BARRIERS TO MANAGEMENT INNOVATIONS:
communicating meanings

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ABSTRACT

The application of the New Production Philosophy (Lean Production) in the construction industry is a challenge to both researchers and professionals due to its innovative approach to the management of production systems. In addition, the consolidation of a theory in this field demands the application of its concepts and principles in practical situations. However, the implementation of Lean Production concepts and principles faces some communication and learning barriers.

This paper presents some of the results of a PhD research project concerned with the development of management competencies, which proposes an integrated use of action learning and cognitive approaches to encourage the application of Lean Production concepts and principles in construction management. This study assumes that learning is strongly influenced by cultural values and beliefs. This cultural approach to learning implies that the development of management competencies requires not only a set of new knowledge but also an in depth questioning process in order to develop adequate attitudes towards production management problems. A reflection on the meanings of Lean Production concepts and principles was undertaken, assuming that the adoption of this theoretical framework by the industry requires a change in the current construction management paradigm.

The objective of this paper is to discuss Lean Production concepts and principles from a cultural perspective and the use of Action Learning approach to identify some cognitive and cultural barriers to the implementation of such managerial innovation. A discussion on Action Learning is followed by an analysis of the changes observed in the attitudes of one construction manager, who took part in an Action Learning set.

KEYWORDS

action learning, cognition, concept mapping, culture, lean construction, meaning

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INTRODUCTION

The Lean Production theoretical framework represents a major shift in the current construction management paradigm (Koskela, 1992). In spite of the theoretical and practical advances achieved in the last few years, the application of Lean Production concepts and principles in the construction practice is still necessary for the consolidation of the theory. This application is fundamental for a careful abstraction of meanings and adaptation of the concepts to the construction context in order to drive the learning process on Lean Construction.

A research project was conducted aiming to explore alternatives to facilitate the use of the Lean Construction theory by construction managers. Figure 1 gives an overview of the research design. The research process comprised three learning cycles, including a number of exploratory studies on individual and organisational learning, which led to the development of an empirical study on management competencies, in which action-research was used as a research strategy. The first learning cycle focused on the communication of Lean Construction concepts and principles, searching for problems on conceptual learning in two groups of civil engineering undergraduate students. Based on the results of this study, a cultural approach to learning was adopted, in which learning was regarded as a social process in which the subject builds meanings based on his cultural values and beliefs and through interaction with the social environment.

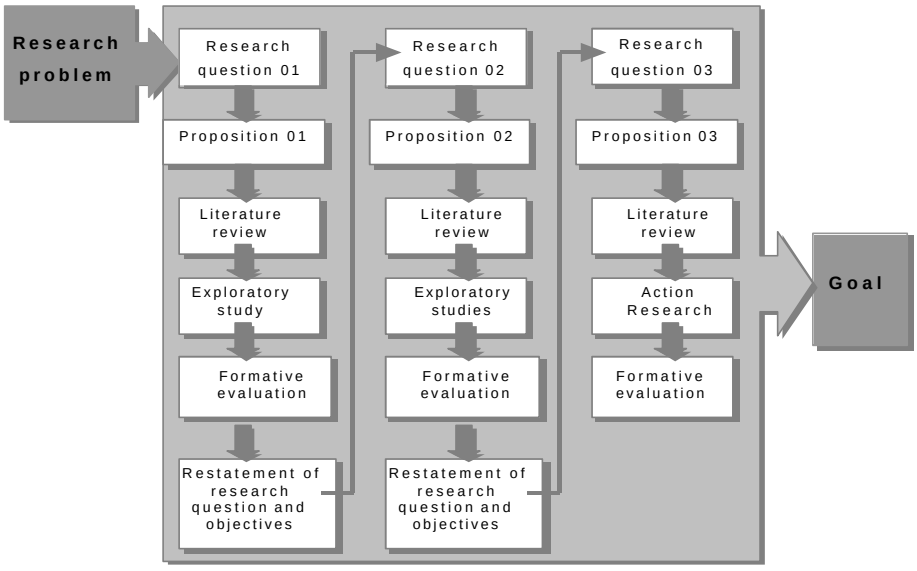

Figure 1: Overall design of the research method

The second learning cycle focused on the meanings of Lean Construction concepts as well as on the identification of an adequate method for the development of management competencies. Along with the literature review, two exploratory studies were developed. One of them concerned with the use of Concept Mapping, aiming to investigate the use of this

tool to facilitate the communication of Lean Production concepts as well as to identify barriers to the understanding of those concepts. The other exploratory study consisted of two Action Learning sets in which the researcher examined the theory and practice of the Action Learning approach for the development of management competencies.

In the final empirical study, the use of Action Learning and cognitive approaches in the development of management competencies related to the application of the Lean Production concepts and principles was investigated.

This paper suggests a cognitive approach to the transfer of Lean Production theory to the construction context. Then, it discusses the journey of one of the Action Learning set members to illustrate barriers created by mental models and tacit knowledge to the learning process and, hence, to the implementation of models, techniques and tools based on Lean Production concepts and principles.

LEAN PRODUCTION

The first attempt to adapt the ideas of the Lean Production philosophy to construction process was carried out by Koskela, in 1992. At that time, he proposed a theoretical framework named New Production Philosophy (Koskela, 1992). This framework has evolved to a proposal for a production management theory, called theory TFV, that integrates the transformation, flow and value aspects of production (Koskela, 2000).

In the traditional model, construction is viewed simply as a transformation of an input to an output which can itself be divided into sub-processes; these in turn are themselves also transformation processes. The transformation model has, to some extent, contributed to the lack of transparency in construction, since it abstracts away from the idea of the flows between transformation activities (transportation, inspection, waiting time, rework), and does not encourage the clear identification of internal and external clients in each process (i.e. value adding activities). . When production is viewed as an integration of transformation, flows and value generation, many factors that were considered unimportant come to the surface, such as inspection, inventory, and the loss of value throughout design and production processes. Also, the requirements for external and internal processes need to be systematically considered, since processes must generate value. In this context, the concept of waste is strongly related to the incidence of non-value-adding activities and operations, such as transportation, inspection, inventory, waiting, and rework (Koskela, 2000).

The development of this new approach involves two different challenges. The first one is how to learn from successful practices from other production environments, such as the Japanese car industry. Lillrank (1995) compares the transfer of innovations from a diverse culture to the electric power transmission between two points: the longer the distance, the higher the voltage that the electric current should be switched at the origin. Similarly, the greater the cultural, historical and economic differences between two contexts, the higher the level of abstraction required for the transfer of innovations in order to adapt and apply the concepts and principles to the new context. Figure 2 illustrates this point. Lillrank (1995) stresses that the success of such transfer depends on two processes: abstraction at the origin and application at the end to adapt the concepts. The copying of methods, processes, techniques and concepts from cultural diverse contexts are simpler but ineffective. More than that, it can lead to distortions.

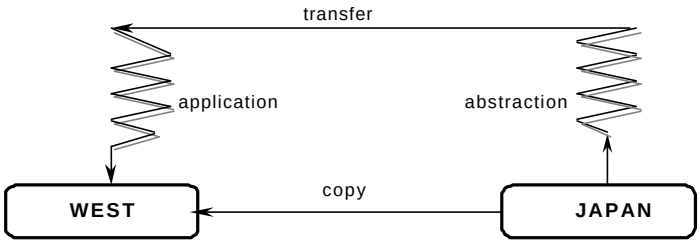

Figure 2: Transfer of complex system (Lillrank, 1995)

Abstraction and transfer deal essentially with words, signs and meanings. This means that the learning process involving the abstraction of Toyota Production System concepts and principles and their adaptation and application to the Western construction industry must consider signs and words used to communicate these new ideas in these different cultures.

The second challenge is how to overcome the conservative culture governing the construction industry. Sommerville and Sulaiman (1997) analysed the implementation of TQM in construction companies and pointed out that most construction managers tend to lack long term, strategic, and systemic views of production management, and have a relatively conservative position towards managerial changes. Koskela (2000) also indicates construction managers strategies for working as a major the barriers for managerial innovations: they are task-oriented and do not reflect on problems and processes adequately because they are usually struggling to make things happen in a so-called "fire-fighting" mode of working (Koskela, 2000).

Both challenges are related to the paradigm shift which is the Lean Production theory's main feature.

PARADIGM SHIFT

Over the last twenty years, economic and technological changes have been pushing companies to undertake both organisational and technical change themselves. Bartezzaghi (1999) pointed out market demand, technological development, the labour market, employee expectations, and industrial relations as some of the distinctive characteristics of the predominant environment at Fordism-Taylorism era and the present.

The expression paradigm shift was first used by Thomas Kuhhun, a philosopher, in 1970, in order to designate significant changes observed in the predominant understanding about a specific scientific subject, as a result of an innovative advance in scientific knowledge (Hopp and Spearman, 1996). Based on this concept, several authors, such as Koskela (2000), Bartezzaghi (1999) and Hopp and Spearman (1996), have argued that Lean Production stands for a paradigm shift in the production management. Hopp and Spearman (1996) stressed that the differences between lean and mass production results essentially from the perspective through which production is viewed.

Both Taylorism and Fordism adopt reductionism as a strategy for facilitating production management (Hopp and Spearman, 1996). This approach is guided by the notion of achieving efficiency by decomposing systems into their components and, therefore, analysing

each one of them, separately and thoroughly. Taylor's and Ford's approaches to production management contrasts with the systemic and holistic view that distinguishes the perspective adopted in some Japanese industries (Hopp and Spearman, 1996). The systemic view is a metaphor of the equilibrium of the organism with its environment (Hopp and Spearman, 1996; Mirvis, 1996). Systems theory examines the relation between parts of the system, taking into account the influence of each part on the whole and vice-versa.

Bartezzaghi (1999) contends that Taylorism and Fordism were generated in a stable context and has been replaced by a new paradigm due to the need for adaptation to a turbulent economic environment. On the other hand, Dankbaar (1997) acknowledges the innovative aspect of Lean Production but regards it as the most perfect form of Fordism, not as a model to replace Fordism. He argues that the main features of the Lean Production's tools, techniques and approaches are collaboration, integration, ownership and systemic approach. According to Dankbaar (1997), these features drive the organisation's capability for improving continuously, innovating, learning and being adaptable to a continuous changing process.

A CULTURAL PERSPECTIVE OF LEAN PRODUCTION

Discipline, commitment to collective concerns, a deep respect for authorities, and aversion to waste are some of the notable features of the Japanese culture permeating Just-in-Time and Total Quality Management. According to Ghinato (1996), the success of the Toyota Production System comes from a combination of characteristics: social, cultural, economic, political, organisational and competitive. Among these characteristics, that author indicates loyalty, management style guided by common-sense, sense of collectivism and collaboration as cornerstones for the success of the Toyota Production System.

Nonaka and Takeuchi (1995) examine the differences between the Western and the Japanese cultures from a cognitive perspective. According to these authors, the main features of the Japanese intellectual tradition are the oneness of humanity and nature, body and mind, self and others. As a consequence, the Japanese think visually, in contrast with the Western logic: literal and rationalistic. The Japanese language is a clear example of this feature. They use ideograms (symbols) for writing, called *Kanji*, which form visual concepts which are highly context-specific. Another consequence of the Japanese intellectual tradition pointed out by Nonaka and Takeuchi (1995) is the value attributed to personal experience rather than to theories and abstract concepts, due to the oneness of body and mind: "*Knowledge means wisdom that is acquired from the perspective of the entire personality*". Nonaka and Takeuchi (1995) also attribute the collaborative and community spirit to the Japanese philosophical concept of self: the individual is not recognised apart from the collective. Japanese realise themselves in their relationship to others.

The Japanese context depicted by Ghinato (1996) and Nonaka and Takeuchi (1995) account for the holistic perspective, the emphasis on collaboration and transparency observed in the operation of the Toyota Production System.

Spear and Bowen (1999) discussed the extent to which the Toyota Production System can be replicated. They stressed the need for decoding the tacit knowledge involved in that system operation. According to those authors, tacit knowledge rather than cultural factors is

the distinguishing characteristic of the Toyota Production System since some companies like Nissan and Honda do not reproduce the performance achieved at Toyota Motor Company.

The co-existence of a rigid specification of activities, connections and production flow, and the flexibility and adaptability of the production system is pointed out by Spear and Bowen (1999) as the key element for the understanding of the Toyota Production System. Those authors stated that a fundamental principle for the operation of the Toyota Production System is the use of problem solving processes strongly connected with hypothesis tests, very similar to scientific methods. They also suggested that this principle is naturally and tacitly followed by the workers, as a result of an organisational learning process. Spear and Bowen (1999) attempted to make explicit some implicit rules guiding the operation of Toyota Production System that were concerned with rigid specification of tasks, simplification, and, mainly, the use of scientific method for problem solving process.

This study assumes that the managers' actions in production management are strongly influenced by their tacit knowledge and, therefore, by their cognitive structure. This was one of the main propositions that resulted from the literature review and the exploratory phase of this research. The influence of conceptual meanings on managers' cognition and actions, is the main focus of this paper. The following sections discuss this barrier, based on an Action Learning set.

ACTIONS AND MEANINGS

Weinstein (1995) defines Action Learning as "*a process underpinned by a belief in individual potential: a way of learning from our actions, by taking the time to question and reflect on this in order to gain insights and consider how to act in the future*".

Action Learning is usually applied for the development of individual competencies in order to improve teamwork (Pedler, 1997; McGill and Beaty, 1995). Action Learning is developed through regular meetings with a set advisor, when set members discuss their problems and commit themselves to doing something towards the solution of these problems, and present the consequences of these actions in the following meeting. This process includes some key elements: problems, commitment, reports and discussion:

- Problems are different from puzzles in the Action Learning approach. A problem has no existing solution, and there might be alternative courses of action towards its solution. A puzzle is a difficulty to which a solution already exists (Revans, 1997).
- Commitment with the set implies that there must be confidence among set members and also that they must volunteer to take part in the group. The climate in a~~A~~n action learning set must allow sharing and comradeship: sharing experiences, and mainly what they do not know.
- Each set member presents a report about actions, which s/he had undertaken since the previous meeting. This process of telling what has happened stimulates the reflection in action.
- The discussion about the outcomes of each set member must be guided by questions instead of advices, which are more likely to occur in the initial meetings.

Although the literature on Action Learning does not explicitly mention connections with cognition, this research attempted to include a cognitive approach in action learning process in order to understand the barriers of meanings to managers' actions.

Vygotsky's study on cognitive process established the foundation for the knowledge on shared meanings (Wertsch, 1985). In the Vygotsky's theoretical framework for understanding the development of concepts in the human mind, speech is a mediation system, which allows the exchange of thoughts and experiences, and, consequently, establishes communication and social interaction. He assumes that learning is the result of a dynamic process of sharing and changing meanings. Words are the essential elements in this mediation system: words are signs standing for things and ideas, and communicate thoughts.

Furthermore, a word is a sign used by the human mind to conduct the mental operations aiming to elaborate a concept and get the solution for the problems faced. The need to solve problems encourages the development of concepts. On the other hand, a word can assume one meaning but with different senses, depending on the context. Vygotsky calls sense the sum of all psychological events that a word provokes in our consciousness, and the meaning is only one of the zones of the sense, the more stable and precise one. This is an important aspect to take into account concerning the process of sharing meanings, because when one is consciously trying to understand something, s/he is more likely to be operating with the sense of the word instead of the meaning (Vygotsky, 1993). The term **transparency**, for example, means the property of being clear and easy to understand. It is the more stable definition for transparency. However, in the context of the New Production Philosophy (earlier in the paper, you seemed to have substituted "Lean Construction" for "New Production Philosophy"), transparency has a more specific sense because it is only concerned with the visibility of **useful** information. It must be focussed on the users (clients) of this information in the working environment, and on their motivation to actions (active communication). Changing the internalised meanings of these words to the point of changing attitudes is not only a matter of literal conceptualisation of words, but changing perceptions and feelings about those internalised meanings.

Knowledge is not entirely objective. Spender (1998) discusses the concept of knowledge and learning, and rephrase Polanyi's quip as " we know more than we know we know" to refer to implicit knowledge. According to Spender there is still a long path to understand the relationship between thought and action, what is learning, where it is stored and how cognition influences actions. However, there definitely is a portion of knowledge that is implicit, tacit, and that does influence thought, problem solving processes, and actions. The distinguishing feature of tacit knowledge is that it cannot be communicated. Still, in the light of Vygotsky theory, it should have been built through sharing and exchange of meanings in social contexts.

Concept Mapping has been used in this study for mediating discussions among researchers on Lean Construction core concepts and principles. Concept Mapping aims to make an explicit representation of meanings in order to enable them to be negotiated between different people.

Figure 3 presents an example of a Concept Mapping. It is a learning tool intended to represent meaningful relationships between concepts, according to Ausubel's Meaningful Learning theory (Novak and Gowin, 1984). Concepts are arranged in a hierarchical structure,

from the more inclusive concepts (at the top) to the more specific ones (at the bottom), since, according to Ausubel's theory, cognitive structures are hierarchically arranged. These concepts are linked by propositions, which are words or sentences connecting the meanings of concepts. These links stand for the way by which a new concept becomes meaningful to the subject. Ausubel contends that one gives meaning to a word or idea if s/he can connect it to an existing concept in her/his cognitive structure. In other words, meaningful learning exists if the new concept or idea is subsumed by an existing one. A subsumed concept can be added to the cognitive structure, when it is a new concept for the subject, or it can change the meanings of some existing concepts in one cognitive structure, because it gives a new perspective for the subject (Novak and Gowin, 1984).

Concept Mapping drives the reflection on concepts, as well as on the process by which the meanings of these concepts are built. It makes it explicit the connections one builds in her/his cognitive structure, either wrongly or rightly. This transparency enables mediation and negotiation of meanings in a group.

The map presented in Figure 3 indicates the difference between visibility and transparency, based on the utility of the information, and stresses the need for autonomy when applying one of the principles proposed by Koskela (1992), which is to increase process transparency.

In the Conceptual Mapping workshops, some of the researchers were surprised with the bias of their own understanding about certain concepts. This fact illustrates Eden and Ackermann's argument for the use a similar tool called cognitive maps: "How do I know what I think until I see what I say?" (Eden & Ackerman, 1998).

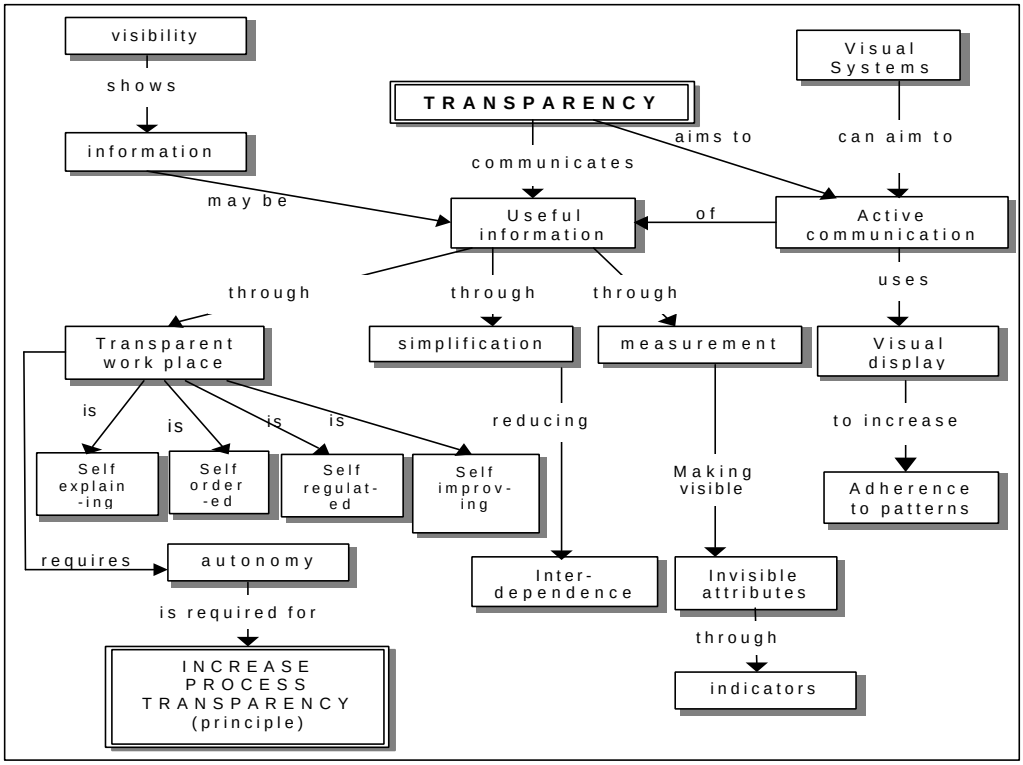

Figure 3: Concept Mapping of transparency

In spite of the benefits of Concept Mapping, it was not directly used in the Action Learning meetings, because it could interfere too much in the discussion. The alternative adopted was the use of these maps to support the work of one of the authors, who was the Action Learning set advisor. It was assumed that only if the set advisor had a clear understanding of some Lean Construction concepts and principles she would be able to communicate and lead the set members to learn and apply the theory.

ACTIONS AND MEANINGS IN AN ACTION LEARNING SET

The Action Learning set carried out in the final empirical study was guided by the following proposition: the questioning process can uncover tacit knowledge used by production managers, and guide them to change focus from transformation to process management, and, therefore, enabling them to apply Lean Construction concepts and principles. The Action Learning set involved four production managers who worked for different building companies. The main interest of two of them was the production schedule and the fact that they were not able to manage the labour force, since the project was behind schedule most of the time. The third set member was troubled about his own time management. He complained that he was involved in many different activities in the company and was not happy about his own performance. The fourth set member joined the group because he wanted to learn and share experience. He usually brought to discussion questions, most of them related to puzzles not problems. For him, it was difficult to find problems.

Data collection comprised interviews and tape records from Action Learning set meetings, which formed the fundamental basis for content analysis using Nudist Vivo software. The journey of one of the construction managers from this set (named Paul in this paper) portrays the influence of cognition and meanings into managers' attitudes towards production management. Figure 4 shows the results of the content analysis on Paul's participation in the Action Learning Set, concerning one of the variables analysed for depicting Paul's journey, his locus of control.

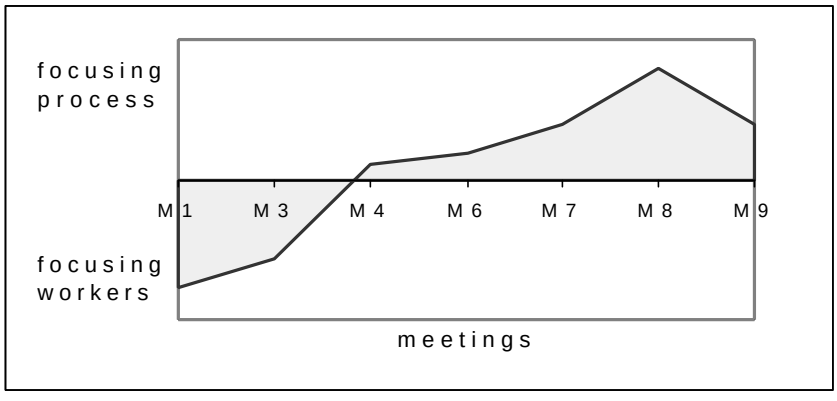

Figure 4: Content Analysis of Paul's locus of control

Paul's first concern was how to 'push' workers harder and more effectively. The word that he often used to describe this was "*cobrança*", which in Portuguese means demanding response or results for a task. During the initial meetings, he assigned all problems on his site to members of his so-called team. He felt they needed to be carefully controlled. In the first set meeting he presented his problem as the need to balance delegation with a demand for "*cobrança*". In fact, his "real problem" was his own ability to control permanent delays in the production schedule. This may well have been due to his own managerial incapability or inability to know just what to do as a manager of this situation. In interviews he would always stress the fact that he had done everything for which he was responsible to correct the situation. So, he laid the blame for any problems on his workers. This is an example of Senge's (1998) notion that "**the problem is out there**".

By meeting number 3, Paul was still stressing that his workers must be kept under strong pressure in order to get the production process back on schedule. In all the questions that he addressed to set mates, he emphasized the importance of *pushing* workers to the limit. This locus of control on workers illustrates the managers' emphasis in conversion, rather than in process. Figure 4 shows his transition from blaming workers for delays (focusing workers) to his personal ownership of the problem as being one of process under his control (focusing process). This transition was probably affected by a deeper consciousness about his lack of ability on dealing with people. He mentioned in set meeting number 3 that he had called in his supervisor to get "inspiration", so he might tackle production problems differently. His supervisor was known as a competent manager, and people who know him say he has the charisma to deal with workers. He used this example to change his ways of dealing with critical situations on site. So, by the 6th meeting, Paul presented three main causes for delays on site: difficulties caused by the lack of formwork design; exclusion of foremen in the bonus scheme; and flaws in material management. All these factors were related to his duties and responsibilities and he began to assume that these were his own problems, rather than off loading responsibility to others, especially his workers. He reported a significant improvement in the reliability of the production system in terms of timing, because, in his opinion, he had tackled these three points.

As a result of perceiving these changes in Paul's, and others' attitudes to materials management on site, the set Adviser changed her strategies of running the meetings. At the 7th meeting she started to focus more on concepts relating to Lean Construction such as process, commitment, partnership, and to supply. This gave others an opportunity to challenge Paul's mental models ("*the problem is out there*") and focus on process instead of transformation. It also helped set members understand some more about the LC concepts based on real problems and in reflection in action.

In the last meeting the set Advisor decided to address some incisive questions to Paul, aimed at uncovering the meaning he was holding for the word "process". Overall, set members used this word much in their discussions. However, the set advisor perceived that the meaning each attributed to the word "process" was relatively vague. Process seemed to mean almost anything to them. When Paul presented his problem in a wider perspective, he began to question the links and interdependencies between production units, supply, design, planning, managers, standard procedures, partnering, etc. Set members did not realise that their *own* concept of process was so imprecise and unhelpful. Paul mentioned, in his

assessment interviews, that he felt under pressure during such questioning at SET meeting, but he had become astonished and excited with his findings about process and their usefulness to him in his everyday working. He added that he would not have been able to change his attitudes towards workers if he had not deeply understood the meaning of "process" in the new production philosophy. Besides, he said it would take some time to consolidate his new attitudes, because there were still some values deeply rooted as a consequence of his long experience as a site manager.

FINAL COMMENTS

This paper presented some insights on the study of the relationships between cognition and meaning, and action and meaning, in the light of Vygotsky's theory. The integrated use of action learning and cognitive approaches seems to impel a reflection on actions and meanings, especially due to the questioning process in Action Learning sets.

The journey of one of the Action Learning set members, Paul, portraits the influence of cognition and the meanings of words to actions. His attitudes towards the delays in the production schedule changed from the focus on workers (transformation) to management problems (process) only after a reflection in action, uncovering meanings he attributed to words like partnership, commitment, and process.

In spite of the lack of a robust theory on Action Learning, this study showed that it is an adequate approach for dealing with paradigm changes in management practices.

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