Inter-project learning: processes and outcomes of knowledge codification in project-based firms

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Abstract

In this paper, we argue that the literature on knowledge codification has been overly concerned with the economic properties of its outcomes, neglecting the importance of its underlying learning processes. Following Zollo and Winter [Organisation Science, 2001, in press], the paper distinguishes three learning processes: experience accumulation, knowledge articulation and knowledge codification and suggests a framework to analyse the learning abilities of project-based firms. We propose that mechanisms for inter-project learning draw upon these learning processes and can be found at various levels of the project-based firm. Using empirical evidence from six case studies, we discern three empirical patterns, that we defined learning landscapes, of such mechanisms. Implications for the literature and practice of knowledge codification are discussed.

Keywords: Project-based firm; Organisational learning; Firm; Codified knowledge

1. Introduction

The literature on the knowledge-based theory of the firm suggests that the capabilities of a firm are learning-based (Grant, 1996; Lazonick and O’Sullivan, 1996; Dosi et al., 2000). Accordingly, the core activities of the firm, what the firm chooses to produce and sell, as well as the boundaries of the firm, are determined by the knowledge a firm possesses. As observed by Levitt and March (1988), learning in the firm tends to be local. Interpretation of experience is difficult, as lessons must be drawn from a relatively small number of observations in a complex and changing environment. This makes it laborious to identify causality and draw correct inferences. Organisations and organisational members exhibit systematic biases in interpretation, since they concentrate overwhelmingly on recent and salient events. Also, they may be insensitive to sample size, attribute too much importance to intentionality, and may use simple and linear algorithms.

The aim of this paper is to discuss the learning abilities of project-based firms. We study whether and how project-based firms are able to capitalise on knowledge that is acquired during the execution of one project and their ability to transfer it to other projects or parts of the organisation. In its ideal form, the project-based firm is organised solely around projects. Galbraith (1969) suggested that there is a continuum of organisational forms ranging from the pure functional form through the matrix form to the pure product- or project-based form. While in the functional form, a firm’s business activities are organised according to functional specialisation (e.g. marketing, R&D); in the matrix form these activities are organised both within projects and
along functional lines. Within a pure project-based firm, projects “embody most, if not all, of the business functions normally carried out within departments of functional or matrix organisations” and act as the main mechanisms for co-ordinating and integrating them (Hobday, 2000, p. 874). The project-based form has, for instance, been studied in consultancy and marketing firms (Alvesson, 1995), the film industry (DeFillippi and Arthur, 1998), in architectural practice (Winch and Schneider, 1993), and construction firms (Gann and Salter, 1998).

The project-based firm can also be found in the production of so-called complex product systems (CoPS) industries (Davies and Brady, 2000; Hobday, 1998, 2000; Prencipe, 2000). CoPS are capital-, engineering- and IT-intensive, business-to-business products, networks, constructs and systems. They are often produced in multi-firm alliances, as a one-off or in small customised batches for specific customers and markets. Examples include global business networks, aircraft engines, civil airliners, power stations, off-shore oil platforms, mobile telephone systems and large civil engineering projects. The focus of this paper is on this category of products.

The strong focus on projects displayed by firms developing CoPS suggests that there might be problems associated with organisation-wide learning (Lindkvist et al., 1998). While in a functionally-based firm, departments act as knowledge silos, the pure project-based firms lack the organisational mechanisms for the knowledge acquired in one project to be transferred and used by other projects. Two further issues impair organisation-wide learning in project-based firms: the unique and the temporary nature of projects (Brusoni et al., 1998). With regard to the former, projects differ from each other in several critical aspects. They entail heterogeneous activities that may well not be repeated in successive projects. If projects exhibit one-off characteristics, the project-based firm confronts the difficult task of “learning from samples of one or fewer” (March et al., 1991). In addition, projects may be characterised by relatively long life cycles, requiring similar project activities to be retrieved and repeated after long time intervals. With regard to the temporary nature of projects, projects can be characterised by the temporary constellation of people they entail (DeFillippi and Arthur, 1998; Tell and Söderlund, 2001). This feature implies that new human encounters and relationships take place whenever a new project is started, which may increase the barriers to learning from the previous experience of others.

Warglien (2000) argued that project-based firms can be regarded as a population of projects. If one puts on Darwinian spectacles and looks at the projects portfolio of such firm, he will see populations of entities (the single projects) that are born, die, compete for limited resources (skilled labour, equipment, and financial means), inherit clients, technologies and other traits from preceding generations, and re-transmit them (sometimes modified or innovated) to next generations (Warglien, 2000, p. 5).

Based on Warglien, we submit that projects can be characterised by quasi-genetic traits (Cohen et al., 1996) that can be technological (i.e. technologies, components) and organisational (reporting systems, project management). These quasi-genetic traits embody the firm’s capabilities and routines and “can usually be inherited from project to project, and they are sometimes modified by project development efforts” (Warglien, 2000, p. 5). Following Davies and Brady (2000), who found that firms developing CoPS try to economise by the repetition of similar categories of projects, this paper analyses the mechanisms adopted by project-based firms to make these quasi-genetic traits inheritable from project to project.1 In other words, we look at how these firms are able to learn between projects.

We build on the literature on knowledge management and, in particular, on the debate on knowledge codification (Steinmueller, 2000). It has been suggested that the ability to codify tacit knowledge carries some important implications for the efficiency properties of economic organisation. In fact, if knowledge can be codified and commodified, the ease of knowledge transfer will increase and costs associated with such transfer will decrease (Cowan and Foray, 1997). Given the features of a project-based firm

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1 We are aware, however, of the limits of the biological metaphor. As pointed out by several authors (e.g. Penrose, 1952), in organisations such as business firms, on the one hand there is no sexual reproduction, but on the other hand there is deliberate action and strategy.
highlighted above, knowledge codification could have profound implications for organisation-wide learning. Although the impact of codification for the efficiency of organisational processes warrants further study, we argue that the debate on codification focuses mainly (and wrongly so) on the importance of the outcomes of codification leaving the cognitive process underlying it unexplored. We base the analytical framework of this paper on Zollo and Winter (2001) who emphasised the relevance of the process dimension of knowledge codification.

This article is structured as follows. Section 2 briefly introduces the debate on knowledge codification. Based on Zollo and Winter (2001), Section 3 suggests a simple model that outlines three learning processes that occur in the firm (experience accumulation, knowledge articulation, and knowledge codification). We then identify the different mechanisms used by the project-based firms investigated in relation to their inter-project learning processes. These mechanisms are categorised into learning landscapes of an ideal form (Section 4). We conclude the article by discussing the implications for firm capabilities and the processes and outcomes of knowledge codification, as well as identifying future research issues.

2. A note on the codification debate

Increasingly, the nature and processes of organisational knowledge have become the focus for theorists in their attempts to delineate a viable theory of the firm. A number of definitions of organisational knowledge has been suggested in the literature (see, e.g. Tell, 1997; Baumard, 1999; Eisenhardt and Santos, 2001, for literature reviews). The aim of this section is to briefly introduce the literature on the codification debate.

In reviewing current perspectives on knowledge codification, we are going to employ two assumptions. The first is that information and knowledge are two different concepts. Dosi et al. (1996) considered information as “well stated and codified propositions about (i) states-of-the-world (e.g. “it is raining”); (ii) properties of nature (e.g. “A causes B”); (iii) identities of other agents (e.g. “I know Mr. X and he is a crook”) and (iv) explicit algorithms on how to do things”. Knowledge is instead understood as including (i) cognitive categories; (ii) codes of interpretations of the information itself; (iii) tacit skills and (iv) search and problem-solving heuristics irreducible to well-defined algorithms. We submit that information is symbol, code: a sign without meaning (cf. Dretske, 1981), whereas knowledge is meaning, meaning that can only be given by an observing system.

This distinction between the two concepts of information and knowledge leads to the second assumption. Organisations, and particularly business organisations, are viewed here as knowledge-based rather than simple information-processing systems (Dosi and Marengo, 1994; Fransman, 1994; Nonaka and Takeuchi, 1995). Firms do not merely process information, but elaborate and interpret it according to beliefs developed and accumulated by them over time. New knowledge is acquired via firm-specific processes, in turn sedimented over time, which filter and constrain a firm’s current behaviour.

Cowan and Foray (1997) defined the codification process as “The process of conversion of knowledge into messages that can be processed as information” (p. 596). Hence, codification refers to the process of knowledge being transformed into information, where information is in the form of messages, or sets of identifiable rules and relationships, that can be transmitted to decision agents (Kogut and Zander, 1992; Ancori et al., 2000). Codified knowledge, thus, can be characterised as information-like and objectified (Kogut and Zander, 1992; Spender, 1996). In business practice, knowledge codification seems to play an important role in what organisations and business consultants label knowledge management. Through the development of new technologies more information can be stored and retrieved. A number of technological applications developed for knowledge management aim at substituting human activity and knowledge with rule-based systems that can aid, or perform, problem-solving (Davenport and Prusak, 1998).

Two antagonistic positions in the codification debate on the pros and cons of codification of knowledge can be discerned. Ancori et al. (2000, p. 257) labelled these the ‘absolutist position on codification’ (emphasising that all knowledge can be codified) versus the ‘absolutist position on tacit knowledge’ (for whom all codified knowledge requires tacit knowledge to be useful).
Advocates of codification argued that it reduces the cost of knowledge acquisition due to ease of storage, retrieval and reliability. As an outcome, the economic properties of codified knowledge are very much akin to the economics of information (Arrow, 1984). There are high initial fixed costs, but since messages become reproducible successive operations can be carried out at very low marginal cost. Through codification complexity can be reduced when confining the description and analysis of a domain into what is expressible in codes (Boisot, 1995). This means that codified knowledge can instruct machines, as is the case with computers, which then can substitute for people in certain situations. Because of the public nature of codified knowledge, codification has the potential to reduce asymmetric information in markets. Moreover, codification may transform knowledge into a commodity that can be bought and sold in markets, thereby allowing firms to purchase knowledge instead of developing it internally (which may lower costs for knowledge acquisition, e.g. through outsourcing). Through the creation of a memory external to individuals, codification may make organisations less vulnerable to loss of tacit knowledge stored in individuals.

Advocates of tacit knowledge, however, pointed to the drawbacks of organisations’ relying too much on codification of knowledge. For instance, the inherent flexibility in the skilled use of tacit knowledge seems to suggest that the exercise of such skills involves more than the internalisation of codified rules (cf. Nightingale, 2001). If followed accurately and precisely, codified knowledge, understood as rules, may instead imply rigidity. Hence, in the context of change excess codification can stifle the development of new knowledge and inflict stability and inertia on systems. Moreover, the production of codified knowledge implies the production of new forms of tacit knowledge, due to the contextual nature of economically valuable knowledge. In addition, and implicit in this, non-algorithmic judgement is necessary even in contexts where it would seem that complete codification is possible.

In this paper, we will refrain from taking either of these positions. In line with Hansen et al. (1999), who discussed knowledge management strategies in terms of codification and personalisation (contingent upon the strategy of the firm), our position is that several strategies for knowledge management are viable for the firm. Also, we argue that what is lacking in such a simplistic model of the benefits and drawbacks of knowledge codification is the importance of a knowing subject being involved in most learning processes (cf. Polanyi, 1962). We want to emphasise the cognitive element of knowledge in organisations by pointing to the activities of the knower in project-based firms. As recognised by several authors (e.g. Brown and Duguid, 1991; Lave and Wenger, 1991; Weick, 1995; Spender, 1996; Baumann, 1999), such knowers may be individuals, but are often participants in a collective community that develop their knowledge by drawing upon several sources of knowledge in their actions. In a project-based context, both individual and collective knowledge processes may be hypothesised, due to the complexity of the problems involved that implies both individual and collective effort. In conducting this research on knowledge codification, therefore, we try to ask questions not only to establish the outcomes of codification, but also as a way of informing ourselves about what the possible cognitive and social mechanisms involved may be. What are the processes in project-based firms involved in the management of knowledge? What are the collective mechanisms used for developing knowledge that can be reused in other activities and projects?

3. Managing knowledge in project-based firms: a tentative framework

Since we consider learning between projects as, at least in part, a collective endeavour, we follow Zollo and Winter’s (2001) argument on the evolution of collective knowledge within organisations. As has been suggested by several authors (e.g. Nonaka and Takeuchi, 1995; Boisot, 1998; Baumann, 1999; Ancori et al., 2000), the dynamics of learning in organisations can be depicted as a cyclical pattern. We focus on the knowledge processes associated with learning from experience and the possibility for the organisation to articulate, elaborate and draw inferences from experience (Levinthal and March, 1993; Levitt and March, 1988; March et al., 1991).

Zollo and Winter (2001) identified three learning processes, namely experience accumulation, knowledge articulation and knowledge codification. They argued that the effectiveness of these processes depends
on the characteristics of the tasks that the organisation attempts to learn. In particular, the frequency, heterogeneity and causal-ambiguity of the task render experience accumulation and knowledge articulation and codification more or less effective. The lower the frequency (temporary nature) and the higher the heterogeneity (uniqueness) of the task, the more effective are knowledge articulation and knowledge codification. Their argument rests on the concept of the learning investment function, according to which knowledge articulation and knowledge codification involve more resources (e.g. time) and cognitive efforts than the mere accumulation and routinisation of knowledge and experience. Also, Zollo and Winter (2001) emphasised the processes of knowledge articulation and codification as compared to their outcomes. In line with their argument, we argue that the processes of knowledge articulation and codification serve an important purpose in the dynamics of learning between projects as the project intensity in CoPS production implies unique (and therefore heterogeneous) and temporary (and therefore infrequent) tasks.

We argue that the distinction between the dimensions of outcome and process is fundamental to understanding the knowledge management strategies of project-based firms. When conceptualising codification, many writers drew on Kogut and Zander’s (1992) useful insight that knowledge codification facilitates the transfer of knowledge and, thus, contributes to the firm’s combinative capability. In line with this, knowledge codification is important because of the gains that can be made through new combinations of stocks of codified knowledge. Hence, incentive structures should be established, to encourage the codification of knowledge due to this outcome property. While acquiescing with this argument, this paper acknowledges both the stock (outcome) and flow (process) characteristics of knowledge as an economic resource (Dierickx and Cool, 1989), with particular emphasis on the latter. This process aspect of knowledge articulation and codification seems to have been neglected in the existing research, which tends to focus more on the outcome and the economic benefits related to such outcomes. 2 Fig. 1 is an attempt to single out the learning typologies, outcomes and economic benefits related to experience accumulation, knowledge articulation and knowledge codification. The figure also attempts to frame and highlight the focus of the current debate on knowledge codification.

3.1. Experience accumulation

Levitt and March (1988) argued that organisational learning is target-oriented, is based on historical experience and stored in routines. As emphasised by Nelson and Winter (1982), routines can be characterised by their tacit and programmatic nature. Such routines are an outcome of trial-and-error and reflect the accumulation of experiential wisdom (Gavetti and Levinthal, 2000). Experience-based learning tends to be local, i.e. closely related to existing routines. Learning by doing and learning by using are based on experience from actions where actors either have difficulties in drawing or ignore inferences to causality (Levinthal and March, 1993). The knowledge developed by organisations in such situations, thus exhibits certain elements of procedural rationality, lacking conscious volition (Nelson and Winter, 1982). In such situations, actors learn fairly passively through what Argyris and Schön (1978) labelled single-loop learning.

Viewing the organisation as a collection of learning-based routines, Levith and March (1993) suggested that organisations run the risk of myopia, exemplified by capability traps and superstitious learning. Such learning disabilities stem from the tendency of organisations to execute existing operational routines in response to problems encountered, and the restricted range of alternatives that search routines may select from (Nelson and Winter, 1982). As discussed by Zollo and Winter (2001), experience accumulation and organisational routines are fundamental for firms’ capability development. First, the smooth functioning of routines creates the possibility for automatic behaviour, which requires less attention and effort on behalf of the skilled worker (cf. Penrose, 1959). Second, organisational routines allow for efficient specialisation and coordination. As discussed by Nelson and Winter (1982, p. 105): “While each organisation member must know his job, there is no need for anyone to know anyone else’s job. Neither is there any need for anyone to articulate or conceptualise the procedures employed by the organisation as a whole” (emphasis

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2 The distinction between knowledge as process and knowledge as outcome is also discussed in Paoli and Prencipe (1999).
Skilled labour that performs routinised activities can be partitioned using division of labour, hence giving rise to benefits related to economics of specialisation.

### 3.2 Knowledge articulation

The behavioural focus on learning as routine-based, however, neglects some of the deliberative processes involved in organisational learning (Nonaka and Takeuchi, 1995; Witt, 1998; Zollo and Winter, 2001). Apart from the procedural nature of organisational learning, there are arguably elements of substantive rationality or logic of consequence involved (March and Olsen, 1989). Through agents’ abilities to express opinions and beliefs (Zollo and Winter, 2001), the ability to develop visions (Fransman, 1994) and the creation of metaphors and analogies (Nonaka and Takeuchi (1995), cognitive processes drawing more global inferences and determining causalities are triggered. Therefore, Zollo and Winter (2001) submit that articulation processes form a second important device of the cognitive dimensions of organisational learning processes.

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**Fig. 1. Learning typologies, outcomes and economic benefits.**

<table>
<thead>
<tr>
<th>Learning typologies</th>
<th>Experience accumulation</th>
<th>Knowledge articulation</th>
<th>Knowledge codification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learning by doing</td>
<td>Learning by reflecting</td>
<td>Learning by writing and rewriting</td>
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<tr>
<td>Learning by using</td>
<td>Learning by thinking</td>
<td>Learning by implementing</td>
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<td>Learning by discussing</td>
<td>Learning by replicating</td>
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<td></td>
<td>Learning by contemplating</td>
<td>Learning by adapting</td>
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<tr>
<th>Outcomes</th>
<th>Experience accumulation</th>
<th>Knowledge articulation</th>
</tr>
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<tbody>
<tr>
<td>Local experts and experiential knowledge in individuals (e.g. subject matter expert)</td>
<td>Symbolic representations and communication</td>
<td></td>
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<tr>
<td>Improved understanding of action-performance relation (predictive knowledge)</td>
<td>Codified manuals, procedures (e.g. project management process)</td>
<td></td>
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</table>

<table>
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<tr>
<th>Economic benefits</th>
<th>Experience accumulation</th>
<th>Knowledge articulation</th>
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</thead>
<tbody>
<tr>
<td>Economics of specialisation</td>
<td>Economics of co-ordination</td>
<td>Economics of information (diffusion, replication, and rest of information)</td>
</tr>
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</table>
Being able to articulate practical knowledge is an important facet of the reflective practitioner (Schön, 1983). Schön (1983) discussed how the practitioner by experimenting can obtain reflection-in-action, that is, an ability to attend to a situation where he/she is executing routine-based knowledge. Hence, in the framework of Schön, articulation of knowledge may occur in the practical context of experiential learning. At the individual level, the learning typologies at the basis of the articulation process are learning by reflecting and learning by thinking.

Zollo and Winter (2001) pointed out that articulation of knowledge performs two roles. First, it constitutes a context for justification (cf. Tell, 1997, 2000; Grand and Von Krogh, 2000). Second, it is a cognitive process that implies deliberation and carries the possibility that individuals and groups can come to grips with causality and feasibility in performing different tasks (cf. Nonaka and Takeuchi, 1995; Witt, 1998).

By discussing the role of conversation in the articulation of knowledge through reflection, both Zollo and Winter (2001) and Schön (1987) introduce a collective element of knowledge articulation. By dialogue and discussion knowledge can be articulated by organisational members and an arena can be created for double-loop learning (Argyris and Schön, 1978). Besides learning by reflecting and learning by thinking, the articulation process subsumes also learning by discussing and learning by confronting.

The articulation process improves the understanding of action–performance relationships and enables the creation of agreed upon representations. This creation of agreed upon representations facilitates communication amongst the actors using the concepts embedded in such representations (Foray and Steinmueller, 2001). Common representations, in turn, allow for better task co-ordination (economics of co-ordination).

3.3. Knowledge codification

Zollo and Winter (2001) further argued that an organisation may produce even higher cognitive efforts in the process of codification. In a sense codification is an extension of articulation. Even more so than articulation, the ability to codify knowledge allows for the creation of externalised knowledge, brought forward in linguistic and symbolic representations. Moreover, codification processes are associated with much effort and high costs. When individuals in organisations codify articulated knowledge into codebooks (Cowan et al., 2000), the aim may be to reveal even stronger links between actions and outcomes. In such cases, efforts may involve, e.g. the screening of multiple scenarios, different explanatory frameworks, or the testing of different organising principles. Codified rules as contained in manuals and procedures can also merely serve to provide guidelines for repetitive actions. In such instances, codification (as an outcome) primarily serves the purpose of facilitating routine replication. The economic benefits of codification lie primarily in the re-use and diffusion of codified knowledge (economics of information).

As emphasised by Zollo and Winter (2001), however, the cognitive efforts of creating codified knowledge from what has been (perhaps) tacitly known involves creative elements (cf. Nonaka and Takeuchi, 1995) as well as the establishment of internal selection processes. Along the same lines, Ancori et al. (2000, p. 258) suggested that the cognitive and organisational mechanisms mobilised by codification are particularly important. These authors submitted that knowledge is dependent upon the cognitive abilities of actors and cannot be separated from the communication process through which it is exchanged. Following Foray and Steinmueller’s (2001) discussion, one can distinguish between two functions of codification. The first function is that codified systems of symbols allow for storage and transfer across time and space. The second function of codification is to allow humans to rearrange, manipulate and examine symbols and symbolic relationships in order to transform the underlying knowledge represented in such systems. Hence, not only is there an aspect of inscribing what is tacitly known involved in codification, but also, as Foray and Steinmueller (2001) emphasised, a higher effect of changing knowledge structures by the potential and actual transpositions implied by such a literate form of knowledge representation. This line of reasoning suggests that besides the substantial cognitive investment in the learning by writing and re-writing suggested by Zollo and Winter (2001), organisations learn by implementing, replicating and adapting codified knowledge.

The processes of experience accumulation, knowledge articulation and knowledge codification are certainly not unidirectional. Moreover, there are overlaps...
between these types of learning and any seemingly
definite distinction between them may sometimes blur.
What we have tried to emphasise in the preceding dis-
cussion, however, is an increasing element of delib-
eration and, in one sense, rationality, as articulation
and codification processes are included in an under-
standing of the creation of organisational knowledge.
To borrow Weick's (1995) terms, one could say that
sense-making processes become an explicit element
of the learning processes involved when individuals
and communities of individuals create representations
which they can use to interpret and elaborate on ex-
periences encountered (Choo, 1998).

4. Project-to-project learning and learning
landscapes: some empirical evidence

This section illustrates the approaches of project-
based firms to managing knowledge and the main
mechanisms adopted by them to accumulate experi-
ence, and to articulate and codify knowledge at the in-
dividual, project (or group) and organisational levels.
The empirical evidence reported here originates from
six case studies of project-based firms (see Appendix
A for the research method). We found that firms invest
in a variety of tools and mechanisms to try to capitalise
on the knowledge developed during the execution of
one project and transfer it across the organisation. We
developed a $3 \times 3$ matrix to categorise the various
project-to-project learning mechanisms (Fig. 2). The
horizontal dimension of the matrix refers to experience
accumulation, knowledge articulation and knowledge
codification, shown in the first row of the matrix pre-
sented in Fig. 1, while the vertical refers to the level
of analysis (i.e. individual, project — or group — and
organisational).\(^3\)

The project-to-project learning mechanisms that
firms may use vary according to both the hori-
zontal and vertical dimensions. The analysis of
project-to-project learning mechanisms, based on a
combination of the two proposed dimensions, enables
a detailed assessment of the type of approach that
firms adopt to project-to-project learning. In particu-
lar, the analysis of the horizontal dimension enables
an assessment in relation to the identified learning
processes (experience accumulation, knowledge ar-
ticulation and knowledge codification) on which a
firm focuses. Along the vertical dimension, the ma-
trix maps the project-to-project mechanisms on to the
individual, project, and organisational levels. Boisot
(1995), Nonaka and Takeuchi (1995), and Brown
and Duguid (1991) studied the mechanisms through
which knowledge becomes diffused throughout an
organisation. The analysis of the vertical dimension
enables an assessment of the approach that firms
use to diffuse knowledge across projects and within
the organisation. Firms may be more or less focused
on the replication and diffusion of routines (or best
practices) across the organisation.

The analysis of the horizontal and vertical dimen-
sions combined enables the identification of what we
have termed a firm’s learning landscape in relation to
project-to-project learning. We define a firm’s learn-
ing landscape as the mix of project-to-project learn-
ing mechanisms adopted and implemented.\(^4\) We ar-
ge that the concept of learning landscape reflects
the multidimensional nature of a firm’s approach to
project-to-project learning. Our approach to a firm’s
knowledge management strategy builds upon Hansen
et al. (1999), who maintained that firms follow two
knowledge management strategies, namely the per-
sonalisation strategy and the codification strategy.
Firms that pursue a personalisation strategy, “knowl-
edge is closely tied to the person who developed it
and is shared mainly through direct person-to-person
contact” (Hansen et al., 1999, p. 107). A codifica-
tion strategy, on the other hand, would revolve around
ICT-based technologies, “knowledge is carefully cod-
dified and stored in databases, where it can be accessed
and used easily by anyone in the company” (p. 107).
Hansen et al. (1999) also argued that to use knowl-

\(^3\) Whereas the majority of the learning mechanisms we focus on
in this paper may hint at a conceptualisation of learning internal
to the firm, we point out that the sources of such learning may
be both internal and external. In fact, given their multitechnology,
multicomponent nature, complex product systems are increasingly
developed via collaborative partnerships with suppliers as well
as with customers. This externalised learning is as important as (and sometimes more important than) internally
stimulated learning.

\(^4\) Learning mechanisms are empirical instances such as, e.g.
lessons learnt meetings, databases or informal encounters. The
learning landscape then refers to the collection, or portfolios, of
such mechanisms, here clustered into three distinct patterns.
<table>
<thead>
<tr>
<th>Level of analysis</th>
<th>Experience accumulation</th>
<th>Knowledge articulation</th>
<th>Knowledge codification</th>
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<tr>
<td>Individual</td>
<td>On-the-job training</td>
<td>Figurative thinking</td>
<td>Diary</td>
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<td>Job rotation</td>
<td>“Thinking aloud”</td>
<td>Reporting system</td>
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<td>Specialisation</td>
<td>Scribing notes</td>
<td>Individual systems</td>
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<td>Review of experts</td>
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<td>design</td>
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<td></td>
<td>Developing group think</td>
<td>Brainstorming sessions</td>
<td>Project plan/audit</td>
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<td>Person-to-person</td>
<td>Formal project reviews</td>
<td>Milestones/report</td>
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<td>Group/Project</td>
<td>communication</td>
<td>De-briefing meetings</td>
<td>Meeting minutes</td>
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<td>Informal encounters</td>
<td>Ad-hoc meetings</td>
<td>Case writing</td>
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<td>Imitation</td>
<td>Lessons learnt and/or</td>
<td>Project history files</td>
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<td>post-mortem meetings</td>
<td>irs data base</td>
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<td>Internal correspondence</td>
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<td>Organisational</td>
<td>Informal organisational</td>
<td>Project manager</td>
<td>Drawings</td>
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<td>routines, rules and</td>
<td>camps</td>
<td>Project management</td>
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<td>and selection</td>
<td>Knowledge</td>
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Fig. 2. Inter-project learning mechanisms.
edge effectively, firms should focus on one dominant strategy and use the other in support of the dominant one. They maintained that firms that try to pursue both strategies at the same time run the risk of failing at both, and proposed an 80–20% split between the dominant and the supporting strategy.

We argue that by proposing the concept of a firm’s learning landscape our approach extends and enriches that of Hansen et al. (1999). The personalisation and codification strategies proposed by Hansen et al. (1999) focused on only one dimension, defined by the continuum whose extreme poles are tacit and explicit knowledge. These two types of knowledge management strategy would find their place in the top-left and bottom right quadrants of the matrix, respectively, as shown in Fig. 2. Relying on the discussion above, however, our research shows that a continuum of approaches defined by personalisation and codification strategies is hardly a good approximation of a firm’s knowledge management strategies. A mono-dimensional interpretation of a firm’s approach to knowledge management is reductivist to the point that it may obscure the identification and the related understanding of important elements that characterise such an approach.

The concept of learning landscape takes into account the multidimensional character of a firm’s approach to managing knowledge. It broadens the focus and emphasises the process dimension of a firm’s knowledge management approaches to experience accumulation, knowledge articulation and knowledge codification and relates them to the individual, project, and organisational levels. Based on the empirical evidence gathered during our field study, we identified three main types of learning landscape (that is, the explorer or L-shaped landscape, the navigator or T-shaped landscape, and the exploiter or staircase landscape) and position them within the matrix shown in Fig. 2.

4.1. The explorer (or L-shaped) landscape

Firms that rely to a great extent on people-embedded knowledge are characterised by L-shaped landscapes. These firms emphasise experience accumulation processes and knowledge transfer through people-to-people communication, and are characterised by a strong and receptive culture. We class these firms as explorers, since we found that their relatively small size in combination with the features of their corporate culture, constitutes a strong enabling springboard from which to explore different routes to adopt and implement ‘project-to-project learning’ mechanisms based on knowledge articulation and codification processes (Fig. 3).

The first firm is part of a larger defence conglomerate and develops and manufactures complex, high technology products for the defence industry. Although it has had two changes in ownership during the last decade, the firm has maintained a corporate culture and identity. A positive and co-operative organisational culture is, in fact, one of the main features of the firm. This friendly environment is partly due to its relatively small size and the geography of its main plant (i.e. open-plan offices), “we are in walking distance”. The top managers of the firm stated that their main knowledge resources lie in people’s heads. Employees (design and software engineers and project managers) are equipped with paper-based tools that should help them articulate and record their day-to-day activities so that can be re-used in different projects.

The second firm operates in the aerospace sector. Following its acquisition by a larger firm, it metamorphosed from a functional to a matrix organisation. The firm is now organised around Customer Facing Business Units that focus on a particular group of customers. The internal business units are called Operating Business Units and are organised around the main product components. Each of the Operating Business Units includes technologists, buyers, and the manufac-
Fig. 3. The L-shaped learning landscape.
turers of the specific component for which they have responsibility. For a new project, Integrated Product Teams are constituted of engineers from the Operating Business Units and a team leader is appointed. This team leader role changes according to the stage of the project. At the start a design engineer would be leader. A supply chain manager would take over once the design is completed. A service manager would assume the lead to sustain delivery. There is a project manager to oversee the work of the Integrated Product Teams.

The firm is characterised by an informal, people-based culture. Personal contacts are paramount for the staffing of projects. The transfer of project knowledge occurs through people-to-people communication. One of the directors stated that although project reviews are held throughout the projects, they are aimed 95% at reviewing costs and schedules, and only 5% to lessons learnt. He added that this 5% is insufficient and that the firm had as far as inter-project learning was concerned a long way. What usually happens is that at the end of a project, the financial resources are exhausted and there is no time to look at the lessons learnt so knowledge continues to be transferred from project to project via people. Another example of the informal, people-based approach to inter-project learning is the Project Management Forum initiative. This is led by project managers and consists of bimonthly events to talk about tools and the share of information.

The shift to a matrix form is being accompanied by a shift in the principles that inform the management of organisational learning. In particular, the firm is trying to engender a procedure-oriented culture. In effect, the firm’s ad hoc project management procedure is being replaced by a more formal one involving training courses and university-level education. The Project Management Forum has evolved into an Integrated Program Management Team (composed of former senior project managers) whose aim is to develop and implement new formal procedures (mainly ICT-based) for project managers. This team is supposed to establish a Centre of Excellence. According to the interviewees, however, the firm is struggling to adopt and adapt to this procedure-oriented culture. One project manager, for instance, argued that the new Integrated Program Management Team is not working well because it is stifling the real learning.

4.2. The navigator (or T-shaped) learning landscape

This landscape characterises firms that started implementing mechanisms for project-to-project learning based on a knowledge articulation process. Their focus was on the implementation and appreciation of these mechanisms not only at the individual and project levels but also, and mainly, at the organisational level. These firms navigate through a few evolving routes to improve their project-to-project learning that may become established at some point (Fig. 4).

The first case is from a firm that develops flight simulators for both civilian and military purposes. The firm has gone through a series of organisational changes following a period of mergers and acquisitions. Here the focus is on the organisation of lessons learnt meetings. The project management guide at one time considered this mechanism only at the end of each project. Because of the length of the development process and the ensuing phenomenon of selective memory, the firm decided to adopt a life-cycle approach. According to this approach, the entire project is divided into phases (from bidding, to delivery to customer) and at the end of each phase a lessons-learnt meeting is held. Project managers usually lead these end-of-phase meetings.

(We) have a process called lessons learnt: as you go through all the phases of a life cycle that a lessons learnt process could be applied. Traditionally, it has been applied retrospectively at the end of the programme, so when you have just handed over to the customer you reflect upon lessons learnt. The life cycle of our products varies between 2 and 7 years. People tend to forget the issues if you leave it for 2 years, so what we try to do is to get these lessons for processes in earlier. We try to introduce a policy which says that if we have a life cycle, we break the life cycle up into partitions and we try to have a lessons learnt (meeting) at the end of each phase which benefits future programmes or projects which are about to embark on that same process. But because of the diversity of the programmes... it depends on how clever you are in applying what lessons you have learnt because only some things are consistent... the environment in which we work is the same, the financial reporting, the...
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| Group/Project    | Brainstorming sessions  | Project plan/audit     |
|                  | Formal project reviews  | Milestones/visual aids|
|                  | De-briefing meetings    | Meeting minutes        |
|                  | Ad-hoc meetings         | Case writing           |
|                  | Lessons learnt           | Project history files   |
|                  | Informal post-mortem    | Into-project lessons   |
|                  | meetings                | learnt database        |
|                  | Informal correspondence |                        |                        |

| Organisational   | Project management      | Drawings               |
|                  | camps                   | Process maps           |
|                  | Knowledge retreats      | Project management     |
|                  | Professional networks   | process                |
|                  | Knowledge facilitators  | Lessons learnt database|
|                  | and managers            |                        |
|                  | Inter-project correspondence |                  |
|                  | Inter-project meetings  |                        |

Fig. 4. The T-shaped learning landscape.
procedures we follow are all standard. So, we try to enhance the process.

Except of the phenomenon of meeting overload, we found that interviewees (and in particular project managers) valued lessons learnt meetings because they offered a context for reflecting on past actions and for identifying what could be carried over to the next phase or project. It is in the course of lessons learnt meetings that project managers and/or practitioners have the opportunity to reflect upon their actions, to try to improve their understanding and, eventually, articulate the relations between actions and performance. Project managers also found the preparation for these meetings extremely valuable for drawing lessons from their previous actions.

Interestingly, we found that this firm does not link such meetings with its appraisal system. In other words, there are no incentive systems in terms of promotion or higher payments linked to the actual implementation of lessons learnt meetings. “The only motivation is in improving the process, in improving our software process in order to make more money if you like, to build it [the product] more cheaply. That is the only motivation and obviously if you can improve the process . . . that is a motivation, isn’t it? . . . But there is no other incentive to do that.”

The articulation of project knowledge does not reduce the importance of people-to-people knowledge transfer, however. According to our interviewees, in fact, inter-project learning still occurs via people. “When you go to work on another project, you learn yourself obviously, well it may not be obvious, but you learn yourself what you did last time that wasn’t so good or something you did last time that was good and you bring this to your next project. But I am not sure that you transfer it to somebody else’s next project.” Knowledge codified (information) in project documents does not get diffused properly. “We have done the lessons learnt meeting, that goes to your engineering manager and he makes sure its signed and then puts it in the file because it has been done. And although it is available, it is not actually used by any other programme.” Also, project knowledge gets transferred probably more easily via informal channels. “If you know that another project is 6 months ahead of you and they might have had the same sort of problems or it might be the same sort of programme, you go and talk to them or picking the phone.” However, “If you do not know the person concerned, you will not go and talk to him”.

The second case is a firm operating in the defence industry. The firm is characterised by a project-based organisational structure and it collaborates in multi-firm projects usually with international partners. It is organised as a matrix with development departments on one axis and projects on the other. During recent years, the firm has changed its organisation from a sequentially partitioned organisation to one relying more on cross-functional and concurrent ways of working. It is also characterised by a formal project management process that, among other things, produces a document (a project history file) in order to capture the lessons learnt. The firm has a process development director who is in charge of developing and maintaining the project management process. Project managers are supposed to prepare this document at the end of the project. This procedure has been mandatory for only a year, however, interviewees admitted that so far “we haven’t been very good at it”. Moreover, four times a year the company has a review meeting with all programme managers to update the procedures in the handbook. Another recent initiative has been to invite an external reviewer to examine project progress and organise de-briefing sessions.

The firm has tried to implement an Intranet to facilitate the re-use of knowledge developed in previous projects. One problem, however, is that much of the information cannot be stored in this Intranet because of its sensitive and classified nature of the information. There was also divergence among project practitioners and the process development director about the degree to which the Intranet was implemented. Project managers do have access to lessons learnt reports, however: “If you start a new project and are a project manager, you can have access to a number of lessons learned reports. But it is not automatically distributed to project managers: it is only on a ‘need-to-know’ basis.” The interviewees were very aware of the reinventing the wheel problem, but were coming to recognise that this is inevitable. Some other important mechanisms for inter-project learning can be found elsewhere, however. As stated by a project manager interviewed:

One can then ask the question: we have learned a lot in this project. But how do we get this information
to other projects? (1) Informal ways: people sitting close to each other, discussions in the corridor, etc. (2) Our process development manager is invited to programme and team managers’ ‘gatherings’ where they sit down and discuss progress and lessons learnt over 2–3 days at some location off the company site. This takes place approximately once a year. (3) Departments: since we have a matrix organisation all technical responsibility rests with the departments. This means that a department is responsible when we start a new program, e.g. for estimating costs, assessing risks, etc.

While not an unusual practice, the interesting feature of this firm was its adoption of what we might call an indirect incentive system for governing use of this information or the social networks that it involves. The firm rewards project manager in relation to performance indicators of projects (e.g. time and use of resources) but does not assess project managers in relation to inter-project learning performance indicators. In other words, project managers are not assessed in relation to the extent of knowledge re-used from previous projects and/or project knowledge made available to other projects (for instance via inter-project meetings). As highlighted by the project managers interviewed, however, it is paramount for the good execution of the project to create an informal network of contacts by referring to other project managers or team members and getting access to their knowledge. Further evidence of this firm’s approach to learning between projects is the initiative of one project manager in calling for a start-up meeting in the early phases of a project. In the initial phase, the project and team managers invite someone from another recently completed project to sit down with them and give them the benefit of his experience. This was an informal meeting and not a requirement in the project management handbook of the firm.

4.3. The exploiter (or staircase) learning landscape

Firms already involved in the advanced development of ICT-based tools to support their project-to-project learning are characterised by what we define the exploiter (or staircase) learning landscape. Their emphasis is on deliberate attempts to codify and store knowledge developed during the execution of a project and document it so that it becomes more easily accessible and exploitable for the rest of the organisation’s members. These firms are involved in the advanced development of ICT-based tools to transfer and exploit project knowledge (Fig. 5).

The first case study focuses on a firm operating in the power generation industry. In the mid-1990s, the firm was taken over by a large conglomerate. The firm under scrutiny is very much rooted in the local context since most, if not all, employees are from the same city (or nearby villages) and, in any case, from the same region. Although the acquirer is well known to pursue a policy of cultural diversity emphasising local values as well as global values (the so-called globalisation), the take over entailed a number of significant organisational and cultural changes in the firm. The acquirer is in fact also well known for instilling in the acquired firms its way of managing the business.

Before the take-over, the firm was a functionally structured organisation. With the take-over, the firm moved first to a light matrix, then to a medium-heavy matrix form. The take-over also impacted on the organisation of the business processes. A formal project management process has been put in place. Such process is software-based so that the project documentation is organised in databases (available on the corporate Intranet). The workload per person is formalised and computer-based. The project process is structured in disciplined, measurable, and repeatable phases (also known as tollgates). In addition to the project manager, the project management team includes a support team comprised of a contract administrator, a completion manager, a project controller and a technical secretary. With the take-over, the project manager emerged as a key figure in the firm.

There are four corporate-wide initiatives dealing with knowledge management in this firm: globalisation, service solutions, TQM, and e-business. The emphasis of all these initiatives is on the business (and project) processes. Process improvement is understood as the main source of business performance improvement. A Quality Team is in charge of the revisions and updates to the project management process. Revisions and updates are accomplished with a top-down approach. The Quality Team also carries out Root Cause Analyses of problems that emerge during the execution of a project. Projects are assessed at in-depth meetings
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Fig. 5. The staircase learning landscape.
Notwithstanding this emphasis on process, people-to-people communication is still a valuable and useful way of exchanging ideas and transferring knowledge. For instance, although there is a database on previous experience of personnel which is regularly updated, project staffing is done on the basis of personal contacts of the director of the specific division. Lessons learnt meetings are ad hoc: i.e. only held when problems arise. The project manager, the director of the division, or also the client can call them. These reviews are minuted, but the outcomes are not shared or made available on the Intranet to other projects or divisions. Culture is considered open, customer-oriented and productivity-oriented.

The second case study focuses on a firm engaged in the development of large software systems for both civilian and defence purposes. The firm is organised around divisions focused on a specific customer group, e.g. infrastructure, defence, aerospace. The divisions are project-based. Software systems are developed in large projects. Some functional disciplines are matrixed, e.g. finance, human resources, and safety. As a result of the acquisitions in the last decade the firm operates in nearly 50 locations worldwide. The multi-site feature of the firm prompted top management to try to leverage the knowledge base of each site to improve business processes across the different divisions. A corporate function labelled Engineering and Technology, is in charge of developing, updating, and documenting the firm’s generic business processes. These are available on the firm’s Intranet. Given the one-off characteristics of the projects carried out by the firm, each project is seen in terms of problematic issue, such as risk management, and extrapolated and defined generic policies and procedures that can then be tailored to the project’s specific needs. The firm has developed a generic process framework that encompasses all its business processes. The process framework is organised in five-tiers. The first three tiers contain organisational-level policies and procedures, which are stored on the corporate Intranet. The organisational policies and procedures are a general road map that broadly defines “what to do”. The last two tiers contain the project-level policies and procedures and are stored on the specific project’s web page or disk space (with restricted access). The corporate Intranet contains a lessons learnt database.

Project policies and procedures are based on organisational ones and tailored to the project. The tailoring is carried out according to the guidelines contained in a guide provided by the firm that defines what, how, whether and why to tailor. As one interviewee said “The generic feature of the process as enforced by the firm is essential for the complexity of the project manager job (in terms of control, costs, resources) as it is the tailoring for the specific project”. Organisational policies and procedures are updated regularly (every 18–24 months). Anyone in the firm can initiate a change process. A new process is reviewed and put on the web. Before being enforced, however, the new process goes through a certification process composed of four steps: (1) project sample (raw process); (2) generic project sample; (3) certified project sample; (4) standard project sample (process enforced). At the project level, the policies and procedures are changed more frequently.

The company has institutionalised a number of different types of project reviews that are embedded and formalised in the business process. These formal reviews can be categorised in two main groups. (1) Reviews led by auditors external to the project. The aim of these reviews is to assess performance status, risks, costs, schedule of the project and lessons learned from previous projects. The diffusion of the outcome of these reviews is limited to those responsible for conducting the reviews and to the corporate managers who assess the project’s merits. (2) Reviews led by a project team member (usually the project manager). These are software reviews, design reviews, customer reviews (held monthly), and quality reviews (held quarterly). The outcomes of these reviews are documented and stored electronically and are available only to the project team members only.

Although project reviews contain a learning element and the firm encourages informal ways of knowledge sharing via seminars and staff meetings, the procedure-oriented culture permeates the firm and is the major driver for organisational and project performance improvements. According to one director interviewed, “A regular update is the best way to improve the business process, much better and more efficient than lessons learned databases, because
nobody looks at them, my line is “You haven’t learned the lessons, change the process.”

Informal ways of transferring knowledge (and particularly people-to-people communication) are still important. In fact, there are informal project reviews. The project manager or other team members on specific issues may call these reviews. A divisional director meets with his project managers once a month to help them re-use knowledge developed in each project. Also, inter-project informal reviews are held in the form of staff meetings between all project managers. As a consequence of this an informal network of project managers has been created. There is also a project manager electronic symposium on delivery mechanisms for a web-based programme. Informal ways of knowledge sharing have been institutionalised via weekly brown bag seminars given by internal or external speakers on specific (usually technical) subjects.

5. Discussion and conclusions

Nelson and Winter (1982) suggested that a capability-based theory of the firm should scrutinise organisational routines. From an evolutionary perspective, such routines could be treated as the quasi-genetic traits of a firm, causing persistent differentials in firm behaviour and performance. In this study, we have been particularly concerned with understanding the project-based firm as a population of projects, where specific project traits may get transferred via various mechanisms from one project to another. In particular, this paper proposed a framework to analyse and interpret firms’ approaches to project-to-project learning. We discussed the importance of the process dimension of firms’ approaches to project-to-project learning. Following Zollo and Winter (2001), we have argued that it is not sufficient to consider knowledge codification only as an outcome. The literature on knowledge codification is characterised by a tendency to think that the costs of codification activities are justified by their outcomes rather than by the cognitive implications of the codification process as such (Zollo and Winter, 2001). In the empirical findings reported in this study, it seems that it is not only researchers that have focused primarily on the outcomes of knowledge codification, however. Project-based firms also seemed to focus their efforts on outcomes rather than on the process of codification in developing technical devices and organisational mechanisms for learning between projects. Interestingly, in the firms we studied we found little evidence of direct incentives, such as monetary benefits, associated with the codification of knowledge. Rather, the codification of knowledge into reports, minutes, lessons learned, etc. is based on a presumption of good behaviour among members in the organisation. In the light of the emphasis put on incentive issues in research into internal knowledge transfer through codification in organisations (Cowan and Foray, 1997; Eisenhardt and Santos, 2001), these findings indicate that determining the empirical properties of incentives for knowledge codification may be difficult. That is, although in a theoretical discourse it may be possible to distinguish what incentives should prevail for knowledge codification by determining its costs and benefits, the way such incentives work practically may be of a character that is subtle and difficult to measure, and assess.

Appreciating the knowledge codification process as a cognitive effort led us to adopt the model suggested by Zollo and Winter (2001) based on the processes of experience accumulation, knowledge articulation and knowledge codification. By relating these three processes to the individual, project and organisational levels we developed a $3 \times 3$ matrix that enabled us to categorise a variety of mechanisms that project-based firms use. We defined a firm’s learning landscape as the mix of project-to-project learning mechanisms adopted and implemented. The concept of a learning landscape reflects the multidimensional nature of a firm’s approach to project-to-project learning. Based on the empirical evidence gathered during our field study, we identified three main types of learning landscape, namely the explorer landscape (or L-shaped), the navigator landscape (or T-shaped), and the exploiter landscape (or staircase). Each of these learning landscapes is characterised by a different emphasis on specific inter-project learning mechanisms, which in turn are based on different learning processes (experience accumulation, knowledge articulation and knowledge codification), both at the individual and organisational levels.

Firms that rely primarily on people-embedded knowledge are characterised by the explorer
These firms emphasise experience accumulation processes and knowledge transfer through people-to-people communication. The navigator landscape characterises firms that started implementing mechanisms for project-to-project learning based on the knowledge articulation process. Firms already involved in the advanced development of ICT-based tools to support their project-to-project learning are characterised by the exploiter learning landscape. These results point to two interesting features concerning the learning dynamics of firms and the development of the firm’s organisational capabilities. First, despite facing quite similar industry characteristics (for one thing they were all operating in so-called CoPS industries), we observed substantial variation with respect to the mechanisms used for the transfer of vital knowledge from project to project. Second, notwithstanding the temporary and one-off nature of the tasks performed by project-based firms, these firms do develop a set of routines that define how to approach projects. The learning landscape as conceptualised in this paper represents an empirical example of the set of routines employed by project-based firms to manage inter-project learning.

How then do our findings fit into the codification debate? Cowan et al. (2000) proposed that the articulation and the communication associated with such processes presuppose some kind of codified knowledge. The properties of codified knowledge should, thus predominate over those of articulated knowledge. While we acknowledge that the outcomes and economic benefits of articulation and codification to a large extent are similar, the framework proposed by Zollo and Winter (2001) provides insight into a process in which articulation is an intermediate step in the codification of knowledge. Based on our empirical investigation of six firms trying to establish mechanisms for inter-project learning we observe that the process through which knowledge is accumulated into tacit, articulated and codified knowledge is highly complementary. Informal processes are sometimes important; some knowledge is really hard to codify, but articulation and codification of knowledge also seem to help firms in their pursuit of better knowledge about why some projects succeed and others fail.

One suggestion for further research is to investigate the contexts in which different inter-project learning mechanisms are useful and effective. This calls for some kind of contingency analysis where variables, such as, e.g. size, strategy, task complexity, uncertainty, rate of technological change, market conditions, etc. are related to the effectiveness of inter-project learning mechanisms such as those discussed here. While authors such as Zander and Kogut (1995), studied the impact of codification on knowledge transfer, we have not focused on this issue. This delimitation of this study relates to our explicit interest in the process, rather than the outcome, of knowledge codification. Hence, we, at least at this stage, have little to say about the efficiency properties of codification strategies for knowledge transfer between projects. Moreover, as pointed out by Eisenhardt and Santos (2001), from a strategic perspective the relationship between learning effectiveness and overall firm performance has yet to be established empirically. Our empirical findings do, however, square with what Eisenhardt and Santos (2001) found in their review of empirical studies of internal knowledge transfer: (1) the relationship between the sender and recipient in the knowledge transfer processes is paramount; (2) integrative mechanisms, both formal and less formal, facilitate such learning. One interesting avenue to explore, therefore, is the emergence of various communities of practices and how such communities contribute to, or impair, more formal or technology-based initiatives for learning between projects (e.g. our exploiter landscape) (Brown and Duguid, 1991, 2000; Lave and Wenger, 1991; Wenger, 2000).

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Appendix A. Research method

The paper draws on qualitative data collected during a field study of six firms. The study is part of a larger 3-year research project designed to explore the management of inter-project learning in a convenient sample of 50 project-based firms developing CoPS. We selected six case studies as the most representative to highlight the relevant features of the identified learning landscapes. The selected firms were based in Italy, Sweden, the UK, and the USA and belonged to the software, aerospace, defence, flight simulation and power generation sectors.

We conducted three interviews per firm. Interviewees covered a corporate manager, a project manager, and a practitioner. This three-layer interview design was explicitly planned to gather data on the same topics from different hierarchical levels in the firm. Also, we chose to interview representatives at three different hierarchical levels in order to analyse and identify the typology of learning mechanisms that characterised each level. The analysis of the typology of the learning mechanisms at each level enabled an assessment of the learning landscape that characterised the firms. We did not develop performance measures to assess the effectiveness of the different mechanisms adopted by the firm for inter-project learning. We relied therefore on interviewees’ perceptions (Lawrence and Lorsch, 1967). Interviews were semi-structured and lasted about 90 min.

Data from these interviews were elaborated to produce mini case studies of the firms involved in the study enabling the identification, evaluation and matching of patterns as they emerged from within individual cases (Eisenhardt, 1989, p. 540). We then cross-compared the cases to identify common patterns. This tactic goes under the name of pattern matching (Yin, 1994, p. 106), “such a logic … compares an empirically-based pattern with a predicted one (or with several alternative predictions)”. The use of this tactic assumes the development of rival explanations involving mutually exclusive independent variables. As Yin (1994, p. 108) argued, “the presence of certain independent variables (predicted by one explanation) precludes the presence of other independent variables (predicted by a rival explanation)”. The use of the pattern-matching tactic strengthens the internal validity of the research. Also, as we followed a multiple case research design, we adopted a strategy of replication in multiple empirical settings in order to establish external validity (Yin, 1994).

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