THE 8TH FLOW – COMMON UNDERSTANDING

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ABSTRACT

Projects are a form of engineered-to-order (ETO) production which require that the definition of Value becomes part of the production process. Project production requires the inclusion of the product design, the design process, and the production process to be integrated in order to fully benefit from waste reduction and process improvement. In construction, project production is more challenging because of the temporal, transient, and fragmented nature of the project team and the supporting supply chain. This requires a form of 'interoperability' between the supply chain organisations, the particular teams involved, the commissioning clients and other stakeholders. It is proposed that this 'interoperability' is a form of common understanding and that this understanding needs to be defined, developed, and nurtured across the project execution as a flow in the same way that other flows are managed. Building on the seven flow model proposal reported by Koskela and Howell (1999), this paper proposes a common understanding as an eighth flow and suggests how it might be managed. The paper classifies the concept of common understanding as a soft flow and shows that although it is a fresh insight it actually has roots in lean production. The identity of common understanding as the eighth flow arises from a number of funded research projects in which the difficulties of lean construction implementation were investigated.

KEYWORDS

Collaboration, flow, common understanding.

INTRODUCTION

The use of the word 'lean' to describe a form of production originates from the study of Toyota (Krafcik 1988) which has subsequently led to global efforts to analyse the success of Toyota and replicate it in other sectors including construction. Toyota's Production System (TPS) is held up as the prescription of Lean Production. It seems however, that when developing the TPS, Ohno (1988) was not unique in his thinking. Emiliani and Seymour (2011) describe the earlier and unconnected work of Frank George Woollard which bears a remarkable resemblance to some of the approaches now ascribed to Toyota and Lean Production. Woollard (1954, cited in Emiliani and Seymour 2011) recognises the system of production must benefit everyone and that a zero-sum mind set amongst senior managers will inhibit flow (of the work). He also indicates that workers are not just 'brainless cogs' within a system but an integral part of it, and their knowledge and participation in problem solving is a necessary component of flow. When considered together, Woollard's understanding and Toyota's 'Respect for People' approach (Morgan and Liker 2006) can be considered

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robust confirmation of the effectiveness of worker inclusion in problem solving and process improvement. A further aspect of Woollard's (1925, cited in Emiliani and Seymour 2011) management of flow is the connection of design to sales and beyond, something still often overlooked today. Flow across the whole enterprise however, is something well demonstrated within exemplar Lean organisations such as Toyota (Liker 2004) and establishes the use of a system approach. Without it, companies are only 'fiddling' with their processes. Liker (2004) cites the application of process improvement alone as a principal reason for the eventual failure of Lean implementations.

LEAN CONSTRUCTION

The word 'construct' can be used as a verb to describe the activity of the construction sector and as such includes to build, fabricate, assemble, create, erect, make, etc. These words all describe *transformational* activities that alter the input resources into outputs. In this way 'construct' has a similar meaning to 'manufacture' and to 'produce'. However, manufacturing and production are not terms widely associated with the construction industry until the recent interest in Lean. Koskela (1992) identified the new Lean Production as applicable to construction and proposed the TFV model (Koskela 2000) that combined the (T)ransformational view of work done, with the work (F)low and the delivery of requirements (Value). New thinking and planning and control have arisen from the work of Ballard and Howell (Ballard and Howell 1995) that addresses variation in the system. Implementation of these theoretical contributions are converging in practice to generate developments in collaboration, linguistic action and commitment/trust management aimed to improve work flow, generate value, and eliminate waste. These interventions are aimed at the people involved in the design and delivery of the project through the involvement of people.

INFLUENCE OF DESIGN IN PRODUCTION

The process of manufacturing starts with design (Boothroyd 1994) and since the 1980s it has become standard practice to design products that are easy to manufacture and assemble – Design for Manufacture and Assembly (DFMA). This is appropriate for mass production (made to stock, MTS) and mass customization (assembled to order, ATO) but is more difficult for bespoke products (made-to-order, MTO, or engineered-to-order, ETO) in which the manufacture (or fabrication) and assembly might be expected to be adapted to reflect the requirements of the design rather than the other way round. This results in continuous 'retooling' of the fabrication and assembly processes from product to product – new supply chain configurations, bespoke components and often significant elements of supply chain designed detail. This is especially so in ETO products such as construction projects. The Toyota Production System (TPS) provides an example of mass customization through ATO production and is largely concerned with operations. More recent research into Toyota has begun to define the design function – Product Development (Morgan and Liker 2006). In Toyota, product development is an engineering task but not to the order of a customer, instead design occurs as a result of market opportunity and in advance of customer orders. This is where the design function of MTO and ETO production begins to deviate as in these latter cases design is triggered by the order.

This creates uncertainty around forecasting product requirements. The reliance of an amount of the end product in an ETO environment on the supply and incorporation of MTS products combined with a construction logic (a building encloses space for example) does remove some elements of uncertainty. But the journey from order to end use for an ETO product requires an ongoing design effort for both the product and the production process as decisions need to be made along the way. Some of the problems associated with this are described by Tommelein and Gholami (2012) in their discussion of clash detection. In construction these decisions start with capturing the requirements of the commissioning client and expressing these in design information. This information is then transferred to the supply chain for production within constraints of budget, time and quality or performance. In most cases the supply chain is separated from the requirements capture and design both by choice (just tell us what to do, and we will go away and do it) and by the procurement route (if we seek the opinion of the supply chain it will cost more). This separation means the design of the production system is undertaken by the supply chain after the product design information has been prepared. This product design information has also been prepared without consideration of supply chain fabrication and assembly resources. A proposed antidote to this is the integration of the design and construction teams. A number of approaches across the world advocate just this, for example, Target Value Design (TVD) (Zimina et al. 2012) and Integrated Project Delivery (IPD) (AIA 2009)

COMMON UNDERSTANDING

Mossman et al. (2011) discuss how integrating the delivery team creates a shared understanding of the project. It seems that this understanding is an essential element of a successful project but it is not clear exactly what it is. Rooke et al. (2012) expand considerably on the theoretical nature of this issue, discussing linguistic action, language games, and forms of knowledge. They associate these with production. Lahouti and Abdelhamid (2012) discuss the idea that more detailed information and directives will lead to better productivity and they also touch upon knowledge and understanding.

These discussions are interesting and useful, but are both embedded within the idea that people act within consistent patterns. Observations from construction sites have shown that people can act in unpredictable ways. See for example Figure 1, which shows that ,…... None of the site operatives or supervisors noticed the problem or they chose to ignore it. It was eventually spotted by the researcher taking photographs. It is hard to explain how this happened because this site was one where Last Planner® was being implemented and the operatives were expected to participate in organising the work collaboratively. It is made more difficult to understand as it wasn’t the first time these operatives had been involved in LPS. The problem was caused by incorrect information but perpetuated by operatives who did not feel any responsibility for anything beyond executing their immediate instructions. In this instance more detailed information would not have helped. The example is even more curious as the company concerned have an incentive scheme in which all operatives share equally in the profit from the project so there was a financial impact on all the operatives involved directly and indirectly in this error.

Figure 1: Hard clash on Site

The sequence of work here was:

- First fix electrical;
- Plasterwork
- Pipework
- Skirting board
- Painting
- Radiator bracket

The error was plain to see when the pipe was fitted.

In the next example, shown in Figure 2, the behaviour of the plastering gang disrupted the work of other trades by physically obstructing the main access to the room. They found when arriving that the room wasn't ready for them to start work and so abandoned their materials, intending to return later. The consequence of this was of course the make ready work slowed down.

Figure 2: Not understanding other people need access

The final example, shown in Figure 3, is clearly and morally wrong, causing not only the air-handling units to fail in commissioning and much rework but, from an environmental perspective a waste of precious, non-renewable resource, additional carbon emission and energy use, etc.

Figure 3: Air-handling units used as a work bench

This latter example also illustrates that it is not only the operatives who need to have a better understanding. The operatives were not provided with adequate work benches and although they might have selected something less costly to rest on, the deficiency in the flow of equipment is accepted as normal practice in the industry with various items of ‘kit’ being omitted from the work in an attempt to reduce cost. This goes on to illustrate the complex nature of the understanding required when attempting to implement Lean and that such understanding needs to be held by all parties from operatives through managers, designers, head office staff to commissioning clients and on.

CONSEQUENCES OF NOT UNDERSTANDING

The examples shown in Figures 1 through 3, illustrate how difficult it is to change the old ways of working and how imperative it is that the people involved in the process really understand what is expected of them, how to behave and why. The consequence of there being no understanding is that flow is interrupted or even stopped.

For this reason, it is proposed that 'Understanding' should be included as one of the flows feeding the project delivery process (Koskela and Howell 1999)) in its own right. In this, work can of course be anything from design activities to site assembly to book keeping. All of these things enable the project to progress towards the customer. Understanding is more than the presence of skills or information but must include the desire to 'do the right thing' in a moral way. This is defined by Rooke et al. (2012) as 'phronesis'. It is also proposed here that this understanding must be managed as a resource flow in the same way as the other resource flows (Koskela and Howell 1999) and that unlike the other seven flows, which may be described as 'hard', it is a 'soft' flow.

Adding 'understanding' as the eighth flow will also clarify the definition of making do. In their paper about inappropriate processing, Emmitt et al. (2012) claim that the phenomenon of doing only just enough to allow the next trade to start necessitating operatives to come back to finish work, identified by Brodetskaia et al. (2009) as re-entrant flow, is a form of waste. This waste should be included within the category of 'making-do' (Koskela 2004) but currently falls outside because it doesn't arise as a result of starting work before all flows are in place. If understanding were one of the flows, then it can be argued more strongly that leaving work before it is at the best stage of completion is a form of making-do because in this example, a proper understanding of the hand-off stage was not present. There would also be a changed perception of the use of snagging lists (punch lists) as many of the reasons cited by operatives on the sites investigated related to leaving work to be picked up later as the proper use of these lists. It seemed that because a snagging list existed they needed to put things on it, it was unthinkable that if work was tackled differently these lists would cease to exist.

MANAGING UNDERSTANDING

In a project environment the product is engineered to order (ETO) *each time* and in construction the project team is temporary and transient (Bryman et al. 1987) causing a high variability in the level of human performance both within trades and between trades. People, within organisations and in differing organisations need to work effectively together understanding not only their own needs but also engaged in the needs of others they impact upon. This reinforces the need to pay attention to these interfaces and ensure they are fully compatible generating a form of interoperability that should be understood by all parties. It is unlikely this understanding will simply exist, as a result of training for example. Understanding needs to be managed in the same way as other resource flows.

Understanding does not mean holding the same belief and value systems, just that we understand each other and can then direct our efforts accordingly. The fundamental Lean understanding must be one of Value both in the needs of others and also one's own needs. Following on from this comes the understanding of waste. A review of a range of approaches used within Lean Production and Lean Construction show a number whose purpose is to directly or indirectly manage understanding.

These include (from Liker 2004):

- Having a Philosophy – this is very much about a shared understanding
- Visual management – again about making sure people understand specific aspects, often without the use of language.
- Eyes for waste – this requires people to understand waste properly
- Problem solving – again requires people to understand the problem and its resolution.
- Go see – ensures a full understanding of the situation
- The use of a big room – to ensure understanding of what is required and by whom is shared

and (from Mossman et al. 2011):

- Collaboration/team work – having conversations to ensure a shared understanding
- Make ready/look ahead – facilitates understanding of the next customer requirement.

That there are explicit approaches included in the TPS to create a common understanding shows that this is an important part of production. In manufacturing, on one hand, the human contribution relies on a relatively stable workforce with a consistent team composition. Construction, on the other hand, is an unstable environment with temporary team composition and transient workplaces making the management of understanding even more important but very challenging.

The use of understanding as a performance indicator alongside, say, percentage plan (promises) complete (PPC) could be very powerful. We could easily hypothesise that if everyone fully understood all that was required there would be little that would be missed. If understanding incorporates phronesis then it engages human emotion and might be expressed as an equation in an attempt to give it form. For example:

Understanding = engagement + meaning;

with its opposite expressed as:

Engagement – meaning = confusion

When viewed in this way it can be seen that project success is about more than money, and suggests that understanding can be managed by or linked to, intrinsic motivation (Darrington and Howell 2010). People act in unintended ways regardless of the amount of information, material, space or other flow. The construction industry's answer to this is the use of additional time and money to overcome the difficulties albeit not always intentionally. These are manifested in higher than necessary tenders, projects running over time and budget, projects in dispute, etc. This answer is no longer acceptable and the idea of collaboration and integration underpinning Lean Construction aims to address the problems of time and cost. The challenges to this still reside with the way people chose to or not to, engage with the processes depending on the way they understand this engagement. The work undertaken by

Rooke et al. (2012) provides an important theoretical explanation that will be interesting to interpret into practice.

CONCLUSIONS

There are three conclusions to be drawn from this paper. The principal conclusion is that the importance of people's understanding of what, how and why to do something warrants the inclusion of this understanding as a flow in its own right. Understanding therefore becomes the eighth flow that needs to be nurtured and managed in the same way that the other sever flows are purposefully managed.

This paper also identifies the existence of understanding as a soft flow that is necessary to support the existing seven hard flows, i.e. pertaining to something tangible and physical. It is also proposed that this flow is especially critical to construction project production as the temporal and transient nature of the industry increases the impact of any dis-function in the actions and interactions of people.

Finally, introducing understanding as a flow expands the interpretation of making-do to clearly include inappropriate finishing as well as inappropriate starting of work. This can provide a clear driver for reducing the reliance of the site teams on snagging (punch) lists and the need to revisit work out of sequence unnecessarily.

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