Linking Projects to History and Context." *Research Policy*, 32(5), pp. 789-808.

____. 2012. "Pert, Polaris and the Realities of Project Execution." *International Journal of Managing Projects in Business*, 5(4), pp. 595-616.

Galison, P. 1997. *Image and Logic. A Material Culture of Microphysics*. Chicago: Chicago University Press.

____. 2010. "Trading with Enemy," M. Gorman, *Trading Zones and Interactional Expertise*. Cambridge, MA: The MIT Press, pp. 25-52.

Henderson, K. 1999. *On Line and on Paper. Visual Representations, Visual Culture, and Computer Graphics in Design Engineering*. Cambridge, MA: The MIT Press.

Hodgson, D. and S Cicmil eds. 2006. *Making Projects Critical*. New-York: Palgrave McMillan.

Iansiti, M. and K. Clark. 1994. "Integration and Dynamic Capabilities: Evidence from Product Development in Automobiles and Mainframe Computers." *Industrial and Corporate Change*, 3(3), pp. 507-605.

Ioro, J and J Taylor. 2014. "Boundary Object Efficacy: The Mediating Role of Boundary Objects on Task Conflict in Global Virtual Project Networks." *International Journal of Project Management*, 32, pp. 7-17.

Johnson, S. 2002. *The Secret of Apollo. Systems Management in American and European Space Programs*. Baltimore: The John Hopkins University Press.

Jullien, B; Y Lung and C. Midler. 2013. *The Logan Epic.* Paris: Dunod.

Kellogg, K; W Orlikowski and J Yates. 200-. "Life in the Trading Zone: Structuring Coordination Accross Boundaries in Postbureaucratic Organizations." *Organization Science*, 17(1), pp. 22-44.

Lawrence, R. and J.W. Lorsch. 1967. "Differentiation and Integration in Complex Organizations." *Administrative Science Quarterly*, 12(1), pp. 1-47.

Linehan, C and K Donncha. 2006. "From Project Ontologies to Communities of Virtue," D. Hodgson and S. Cicmil, *Making Projects Critical.* New-York: Palgrave McMillan,

Midler, C. 2013. "Implementing a Low-End Disruption Strategy through Multiproject Lineage Management: The Logan Case." *Project Management Journal*, 44(5), pp. 24–35.

____. 1996. *L'auto Qui N'existait Pas*. Paris, France: Dunod.

Morris, P. 2013. *Reconstructing Project Management*. Oxford: Wiley-Blackwell.

Nonaka, I. and H. Takeuchi. 1995. *The Knowledge-Creating Company*. Oxford University Press.

Obstfeld, D. 2012. "Creative Projects: A Less Routine Approach toward Getting New Things Done." *Organization Science*, 23(6), pp. 1571-92.

Seidel, V and S O'Mahony. 2014. "Managing the Repertoire: Stories, Metaphors, Prototypes, and Concept Coherence in Product Innovation." *Organization Science*, 25(3), pp. 691-712.

Söderlund, J. (2004): Building theories of project management: past research, questions for the future, International Journal of Project Management. Vol. 22: 183-191.

Söderlund, J. (2010): Knowledge entrainment and project management: the case of large-scale transformation projects, International Journal of Project Management, Vol. 28, No. 2: 130-141.

Star, SL and R Griesemer. 1989. "Institutional Ecology, 'Translations' and Boundary Objects: Amateurs and Professionals in Berkeley's Museum of Vertebrate Zoology, 1907-39." *Social Studies of Science*, 19(3), pp. 387-420.

Van de Ven, A. 1986. "Central Problems in the Management of Innovation." *Management Science*, 32(5), 590-607.

Vaughan, D. 1999. "The Role of the Organization in the Production of Techno-Scientific Knowledge." *Social Studies of Science*, 29(6), pp. 913-43.

Wheelwright, S. and K. Clark. 1992. *Revolutionizing Product Development. Quantum Leaps in Speed, Efficiency and Quality.* New-York: The Free Press.

Yakura, E.K. 2002. "Charting Time: Timelines as Temporal Boundary Objects." *Academy of Management Journal*, 45(5), pp. 956-70.