P. Nightingale, C. Baden-Fuller, M.M. Hopkins, 2011, Projects, Project Capabilities and Project Organizations, chapter in (eds) Cattani, Ferriani, Frederickson, and Taube, Advances in Strategic Management, 28; 215-234

Projects, Project Capabilities and Project Organizations

Paul Nightingale[1], Charles Baden-Fuller, [2] and Michael M. Hopkins[1]

[1]SPRU, University of Sussex, UK;

[2]Cass Business School, City University London, UK and Wharton School, U. Pennsylvania, USA

Corresponding author: p.nightingale@sussex.ac.uk

Abstract: This paper clarifies our understanding of the project based firm (PBF) by sharpening the theoretical foundations of project capabilities. It emphasizes the differences between project capabilities that eliminate variance in project outcomes (to control costs and add value), and economies of scale that reduce costs across multiple projects. It also highlights how the different ways in which value is captured by project based organizations can feedback to influence how these capabilities and scale economies are generated. This opens up new typologies of project based organizations, with implications for theory and practice.

1. Introduction

In recent years there has been substantial growth in the literature on projects and project based organizations (Hobday, 1998, 2000; Lampel et al 2008; Brady and Davies, 2004; DeFillippe and Arthur, 1998; Whitley, 2006; Zollo and Winter, 2002; Sydow et al 2004; Siggelkow and Levinthal, 2003; Scranton, 1997; Lichtenthaler, 2010). This reflects the growing economic importance of project based organizations across a range of sectors, particularly in relation to the generation of new technology (for example, biotech firms in pharmaceuticals) or finding new solutions to established problems (for example hedge funds in financial services). This increased prominence has heightened academic interest in what types of economic activities might best be conducted in

projects – the contingency question - (e.g. Hobday, 2000)) and what sorts of organizations best undertake them – the capability question (e.g. Lindkvist *et al* 1998).

The research that has addressed these questions has
found that project based organizations are particularly effective at: a) dealing with non-routine complex tasks that require the repeated reconfiguration of organizational structures; b) flexibly responding to changing client's needs; and c) integrating diverse bodies of knowledge (Davies and Brady, 2000; Hobday, 2000; Söderlund and Tell, 2010; Davies and Frederiksen, 2009). Conversely, they tend to be less well suited for routine, frequently occurring tasks, for facilitating company-wide learning or supporting traditional career structures (ibid).

While the literature has recognized that some firms are better than others at projects, we still lack a good theory that explains why the capabilities of project based firms differ from those of regular firms. "Project capabilities" are typically defined (tautologically) in terms of the ability to conduct projects. Since project based organizations are defined in terms of undertaking projects, being told that they have the capability to undertaken projects, without explaining what causes that performance, generates little new understanding. Consequently, we put the term in quotation marks because definitions of this kind invert causes and effects, and thereby conflate a range of quite distinct ideas. For example, the ability to control costs, reduce uncertainties, benefit from learning and exploit economies of scale in repeated projects would all help firms to conduct projects, and therefore would be captured by 'project capabilities', but are quite distinct features of organizations.

More recent work (Brady and Davies, 2000; Davies and Brady, 2006; Whitley, 2006; Manning and Sydow, 2011) has made significant advances in unpacking project capabilities. Brady and Davies, (2000) and Davies and Brady, (2006) have related them to strategic learning from 'vanguard' projects that define new markets and provide the learning opportunities that allow subsequent projects to improve in performance (see also Christensen, 2011). Whitley (2006) has further contextualized projects by linking the classic concerns of evolutionary economists - the

cumulative nature of technological learning and appropriability - to the extent firms develop unusual, varied projects that reduce the organizational stability of expertise, tasks, and roles.

Despite these advances there is still a lack of clarity about many key features of the literature (Nightingale and Brady *submitted to this special issue*). For example, the assertion that many "project capabilities" can be exercised repeatedly paradoxically co-exists with the view that project based organizations are poorly suited for routine tasks and scaling across multiple projects. In some instances projects are used as a coordinating mechanisms within an enduring project based organization that can built up considerable advantages over its competitors (Nightingale, 2000), while in other instances project based organizations use their partners' skills (Winter, 2003; Ferriani et al, 2010), while in others they are 'little more than an administrative convenience' (DeFellippe and Arthur, 1998:137) and exist as a project specific legal entity that is disbanded upon completion of the project.

This diversity reflects the complexity of project applications, which has made it difficult to distinguish between the types of activities that are best carried out in projects, what capabilities organizations need to carry them out, and a distinct set of questions about production economies and whether project based organizations are enduring or temporary. Questions about capabilities and production economies are distinct, but are often conflated in the literature. By definition an economy of scale exists when producing two or more of something can be done at lower cost than producing them separately (i.e. $c[A+A] < c[A] + c[A]$), while firm "capabilities" relate to superior relative performance (i.e., $c\text{-}firm\text{-}a[A] < c\text{-}firm\text{-}b[A]$). Firms may have project capabilities that allow them to achieve superior performance, but just because firm *a* can produce a higher quality project at lower cost than firm *β,* it does not follow that firm *a* can produce a second or third project at lower unit cost. One of the main contributions of this paper is to unpack this distinction and clarify what project capabilities are.

Unfortunately, the comparative focus of much empirical research makes unpicking these distinctions difficult. [1] Consequently, this paper takes a more theoretical approach and goes back to first principles to unpack under-explored issues in the literature. The theory involves exploring the speech-act structure of projects, to show how they are structured like 'desires' rather than 'statements', i.e. they are future orientated, and completed by changing the world to match an idea. This structure is then linked back to the Chandlerian theory of the firm, which has traditionally focused on mass production (which has a more 'statement' like structure).

The first contribution of the paper therefore is to unpack project capabilities (note we do not use quotation marks). The movement in a project from the initial idea to the final outcome, is mediated by the application of uncertain 'operational principles' that can, under certain conditions, lead to design dead ends and redesign feedback loops that effect the performance of the project, as measured by cost, time and quality. Project capabilities refer to firm(s)' specific abilities to reduce these performance variances and/or add value for customers.

The second contribution of the paper is to distinguish these project capabilities from scale economies. As noted above, economies of scale that reduce the unit costs of additional products (i.e., a second project costs less than the first) are distinct from project capabilities

Our third contribution is to pay attention to how value is captured. This is rarely mentioned in The existing literature that often implicitly assumes that how project based organizations capture value is unrelated to how they create value. However, as the paper will highlight, this may not be a useful way to proceed. There are many ways to capture value from projects, that create different incentives to develop scale economies and project capabilities. This creates an interesting, and under-explored, feedback loop and suggests value capture is an intervening variable that links the firm's environment to the relative importance of scale economies and project capabilities; with potentially important implications for strategy and public policy.

[1] Many projects are only undertaken once, often in idiosyncratic environments. This makes controlling for contingencies when analyzing capabilities, or controlling for capabilities when analyzing contingencies, extremely difficult.

The rest of the paper is structured as follows. We begin with a discussion of scale showing how scale economies are different from project capabilities in project based organizations. We then explore the theory of project capabilities. In the third section part, we proceed to a discussion of value capture, and link different value capture mechanisms to incentives to create project capabilities and scale economies. In the final section we explore implications for future research on project based organizations.

2. Scale Economies and Project Capabilities

The literature on projects is very empirical and tends to focus on how project organizations differ from traditional M-form counterparts. When it does draw on theory, it tends to be on classic organizational theorists (such as Woodward, 1958; Thompson, 1967; Galbraith, 1973; Minzberg, 1979; Burns and Stalker, 1961; Perrow, 1970; Morris and Haugh, 1987; Constant 1982) and the product development literature (i.e., Wheelwright and Clark, 1990; Larsen and Gobeli, 1987). This literature suggests that project based organizations typically emerge in (1) differentiated and dynamic markets with a high degree of user involvement in the innovation process where (2) production tends to be focused on one-off or small batches and (3) production and development involve complex problems where systemic connections make decomposing problems into smaller packages difficult (Söderlund and Tell, 2010:2). As Söderlund and Tell (2010:2) note the existing literature has rarely unpacked what project capabilities are or explored what facilitates their creation.

To do this, the paper modifies Chandler's (1990) analysis of the causes of variation in production costs for large M-form firms, by linking it back to the speech act structure of projects. Traditional Chandlerian firms generate economies of scale by using high-fixed cost production-systems to effectively transform low-cost inputs into high-value outputs, and generate scope economies by using under-utilized resources to produce additional products and services. This becomes cost effective when sufficiently high levels of capacity utilization are maintained to spread the higher

fixed-costs of production across a large volume of output, thereby keeping unit costs low.[2] The ability to generate scale and scope economies is dependent on a) large markets for homogeneous products, b) simple, standardized products with low levels of customization and user involvement suitable for c) scaleintensive, mass production or continuous-flow production systems, and d) managerial skills to manage the high throughputs required. These scale and scope economies can be more difficult to attain elsewhere (Chandler, 1990:12) and When production is undertaken in small batches or as bespoke, one-off projects alternative production economies must be found (Scranton, 1997).

An important clue about the nature of these production economies can be found in the speech act structure of the word 'project'. It has its origin in the Latin *prōjectum* (projecting part) which came from *prōicere* to throw forward, which in turn came from *pro* 'from (a place)' and *iaciō* to hurl. Its modern meaning emerged in medieval English as its use extended from the hurling of a physical object in space to include the projection of an intangible plan or design in time (see for example, Daniel Defoe's 1697 *On Projects*). Today, this association with a design or plan is maintained and projects are understood to start with an *idea,* that is often novel, and production economies arise during the processes that change the world to match the idea (or some modified version of it).

This "changing the world to match an idea" structure makes projects, like desires, inherently future orientated, as you can only design or desire something for the future.[3] This contrasts with the continuous temporal structure involved in the mass replication of pre-existing products. In the classic Chandlerian firm, actual and potential capacity utilization need to be continuously matched because breaks in production reduce capacity utilization and raise unit costs.

[2] Hence Chandler's Weberian emphasis on instrumental techniques of control to ensure a match between the potential economies of scale (that are determined by the maximum throughput of the production system) and the actual economies of scale that are determined by managerial behavior.

[3] These differences parallel the difference between desires and statements in Speech Act theory (Searle, 2001). Desires (projects) are either fulfilled (completed) or not, and that is done by a *process* of changing the world to match the desire (plan, idea, customer requirement). In both cases the world is changed to match an idea (or design). By contrast, statements (production economies) are true or false (there or not), which is achieved by having a continuous match between the mind (managerial practice) and the world (production process). In these cases an idea (statement, managerial practice) is changed to match the world, and not the other way around.

The structure also has epistemological implications for project uncertainty. Project plans (like desires and promises but unlike statements) are fulfilled (or not) rather than true or false (Searle, 1995). The epistemological issue is whether such plans are realistic, as it makes no sense to ask if a plan (desire or promise) is true, because they are not the sorts of things (unlike statements) that have truth as their "conditions of satisfaction" (Searle, 1995; 2001). Plans, projects, desires and wishes may become true in the future, but a plan that has become true (i.e. that matches how the world is) ceases to be a plan.[4] Project uncertainty is therefore different from Knightean uncertainty, which typically reflects lack of information about quantifiable risks. Instead it addresses whether the processes that change the world to match an idea (i.e. a plan) are realistic and are likely to generate the desired functional outcome. if projects are to be successful then eventually the world and the plans must coincide. This can be achieved by both changing the world to match the plan, and also by changing the plan to match the world when it turns out to be unrealistic. After all, flexible plans can perform better than accurate plans when targets are changing. This different kind of uncertainty is why project efficiency is an *ex-post* fact for project based organizations, rather than the *ex-ante* concept it is in Chandlerian mass production systems.

The uncertainties involved also focus in different areas. Mass production firms may not know if their products will sell, but their production is typically well understood. By contrast with many project firms, the project contracts are signed before the project begins even though the final execution of the project may not be fully understood at the time.

This has organizational implications. Firstly, Project based organizations typically reversed the sequence between design, manufacturing and marketing. As Joan Woodward (1958:23) highlighted: '*with projects… those responsible for marketing had to sell, not a product, but the idea that their firm was able to produce what the customer required. The product was developed after the order had been secured, the design being, in many cases, modified to suit the requirements of the customer. In mass production firms, the sequence is quite different: product development came first, then production and finally marketing*'. Secondly,

[4] A promise implies an obligation to generate a future state of the world, but once this state of the world is generated and a match between the promise and the world is fulfilled, the nature of the promise changes and the obligation is lost.

within the Chandlerian firm, product development is typically distinct from production, and often takes place in functional (project based) R&D units. This is because the first product differs from all the others because it was new when it was first produced (and hence involves changing the world to match an idea). By contrast, with projects, production and development typically coincide (Hobday, 1998) because production of each project involves an element of newness.

Variation in Projects

These theoretical distinctions can also help explain variation in projects, which in turn, forms the basis for understanding project capabilities. The processes that move from an idea to artifact, involve the application of a hierarchy of increasingly specific operational principles that provide guidance about how to generate a desired behavior (Polanyi, 1958: 177; Vincenti, 1990:9; Nightingale, 2000).[5] Because operational principles have the form '*phenomena x can be produced by y'* they have three important properties. First, they are strongly context dependent and uncertain. As a result, they may not generate the desired output, leading to design and production *dead ends* that add costs and time. Secondly, with large, complex projects the repeated application of operational principles generate a hierarchy of increasingly specific sub-problems (*how to generate y*?) that can bifurcate and generate a complex inter-related set of problem solving tasks, with the potential for complex feedback loops and redesign cycles to emerge, which again add time and costs. Thirdly, variations in projects need not take place exclusively on the cost side, as the imaginative element involved in creating the initial design creates the potential for variations in the value clients receive.

The number of these redesign cycles will be contingent on a) the number of problem solving sub-tasks, b) the extent to which the operational principles are uncertain/novel and need to be discovered, c) the extent to which sub-tasks and components are inter-dependent, d) the extent to

[5] Vincenti (1990) gives a classic example of an operational principle in Sir George Cayley's operational principle for a fixed wing aircraft which involves making a 'surface support a given weight by the application of power to the resistance of air'.

which the underlying technology is "fragile"[6] and will need to be redesigned following changes in inter-related components and e) the extent to which customers' requirements are clear and unchanging (Nightingale, 2000).

These Additional problem-solving cycles create variations in project performance (as measured by time, cost and quality), and qualitative differences between simple and complex projects (Vincenti, 1990; Parnas, 1985). One can therefore generate a continuum of projects. Simple projects, such as building a wall have a limited number of well understood, simple steps, a robust underlying technology where problems with one brick rarely generates major changes, and simple value generation. The robustness of the underlying technology means they have limited potential for redesign cycles to emerge and therefore limited variances in performance or the need for project capabilities. By contrast, at the other end of the continuum, building a missile defense system involves novel and innovative technology, a huge number of interdependent components, and a fragile, poorly scalable component technology – software – that is subject to catastrophic failure and often requires substantial changes, if not complete redesign, when its parameters of use change. Moreover, the value of the system can be enormously variable, with the danger that it becomes out of date during the long periods of time it takes to be built, for example by technology changes (Parnas, 1985; Parnas and Clements - 1985), or changes in the environment (i.e. the end of the Cold War).

Project Capabilities Firms that can reduce variances in project costs by reducing the number and extent of redesign cycles can create value. This can be done through effective project management, selection, development and testing (see Nightingale, 2000 for an extensive list). Similarly, firms that can come up with realistic designs that solve customers' problems in new ways can also add value.[7]

---

[6] i.e. where design changes trigger redesign cascades in systemically related components (Nelson, 1982;463).

[7] The balance between the two will depend whether the project is fully specified (in the sense of the customer being able to say *how the project should be executed*), in which case cost control will be highly valued, or customers simply define a problem to be solved, in which case creative design as well as execution will be valuable.

We therefore (re-)define project capabilities as the capabilities firms have to (a) reduce these variances in project performance and (b) design in value for users. These have both a static efficiency component, related to how well a firm can carry out a project, and a dynamic effectiveness component, related to how well they can design solutions to create value.As noted earlier, These project capabilities (of cost control and value creation) are very different from the scale economies of the Chandlerian firm and the two need not overlap. Clearly some project capabilities will be subject to scale economies; even through things as simple as spreading the high fixed costs of capital equipment over multiple projects, but they do not need to be (Loasby, 2010).

scale economies similarly do not need to be connected to project capabilities, and are linked to the repeatability of projects or aspects of the project. Davies *et al* (2006) note that in large complex projects, many aspects are repeated: for example, projects with a maintenance and service element; projects with distributed delivery of output in many locations, or projects that share common components or operational routines. Providing the company can anticipate the repetition of the component or sub-assembly or sub-routine, and so plan ex-ante the effective co-ordination of higher capacity production, it can generate scale economies. Repetition is arguably not enough (Chandler, 1990).

> In summary, *Project capabilities are defined as organizational factors that reduce the variance in costs and/or add value to project outcomes and in doing so increase the performance of the organization. These project capabilities are built inside firms, as processes involved in the design and execution of project plans.* By contrast, scale economies are defined as cost reductions across multiple/repeated projects and occur when organizational sub-processes are replicated (either within or between projects) to permit the use of common resources and-or learning. These definitions, in turn, imply that project capabilities can exist without scale economies and vice-versa.

Unpacking the distinctions

We can elaborate on these points by returning to the previous continuum using new examples (see also Table One). At the simplest end, a project to build a brick wall using an ad-hoc organization of skilled bricklayers would be subject to few if any potential redesign-cycles. There would therefore be little necessity or ability to create or deploy project capabilities to reduce unnecessary variation in the project. any scale economies that exist are likely to be small and related to the repeated laying of bricks in one place at one time. By contrast, a firm building many walls may also employ skilled brick layers, but can produce scale economies by bulk-buying bricks and mortar, standardizing sub-systems and processes, and investing in specialized, higher-throughput machines to reduce unit costs. Such changes and capital investments can generate scale economies by reducing unit costs across multiple projects, and need to be planned before the start of the building process.

Table One Near Here

Formula one car companies, further along the continuum, need to exploit significant project capabilities but have only limited opportunities for scale economies. While The teams that form these companies build knowledge from repeated racing events, the cars are very bespoke, and the economics of the industry is dominated by a focus on the organizational Project capabilities that allow teams to repeatedly win races, rather than on simple cost reductions.

Other organizations capture both scale economies and capability development. Accounting firms auditing large multinationals, for example, carry out projects that differ slightly each year, but have common features across clients and through time. Firms control costs by training staff to recognize and solve project problems. Typically partners bid for projects based on project designs that add value for clients. The projects are then co-ordinated by senior staff to maximize the billing time of junior staff undertaking more standardized tasks to generate scale economies. A similar pattern is found with systems integration firms that create bespoke, one-off projects. Risky

high-level design that can add substantial value for customers is normally kept in house, while the production of increasingly standardized components is outsourced to tiered webs of partners, who maintain high levels of utilization of their production capacity by engaging in multiple projects (Prencipe, 2003).

Lastly, with extremely complex, one-off projects – such as building a missile defense system or landing a man on the moon - there are a very large number of potential redesign feedback loops and therefore substantial variation in project performance, but more limited opportunities to generate scale effects. This rather static framing can be made dynamic by exploring where these capabilities and scale economies come from.

3: Contingencies: Value Capture and Capability Development

To do this, this section explores how value capture mechanisms influence the development of project capabilities and scale economies. Economists modeling the impact of competition on profitability tend to assume that firms' capabilities are largely exogenous. However, the range of the products or capabilities that firms offer their clients and the pricing mechanism they use are often endogenous (see for example, Chatain, 2011 on project based professional service firms). Firms choose a business model, that encompasses how they create and capture value, and organize their capabilities to deal with both, (Teece, 2010). This is a different point than March's (1991) suggestion that exploration and exploitation are distinct. Instead, it suggests that within any industry different value creation and value capture mechanisms prevail and generate interactive feedback loops (Teece, 2001). We would therefore expect differences in the distribution of project value and risk between customers and project suppliers to be influenced by value capture mechanisms, and to generates feedback loops to influence how (or even if) firms develop project capabilities. This is a particularly important issue for project based organizations because the future orientated temporal structure of projects means value is often strongly influenced by

uncertain and unpredictable future events.[8] To capture value, successful project organization must anticipate how to execute the project, how it will be valuable to the customer, how to appropriate value and how to disappropriate risks. Different ways of capturing this value have different balances of risk and uncertainty, require different skills and create different incentives to generate capabilities or scale economies.

Cost-plus contracts shift risk to the customer by requiring the project supplier to deliver the project to time and specification, in return for a mark-up on the incurred costs (often previously defined). As such, little organizational capability or skill is required on behalf of the supplier to assess the economic benefit of the project. In traditional professional services such as law and accounting, for example, services are often performed as projects on a cost-plus basis that avoids firms having to understand their customers in detail. Similarly, in the 1950s many military procurement contracts were let on a cost-plus basis because it was thought that companies were less able to bear the risks of mispricing than the government. However, this transfer of risk also reduces incentives to build any capability to control costs, improve efficiency or generate scale economies.[9] Where contracts are predicable, repeatable and subject to possible cost controls, cost-plus contracts can leave "money on the table". Similarly, with very complex one-off projects cost plus contracts (with monitoring) are often used, as suppliers price the higher risks involved into fixed price contracts, making them counter-productive.

Fixed prices on the other hand shift economic risk onto suppliers. They therefore require skill, especially with bespoke projects, as suppliers need to anticipate an unknown future, control costs and lay-off possible risks.[10] Project capabilities that control variation in costs are vital, and the

[8] By contrast, commonly used, mass production products have known value before purchase. Even when not commonly used, or when its use gives rise to subsequent uncertain outcomes, value capture mechanisms maybe available in the form of contingent contracts that do not pose unusual risks.
[9] As projects get larger and more complex, cost-plus contracts can require organizations to trace and document costs. In 1966 Robert McNamara suggested better incentives reduced overall defense procurement costs by 10%.
[10] In some cases, firms use forward markets to contract away some of their risks by subcontracting parts of the contract to others, again on a fixed price basis.

capabilities that permit successful execution have to be engineered to create information to permit forward cost estimation in order to price projects competitively, illustrating how value capture mechanisms interact with value creation.

Costs and a success fee pricing recognizes that the future stream of benefits from a project may be bound up with successfully anticipating how the project will be used. Sharing future revenues is typical for projects that bring together skilled individuals on a temporary basis. With films and video-games, for example, the value of the project can only be gauged after it is launched and interacts with the final users. Movie production companies sell completed movies to distributors, with a revenue structure that is typically based partly on production costs and partly a percentage of the future revenues. Because successful films requires input from the director and actors that cannot be pre-specified, classical contract theory predicts such contracts should allow surplus benefits to be distributed and critical suppliers to be motivated. Such contracts reward success, but The firm has to put together the skills (or capabilities) to make them work. Like the fixed price contract, these contracts require pricing, bidding and negotiating skills; reflecting again how value capture interacts with value creation.

Success only fees are observed in circumstances where value can be created and captured in very unequal ways. For project organizations, such contracts can generate exceptional risks as effort will be expended without any compensating revenue if the project fails. the problem is two sided and can also occur for buyers: for example, when buying or selling an asset, value is only created when the sale is completed. To take account of this asymmetry of value creation, real-estate brokers and investment bankers (two project based organizations operating at different ends of the value spectrum) charge on a success basis. The broker's profitability lies in their ability to anticipate the market and the customer, and to minimize the costs of failure, for example, by re-using parts of aborted projects .Clearly in such circumstances value capture requires the development of the skills and capabilities required to make a successful sale, that again links value creation and capture.

As table 2 illustrates, different forms of value capture give different incentives to project based organizations to build project capabilities to control costs and add value, and generate scale economies. This alternative perspective on capability development has a number of potential policy and strategy implications.

For example, discussions of the regulation of professional firms currently pay scant attention to how regulations encourage capability development. In the case of venture capital (VC) There is arguably a strong case for public support, given their strong positive spill-overs for the rest of the economy (the case for there being too few hedge funds is much less clear). However, without paying attention to how they are incentivized to build the project capabilities needed to add value to their portfolios, public policy is may be less effective than it might be.

For example, policy measures that reduce the costs of raising a venture capital fund, do not always encourage them to find creative ways to add value (BVCA-NESTA, 2009). Currently many public-private funds are structured using a "2 plus 20" contract where partners can make a nice living on the 2% of the fund they receive each year to run it over the life of the fund, while returning investors, who have limited oversight, a negative return (ibid). The 20% of the final value of the fund in the 2 plus 20 contract incentivizes funds with pre-existing capabilities, where returns are often high, But for poor performing funds, 20% of the final very small (or even negative) added value of the fund is not a major incentive to improve.

By contrast, the regulations that govern the behavior of hedge funds focus strongly on the value creation incentives through a similar "2 plus 20" contract, 'high water mark' payments, the use of the Sharpe ratio to regulate returns, short redemption periods, requirements that partners have 'skin in the game', and careful evaluation of performance when defining terminal value. Given how these features of value capture influence value creation, it is probably no accident that the hedge fund industry has generated higher returns for its investors and managers than the VC industry (Brown, Goetzman and Ibbotson, 1999).

Table 2 about here

4. Discussion

This paper has addressed some of the problems of generating theory from the idiosyncratic evidence produced from empirical research on bespoke, one-off projects. By linking the speech act structure of projects to a Chandlerian framework, the paper has generated a more fundamental definition of project capabilities that distinguishes them from economies of scale.

Projects are future orientated, temporally discrete, organizational structures that involve processes that move from an idea to an outcome, by changing the world to match the idea, or a modified version of it. The processes involve apply uncertain operational principles that, under certain conditions, have the potential to generate design dead ends and redesign loops that add to the costs and time taken to complete a project. These variances in performance are influenced by contingent features of the project, project based organization and its market, and therefore do not exist for all projects. It is therefore important to distinguish between questions of economic governance - why something would be undertaken in a project? and questions about project characteristics - why a project would be subject to performance variances?

In relation to the first question, the reason projects are associated with differentiated and dynamic markets, high degrees of user involvement and customization, non-routine engineering, heterogeneous, infrequent and ambiguous production tasks, and large scale, complex one-off products is because these are precisely the characteristics that make mass production difficult or impossible. In relation to the second question, project variances are caused by the features of the project highlighted earlier (i.e. number of components and subsystems, fragility of the technology (bricks v software), stability of user needs, interconnections between systems, existence and robustness of the operational principles that are followed).

When variances are significant, firms with project capabilities can exploit them to control costs and add value. These are a distinct kind of production economy from the Chandlerian economies of scale, scope and speed. Clearly, the repeated use of high-fixed cost project capabilities, for

examples, ones associated with learning or the reuse of costly organizational assets, will generate economies of scale. However, the existence of temporary project based organizations shows that they don't have to be reused, and interesting questions about economic governance emerge in relation to the level at which these economies of scale are exploited (Whitley, 2006). For example, do highly skilled individuals exploit them moving from project to project, or can they be accumulated at the firm level or even the industry level. This would seem to be an important question for future research.

The paper also explored how value is captured and highlighted how different value capture mechanisms can influence the incentives to generate scale economies and project capabilities. Because of the uncertainties involved in assessing how realistic project plans are, projects can be highly risky, and project based organizations are particular influenced by their ability to dis-appropriate the risks of innovation while appropriating the benefits. As a result, value capture mechanisms provide another dimension for classifying project based organizations (Baden-Fuller and Morgan 2010). In this paper we have focused on contracts as a key way in which value capture is structured, but clearly it is not the only one. Cross selling, or bundling products and services are clearly others, and their characteristics and interactions would again seem an interesting avenue for future research, particularly given the increasing service element seen in project based organizations.

Hopefully, these clarifications will contribute towards better theories and models of the behavior of project based organizations, by providing an alternative perspective on a set of contingencies that influence organizational design. As the VC and hedge fund comparison suggests, this perspective may have interesting policy and strategy implications. In conclusion, the prior literature has too often defined project capabilities in terms of the ability to deliver projects better than other firms, or worse, in terms of just being able to deliver projects. By exploring the fundamental structure of projects and how they differ from traditional manufacturing, this paper has defined project capabilities in terms of the ability to reduce costs or add value in conditions where significant potential project variances exist (in cost, time and quality). These differ

fundamentally from economies of scale. Unpicking these distinctions, and then linking them to value capture, allows a more nuanced appreciation of the diversity of project based organizations, which in turn, will hopefully provide a sharper lens to understand where projects are most useful, and what organizations are best suited to undertake them successfully.

Acknowledgements The authors are grateful to the Engineering and Physical Sciences Research Council for supporting this research through Grant **EP/E037208/1; and** for financial support from NESTA-BIS-ESRC and TSB as part of the IRC imitative. The authors also want to thank the editors of the volume: Gino Cattani, Simone Ferriani, Lars Fredrickson, and Taube for their encouragement and helpful comments; any errors that remain are the authors' responsibility.

References:

Baden Fuller C. and Morgan M. (2010), 'Business Models as Models' *Long Range Planning,* 43(2-3) 156-171

Brady, T. & A. Davies (2004): Building project capabilities: from exploratory to exploitative learning, *Organization Studies*, Vol. 25, No. 9: 1601-1621.

Brown**,** Stephen J.; Goetzmann, William N.; Ibbotson, Roger G.. 'Offshore Hedge Funds: Survival and Performance, 1989-95' (1999) *Journal of Business*, 72 (1) 91-117

Burns, T., Stalker, G.M., 1961. *The Management of Innovation*. Tavistock, London.

BVCA-NESTA (2009), "*From Funding Gaps to Thin Markets*", British Venture Capital Association & NESTA, London.

Chandler, A. D. (1990), *Scale and Scope*. Harvard University Press, Cambridge.

Chatain, (2011) 'Value creation, competition, and performance in buyer-supplier relationships' *Strategic Management Journal,* 32: 76-102

Christensen, J. F. (2011), Industrial evolution through complementary convergence: the case of IT security *Industrial and Corporate Change*, 20(1): 57-89Constant, W (1982), *Origins of the Turbojet Revolution*, Johns Hopkins University Press, Baltimore.

Davies, A; T. Brady and M. Hobday (2006) Charting a path toward integrated solutions *Sloan Management Review* 47 (3) 39-48

Davies, A. and T. Brady (2000) Organizational capabilities and learning in complex product systems: towards repeatable solutions *Research Policy* 29: 931-953

Davies, A. and Frederiksen, L. (2009). 'Project modes of innovation: the world after Woodward', *Research in the Sociology of Organization Series*, 'Technology and Organization: Essays in Hon or of Joan Woodward'.

DeFillippi, R. J. & M. B. Arthur (1998): "Paradox in project-based enterprise: the case of film making," *California Management Review*, Vol. 40, No. 2:125-139.

Ferriani S., Corrado R, Boschetti C. (2005) Organizational Learning under Organizational Impermanence: Collaborative Ties in Film Project Firms *Journal of Management and Governance* 9:257–285

Galbraith, J. R. (1973) *Designing complex organizations*, Reading: Addison-Wesley.

Gambardella, A. and McGahan A. M. (2010) 'The ripple effect of business model innovation through industry architecture' *Long Range Planning*.

Hobday, M. (1998). "Product complexity, innovation and industrial organisation." *Research Policy* **26**(6): 689-710.

Hobday, M. (2000). "The project-based organisation: an ideal form for managing complex products and systems?" *Research Policy* **29**(7-8): 871-893.

Lampel J, Harry Scarborough and Sebastian Macmillan (2008), 'Managing through Projects in Knowledge-based Environments', *Long Range Planning*, 41, p.7-16;

Larson, E and D. Gobeli (1987): "Matrix Management: Contradictions and Insights", *California Management Review*, Vol. XXIX, No. 4,

Lindkvist, L., J. Söderlund & F. Tell (1998): "Managing product development projects: on the significance of fountains and deadlines," *Organization Studies*, 19, 6:931-951.

Lichtenthaler, U. (2010), Outward knowledge transfer: the impact of project-based organization on performance, *Industrial and Corporate Change* 19(6): 1705-173

Loasby, B. J. (2010), Capabilities and strategy: problems and prospects, *Industrial and Corporate Change* 19(4): 1301-1316Lorenzoni G and Baden-Fuller C. (1995) 'Creating a strategic centre to manage a web of partners' *California Management Review* 37 (3) Spring 146-163.

Maister, D (1993) *Managing the Professional Service Firm* New York: Free Press

Manning S., and J., Sydow, (2011), Projects, paths, and practices: sustaining and leveraging project-based relationships, *Industrial and Corporate Change* forthcoming.March, J. (1991) "Exploitation and Exploration in Organisational Learning" *Organization Science*, 2, 1, 71–87

Miles, R.E. and Snow, C.C. (1986) Organizations: New Concepts for New Forms *California Management Review* **,** XXVIII, 3, pp.62-73

Mintzberg, H. (1979), 'Patterns is strategy formation', *International Studies of Management and Organisation* IX(3), 67–86.

Mintzberg, H. and Waters, J. A. (1985) 'Of strategies, deliberate and emergent' *Strategic Management Journal* 6, pp 257-272.

Morris, P.W.G. and G.H. Hough (1987): *The Anatomy of Major Projects*, UK, John Wiley and Sons

Nightingale P. and Brady, T. M. (*submitted to this special issue*) Projects, Paradigms and Predictability,

Nightingale, P. (2000). "The product-process-organisation relationship in complex development projects." *Research Policy* **29**(7-8): 913-930.

Nightingale, P. (2004). "Technological capabilities, invisible infrastructure and the un-social construction of predictability: the overlooked fixed costs of useful research." *Research Policy* **33**(9): 1259-1284.

Nightingale, P. (2008). "Meta-paradigm change and the theory of the firm." *Industrial and Corporate Change* **17**(3): 533-583.

Parnas D. L. and P. C. Clements (1985), A rational design process: How and why to fake it, *Formal Methods and Software Development*, 186, 80-100,

Parnas, D. L (1985), "Software aspects of strategic defence systems", *Communication of ACM*, 28, 12, pp. 1326 - 1335

Perrow, C. (1970) *'Normal Accidents: Living with High Risk Technology'*, Princeton University Pres

Polanyi, M. (1958), *Personal Knowledge*, Cambridge University Press.

Prencipe, A. (2003) Corporate Strategy and Systems Integration Capabilities: Managing Networks in Complex Systems Industries, in Prencipe, A., Davies, A., and Hobday, M. (eds.) *The Business of Systems Integration*, Oxford: Oxford University Press

Scranton, P. (1997) *Endless Novelty*, Princeton: Princeton University Press.

Searle, J. R., (1995) *The Construction of Social Reality*, Allen Lane

Searle, J. R., (2001) *Rationality in Action*, The Jean Nicod Lectures, MIT Press

Siggelkow N., and D. A. Levinthal (2003) Temporarily Divide to Conquer: Centralized, Decentralized, and Reintegrated Organizational Approaches to Exploration and Adaptation, *Organization Science,* 14, 650-669

Söderlund, J., and Tell F. (2010) *The P-form organization: Contingencies, characteristics, and challenges*, unpublished mimeo.

Sydow, J., L. Lindkvist & R. DeFillippi (2004) Project-based organizations, embeddedness and repositories of knowledge: Editorial, Special issue, *Organization Studies*, Vol. 25, No. 9: 1475-1489.

Teece, D. J., (2001) 'Strategies for managing Knowledge Assets', Chapter 6 in *Managing Industrial Knowledge*, Ed. Teece, D. J. and I. Nonaka, OUP Press.

Teece, D.J., (2010), Business Models, Business Strategy and Innovation, *Long Range Planning* 43, 2-3, 172-194

Thompson, J.D. (1967), '*Organisations in action'*, McGraw-Hill Book Company: New York.

Vincenti, W. G. (1990). *What Engineers Know and How they Know It* Baltimore, Johns Hopkins University Press

Wheelwright, S., Clark, K.B., (1993). *Revolutionising product development: quantum leaps in speed, Efficiency and Quality*. Free Press, New York.

Whitley, R. (2006) Project-based firms: new organizational form or variations on a theme?, *Industrial and Corporate Change,* 15, 1, 77-99.

Winter, S. G. (2003), Understanding Dynamic Capabilities, *Strategic Management Journal*, 24, 10, 991-995

Woodward, J., 1958. *Management and Technology*. Her Majesties Stationary Office, London.

Zollo, M. and Winter, S. G. (2002), Deliberate Learning and the Evolution of Dynamic Capabilities, *Organization Science*, 13, 3.

TABLE ONE: Project Capability and Scale Possibilities

Project Complexity	Client	Example	Variance	Project Capability	Scale Yes/No
Low	Single house hold	Building a wall using skilled brick layer	Limited	None	No
Low	Building company	Building many walls	Variance in costs but limited variance in added value	Limited capability development opportunity	Many scale opportunities in buying and equipment
Moderate	Formula One car racing	Racing cars	High variation possible	Highly developed capabilities to improve performance	Few scale economies possible
Moderate	Professional Service firm (Accountant)	Undertaking large audit	Lots of opportunity to get things wrong Some creativity	Capabilities built to undertake sub-routines	Scale possibilities due to repeated jobs across clients and time
Very High	Space program	Land man on moon (first time once only)	Lots of possibilities for creativity	Almost impossible to generate capabilities systematically	No scale possibility, one off project

Table 2: Value Capture and Context effects on Incentives to generate capabilities and scale economies

Project Complexity	Project	Project Capability	Scale Yes/No	Pricing Possibility	Incentive effects
Low	Wall building	none	None		Contract costs determine the kind of contract
Low	Multiple walls	Limited: Team solutions	YES – spread fixed costs	Fixed prices	Clear incentives present to generate cost reducing capability and scale economies
Moderate	Formula One car racing	High, due to learning over years	Low	Winner takes all	Strong incentives to generate capabilities to win valuable prizes
High	Multi departmental services bought from large accounting firm	Capabilities built to undertake this kind of complex work without making mistakes	Scale possibilities in selling and organization due to repeated jobs for same client across departments and time	Fixed prices common in parts of service, but cost plus may occur occasionally.	Scale of enterprise and its complexity is often driven by search for scale and capability
High	Space program	Need to be built over the life of the project	No scale possibility with a one -off project	Cost plus	Initial low scale possibilities; post contract performance incentives may be used to generate large value in subsequent projects