

‘IRON TRIANGLES’ OR ‘HOLY TRINITIES’: ‘TIME’ OR ‘TEMPORALITY’ IN CONSTRUCTION PROJECT MANAGEMENT

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Time is presented as unproblematic in construction. There is a view that participants share a linear and rational view of time. Given the range of players in construction the realism of this is questioned. A literature review focuses on possible conflicting perspectives on time in a project. A comparison is offered between 1950s Tavistock research into coalmining and construction in the 1960s and the Building Industry Communications Research Project, both Socio-technical in inspiration. Temporal/spatial dispersal of production and the instability of the organizational ground undermine production-engineering approaches but permit access to the problem of time. More recent publications are drawn into the paper, which raises wider issues as a prelude to research.

Keywords: heterogeneity, inferential, qualitative, time.

INTRODUCTION

The paper reviews a literature on time in organizations, comparing Tavistock work on mining and construction in relation to spatio-temporal co-ordination. Problems of time in construction add ‘temporo-spatial fragmentation’ to other ‘fragmentations’. Reciprocal Interdependence in mining operations disturbs the organizational ground undermining bounded rationality. To maintain the system required, “... a common skill of a higher order...” (Trist and Bamforth 1951). Is construction the same? If so, is this ‘common skill’ project management or ‘tacit co-ordination’ (Stringer 1967), a negotiated order, which allows participants to ‘serve the time’ of their transient sub-contract? Do theories, which seek “...universal time-space free solutions to economic and social problems through frameworks...often technocratic, individual, utopian, linear and rationalistic.” (Clark 2000) operate in construction? What are their effects?

Kolb (1984) reports the understanding of time derived by Piaget. In classical mechanics speed and time are co-equal, measured in relation to space. In relativistic mechanics speed is more elementary since it has a maximum velocity. Einstein asked Piaget “...to investigate...whether there was a sense of speed that was independent of time and...more fundamental. Piaget...found that speed was the more basic notion based on perception...time is a more inferential, complex ...” and abstract construct. Einstein implies “...there is no universal time...experience runs differently for the traveller and the stay - at - home and so for each of us on his own path.” confirming Leibniz: “I hold space to be something purely relative as time is.” (Bronowski 1973)

HASSARD'S REVIEW OF TIME

Hassard (1997) reviews metaphors of time: the Cycle and fluctuating rhythms and the Line and clock rhythms. Ontologically he discusses Time and existence, epistemologically Time and understanding, interpreting time along three dimensions:

- As an external, objective fact vs. as a subjective essence, socially constructed.
- Homogeneous time vs. heterogeneous time
- Time as unitary and quantitative vs. time as manifold and qualitative

Linear time is progressive and rational; commodified in the market, compressed by the efficiency of specialization and conceived as money; a limited resource and a valuable commodity, in settings of reciprocal appropriation and synchronization. Factory settings induce temporal rigidification and standardization. Man is synchronized to the work: "...technical determinism dominates modern perceptions... arithmetic equations...offer...finite limits and optimal solutions to temporal structuring. " Visible, standardized clock time provides an organizing framework to synchronize activities. It commodifies and finely controls labour as a factor of production through Scientific Management. Quantitative Time Reckoning emphasizes scarcity and stewardship. Rational time is "...a **boundary condition** of the employment relation...an objective parameter rather than an experiential state." Precise structuring and distribution of temporal assets in organizations are ideal.

Qualitative time reckoning suggests the world includes self-paced work processes. New employment forms and boundary spanning organizational functions imply temporal flexibility. Professional roles retain flexible, event-based trajectories. Non-professional roles including crisis and maintenance functions operate within irregular, partly self-determined and heterogeneous time settings. Employer time structuring practices are complex and less deterministic. Socio-technical theory emphasizes temporal autonomy, with time structuring in the hands of those within semi-autonomous work settings. Work groups construct their own time-reckoning systems. Manufacturing time involves bounded rationality subject to the contingencies and limits of every day practice. External chaos deprives market based post-modern organizations of long-term horizons. "...temporal strategies...seldom equate with ideal calculations..." Time compression reverts readily to loosely coupled models.

In French writing time is a form of collective consciousness, symbolic of the social and its rhythms. American writers identify time as fragmented and reconstituted at the level of society: social time is qualitatively different as a category of thought. Time reckoning is a pluralistic group activity. Gurvitch develops a complex, plural typology of Time differentiated between social groups and classes. Ethnographic research reveals time strategies of workers to mitigate boredom and contest management control. Temporal/Structural Repertoire (Clark 2000) reflects differences in the 'Phase intensity' of work with degrees of self-regulation and management control. 'Structural Pose', the tacit, experiential rules of conduct, reflects recurrent sequences of actions related to shifts in context, which require innovatory responses; a time reckoning related to strategic, cyclic, event based trajectories.

Western time concepts reflect functionalism, specialization, formalization and rationality. The temporal patterning of an actors multiple actions creates three key co-ordination problems: internally, in relation to those of other actors and in relation to other objects or events. These involve: reduction of temporal uncertainty, requiring

schedules, conflicts over activities, requiring synchronization and allocation of scarce time, requiring distributional efficiency. Organizations must buffer their operational core against uncertainty to attain bounded rationality (Thompson 1967) as a pre-condition for resolving problems of time structuring. Pooled, sequential and reciprocal interdependence require standardization, planning and mutual adjustment in sequence. These contain the others, implying increasing costs of co-ordination and resources of time. The most formally efficient structure works from reciprocal interdependence to serial and pooled interdependence.

Size implies greater specialization and complexity. Performance for functional efficiency of an activity is at the expense of integration. Specialization fixes activities rigidly, creates pressure to automate and violates its own key premise, the interchangeability of parts. Larger systems are more demanding spatially and temporally generating formal synchronization. Implicit rules, previously indexed to individuals, become formalized and tied to specific roles. Expected behaviour is objectified onto functions in the structure. The role acts and formal procedures permit more explicit synchronization. Such tight coupling is not universal. "...many organizational activities...require the synchronizing of individuals - as subjective actors - as well as of processes...by the organic...developing (of) implicit (regulatory) norms." mitigating the economic costs and social dissatisfactions of poor synchronization. Time scarcity involves efficient matching of tasks to limited time slots through prioritization with problems of role overload and perceived scarcity of time relative to task. Time precision is double-edged: functional specialization; temporal and spatial segregation, synchronization and time measurement eventually conflict. More tightly synchronized and scheduled activities may conflict with perceived scarcity of time in each role, the precision of synchronization and strains on role boundaries.

TAVISTOCK ON MINING AND CONSTRUCTION

Trist and Bamforth (1951) report the transition between craft, hand-got production of coal and the mechanized long-wall method, which never realized its production engineering potential. The production cycle was extended significantly and the responsible autonomy of the craft process was lost. This aligned methods, organization and legal constraints within the face-to-face, self-managing workgroup; its context of time, space and darkness; the absence of intermediate management and the moral intensity of the community. Long-wall technology replaced this with a large working group 'organized' by intermediate managers. In this "...large-scale mobile layout...the spatio-temporal structure of the long face and the shift sequence makes a difficult habitat when considered as a theatre of communication and good working relationships...between forty men, their shot firer and shift deputies...the scale...of the task transcends the limits of simple spatio-temporal structure...under which those concerned can complete a job in one place at one time..."

Differentiation and interdependence of tasks was exacerbated by engineering difficulties and the social disintegration of the workforce. The system "...vulnerable to its need for one hundred per cent performance at each step..." was inimical to the stability of the 'organizational ground'. Tight coupling fed disturbances in production into the organizational framework: a tendency to crisis management in a "...system always working to some extent against the threat of its own breakdown..." Maintaining stability in the 'ground' implied "...a common skill of a higher order than that required to simply to carry out, as such, any of the operations belonging to the

production cycle.” The simplicity and stability of the hand-got system buffered the operational core of the colliery assisting bounded rationality in the ‘organizational ground’. The long-wall system required greater effort and skill to attain similar bounded rationality. The miners significantly initiated learning it. Their reflexivity “...(a) capacity of actors to modify present action by imagining its consequences based on previous experiences...” (Clark 2000) recovered and adapted certain features of the hand-got system. The sociological boundedness of the wider community and the stable political economy of government support assisted this organizational creativity of a traditional working class community.

A COMPARISON WITH CONSTRUCTION: SPATIAL DISPERSION

Comparing coal and construction raises questions about stability in the outer and inner contexts of construction firms and projects in relation to project operations. Construction is similar to mining, discounting underground conditions and the anxieties they induce, in the masculine work force and the intrinsic difficulties of its spatio-temporal structure. Gilbreth attempted to develop Scientific Management to rationalize diversity of methods amongst bricklayers. Distance of sites from head office undermined his ‘Field System’, which took the separation of planning and working to a logical conclusion and failed (Pollard 1974). Alsop (1964) compares the spatial dispersion of agriculture to construction. Groak (1994) views construction as ‘a population of projects’. Construction is a set of shifting figures (projects) on a shifting sociological ground (Trist 1976). Instability of the organizational ground of the project is implied. Production, that is subcontracts, is a set of shifting figures in a world of stratified instabilities, sociologically derived at first and then self-induced.

TIME IN CONSTRUCTION: THE INSTABILITY OF OPERATIONS AND THE PROJECT

Post-war reports on construction are preoccupied with time compression (Wild 2002a) through management control. Higgin and Jessop (1965) use time diagnostically. Their model of linear communications is fragmented by external forces, acting through construction project role systems. Serial interdependence is transformed into reciprocal interdependence by the conservative ideologies of construction organizations and shifting social forces. Uncertainty and Interdependence (Crichton 1966) demonstrates the effects on an ideal operational decision process. Optimum functioning of operations implies “...certain inherent qualities...that any control system must take account of if...” Constant, comprehensive attention and feedback are critical for a valid, timely sequence of decisions. Problems of time structuring are not easily reduced to clarity of means and ends within serial interdependence (Thompson 1967). Reciprocal interdependence is intrinsically more expensive to co-ordinate implying difficulties with process approaches. Feedback forces projects towards their origin in design (Crichton 1966) - time compression in reverse.

In this formally serial process, responsibility for the effectiveness of communications has to be handed on from phase to phase. Due to ‘Fragmentation’ it becomes a reciprocal process requiring high skills among the parties as the condition for bounded rationality. Reciprocal interdependence diverts attention and resources down the line of prior decisions disturbing cost and quality, which may be sacrificed in crisis driven recovery processes, inducing further uncertainty. Serial interdependence underpins the false coherence (Wild 2002b) of prescriptions for solving construction ‘problems’.

External instability, institutional fragmentation and reciprocal interdependence in production explain its under-boundedness. Production engineering models draw government construction policy into a linear time paradigm, a conventional wisdom (Boyd and Wild 1999) around a discourse of a self-fragmenting industry.

TIME, SCIENTIFIC MANAGEMENT AND CONSTRUCTION 1945 -70

Britain adopted Scientific Management slowly and patchily. Rationalization reflected expansion of new industries and decline of the staples. Bedaux was the dominant approach. It limited "...the restructuring of management...and enabled the control system to be clipped onto the existing management structure...the traditional assembly industries, such as building were not affected ...” (Littler 1982). Pre-war unemployment resolved organizational problems, absorbing indeterminacies, guaranteeing flexibility and obviating any need for costly planning systems. Wartime denied construction the systematization of other industries (Phillips 1950). Construction from 1945 had to re-establish a work force of changing skills. Electrical contractors doubled from 1945 to 1949 indicating the post-war role of electrification. In the 1960s systematic management was restricted. Emmerson (1962) reported 14% of operatives on incentive schemes compared to 42% of manufacturing. NBPI (1968) showed 33% of craftsmen and 47% of labourers received a variable bonus related to output. Most PBR schemes were weakly managed indicating constructions inability to accept transferred ‘solutions to its problems’.

Crichton (1966) reported the “...uncritical and inappropriate application of techniques of ‘scientific management’. We have yet to see these techniques used as true planning tools. Usually they are abandoned in the face of the inevitable uncertainties encountered. At best they are kept up to date after the event as a record... inappropriate use of mechanistic management tools such as the critical path method ...leads to antagonism to all control techniques...” Higgin and Jessop (1965) used operational research to investigate functional relationships and communications and compress pre-construction time using concurrent processes. Such methods were context dependent. While greater formal efficiency was possible through a sole co-ordinator, existing interests, values and power relationships undermined this. The critical importance of reciprocal communications processes has been discussed.

TIME RECKONING IN CONSTRUCTION

Construction demonstrates diversity of organizational cultures (Lansley 1994), and personal and professional constructs (Boyd and Wild 1996). How do these relate to the analysis of time? Time Reckoning systems (Clark 2000) are institutionally located and substantively rational. The evolution of management (Teulings 1986) suggests four functions whose time frames range from long to short term:

- Ownership
- Allocation of investment
- Innovations and product market development
- Operations and the labour process

Their problematic alignment, if resolved, is a source of competitive advantage. In construction temporal alignment is intrinsically weak. Investment decisions, design and innovation lie outside the construction firm. Production is sub contracted and project transience is normal although the implicit strategies for reducing uncertainty of those who work in the game, ameliorates the effects (Beardsworth et.al.1988). Informal long-term relationships and trust transform the subcontract into a quasi firm, with responsible autonomy in the project. This temporal autonomy results from the clash of strategic concerns at the apex of construction firms with cost and flexibility which support subcontracting, with difficulties of supervision and control on site. The site is a local arena for problems of time in relation to activity schedules. The limited time horizon of the project inhibits conventional, systematic management.

Motivation on site requires time to build trust, hence the preference for a team of core workers to transfer from site to site. The unpredictable flow of activity constrains continuity amongst direct production workers. Activity density: the problematic concentration of work into limited physical space creates congestion, overlapping activities and conflicts within an improvised production process. Attempts to compress time induce greater density of activity against limited available space. Value conflicts over priorities and access induce a directive style of management. Critical path methods presenting event sequences as parallels clash with spatial constraints.

Construction is subcontracted for reasons of cost, technical and labour market factors. Unfamiliarity of people is a source of instability. This cuts both ways in production, affecting the dynamics of power relationships, surveillance and expectations of performance within a game of wider discretion played due to the indirect character of management. Long-term networks buttress market relationships, build trust and induce higher performance and quality. Varying market conditions influence power and dependence relationships. The site manager role reflects a short-term industry with a fragmented division of labour in a sub contracted setting. 3 - 4 men's work is concentrated in one role with pressures from the client, firm and the value of the job. In a fragile environment he is at the mercy of the weather, material deliveries, and problems with labour and problems for getting information:

“This is an industry without understanding. We don't understand people. We don't want to understand, we haven't got time to understand...”,
(Beardsworth et al 1988).

Too much time is spent accommodating and dealing with multiple demands in a temporally limited context. Yet there is clarity about the expectations placed upon them. Role ambiguity and lack of authority are not issues of great significance for these site managers (Beardsworth et al 1988).

The 1990s crisis in architecture (Danks, Shephard and Wild 1998) forced a focus on finance, clients, costs and time using IT. Relationships with clients are actively managed to ensure cash flow. Larger practices accumulate financial information for bids. Partnership and senior time is committed to these problems, supported by information systems and external partnerships with consultants, finance specialists and clients. Different practices reflect personalities and organizational histories. Reflective time is spent understanding the uncertainties, which surround work. Networking with selected consultancies is preferred. Specialist services around project finance and client uncertainty about money are provided through relationships with preferred financial institutions. Advice on the CDM Regulations and the lifecycle of buildings

offer the opportunity to sell on a time charged basis. These are ‘...a structural pose...’ (Clark 2000) a new attention to time and iterative planning.

Medium sized privately owned regional construction firms reflect a strategic recipe (Spender 1989). The firm is ‘bought out’ of direct regulation by financial markets by its management and reserves allow you to buy time to build relationships. Design and Build operates partly through partnering with architects but with detail in house. Short and long-term orientations are crucial and these operate at different levels of the construction system. Financial markets regulate metropolitan construction firms in the investment market. Other sectors seek stability and a practical realization of ‘Trust and Money’ (Latham 1993) through tactics for reducing uncertainty within local and regional contexts. Do these contexts lack the formal managerial time of Latham (1994) and Egan (1998) creating an implicit collaborative order (Gray 1989), which underpins initiatives such as Construction Productivity Network? Do m4i and CBPP represent a recursive (Clark 2000) past of institutional fragmentation and official ignorance (Wild 2003), and a proliferation of initiatives under the patronage of ‘powerful characters’? The briefest discussion of time raises important questions.

Evans (1994) argues that the milestone chart is crucial in diagnosing project failure. The literature emphasises a balanced focus on objectives. Is this misleading? Do contingencies around cost, quality and external pressures (Vaughan 1996) stack up against project schedules? Are procedures for time, cost and quality dealing with analytically and substantively distinct logics, which hide beneath a nominal formal rationality? Would sophisticated time reckoning (Clark 2000) constitute appreciation of ‘thick’ qualitative rather than ‘thin’ quantitative information? (Mintzberg 1989). Bissell (1998) argues for judgment by the project manager. Procedures are necessary but not sufficient. This is ‘Diagnostic use of Concepts’ (Boyatzis 1982).

What appreciations of time operate in construction? ...laying a brick...the temporal short-sight and limited function of the subcontractor...the ‘day work antenna’ of the labour only ganger...the overlapping scenarios of the project manager...the temporally structured uncertainties of the client as the false coherence of the expenditure ‘S curve’ decomposes into phases of investment inducing crises in the shifting inner context of the client...the fifty year life cycle of buildings...the eternity of ‘great’ architecture? What happens to reflexivity in a crisis? Do players in the game have time to mobilise past experience? Do they negotiate around their conventions, uncritically recycling experience (Boyd and Wild 1996)? What is the psychological content of cycles of recursive-ness and improvisation in projects? (Clark 2000) Do we know which and whose time constructs are inside or outside the project, at which levels and functions of management? Do strategic time calculations correspond among clients and construction firms? Is an initial view of ‘...strategic time reckoning...’ in construction available?

Wild (2001) argues that project management roles must be found, made and taken. This action must be replicated to maintain the project organization against temporal transience and conflicting time constructs. These have to be aligned as the project migrates haltingly along its nominal critical path through a ‘Plurality of Social Systems’. (Burns 1966) The project manager develops a personal form of social forecasting, a set of ‘...overlapping temporal gestalts...’ (Emery 1974) to tacitly coordinate the project as multiple, shifting and overlapping presents. Sharifi (1988) emphasises a similar *in times* approach: a ‘Chunking of time...’ and the “...organizational temporal context as a spread of experienced past events, perceived

present events and anticipated future events...” which provides a framework for the politicking and networking of managerial activities. These templates and interpretations are personal constructs (Boyd and Wild 1996), which relate to recurrence and non-recurrence. Construction management requires advance recognition of discontinuities as the basis for adaptive action. Connaughton and Mbugua (2003) and Male (2003) establish the heterogeneity of time in 1980s reports pre-occupied with time compression. Male (2003) reports a contingent “...unique optimum time...” for each project. However “...customers often had widely differing views and expectations on pre-construction and construction times...” (Male 2003) suggesting that temporal heterogeneity may also be ‘Uncertainty over Governing Values’ (Friend 1997) and a source of disturbances.

CONCLUSION

Discussions of construction from a Socio-technical perspective on time reveal ‘disintegration’ and ‘disorganization’. The mutual constraints of the social and technical revealed by studies of changing mining systems and their potential for reflexive social learning among the parties are replicated in construction with wider ranging considerations of time present. These generate the streams of disturbances, which constitute the pragmatic reality of time management in projects possibly indicating why, although past experience yields creativity, there is no retention of learning. Participants in the project overcome the situation but their varying time perspectives are unaligned externally.

Where does this leave the metaphors of the title? Is Time a constraint, a fragmenting ‘iron in the soul’ of the construction machine? Does its abstraction and complexity render it virtual and ‘holy’ with the ultimate criteria of judgement as ‘Getting the project out on time’? Yet lest we assume that the original sin of heterogeneity affects time alone in the ‘Iron Trinity’ the Archives of the Building Industry Communications Research Project (1963 –66) contain this statement: “ The lack of formal links between the different Directive Functions was exemplified by three different costing systems: cost planning in terms of elements, by trades in the bill of quantities and by certificates etc. in final accounts. Effective comparison between these three was not possible.” Since ‘time is money’ then the ultimate judgement may be private to the hubristic, semi-mechanised masculinity, which really delivers projects.

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