Mini-muddling: learning from project plan deviations

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Abstract

Purpose – This paper aims to contribute to the understanding of the informal and incidental learning that takes place in project work among individuals who must adapt to deviations from project plans.

Design/methodology/approach – Reflections in the study are built on four power plant projects found in an integrated provider of projects of this type. The projects were followed by participative observations during ten weeks of onsite visits. Furthermore, 26 interviews were done among participants in the organisation on working practices and implications. Data included interviews, reports, minutes-of-meetings, observations, and e-mail correspondence that characterised the cases.

Findings – The paper finds that learning occurred at two levels. First, there was the learning that occurred as each of the deviations was handled. The second aspect of learning involved the patterns in which remedies were handled.

Research limitations/implications – Because research was built on case studies, one has the reservations common with that approach. Nevertheless, the learning architecture that Sense related to intra-project learning has features that relate to the situation where learning has occurred from projects. Further, by associating observations with the background provided by Lindblom and Simon, suggestions carry inherent credibility.

Practical implications – The organisation that was set up seemed particularly effective in handling the deviations. Also, intuition came into play. Both these items may interest consultants and trainers as well as academics.

Originality/value – Although the need to handle project deviations is appreciated in practice, it is not clear that there is an understanding of how response occurs. The paper documents response across the stages of projects, which is original. Value is associated with the interpretation.

Keywords Learning, Project management

Paper type Research paper

Introduction

"Project management – It's all about change and deviations!" – the words of a project manager with 30 years of project experience. This thought is reflected in present thinking of projects and their management, i.e. most projects are not as planned and controlled as they might seem (see Dvir and Lechler, 2004). Further, the thought takes on special importance when it is considered that projects appear to be becoming more important as a means for getting things done (see Whittington *et al.*, 1999; Kerzner, 1998; Wysocki, 1996; Midler, 1995).

The need for managers to adapt to these changes and deviations strongly suggests that there is informal and incidental learning in the workplace for these individuals – at least the successful ones. Although this need is appreciated in practice, it is not clear that there is an understanding of how it occurs. The purpose of this paper is to

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contribute to that understanding. It reports on actual changes that had to be incorporated in global construction projects. Decisions are interpreted in terms of Lindblom's (1979, 1959) concepts of muddling – the idea that means and ends are necessarily interrelated in some decision processes. Of necessity, there is learning in that process. There is also learning in the organisation as reflected in the system that is set up. It is thought that these observations will have practical implications and relevance for those individuals involved in supervising, facilitating and undertaking workplace learning.

Background

Project management – projects as complex, hierarchic systems

An essential element of projects is uniqueness, i.e. projects deal with producing developments that have not been accomplished before (see Nicholas, 2001, pp. 4-9). Further, an essential feature of project management is the idea that it is possible to accomplish these unique developments within time and cost constraints with a reasonable assurance. Put another way, project management tends to approach operations by planning (Christensen and Kreiner, 1991, p. 39), which has influenced much of the current literature and practice on projects (Söderlund, 2004). Of course it has been recognised that there are projects and there are projects (see Nicholas, 2001, p. 6; Turner, 1999, pp. 25-7; Lundin and Söderholm, 1995, p. 452). That is, there is a natural uncertainty in projects depending upon how well work methods and goals can be identified. Nevertheless, classical project management approaches would assert that it should be possible to bring a project to completion within time and cost constraints despite the associated uncertainty. Consequently, virtually every project has some sort of plan to cope with the uncertainty and the ambiguities to which the project might be subjected.

In addition to uncertainty, projects also have unforeseen interruptions that disrupt progress. In other words, a research project may carry uncertainty because it is not evident how long a specific step might take. A construction project, on the other hand, which should proceed with relative certainty, can be disrupted by unforeseen circumstances such as a delay in material delivery. These circumstances are called deviations in this paper – primarily deviations from project plans. Studies that follow projects closely show that deviations from a general, planned endeavour do indeed happen. In response, the actions of a project team must rely upon previous knowledge and emergent strategies to handle these deviations as they occur (see Dvir and Lechler, 2004; Nilsson, 2004, pp. 59-63; Lindahl, 2003, pp. 435-39).

Simon's (1996) analysis of complexity could be used to rationalise these observations by suggesting that real projects containing uncertainty and deviations have an underlying regularity that makes their implementation within time and cost constraints possible. That is, projects tend to be complex, hierarchic systems. They are systems because they are composed of parts (tasks) that have many interactions (Simon, 1996, pp. 183-4). They are hierarchic because these tasks in turn can be resolved into subtasks, which in combination build up the project from this elementary level. They are also hierarchic insofar as there is a sequential order in which the tasks are performed. The uniqueness aspect of projects, however, makes them complex. It is this property that makes the hierarchic system incompletely, but frequently and fortunately, nearly decomposable. In other words, interactions between and within the tasks cannot be completely specified at the planning stage (see Simon, 1996, p. 197). Nevertheless, in most cases there is enough regularity in projects that they can be planned as if the unspecified (random) components of interaction were not present. This approach means that an outline exists for controlling the activities, but in a practical sense the unspecified interactions must be managed as they arise.

Temporary and permanent organisations

Associated with projects and project management is the concept of temporary organisations (Lundin and Söderholm, 1995). Turner and Müller (2003, p. 7), in fact, defined projects in terms of temporary organisations:

> A project is a temporary organisation to which resources are assigned to undertake a unique, novel and transient endeavour managing the inherent uncertainty and need for integration in order to deliver beneficial objectives of change.

Put another way, in order to make things happen, special groups are set up to accomplish the task at hand. A distinguishing feature of these groups is that members would be identified with the group only during the implementation of the task (Lundin and Söderholm, 1995). Consequently, these organisations had an action orientation and were built around the constructs of task, time, team and transition. In proposing this model, the authors carefully distinguished its features from the theory of the firm (Cyert and March, 1963), which had as its basis a decision-making orientation. In fact, care was taken to decouple action and decision making as a requisite for the development of a temporary organisation model. In comparison with the constructs of a temporary organisation model, the theory of the firm also had four concepts necessary for its specification – goals, expectations, choice, and control.

Learning in project organisations

The ability of permanent organisations to learn from projects has been questioned (Ekstedt *et al.*, 1999, pp. 124-54). Essentially, it is suggested that the knowledge processes that take place in projects are difficult to feed back to the permanent organisations. The argument is that projects are temporary endeavours in specific contexts where routines necessary for learning cannot be developed as in a permanent setting. To the contrary, March *et al.* (1991) have asserted that not only do organisations learn from projects, but also their competitors may as well. Within this journal, Sense (2004) has surveyed the literature on organisational learning and suggested that it is possible to group different authors' observations under specific perspectives on organisational learning. These perspectives included cognitive, which is an informational processing view, behavioural, which has an outcome focus, and sociological, where meaning is a result of social relations and practice. Project learning was viewed as a product of the community rather than of the individuals within it. Five interdependent elements (learning relationships, cognitive style, knowledge management, learning support and a pyramid of authority) were identified that constituted a learning architecture for intra-project learning. Gieskes *et al.* (2002) inferred from the CIMA methodology applied to product innovation that although continuous improvement in operations may be desired in multinational corporations, barriers exist that mitigate this improvement. Consequently, learning communities may in reality be primarily employees at single units.

Scientific muddling

In a seminal paper Lindblom (1959) introduced the term "muddling through" to the management literature. On the one hand, this observation has made his name synonymous with the term forever, but on the other hand, the connotation carried the danger of unfortunate consequences. Put another way, muddling may be mistaken for a jumbled, confused, bungled approach to decision making. Instead, he was outlining an approach for making policy decisions where alternatives could not be identified, nor quantified. Subsequent reflections on these real decision-making situations, it was explained that there is a class of non-rational problems in which the problem is in fact a cluster of interlocking problems with interdependent solutions (Braybrooke and Lindblom, 1963, pp. 54-6). In turn, the solution is one that provides some reconciliation for the diverse sources of the interlocking problems in a way that provides some satisfaction for each. In effect, this approach describes the situation under which complexities are handled in projects. In its pure form, this approach has the following steps (Lindblom, 1979, p. 517):

(1) limitations of analysis to a few somewhat familiar alternatives;

(2) an intertwining of analysis of goals and other values with the empirical aspects of the problem;

(3) a greater analytical preoccupation with ills to be remedied than positive goals to be sought;

(4) a sequence of trials, errors, and revised trials;

(5) analysis that explores only some, but not all, of the important possible consequences of a considered alternative; and

(6) fragmentation of analytical work to many (partisan) participants.

Methodology

The purpose of this paper is to contribute to the understanding of the need that project managers have to adapt to changes from plan and the informal and incidental learning that may occur in the workplace as a consequence of this adaptation. A multiple case study approach was used in which cases were taken from four distributed power plant projects developed by an integrated provider of projects of this type. The projects were followed by participative observations during a total of ten weeks of onsite visits for each project. These observations were in line with the classic ethnographic studies of Mintzberg (1973) and Carlson (1964) and the stream of ethnographic studies associated with contemporary practice research (see Jarzabkowski, 2005; Johnson *et al.*, 2003), which have gained appreciation for producing knowledge based on actual practice in everyday situations. Basically, the multiple case protocol described by Yin (1989, pp. 52-60) and his suggested six sources of evidence (Yin, 1989, pp. 85-103) were utilised in the study.

The actual cases arose as unanticipated events in the broader study of projects as they actually are conducted (Hällgren, 2004). That is, although one may expect that deviations will occur within a project, one does not know at which point they might happen. In fact, it was found that they occur at any point within a project as shown in Figure 1. Consequently, identification and follow-up virtually mandated an onsite presence. One suggestion by Van Maanen (1988) of keeping a field diary was helpful in the association of events prior to and after these incidents occurred, as well as what

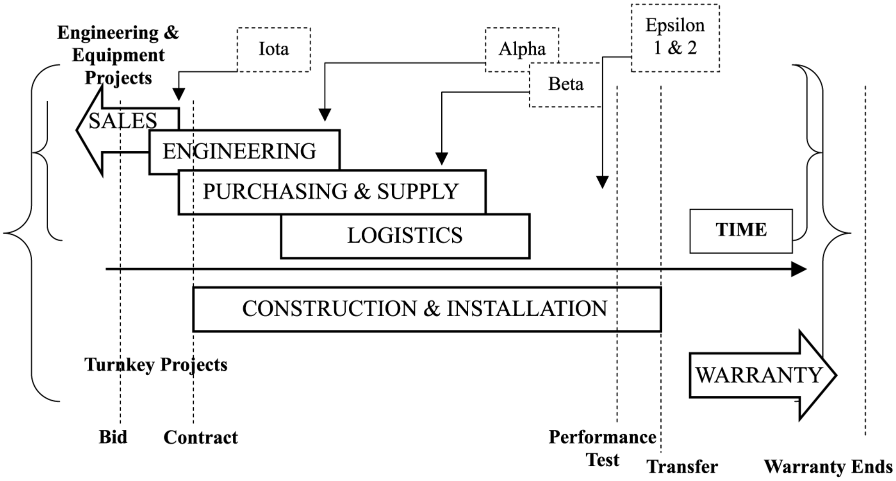

Figure 1.
Composite Gantt chart of projects at start of observations

was considered deviations by the project team. The observations themselves were somewhere between the direct and participative observations described by Yin (1989, pp. 91-4). In other words, the observations were made contemporaneously, but the observer was not really part of the project team thus avoiding the bias that might be associated with such involvement (Yin, 1989, p. 94). Informal conversations also were noted and recorded. In this way, the diary provided notes on team conversations as well as those conducted with onlookers. There was full access to the database of plans, emails and reports. Previous agreement gave access to phone calls and other records for the specific periods in which the deviations occurred. Subsequently, formal, semi-structured interviews among participants ranging between 30 minutes to two hours were conducted and tape-recorded.

Data collected in this manner were used to build cases as in a manner described by Yin (1989) and Eisenhardt (1989) who in combination suggested first that cases include several types of data in order to triangulate evidence. Data hence included interviews, reports, minutes-of-meetings, observations, and e-mail correspondence to characterise the cases. In addition to the 26 formal interviews conducted on these cases, there were 26 informal conversations monitored among participants, ten meetings attended, 138 e-mails monitored and two formal reports made available as shown in Table I. Second, it is recognised that good practice provides breaks for analysis in order to get some distancing from observations so that modifications might be made in the methodology. Two-week long breaks between the cases were therefore used for post-analysis. This time was utilised to summarise the individual cases as suggested by Yin (1989). Third, it has been recommended that cases should be spread in order to extend the findings. In this regard, projects were available with different geographic locations and type, which produced deviations along the projects' time lines. Finally, cross-case observations have been discussed in internal seminars with the project group at the authors' university and at external conferences of peers, which provided a sense of credibility for observations and inferences made from them (see Lincoln and Guba, 1985, pp. 281-308). The projects identified for evaluation are described in Table II, and the sources of the information cited in the paper are given in Table I.

Project and deviation	Primary sources of information	Supporting information
Alpha – missing blue print	Onsite when problem arose. Subsequently, three formal interviews with project engineer	Discussion of two telephone calls that rectified situation
Beta – transport damages	Present onsite for first two days of occurrence. Six formal discussions with project manager. A total of 14 conversations with insurance co. reps, site engineers, logistic co. reps, and management of quality assurance. Present at two report meetings with transport consultant and logistics company	Minutes from four monthly report meetings. Damage reports from independent consultant, site team, and insurance co. Minutes from meetings with consultant and logistic co. rep. 107 e-mails to and from project manager on topic
Epsilon – failing breaker	Onsite one week with the project team at the occurrence. Five formal discussions with the project manager and the project engineer. Ten ingoing e-mails to the project engineer	Five verified (and later summarised) telephone calls to the site team, the local sales and the R&D department
Epsilon – engine variance	Present at the time of the occurrence, ~ 15 days. Four formal discussions with the project manager and the project engineer. One e-mail from site to the project manager	Four verified, observed phone calls to the site, the local sales office and the customer. Present at report meeting. Minutes from one monthly report meeting. One monthly report
Iota – language incompatibility	Onsite for three months during escapade. A total of 20 e-mails to and from the project manager. Four formal discussions spread out over the time period. One observation meeting with the documentation department. Brief conversation with local sales rep.	Four summarised conversations with the documentation deputy, line organisation members and local sales rep. Present at report meeting. One minute of meeting from report meeting. One monthly report

Table I.
Sources of information

Observations

General

The organisation that cooperated in this study was an international project organisation, which specialised in power plant and power conversion construction. The company operated with a quasi-independent sales force, which responded to opportunities and was responsible for bid preparation, together with an appointed project team when appropriate. Projects officially started when a bid was accepted and a first down payment was made. Typically, these projects would either be turnkey projects, i.e. the full responsibility for the construction of a plant, or engineering and equipment projects, i.e. the design, procurement and transportation of materials for plant construction. Ostensibly, the size of the project (13 to 80 megawatts) and duration (eight to 16 months) reflected the complexity and cost of these projects. The nature of work at the time of this research produced the opportunity to visit projects at various stages of completion ranging from start-up to transfer (see Figure 1). The majority of

Table II. Background information on projects

Items	Alpha	Beta	Epsilon	Iota
Technical objective	Turnkey project	Turnkey project	Turnkey project	Engineering and equipment project
Time (months)	8	8	14	15
Manpower[a]	Project team 1 + senior civil engineer + site team 1	Project team 1 + senior civil engineer + site team 2	Project team 2 + senior civil engineer + site team 4	Project team 2
Size (megawatts)	~ 19	~ 13	51	80
Location	Central America	Central America	Asia	Europe
Project phase	Construction-installation	Construction-installation	Hand over	Start-up
Special circumstances	Same customer as project 2 – thus, sharing of resources	Same customer as project 1 – thus, sharing of resources.	Two phase project, with 2nd phase to follow	

Note: [a] Definition of abbreviations: Project team – one project manager + two senior engineers (electrical and mechanical), "1 and 2" refer to different identities within company; Site team 1 – site project manager + three senior site engineers (mechanical, electrical, civil) + contract engineer; Site team 2 – site project manager shared with site team 1 + three senior site engineers (mechanical, electrical, civil) + contract engineer shared with site team 1 + location manager; Site team 3 – site project manager + three senior site engineers (mechanical, electrical, civil) + contract engineer; Site team 4 – site project manager + three senior site engineers (mechanical, electrical, civil) + contract engineer projects were conducted as concurrent engineering projects even though concurrent engineering may be problematic. The firm employed the approach because it proved to be a competitive advantage. That is, it allowed customers to respond to sudden market windows (Wikström, 2000, p. 140). At the time of this study, all the projects were of concurrent engineering nature.

Under common circumstances, the organisation would have two teams working on each project. One team would be a project team that would be located at the corporate office. This team had the overall responsibility for the project, i.e., it would plan, organise, monitor and control the project. Table II shows that within the framework of this study, two corporate project teams were operating and they had responsibility for multiple projects. The site team had responsibility for operations at the physical project location. In other words, for a project such as Alpha, there would be a site team in Central America and a project team at the corporate office. Site teams were devoted to the project upon which they were working and in general did not share responsibilities with other projects. Every team in the organisation had its own project manager with the exception of Alpha and Beta projects, which shared a project manager because they were for the same customer in proximate locations. Senior engineers staffed the teams – project teams used electrical and mechanical engineers and in case of turnkey project a civil engineer; site teams were staffed with an electrical, mechanical and civil engineer as well as a contract engineer and other experts where they were needed. In terms of usual terminology, the site team would be a temporary team devoted to the project for the customer in Figure 2. The project team, on the other hand, would be part of the permanent organisation in that diagram, however, temporarily assigned to specific projects, thus representing a temporary organisation within the permanent setting.

Specific observations

As it turns out, specific observations spanned the range of progress in a project. The deviation in Iota actually was noted before contracts were signed. The two deviations in Epsilon came late in the project – during the performance test prior to transfer. The Alpha and Beta problems came between these two extremes.

Both the nature of the deviation and the time of discovery affected the timing and manner in which recovery was possible. For instance, in the Alpha project (Table III), it was discovered during the design phase that one of the control panels did not yet exist. The electrical engineer in the corporate project team could not immediately come up with the final design by himself. Other drawings included the control panel so it was necessary to make an estimate (decision or choice) in order to be able to go on with the

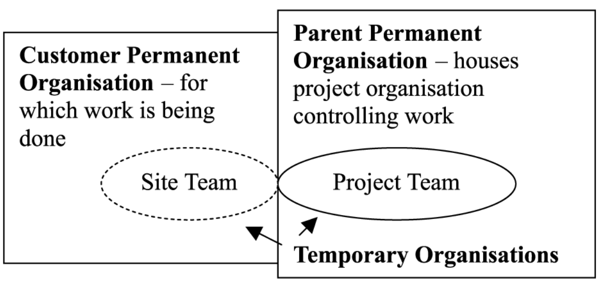

Figure 2. Temporary organisations in permanent organisations

Table III. Muddling in projects as a consequence of deviations from plan

Project	Problem	Explanation	Project muddling	Comments – temporary and final solutions
Alpha	Missing blue print	Blueprint was missing due to product development. Final solution not known until development is finished	Responsible project engineer used blueprint from previous project to estimate solution in order to proceed "Final" resolution met with finished drawings, which were relatively unaffected by interim solution	One day to come up with the temporary solution, which was to "mock up" a design on basis of past experience. Approximately 30 days from the temporary to the final, implemented solution
Beta	Transport damages	Important components were damaged during transport	Several days taken with stakeholders to determine responsibility. It took two days to ascertain damage and order new components. Certain components could be repaired, but others had to be re-ordered	It was discovered that the goods were damaged before transportation but also that the transport was severely delayed due to bad weather, bad customs clearance, and inadequate transportation capability. In the end, about two months later, the logistics company agreed to pay about a third of the money that the project manager demanded. However, they were not contractually obligated to do so
Epsilon – 1	Failing breaker	Breaker went off for no obvious reason	The site and project team tried to find a solution but had to settle with buying a new part instead of finding the explanation	Because the installation was similar to another, three days were spent trying to find defective components. Finally, a breaker was replaced by other breakers taken from other engines, and later on replaced by a new one from the supplier
Epsilon – 2	Engine variance	Extraordinary variance found during performance test	Explanation required. Plants usually run at base or peak load. Because of delay in modification, variance appeared. To be adjusted later	Approximately 15 days from the time that the deviation was observed until the customer was convinced
Iota	Language incompatibility	All required documentation found to be in language unknown to project team	The most critical problem of translation could be handled, although the problem persisted as there was too much material to translate. Translator used to resolve immediate problem of plan, but marginal deviations persist	The situation remains unresolved. Although the situation continued to be problematic and caused unnecessary deviations, only timely, temporary solutions were implemented in order to proceed with the project and the design

other drawings. In order to be able to proceed with the project, however, he made an estimation based on previous control panel. The deviation did not create much consternation at the time because there was not much that could be done in order to fix it. The most important consideration at that moment was to be able to continue with the other drawings in order to meet the deadline on the drawings. The engineer was aware that the drawing had to be updated later on. Necessity forced this decision, but he expected a final solution that was reasonably close to the current estimate. During the interview, the engineer said:

> This kind of deviation is rather easy to handle in the beginning because you have a lot of degrees of freedom before the product is put into the field. If the problem arises later, things get complex and expensive.

It took one day to come up with the temporary solution, which was to mock up a design on the basis of past experience and approximately 30 days from the temporary to the final, implemented solution.

Similarly, in Beta there was a necessity for a forced decision, but the situation was much more complex. Equipment had to be shipped to the site for installation. When it arrived, it was found to be damaged. The site manager reported this damage to the project manager, which set in motion a process of assessment and information gathering. During the first and second day, while the information was gathered, the project manager was observed talking on his phone most of the day. Penalties existed for delays in turnover, and transportation itself added several months to any replacement process. The telephone calls went to the parties involved. During one call the project manager rather angrily said that he:

> [. . .] must be able to order disregarding the responsibility of the situation.

Consequently, the temporary, expeditious solution was therefore to place orders without having a perfect estimation of the damages on the basis of the project manager's intuitive assessment of the situation. In the end, about two months later, the logistics company agreed to pay about one-third of the money that the project manager thought suitable despite the fact that they were not contractually obligated to do so.

In the Epsilon project a number of problems were encountered during the performance test stage. For one, a breaker was found to fail even though both the site and project teams could not find a probable cause for failure. Because the installation was similar to another, initial attempts were made to find defective components in the circuit. Since the failure had to be fixed before transfer of responsibility, there was no time to find the optimal solution. Thus, the approach instead focused on finding a good enough solution, which in this case was ordering a new product from the supplier and replacing the failing part. Second, there was also an extraordinary variance in engine performance found during shakedown. In this instance, an explanation was developed; plants usually operate under full power. Because that state had not been accomplished, the variance was seen. Said the project manager:

> The project got its tricky parts, which need to be thought over. We have to fix this particular problem with a document containing the explanation and then send it to the customer.

Nevertheless, it took approximately 15 days from the time that the deviation was observed until the customer was convinced. Adjustments would be made later, as would the punch-list when the customer developed their end of the installation.

While the other project's deviations occurred during the process of planning and implementation, the Iota project's problem was present from the very beginning. At the time of the contract award, it soon became apparent that only the tender document was in English. The main contract and all the appendices where in a language from a completely different language family, making it impossible for the project team to interpret. Because of the large number of pages (several thousand) and their complex nature, a simple, complete translation was not available. The most critical problem of translation could be handled although the situation persisted, as there was too much material to translate. Further, all final documentation had to be made in the foreign language. In this case, a translator was temporarily added to the site team. The translator has been used to resolve immediate problems of the plan, but marginal deviations persist. The situation remained unresolved. Although the situation continued to be problematic and caused unnecessary deviations, only timely, temporary solutions have been implemented in order to proceed with the project and the design.

Discussion

Mini-muddling

Lindblom (1959) suggested that it was not always feasible to assess all possible outcomes as a consequence of policy decisions. He thus outlined a process of successive approximations in which outcomes would be assessed subsequent to policy choice and then revised when results were available. The situations outlined here were not policy decisions, but they nonetheless had a Lindblomian aura about them. To differentiate these decisions from policy counterparts, they have been labelled as mini-muddling decisions. That is, choices were being made in which consequences were not known until progress was made. In Alpha, for instance, there was a solution that had to be found – the final drawings. Second, these drawings could not be finalised because of missing data on the control panel. Third, the engineer made estimations based on previous knowledge because situation was too sensitive to create a solution that might be farfetched. Fourth, it was perfectly known that it was an estimation that had to be updated. The second iteration developed when the final drawings were produced. When they were made it was found that the interim solution adequately provided space for the end use component.

In Beta, there was neither time nor resources available to find the perfect solution, even though it might be argued that it would not have required much more effort to do so. Nevertheless, that effort was too much to ask under the time limitations of the project. Mini-muddling in this case was about inadequate information where a decision had to be made under restricted circumstances and relied on some experience and intuition. In Iota, there was a hire, a translator to keep a step ahead of the project as it progressed. The intent was to push back total translation until a remedy could be found to which the customer could agree. Finally, there was Epsilon and the two problems at transfer. Each had to be evaluated and a remedy set. In each case, the company was working in uncharted areas. Expeditious decisions were required and expeditious decisions were made. The company knew what it cost to keep a team on site – whether they were working or not. The project team also knew the penalty costs associated with over runs in time.

The decisions made may not have been the best decisions, but they were good (enough) decisions at the time. It is suggested that muddling patterns can be observed in the cases that have been described here, which as it were, ranged across the stages in a project as shown in Figure 1. This process has been referred to as mini-muddling instead of muddling for two reasons. First, they occur relatively far down in the hierarchy of decision-making. Lindblom (1979, 1959) described his muddling process as an approach to policy making or strategy formulation. The examples came from problem resolution situations within projects for paying customers and within strict time pressures so they were made at the level required – the project manager level. Beta's deviation, for instance, brought activity in two days. Second, it is not clear that there were an inordinate number of trials, errors, and revised trials as outlined in step 4 described in the background section. Instead, many of the problems were resolved in one trial (although the temporising approach in Iota persists). Because muddling in general is learning by doing, it seemed as if there must have been prior learning by doing in these types of things for the individuals involved in these projects.

At the same time, however, it is important to note that it was only the deviations that received this muddling treatment. The rest of the projects followed a formal planning and implementation approach. It is also important to recognise that regardless of its ability to recover from these situations, the company did not display a tendency to shirk its planning discipline. It remained rigorous and despite the fact that the deviations were handled effectively, it would seem that the company would have been much happier if they had never occurred.

Evidence of learning

Simon (1996) defined learning as "any change in a system that produces a more or less permanent change in its capacity for adapting to its environment", and in this company one change was a structural one. In reflecting on this study, an impressive observation was the organisation the firm set up to handle its projects. Each project in the field had a project team at the corporate office that fielded deviations as they occurred, which has some precedence in the literature. Lindahl (2003) observed deviations at the site level in similar projects. At the operational level, his site teams constantly faced a changing context in which resources were deployed and redeployed to get the most from them. This study incorporated corporate observations also. These people were seen to have had the more general task of providing support to the site team on various occasions as was documented here.

A common observation on learning is that it tends to occur on two levels (see Sense, 2004). In this study, this general observation was also observed. First, there was the learning that had to occur as each of the deviations was handled. In Alpha, for instance, there was recognition of possible consequences if the control panel was mocked into the design. In a Simon (1996, p. 100) context, these situations would be associated with his acquiring information end of a cognitive spectrum. This step is common to any decision-making situation and although outcomes cannot be certain, they persist in a step toward rational behaviour. These steps have been associated with a Lindblomian type approach (Lindblom, 1979, 1959) because the decisions themselves could change on the basis of feedback. In fact, an essential element of scientific muddling is that improvements are sought through iterations on the basis of learning that occurs as a consequence of the decision.

The second aspect of learning observed in these cases involved the patterns in which they tended to be handled. There appeared to be a clear division of labour. There are certain problems a site team (in this study) can and cannot be expected to solve. If an axle or a cable breaks on a tractor, it must be fixed to keep the project going. Those deviations are operational. If the blue prints are incomplete, or in a foreign language, then that deficiency presents another set of problems. They require help from staff back-up. Note the common pattern in the five cases. These deviations are problems that were handled by the project team at the corporate office regardless of where they were discovered. Ekstedt *et al.* (1999, pp. 140-2) would call this development system embedded knowledge and would be effective in what they call the generation phase of learning. That is, the system adapts so that deviations of the type documented here can be handled in an expeditious manner.

With regard to the project manager with 30 years' experience, the "change and deviations" that he saw as being essential to project management were handled in these cases in an expeditious manner. Thus, organisations that have a back-up team at corporate office seem to present an effective remedy for handling unforeseen disruptions to project progress. In this regard, the reflections made by Sense (2004) about a learning architecture would seem to have an element of generality when applied to project organisations. It would be noted that although the learning architecture that he described related to intra-project learning, there are features of his five elements that relate to the present situation where learning has occurred from projects. that is, learning relationships, cognitive style, knowledge management, learning support and a pyramid of authority are important whether learning occurs within a project or within a multi-project organisation from projects.

Further, although the quality of planning is important for project success (Dvir and Lechler, 2004), it is not the planning as such that resolves the deviations that occur as described here. By definition, deviations occurred because they were unplanned. It thus is the ability of the project team to adapt to changing conditions and put knowledge into use, or alternatively develop the knowledge needed in order to produce a resolution to the problem. In this respect, one is reminded of Simon's (1996, pp. 208-10) discussion of complexity in hierarchal systems. That is, real projects may be complex in a Simon sense. Simply put, they have some underlying regularity for which plans can be made as Dvir and Lechler (2004) suggest. Separating these areas of regularity, however, are regions in which random deviations occur. These deviations need to be handled expeditiously if projects are to succeed within a framework of time, cost and quality goals.

Practical implications

It is the nature of projects that they do not always go smoothly. In fact, there is a line of thinking that suggests that not only are projects unlikely to turn out as planned, project management *is* the management of uncertain developments, i.e. the rapid response to those deviations from plan (see Nicholas, 2001, pp. 307-26). The research depended on cases and one is always cautious in generalising observations. Nevertheless, some reflections seem in order. The benefit of this study to trainers and/or managers could be threefold. First, projects are realistically complex. Organisations must therefore be set up to handle the deviations that occur in projects. They cannot be anticipated in advance. If they could, then they could be planned for. Since they cannot, then the system must be able to deal with them. Trainers can help to establish these systems. They must be ones in which the temporary and permanent organisations interact. In fact, it is not so easy to separate the temporary from the permanent. On the one hand, decisions made in the permanent setting highly influence the situation in the project, i.e. decisions regarding the resources assigned to the project and standards that are implemented affect progress. On the other hand, deviations, as evidenced in the project organisations, need to be handled by the permanent organisation in a manner consistent with overall goals of the organisation. Further, it may be within the permanent organisation locus that learning to deal with these deviations occurs. Their members see a cross section of such problems and thus have to deal with them. It is thus they who learn to treat them in an expeditious manner.

Second, employees could be encouraged to make better use of their intuition. The pattern in the cases seemed to be one in which expeditious decisions were made. Thus, it seems likely that intuition was relied on in order to reach a resolution. Simon (1996, pp. 89-90) explains intuition in terms of recognising features and the moves they suggest. Experts arrive at this feel through experience whereas novices can find the same moves (if at all) only through protracted search. The patterns of resolution appeared straightforward in these cases:

- discovery of problem (two cases by site team, three times by project team);
- problem referred upstairs to corporate office in expeditious manner;
- corporate office considered limited set of alternatives;
- a decision was made that was strongly affected by time pressure;
- the decision was implemented; and
- changes were made later that set things straight.

It may not be possible to teach intuition; that apparently comes from experience. One, however, can encourage confidence and curiosity. In fact, a line manager offhandedly in this study said that in order to be a project manager, one needs to be curious (his term) and be able to do a lot of things well. In as much as these deviations had interim treatments that had final resolutions, it seems that moving on quickly minimised cost exposure. Courage to make expeditious decisions can be encouraged, thus encouraging intuition, and success will further encourage expeditious remedies.

Finally, something might be said about the nature of deviations themselves. The context of the study has appeared to emphasise their negative nature. In reality, however, they may have a positive characteristic. That is, they extend the opportunity for the organisation to learn. Success in each of these cases has tended to make the organisation more of a quick-response firm.

Conclusion

A study has been described in which a project organisation has learned to deal with deviations that occur. These deviations did not tend to form at any one stage of the project cycle, but rather examples were found that occurred in each stage. A clear pattern was observed that reminded us of the scientific muddling described by Lindblom (1959). For concerns in relative importance and simplicity, the patterns of remedy observed here have been referred to as mini-muddling. Learning occurred within the workplace in two ways. First, because muddling is a learning by doing approach, learning occurred with regard to how to handle random problems. Second, learning also occurred with regard to how these problems can (should) be handled in general. The recognition of these developments represents the contribution to the understanding of real projects. On the other hand, the study had apparent practical applications. The system set up tended to handle these problems well. Thus, similar organisations may be encouraged. Further, because expeditious treatment was at a premium, greater use of intuition might be encouraged.

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