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HARD, SOFT OR LEAN? PLANNING ON MEDIUM SIZE CONSTRUCTION PROJECTS.

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In a paper presented to the 11th Annual ARCOM Conference, Johansen examined the way that managers and planners in medium sized construction projects plan in a flexible manner. This was termed 'soft planning' and contrasted with the textbook approach which was termed 'hard' planning. The fundamental components of hard planning are firm dates and critical activities. The reality was found to be quite different from the textbook approach. (Johansen, 1996a) The conclusion then, was that methods of soft planning methodologies should be developed to support what was actually happening. Here this conclusion is revised in the light of lean production concepts. After defining these concepts, the authors consider how they can affect the development of planning theories in construction; in particular, how concepts such as "shielding", "lookahead planning" and "last planner" can allow managers to overcome the barriers to hard planning.

Keywords: Hard/Soft Planning, Lean Construction, Last Planner, Lookahead Planning

INTRODUCTION

Johansen (1996a) describes an investigation into the reality of planning on medium sized building projects, and argues that planning was not being carried out in a rigid 'hard' manner but that those who produced plans were using what was termed 'soft' methods. He concludes that for most managers in this situation the reality was that the textbook (hard) methods of planning were impossible to achieve; that this should be accepted as *fait accompli*; and the research community should concentrate on developing alternative techniques to support the soft approach. The assumption was that the barriers identified as impeding the achievement of hard plans were insurmountable. On the other hand, the paper did not question whether there was any merit to the soft approach. It simply identified its existence. Recently, the publication of 'Rethinking Construction' (Construction Industry Task Force, 1998) has aroused the U.K. industry's interest in Lean Production, and prompted efforts to access research into Lean Thinking, such as that carried out by Womack and Jones (1996). This paper considers whether the application of Lean Thinking to construction can overcome the barriers to hard textbook planning.

The original paper

Johansen's paper (1996a) was based upon a longitudinal study of planning on medium size construction projects. The data collection was by semi-structured interview and observation and its analysis was by qualitative methods being particularly based upon the Grounded Theory approach, in which the theory developed from the researcher's interaction with the data rather than from outside imposition.

Previous literature had revealed two opposing approaches to planning. The first, which was supported in the teaching of planning in construction, was the production of rigid plans which highlighted and allowed monitoring of the critical activities. The second approach was based upon the belief that rigid methods could not be successful in dealing with an uncertain and complex future (Johansen, 1996b). The second approach, while the subject of considerable discussion in research papers, found little expression in the developed techniques which were being passed on in teaching or training.

Discrepancies were found between the way planning was actually done, and the textbook approach which managers and planners professed to follow. These discrepancies were found in five areas:- information gathering; the use of performance data; the planning method; the identification of critical activities; and the calculation of critical activities. Johansen (1996a) grouped these into PLAN CALCULATION (comprising the first three areas) and CRITICALITY ASSESSMENT (comprising the last two). They are considered briefly below.

Plan calculation

The way programmes were produced was similar on all projects. Uncertainty was acknowledged as existing throughout the construction process particularly in the availability of good quality performance data and in the time available to produce plans. Most companies relied much more on experience and what were called *guesstimates* or *gut feelings* than on calculated durations based on quality performance data. The observed strategy for overcoming this uncertainty was to introduce soft/flexible decisions about individual activities by adding an element of float into each activity. The managers appeared to make subjective experiential judgements of the achievability of durations. Any they were unsure about had a hidden (unpublicised) float added.

The paper observed that managers appeared to be assuming that the accuracy of plans was always suspect because of the endemic uncertainty in construction. Because of this they were planning within their perceived limits of uncertainty, which the paper termed "Soft" planning.

Criticality Assessment

Criticality was considered to be closely associated with planning accuracy which in turn affected the judgement of planning. Construction planning was seen as uncertain because of; client and design team relations, trust and confidence in the subcontractors, the perception of the manager of the quality of any existing plans and problems with information flow. These influences affected the strategies used by managers in producing

and communicating plans. Their strategy was to build in flexibility. The person producing the plan became a “soft analyst” (Mintzberg, 1995) looking for the widest possibilities available for activity durations and sequence logic.

As with Plan Calculation, decisions on float and criticality were usually based on “gut feeling” or experiential factors. Critical activities often had “safety zones” built in. Dates which were publicised as being “firm” had an in-built, undeclared flexibility. Criticality decisions were, again, based heavily on experience with little factual back up. This was also profoundly affected by the choice of bar charts, in all cases, as the method of expression of the plans because this method does not allow for accurate calculation of criticality, which is “kept in the head”.

Conclusions of the original study

The paper concluded that the textbook model of construction planning was based on a HARD approach. This suggested that work is broken down into activities and information is gathered in as accurate a form as possible and, taken with accurate performance data, is used to calculate the durations of these activities. The logical and sequential relationships between these activities can then be established using network based techniques. This produces plans which are as accurate as possible within the constraints of the project at the time of plan production. It further concluded that in reality the pressures of uncertainty in the construction process mean that the textbook model is not used although it is spoken of as if it is. The plan is rooted in an acceptance that it will not be accurate. The key reasons for this are:

1. Information is uncertain
2. Plans are produced under time pressure and the heavy commitment needed for accurate planning is not available
3. The bar chart is used because it is easy to understand and produce. This allows float and criticality to be produced in an informal, unmeasured manner
4. There is a lack of accurate, easily obtained performance data
5. The planning horizon in uncertain situations means the plans may be produced too far ahead to be achievable yet they are used for interpretation of very important dates.

The results are that planning strategies involve over assessing durations and alternating logic to give float to items which are stated as being critical. This is to give as much hidden flexibility as possible. This concept was named SOFT planning

PROBLEMS WITH THE SOFT APPROACH TO PLANNING

While the Soft planning approach was observed as existing and being used in real construction planning it can be argued that, in fact, it is simply a reaction to circumstances and not the root of a new planning requirement. It is difficult to consider how techniques can be developed to support the soft approach. The definition of planning that was accepted as the basis for Johansen’s work was:

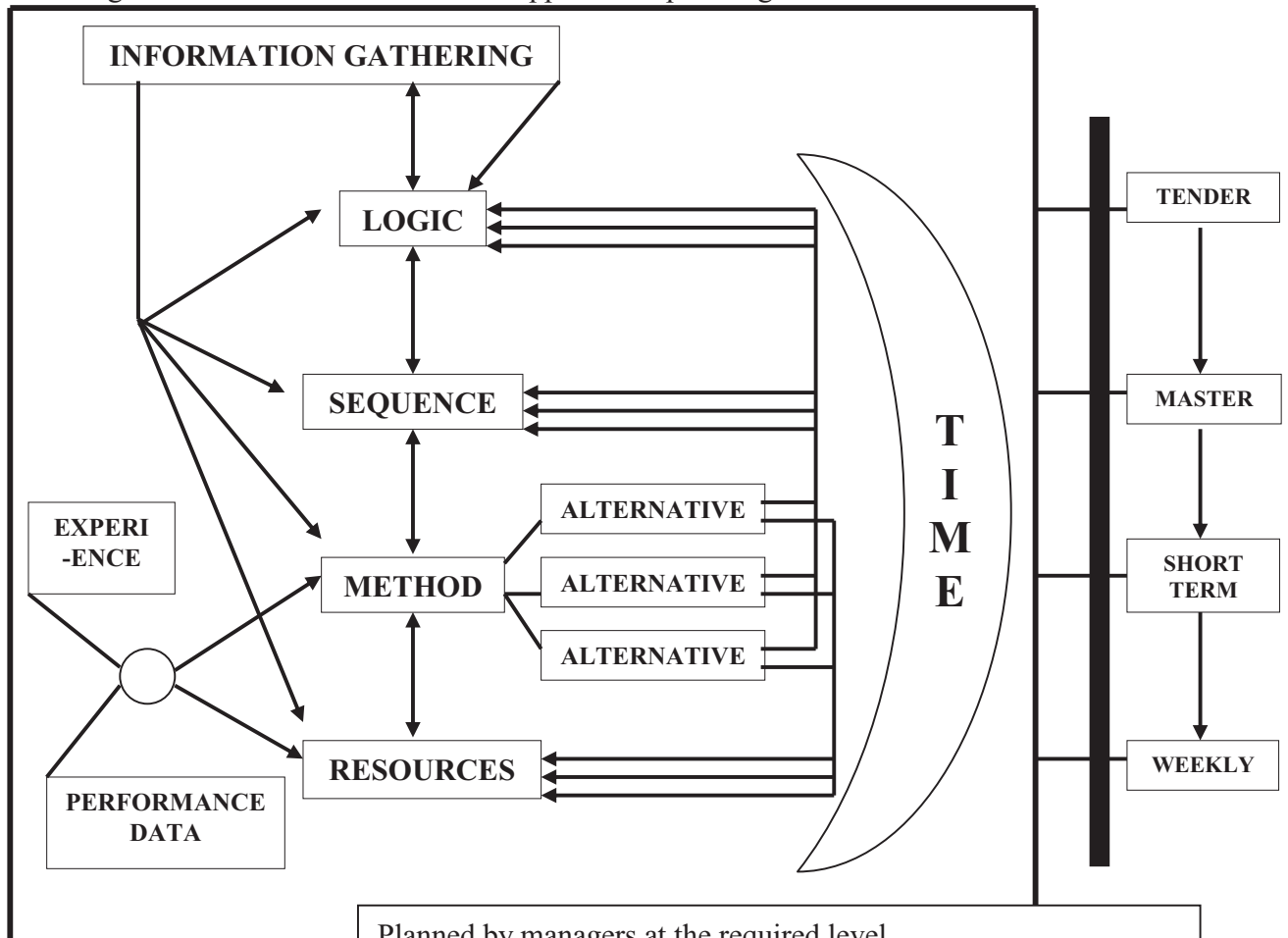
“...the definition of future action (including methods of achievement) by making decisions based on current state information and that, as a management process, it is closely linked with control.”(Johansen, 1996b).

The soft approach does try to define “*future action*” and it can be argued in a more realistic way than hard planning because it acknowledges the uncertainty caused by *current state information*” and the planning horizon. However, in terms of the definition of “*methods of achievement*” and the use of the plan for “*control*” purposes it is lacking. One of the reasons for the use of soft planning appears to be the lack of information and performance data which means that deep consideration of alternative methods and production of accurate durations is impossible. It would seem that the nature of soft planning is to accept that certainty cannot be produced yet certainty is needed if planning is to succeed. The control cycle requires measurement against yardsticks and if the yardsticks are uncertain how can the control be of any value? The original research did not measure in any detail the achievement of plans but acknowledged that managers and planners accepted they were likely to be unachievable. The use of soft plans was in part to make sure that the loose interpretation involved ensured that management could not be criticised for lack of achievement of planning targets. How this related to any major planning milestones (in particular project completion) was also not considered in detail but it was acknowledged that these milestones were prominent in managers’ minds. It can be argued that plans were produced because they were deemed necessary but they were only loosely related to the achievement of real milestones. In addition, managers knew that accurate planning required time and effort but they did not believe that accurate plans were achievable so they were unwilling to put in the time and effort required; a vicious circle.

The dichotomy appears to be that planning requires certainty to be useful which is what the hard approach tries to achieve. However, the nature of the industry and the process is such that the hard approach is rejected by those who plan because it does not produce achievable plans. The soft approach has developed informally to allow plans to be produced which give an appearance of well planned and controlled projects but which in reality lack much certainty and are therefore of little use. Faniran *et al* (1997) mention four approaches to planning; satisficing, optimising, contingency and responsiveness. It would appear that soft planning has common factors with the satisficing model; minimum time and effort goes into planning, there is little information gathering, and plans are adjusted to actual performance with little consideration of alternatives. However, on the positive side, it also shows signs of commonality with responsiveness planning in trying to introduce flexibility.

Figure 1 is an attempt to model the process as it should exist (a textbook approach) and to identify what really happens. This should assist in considering hard and soft planning in the light of Lean issues.

Figure 1 - A model of the textbook approach to planning



Planned by managers at the required level
 With technical and information gathering support
 So logic, sequence and method are owned by those who ensure plan achievement
 Based on accurate calculation of resources and durations
 Gangs of workers are informed of their expected performance
 Management have accurate control measures
 Suppliers can be informed early of delivery requirements

The reality is:
 Uncertainty is inherent throughout the process
 The planning horizon is long which adds to uncertainty
 Managers do not have the time to be fully involved in accurate planning
 There is little information gathering + little input from subcontractors and suppliers
 Time is based on guesstimation and experience giving inaccurate durations
 There is little consideration of alternative methods
 Activity durations and overlaps are “fudged”
 Achievement of individual activity plans is low

THE DEVELOPMENT OF A 'LEAN' APPROACH

The concept of lean production first came to prominence through the publication of the book "The machine that changed the world" (Womack *et al*, 1990). This book described the main findings of a five year study by the International Motor Vehicle Program into worlds motor vehicle industries. The term "lean production" was first used by an IMVP researcher John Krafcik and it was termed "lean" because, in comparison with mass production it used "*less of everything*". The book identified good and bad practice within the motor industry and particularly used the Toyota production system as the model of best lean practice. However, two of the books authors later decided that the original research, while giving detailed analysis and descriptions of what lean production was about, had not really defined a set of key principles. They set out to do this in a follow up book Lean Thinking (Womack and Jones, 1996). This summarised lean thinking in five principles: precisely specify *value* by specific product, identify the *value stream* for each product, make value *flow* without interruptions, let the customer *pull* value from the producer and pursue *perfection*. Goldratt (1984) approached the problems of manufacturing production from different perspectives and, before the term lean production was coined, developed theories which have some similarities to lean. In The Goal (1984) and later publications he developed the Theory of Constraints (TOC) which is a set of management principles that help to identify impediments to a company's goal(s) and effect the changes necessary to remove them. It proposed that a production system's performance will be constrained by the least productive steps (the strength of any chain is dependant upon its weakest link). In the TOC system there are three elements: Throughput (the rate at which a system generates money through sales), Inventory (all funds that the system has invested in purchasing things that it intends to sell), and Operational Expense (all funds the system spends in order to turn inventory into throughput) are the three operational measures by which the performance of any profit-making organisation should be gauged. Improvement is made by increasing Throughput, reducing Inventory, and reducing Operating Expense. This is similar to the lean approach in its concentration on removing waste from the process and identifying what is the purpose of the business. The lean approach has been the subject of further research to consider its application to the construction industry. This has been categorised as Lean Construction. The report Rethinking Construction, produced by Sir John Egan (1998) gave particular prominence to Lean Thinking and Lean Construction.

Lean Construction

Construction is seen as being more closely related to a manufacturer's production development process rather than a factory production process (Howell and Ballard, 1996a). This is based on an acknowledgement that design and construction must be closely linked and that lean construction "*..demands concurrent design of product and process.*" (Howell and Ballard, 1999a). Koskela (1992) described the conventional production philosophy as being a conversion process where inputs convert to outputs. Koskela and Houvila (1997) propose three processes; the conversion process, the flow process and the value generation process. Howell and Ballard, (1998) argue that the flow

and value models are the centre of what they call the lean revolution. This is where the flow of materials and information assist in reduction of waste while value comes from negotiating between ends and means for the customer. They also propose that construction projects range from the slow and certain to the quick, uncertain and complex (dynamic). The projects involved in Johansen's study (1996a) are all in the latter category and anecdotal evidence suggests that for medium size projects in the UK this would be a common description. The conversion model of construction (Koskela, 1992) identifies construction as being based on sequential activities. In this, separate responsibilities for activities exist which rely on each group being responsible for how they achieve their own objectives and project management do not care how this is achieved as long as the "commitment" is met (Howell and Ballard, 1999b). The commitment is driven from the front and control consists of checking the result then looking backwards to identify fault if achievement is not reached. This up front "pushing" has already been seen as causing problems in uncertain environments in Johansen's research (1996a).

Lean construction fundamentally differs from the conventional model of optimising the project on an individual activity basis which assumes that increasing the speed and reducing the cost of each activity gives a better project outcome. (Howell and Ballard, 1999b) believe that a reliable flow of work (throughput) is more important than individual activity speed (point speed) and the cost of individual activities. They believe that lean construction differs because it:

1. *Has a clear set of objectives for the delivery process*
2. *Is aimed at maximising performance at the project level*
3. *Designs concurrently product and process*
4. *Applies production control throughout the life of the project*

They also believe that "*.. the primary concerns of lean construction are ignored in current construction practice*" (Howell and Ballard, 1999b)

For this paper it is the area of production control and the developments from lean construction research which are most important, indeed, Howell and Ballard, (1998) point out that for dynamic construction under lean principles "*..it is necessary to develop standard procedures for planning and managing the design and installation of unique facilities.*"

Lean Planning

The lean approach to planning can be considered by starting with ²Howell and Ballard's (1996b) theory about controls. They consider the construction model of control to be about project control not production control. They describe the "*classic*" approach to control as one of relating what SHOULD happen against what DID. They particularly acknowledge that the method and accuracy of measurement may result in mis-reporting and that under this system it is assumed that this is because of "*evil intent*". They believe that for the classical system to work requires highly accurate yardsticks to be set under the SHOULD category. They further state that in situations of high uncertainty the yardstick quality reduces and large buffers are provided to assure flexibility which results in unpredictability in downstream work flows. This theory seems to fit closely to the

problems identified in Johansen's paper and the use of soft planning. The soft planning approach has already been described as a method of ensuring that management could not be criticised for lack of achievement of planning targets which would seem to meet the classical systems ideas of evil intent. In addition the soft plan and its introduction of "*float in everything*" can be described as adding large buffers to ensure flexibility. Howell and Ballard (1996b) develop a lean approach to controls. They identify that the accurate forecasts needed for control come from planning. They believe that the classical approach produces waste in the lack of achievement of DID against SHOULD. For dynamic projects they think there is a need to consider the concept of CAN. That is the ability to achieve the yardstick. The process then involves adjusting what SHOULD be done to what CAN be done to produce what WILL be done. Measurement is carried out of DID against WILL. This allows planning to become more accurate and to focus on upstream preparation to ensure as close a match as possible between SHOULD and CAN. This introduces more certainty into the planning process and reduces the need for the soft planning methods described in Johansen's paper. If managers can be more certain of plan achievement they may be more prepared to put in the effort needed to plan. In practice there is much further development needed to move from these control concepts to a workable planning system. Ballard and Howell (1999a) produced a model of a planning system which involved three levels:

1. Initial Planning which pushes production by providing an early schedule and budget for the project.
2. Lookahead planning which pulls resources into the process by adjusting the schedule and budget
3. Commitment planning which is what happens in the above model after evaluating SHOULD against CAN.

A fourth issue of method planning occurs at all levels. They believe that the starting point for effective production control (which they believe is required for lean construction) is commitment planning. This is based on the Toyota process of having a system which stops production rather than producing bad product. Bad product in this case would describe the system observed in Johansen's paper, where heavily buffered, loose plans are used to control construction. It is clear that the planning horizon is an important issue here. Commitment planning, to be useful, is a short horizon policy and the authors use a weekly time scale to model the quality requirements for effective work plans. This requires plans to meet the following requirements: *Definition* – specific, achievable assignments, *Soundness* – all pre-requisites are complete and available, *Sequence* – assignments selected in the correct order, *Size* – assignments sized to suit the productive capacity and the next production unit, *Learning* – incomplete assignments are tracked and audited. Assignments which meet the quality requirements are reliable and provide a shield against uncertainty from upstream i.e. we know they are achievable. An additional part of the shielding process is a concept which Ballard and Howell (1999b) refer to as the Last Planner. The Last Planner is the person responsible for "*directing physical production*" who checks and accepts that a quality plan is produced which WILL be done because it CAN be done and then ensures that it is done. Another key concept here is the idea that planning can be improved by the measurement of the achievement of individual

assignments. The Percent Planned Complete on a weekly basis and the auditing of non achievement serves to improve the process because it is measuring against reliable, certain and accurate plans.

In order for Shielding, Last Planner and Commitment planning to work there must be a link between this stage and project milestones which come from initial planning. This is defined as Lookahead Planning (Ballard 1997). This process is a practical one of producing detailed lists of work to be done in the correct sequence to suit overall objectives with high quality performance based resource assessments and analysis of resource availability. This allows resource discrepancies to be identified and actioned (a make ready process). The Lookahead plan will be short term (perhaps 5 to 6 weeks) with week 1 the week of actual production. Only assignments which are achievable and have resources available are allowed to pass into week 1 of the plan. Plans can be tested with those involved in doing the work using First Run Studies (Howell and Ballard, 1999b).

CONCLUSIONS

The reality for planning and the reasons for the use of SOFT planning which were given in figure 1 were:

- Uncertainty is inherent throughout the process;
- The planning horizon is long;
- Managers do not have the time to be fully involved in accurate planning;
- There is little information gathering & little input from subcontractors & suppliers;
- Time is based on guesstimation and experience giving inaccurate durations;
- There is and little consideration of alternative methods;
- Activity durations and overlaps are “fudged”;
- Achievement of individual activity plans are low.

It seems that the lean construction model for planning addresses many of these issues. The model is based on an acknowledgement of the uncertainty of the process and an attempt to introduce certainty by reducing the planning horizon. This allows more planning to occur at the level of plan achievement. The model encourages deeper consideration of methods and resources which adds further certainty. It caters for the psychological objections to a hard planning approach by requiring a fundamental re-assessment at all management levels of why planning takes place. This should mean that the front end “push” for producing plans that are more concerned with flexibility than achievement, is replaced by a concern for production “pulling” the process. There could be a change to a mindset that is more concerned with measuring and ensuring planning success. This means not passing wasteful flexible plans down the line and demanding that subcontractors, suppliers, site managers and operatives meet arbitrary targets that may have been set well before anyone knew what was really required.

An area that the current model of lean planning has not fully addressed is that of the availability of accurate performance data. The model makes clear the need for this and the Lean Construction Institute is beginning to consider this in detail as the lean construction

model develops.

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