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Effective Project Control: Insights from the Australian Construction Industry

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Abstract

Information systems development (ISD) projects continue to struggle with high rates of failure and escalation, despite years of research and practice. To provide an alternative exploration of this concern, this paper examines the development of another industry, which has similarities to ISD, and has transformed itself from a poor performer in an uncertain environment to a strong performer in a certain environment. Insight from another industry could be valuable for revealing a new direction for research. In this paper, the study is a 45-year historical case of the market leader in the Australian construction industry from 1951 to 1996. The starting point for investigation is project management control mechanisms. Currently, one of the guiding principles of ISD project management is that to improve performance, firms should adopt a standard toolkit of control mechanisms, which is assumed to be appropriate for all situations. This paper finds that, in contrast to this standard set, the use of controls is context contingent. Organizations in high uncertainty environments should adopt input controls, while those in low uncertainty environments should adopt behavior and output controls. The implications for ISD are substantial.

Keywords: project management, control, information systems development

1. The Project Challenge

Project management is a pervasive influence on information systems development (ISD) (Hodgson 2002). The general assumption is that effective project management enables projects to be systematically managed from initiation through to completion and delivered on-time, in-budget, of-quality and to-scope, through the tight coordination of work processes and resources (Kerzner 1998). In addition, ISD is "…one of the pioneering industries in the development of project management and has remained at the forefront of the discipline throughout the years since its development" (Morris 1996, p321).

Despite the focus on project management, the rate at which ISD projects are completed on time and in budget is low (Sauer 1999; Johnson et al. 2001). For example, Johnson et al. (2001) found that only 28% of projects were completed on-time and in-budget. The concern for this paper is to examine how this performance may be improved.

The starting point for investigation is project management control mechanisms. There are a variety of controls available. They include, for example, tools for scheduling, resourcing, planning, development and risk management (Kerzner 1998). The current trend in their use is to consolidate them into a universal and politically neutral toolkit, appropriate for all projects (Hodgson 2002). For example, the Project Management Institute, the national body for project management in the United States, has a 'Guide to the Project Management Body of

Knowledge' (PMBOK). The implicit logic of this guideline is that, to improve project performance, organizations should adopt the universal set of practices.

The question for this paper is whether one or many toolkits are appropriate. To do this, the paper extends organizational control theory and examines what insights can be gained from other industries. Any findings would be highly valuable if they can fast track ISD improvement. Further, there has been over 25 years of ISD research (Verner et al. 1999), so it is an opportune time to look outside the usual ISD discipline boundaries.

The industry selected for this study is the Australian construction industry. In the 1990s, the Australian construction industry was recognized as the second most efficient construction industry worldwide (Sauer et al. 2001), in contrast to its poor performance in the 1950s and 1960s (Hutton 1970). Within construction, one firm, Bovis Lend Lease (BLL)[1], is the focus of research. From its initial public offering in 1958 to its restructuring as an international property developer in 1996, BLL was successful, continuously adjusting its control mechanisms to match the evolving context. In addition, the analysis shows how it not only matched its control mechanisms to the changing context but also how it shaped that context to support the delivery of projects. These two findings have important implications for project management, supporting the need for guidelines to select an appropriate toolkit.

2. Contingent Project Management

Project control is the process of ensuring that project stakeholders act in a coordinated manner, so that resources can be used optimally to achieve project goals (Lebas and Weigenstein 1986). Current ISD project management theory and practice suggests that a generic set of control mechanisms should be adopted. For example, PMBOK has nine knowledge areas (Project Management Institute 2000). In each area, there are individual recommendations for action but no guidance is provided for selecting an appropriate mix of controls to suit different organizational contexts and/or industries. It is assumed, at least implicitly, that all the control mechanisms are required.

In contrast, organizational control theory presents a contingent model (Ouchi 1979; Ouchi 1980; Govindarajan and Fisher 1990; Kirsch 1996). A contingent model is one that suggests that different approaches are required in different situations (Donaldson 2001). Figure 1 shows how to match the required control mechanisms to the context. The appropriate use of the three control mechanisms - input, behavior and output - is a function of two contextual characteristics, outcome measurability and task programmability. The framework was developed by the authors to extend the current literature on organizational control theory to project-based environments. To date, the research on organizational control theory has focused on the task as the level of analysis, rather than the project level.

[1] In this paper the firm is referred to as Bovis Lend Lease (BLL). The current name is the result of Lend Lease acquiring Bovis from P&O in 1999. The firm has also had a few other names over the years, starting in 1951 as Civil and Civic. For simplicity though, the name BLL is used throughout the paper.

TASK PROGRAMMABILITY

OUTCOME MEASURABILITY	LOW	HIGH
HIGH	**Cell 3** Output	**Cell 4** Output and/or Behavior
LOW	**Cell 1** Input	**Cell 2** Behavior

Figure 1: Project Control Mechanisms

Input controls refer to the management of materials and human resources. Examples include socialization, procurement, selection and training practices. Behavior controls include process rules and procedural norms. Examples include development methodologies, job descriptions and organizational hierarchies. Output controls are performance measures, such as cost and schedule. Examples include target dates, budgets, milestones and expected levels of performance.

Outcome measurability is an output's susceptibility to reliable and valid estimates and measurement (Govindarajan and Fisher 1990). These outcomes are typically measured through metrics of time, cost, quality and scope. To achieve high outcome measurability, it is important that actual outputs are tracked against the schedule in a timely manner. In cases where it takes a long time to complete tasks, involves joint or team effort, or produce soft outcomes, the outcomes are either difficult to measure or difficult to measure within a practical amount of time, and so outcome measurability would be low.

Task programmability is a task's susceptibility to clear definitions of the behaviors needed to perform it (Govindarajan and Fisher 1990). It is high when there are both clear definitions of the behaviors needed to deliver the project and management control over those behaviors. Behavior can be monitored more easily and corrective action taken if necessary when task programmability is high rather than when it is low.

The critical assumption of organizational control theory is that, when organizations use control mechanisms that match the context, the probability of project success increases. For example, firms in Cell 4 (Figure 1) have a clear understanding of the tasks and related outcomes of those tasks and so are recommended to use output and/or behavior controls. Conversely, in Cell 1, where tasks and outcomes are uncertain, input controls are more effective. Organizational control theory does not argue that only the specified control mechanism(s) should be used in each cell. Rather, it identifies the dominant recommended mechanism(s) (Kirsch 1996).

In addition, organizational control theory is silent on the issue of the determinants of the context. This study of BLL spanned 45 years and obviously the context changed markedly over the period. This presents an opportunity to explore how that context changed and whether BLL and the Australian construction industry followed a path to maturity as mapped by a trajectory from Cell 1 to Cell 4 in Figure 1.

3. Methodology[2]

3.1 Research Approach

The objective of this study is to examine the experiences of another industry to advance our understanding of how ISD can improve performance. There are two principle benefits of examining another industry. First, it removes the barriers to learning that are apparent when only a single industry is examined. After over 25 years of ISD research, this appears to be an opportune time to do this. Second, it can fast track learning such that firms can adopt ideas without making similar mistakes. Given there is still some way to go before project stakeholders are satisfied with ISD performance, learning from other industries is an attractive proposition.

To address the research question and to ensure that the insights are relevant to ISD, it was important that the industry and firm studied satisfied three criteria. First, the industry had to have transformed itself from a poor performer to a strong performer. In doing that, the changes that occurred, and the reason for them, can be examined. Second, the industry had to have leading firms that drove the changes. This simplifies the study because the focus could be maintained on specific firms. Third, the industry had to be similar to ISD in that it was project-based, and one of its foundation disciplines was engineering. This is so that insights would be transferable.

The construction industry in Australia satisfied these criteria. In this study, the construction industry is assumed to encompass the entire value chain of the development and execution of a building project including financing, architecture, engineering, contracting and subcontracting. Consider the three criteria. First, the study period was 1951-1996. In that time, the construction industry in Australia transformed itself from a poor performer in a high uncertainty environment (Hutton 1970), to a strong performer in a low uncertainty environment (Sauer 1999). Second, the Australian-based BLL (www.bovislendlease.com.au) was a lead adopter, driving many of the changes in the construction industry. Its success spanned both high and low uncertainty environments.

Third, both the ISD and construction industries are project based. For example, in a study of project-based industries, Wirth (1996) found that the principle difference between ISD and construction was the level of uncertainty, with ISD being more uncertain. In addition, Wirth found that in terms of size and project management capabilities the two industries were similar. Finally, the base discipline of both industries is ‘engineering’ (Bryant 2000). Construction is a traditional engineering discipline, with ISD a newer engineering discipline (Shaw 1990; Parnas 1999). In addition to these criteria, there are precedents for this research. For example, Sauer et al. (1999; 2001) focus on organizational level issues to draw comparisons between the two industries. This paper adopts a similar approach.

[2] Due to space limitations, this section only provides a brief overview of the approach and methodology. Please refer to Vlasic (2003) for a complete description.

3.2 Research Methodology

This study uses the historical method (Kieser 1994). The objective is to examine whether the long-term experiences of a leading organization in a project-based industry can advance our understanding of how to improve ISD project performance. There is no single method for historical research. It is a family of methods designed to present and interpret the past (Neuman 1994; Mason et al. 1997; Golder 2000). For the study of BLL, the objective is to explore the relationship between control mechanisms, the project context and performance. To do this, Mason et al.'s methodology is adopted. This methodology is designed to address situations where the events are unique and there is an intensive examination of a few subjects, as is the case here. Following Mason et al., there is a seven-step process to create a comprehensive historical study, including: (1) begin with a focusing question; (2) specify the domain; (3) gather evidence; (4) critique the evidence; (5) determine patterns; (6) tell the story - the account; and (7) write the transcript. This methodology supports a researcher in developing the case transcript.

To gather the evidence, over 700 documents were collected and 12 interviews of one-and-a-half to two hours each were undertaken. There were three steps in data gathering. The first step was to review the BLL annual reports to establish some understanding of developments in the firm. The second step was to conduct the interviews. The interviews were designed to illuminate key events and stimulate the investigation. The interviewees were chosen to represent a cross-section of the firm, across the value chain from engineering and design through to construction. All the interviewees had worked for a considerable time in BLL, with eight of them having worked there for over 20 years. The interviews were supplemented by informal telephone conversations, to clarify issues or to obtain comment on points raised in other interviews. The third step was a comprehensive review of the literature, including, annual reports, the BLL magazine, manuals, procedures, plans, guidelines, project reports, brochures, press clippings, books and journal articles. This information spanned the entire study period. Most of the documented evidence was gathered from the public domain. BLL also has a large archive of this information that was made available to the researchers, which is well catalogued, intact and dates back to the foundation years of the firm.

Following the development of the transcript, a three-stage protocol was adopted to evaluate the state of the control mechanisms. First, the interviewees were explicitly asked to rate the changes over time. Second, data was gathered from the press and other documented evidence on the issues. For example, numerous articles mentioned BLL's dominance in the marketplace. The findings for the industry and BLL were then included as part of the case transcript and sent to six of the interviewees for feedback. The interviewees were explicitly requested to highlight any findings with which they did not agree and to suggest alternatives where appropriate. No changes were suggested. Finally, an independent research colleague in engineering, was sent the case transcript, and asked to evaluate the categories. Her judgments were also consistent with those reported. This triangulation provides confirmation and confidence in the findings.

4. The Historical Case of Bovis Lend Lease: 1951 - 1996

BLL was established in 1951 and was a leading firm in the Australian construction from the 1960s up until the end of the study period. Figure 2 identifies five distinct periods of development from 1951 to 1996. As described below, the first period was driven by the industry, the second and third periods by changes at BLL, and the last two again by the industry. In each period, BLL changed its use of control mechanisms to manage projects.

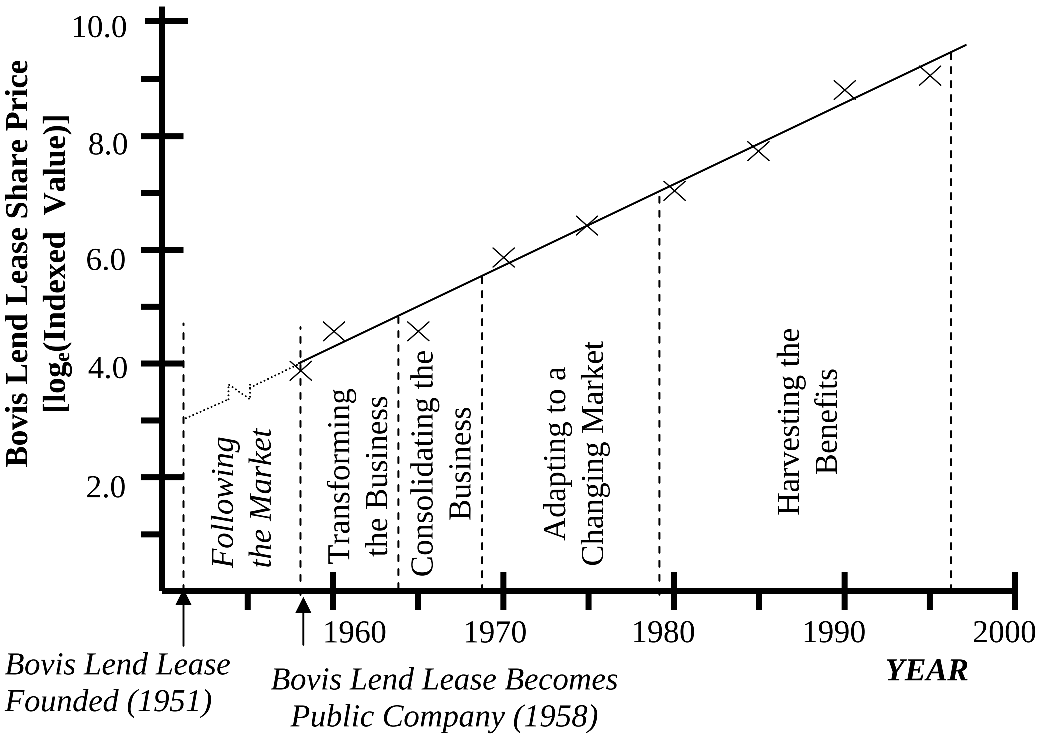

Figure 2: The Successful Evolution of Bovis Lend Lease

BLL established itself as a leading construction firm in Australia in the 1960s and remained a market leader for the study period. Figure 2 graphs BLL's success over the 45 years. During that period, it out performed the stock market composite, the All Ordinaries Index. With the BLL share price and the All Ordinaries Index set at 100 in 1960, BLL's indexed share price in 1996 was 8,864, against the All Ordinaries of 1,146 (See Table 1).

Table 1: Bovis Lend Lease Share Price and Australian Indices

Year	BLL Year-End Stock Price ($) [a]	Year-End All Industrial Index [a]	Year-End All Ordinaries Index [a]
1960	100 [b]	100	100
1965	100	106	117
1970	336	125	188
1975	609	139	161
1980	1126	251	386
1985	2255	566	542
1990	6664	743	691
1995	8864	1250	1146

(a) Stock Price and Index's were set at a baseline of 100 in 1960.
(b) This value was not available from the Australian Stock Exchange. It is an estimate inferred from BLL's annual reports.

Source: Australian Stock Exchange

4.1 Following the Market: Period 1 (1951-1957)
Period 1 was a time of major economic growth in Australia, fuelled by a growing youthful population. During that period, the supply of construction materials to site was erratic and unreliable because materials were scarce and restrictive work practices were widespread. In addition, tradesmen and laborers were temporary employees who could be retrenched on one hour's notice, resulting in frequent Union-based disruption focused on wages and conditions. Finally, architects and their clients often made unpredictable design changes during construction.

With construction contractors like BLL having little control over labor and material supply, and with late changes in design, task programmability was low. In addition, a construction contractor's project plan was a poor guide to project outcomes. Projects took a long time to complete; goals changed continually, making it difficult to measure project performance; customized work made comparisons difficult; and teamwork confounded measuring individual performance. Outcome measurability was low.

In this uncertain industry context, construction contractors were expected to sign fixed price contracts with demanding delivery dates. The focus was on the management of outputs, using schedules and plans to manage the requirements of time, cost and scope. Not surprisingly, given the unreliable supply conditions and unpredictable client behavior, BLL, along with its competitors, typically could not meet the contract conditions. Both BLL and the construction industry in general were judged to be unreliable and poor performers, with an *"uncertain nature and timing of projects"* (Hutton 1970, p152).

> The mismatch between the dominant control mechanism, *output,* and the context, *Cell 1: Low outcome measurability and low task programmability*, contributed to poor performance for both BLL and the industry.

4.2 Transforming the Business: Period 2 (1958-1963)
In 1958, concerned by the lack of control over the construction process in the mid-1950s, the founder of BLL, Gerardus Jozef Dusseldorp, set about transforming the business. His strategy was based on his experience at the Harvard Business School in 1957 where he studied the US shoe manufacturing industry, in which the average life expectancy of a firm was seven years. The short life span was attributed to the industry's inability to control the cost and quality of inputs. Dusseldorp recognized parallels with the Australian construction industry (Murphy 1984).

On his return to Australia, Dusseldorp focused on the control of inputs. In doing so, he:
- developed an engineering and architectural competency to '*direct the design*'
- established a finance company to secure funding and '*control the money'*
- forged a union agreement to attract and retain a premium workforce. Workers were given three month's job security, a productivity allowance, life insurance, sickness and accident insurance, and training. This allowed BLL to develop an environment that was

epitomized by a *"…cooperative competitiveness, with highly competitive people learning to co-operate and pool their resources for their common benefit."*[3]

- developed project engineering skills. Before this *"…everything had to be engineered. You engineered the hydraulics, the structure and the air-conditioning. The one thing that was not engineered was the project."*
- purchased other businesses, including timber, brick, window, elevator, electrical and real estate, to control the uncertain supply and quality of those inputs
- developed a new competency in industrial engineering, standardizing and optimizing on-site practice. "*There was really only two elements in building: materials and handling…What happened on a construction site, and still happens, is that loads of 4x2 timber comes in, and loads of bits of timber go out. It's constantly chopped up.*" Standardizing reduced costs significantly.

These inputs supported BLL's novel and unique design-and-construct 'package-deals', called 'guaranteed maximum price and time contracts', which matched prices and costs.

The rest of the construction industry and business media analysts predicted BLL's early demise and the industry continued to focus on output controls.

During this period, however, BLL's performance improved significantly. With the improvement came changed attitudes in the business press. The firm was described as a *"booming Australian business" (Cleveson 1960).* Projects, such as the new television station building for CTC7 in Canberra, were completed in record time. BLL also won the first pennant awarded by the National Safety Council in 1961.

> BLL's performance improved, with a match between its dominant control mechanism, *input*, and the context, *Cell 1*. In contrast, the industry's performance remained poor, continuing to mismatch *output* controls to the context. *Cell 1*.

4.3 Consolidating the Business: Period 3 (1964-1968)

Following the radical changes in Period 2, the third period was a time of consolidation for BLL. In 1964, it articulated a policy shift, from 'transforming' to 'developing' the business (Murphy 1984). The businesses purchased in Period 2, windows, timber, bricks, electrical and elevators, acted to buffer BLL's core business technology. Essentially, BLL had shifted the context for its construction business from Cell 1 towards Cell 4, while the industry remained in Cell 1.

Client practices were also changing across the industry. There was a trend towards appointing the construction contractor as project manager to exercise control over design and other changes. This further increased task programmability, reinforcing the shift towards Cell 4. Prior to this, the architect was often the project manager, which limited the control of the construction contractor over the project.

This shift towards Cell 4 was supported by an increased emphasis by BLL on behavior controls. Project control groups (PCGs), functioning as management review boards, were introduced to supervise projects at a business level. Other initiatives included improving

[3] Comments in quotation marks are direct quotes selected from the interviews, unless stated otherwise.

employee provisions to reinforce BLL's premium position in the labor market; rewarding safe site practices by introducing internal safety awards; conducting in-house general management training (the Louis Allen management program); and implementing critical path methodology for project scheduling.

BLL continued to deliver projects ahead of time, with, for example, the Enoggera Army Camp delivered six months ahead of a 20-month schedule. The industry also began to copy some of BLL's behavioral controls to contract with suppliers and subcontractors.

> BLL's performance remained outstanding, as it matched its control mechanisms, *input* and *behavior*, to the evolving context, moving from *Cell 1* (low outcome measurability and low task programmability) towards *Cell 4* (high outcome measurability and high task programmability). In contrast, the industry lagged BLL's performance, continuing to emphasize *output* controls while beginning to introduce *behavior controls*, both of which were a mismatch to the industrv context. which remained in *Cell 1*.

4.4 Adapting to a Changing Market: Period 4 (1969-1979)

The beginning of Period 4 was marked by the mainstream introduction of subcontractors, changing the industry context. Until this time, traditionally, only plumbers and electricians had been subcontracted, with all other functions in-house. The skilled immigrants of the 1950s and 1960s were the drivers for this change, as they set up specialized trade businesses.

By the end of the period, suppliers and subcontractors delivered reliable services and contracts were modified so that variations were less common. Task programmability and outcome measurability both improved. Engineering broke projects into smaller stages, so that measurements were available sooner; standardization enabled hard measurements across comparable units; and reformed work practices, and sales and service contracts supported individual performance measurement. BLL began to divest itself of non-core subsidiaries, such as material suppliers, which were no longer needed to buffer its core business from supply uncertainty. The front-end of project development was seen as where value was created, so engineering competencies remained in-house.

Along with these changes in context, there was a shift at BLL from a focus on input and behavior controls to one on behavior and output controls. BLL continued to outperform the market, with over 50% of its work being repeat business. A major development, the MLC Centre in Sydney, won numerous accolades. Completed five months ahead of schedule, it was the tallest concrete office tower in the world. In this period, industry performance, with its continued focus on output controls supported by new behavior controls emphasizing effective subcontracting, began to improve.

> BLL sustained its high performance in Period 4, focusing on *output* and *behavior* controls to match the requirements of *Cell 4*. Industry performance also improved, its dominant control mechanisms, *output* and *behavior*, now matching the emergent context of *Cell 4*.

4.5 Harvesting the Benefits: Period 5 (1980-1996)

The final period was characterized by incremental changes in the industry. By this time, the industry had developed a capability to deliver large projects on-time, in-budget and to-scope. Quality, the last piece of the performance puzzle, was still a concern. To overcome this, the industry collaborated in developing a quality control standard based on the international ISO9000 series. BLL was one of the first businesses to become ISO accredited.

BLL continued to divest non-core businesses at the back-end of project development, selling the timber, elevator and mechanical services businesses. It also revamped procedures including project management and site supervision. The new procedures, 'Project Management for the 80s', formed the first comprehensive operating manual for the firm, formalizing their focus on output and behavior controls.

Finally, the industry's continued focus on output and behavior controls matched the emergent context in Cell 4. Both BLL and the industry enjoyed high performance. The Glebe Island Bridge, the Sydney Harbor Tunnel and the Sydney Airport Third Runway were all delivered ahead of schedule, under budget and to scope.

> The match between control mechanisms, *output* and *behavior*, and context, *Cell 4*, supported both BLL's continued high performance and the industry's improved performance.

5. Analysis and Discussion of Best Practice

The findings above show that project performance is contingent on the match between the control mechanisms and the context. BLL succeeded by adjusting its control mechanisms to match the different contexts in Periods 2 to 5. In contrast, the Australian construction industry followed a basic one-size-fits-all approach, continuously emphasizing output controls, reinforced by behavior controls in Periods 4 and 5. The industry's performance was poor in Periods 1 to 3, when its control mechanisms were a mismatch with the context. Its performance improved and came good in Periods 4 and 5, when its control mechanisms matched the emerging context.

Figure 3 maps the key findings for BLL into the organizational control theory framework. The stars locate BLL's context during each period. The mismatch/match assessment refers to whether BLL's use of control mechanisms was consistent with organizational control theory. The stars also map the dynamic trajectory followed by BLL, as it initially led the industry, shaping its context, in Periods 2 and 3, and then followed the industry's emerging context in Periods 4 and 5.

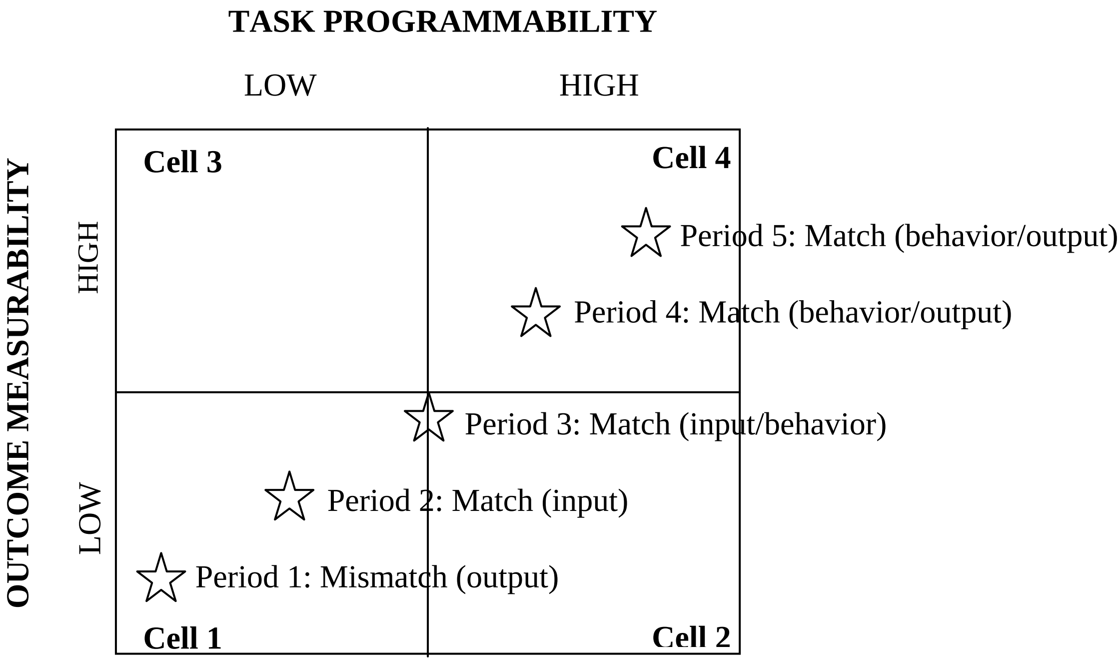

Figure 3: Control Mechanisms Adopted by Bovis Lend Lease

The powerful implication of the above findings is that successful control mechanisms from project-based industries, such as the current Australian construction industry in Cell 4 of Figures 1 and 3, would be inappropriate for industries or organizations in Cell 1. In the next section, the implication of these insights to major ISD projects are discussed.

5.1 Implications for ISD Projects

The literature suggests that ISD project estimates are both biased (large average overruns) and unreliable (high performance variance) (Johnson et al. 2001). Consistent with this, it is likely that the project schedule estimates are unreliable and that outcome measurability is low to moderate. Research also suggests that many ISD projects suffer from scope creep (Johnson et al. 2001). That is, over the course of a project, additional tasks are included. Those unanticipated tasks are difficult to plan for at the start of a project. Although organizations have improved task programmability by implementing methodologies, it is still, at best, moderate. Plotting these two contingent variables on Figure 1, the typical large ISD project context would be located in the upper right of Cell 1. The contextual match is a mix of input and some behavior controls. In contrast, the typical ISD project focuses on output and behavior controls (See for example, Schwalbe 2002). This mismatch of control mechanisms and context may account for part of the reported poor ISD performance.

BLL experienced a similar context, located in the upper right of Cell 1, in Period 3. The critical contributory factors to its project performance then were high quality project teams, access to reliable suppliers and management support. Consider each of these three needs as they influence ISD project performance.

First, members of an ISD project team are frequently consultants and contractors who, at the outset, are unknown to each other and to the organization. Consequently, the impact of these consultants and contractors is difficult to forecast. Furthermore, development of these employees is not under the control of the organizations that hire them (weak input control).

Retaining a high quality, stable project team would make a major contribution to performance (input control) (See for example, Yetton et al. 2000).

Second, suppliers for ISD projects have traditionally been unreliable in their delivery of services. The development of selective outsourcing strategies (input control) has started to improve service delivery as the suppliers compete for client business, as described for example by Lacity et al. (1996).

Third, management is a key criteria for success of ISD (For a discussion, see for example, Sharma and Yetton 2003). There are two organizational mechanisms to provide management support to project teams. One is to establish a project board for each project to oversight technical and business issues, monitor performance and resource the project, and focus on the business deliverables (behavior control). BLL developed such project control groups in Period 3. The other is by building a project office to both leverage learning across projects and use project boards to build a core competency in managing ISD projects (input control). To do this, in Period 3 BLL restructured its organization around a project-based environment.

While the typical ISD project may be located on this trajectory between Cells 1 and 4, other ISD projects could clearly be located in either Cell 1 or Cell 4. Performance on the projects located in Cell 4 would be better (where there is a match between the typical focus on output and behavior controls and the context) than performance on the projects in Cell 1 (where there is a mismatch between the typical control mechanism and the context). This difference would account for some of the high performance variance reported on ISD projects. To both improve project performance and reduce project variance, the need is to diagnose the context and match the control mechanisms to that context.

Two recommendations to improve project management practice summarize the above:

- ***Step 1:*** Diagnose the organization's context and implement the appropriate control mechanism(s) from Figure 1.
- ***Step 2:*** Identify the trajectory followed by the context, and position the organization to capture the benefits of that trajectory.

5.2 Implications for Professional Institutions

Professional bodies, such as the Project Management Institute promote the development and application of generic accreditation procedures for project managers, with accreditation the same for all industries. The findings show that this could be misleading. The use of control mechanisms is contingent. There is the need for considerable customization. Consistent with this, the professional bodies have developed special industry interest groups, such as one for ISD. Further work is needed to tailor and customize the accreditation and training to reflect the contingencies in practice.

5.3 Future Research Implications

This paper contributes to the contingent project literature for ISD in two ways. First, the paper shows how organizational control theory increases our understanding of ISD project management. It does this by establishing the nature of the contingencies for controlling projects. Second, the paper identifies the dynamic nature of the contingencies and the need to both diagnose and model the context over time. The trajectory from Cell 1 to Cell 4 maps a decrease in contextual uncertainty. Most important, the findings show the contingent fit between the dominant control mechanism(s) and the context changes over time.

Further research is required to establish which specific tools are required. For example, it could ask which tools from input, behavior and output controls should be adopted. Also, in considering future research, the findings here are limited by the choice of industry and the sample chosen. The analysis at present is undertaken in the construction industry. Although this has provided a strong starting point for considering the issues of ISD from an alternative perspective, a study would now be required of ISD to confirm the findings. Also, this study focused on one firm in the construction industry, which limits generalizability. Future research could increase the size the generalizability of the data set by considering other industries. Finally, the study makes the assumption that there are number of stage of growth. In practice, this might not be the case, or alternatively, it might be non-linear. Future research could consider the implications of this for the use of control mechanisms.

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