SOME DIRECTIONS FOR DEVELOPING CONSTRUCTION MANAGEMENT TRAINING PROGRAMMES ON LEAN CONSTRUCTION

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ABSTRACT

The consolidation of the Lean Construction theory depends on the application of its principles and concepts by practitioners. Only feedback from the construction industry itself can support further research on the analysis and adaptation of the Lean Production principles to the construction process. Therefore, it is necessary to work on construction managers education in order to incorporate the lean production concepts and approaches in their daily practice.

This paper describes an ongoing research project concerned with the development of construction management training programmes on lean construction, aiming at fostering changes of paradigm in process management. An exploratory study on the learning process of undergraduate students was carried out, focusing mainly on the relationship between teacher and students along lectures dealing with lean construction concepts and principles. The study has indicated that it is relatively straightforward for the students to understand and to apply some basic concepts like process, operation, conversion and flow activities and the general concept of waste. But it has also pointed out that it is not so easy for them to understand and comprehensively incorporate the lean construction principles and approaches.

This paper discusses the complex problem connected to the change of paradigm and the learning process involved in the introduction of the lean construction theory in construction management training programmes.

KEY WORDS

Lean construction, learning, management education.

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INTRODUCTION

Developing a construction management training programme on Lean Construction Theory seems to be paradoxic, since this theory still needs to be consolidated. There are few research groups mastering the conceptual understanding of the application of the Lean Production theory to construction. Therefore, the approach of the construction process through the Lean Production theory is still a complex matter. Its relevance and urgency cannot be denied, but it must also be realized that the adaptation of the concepts and principles from manufacturing process to the construction process is not straightforward: we must understand the meaning of the concepts, principles and approaches used to explain and improve manufacturing processes and afterwards transfer them to the construction environment.

Koskela (1992) introduced an overview of this subject with his seminal work in 1992, and still now, after six years committed to the development of a lean construction theory, he points out many conceptual questions. He states that a theory is relevant because it is a basis for communication and it enables explanation and prediction of phenomena. A theory of production, specifically, enables the structuring, controlling and improvement of production systems (Koskela 1998). In addition, Lillrank (1995) states that the consistent transfer of systems as complex as the Toyota Manufacturing Systems to Western construction industry requires a process of abstraction and application rather than simply copying. It means that besides theoretical abstractions we need to apply the Lean Construction approaches, principles and concepts to foster the consolidation of a theory.

We must bear in mind that in order to put Lean Production approach in practice in construction, the old thinking patterns must be abandoned. These patterns include the belief that the construction industry is too particular to have any similarity with manufacturing as well as the focus on solutions exclusively drawn from new technologies and financial support when time and economics constraints are involved. Furthermore, in Brazil, particularly, building entrepreneurs seldom have thought about clients requirements until recently because trading used to be easy due to the Federal Government financial support and to the enormous housing shortage. Nowadays, in spite of the changes on this field, the culture among the construction industry professionals remains quite the same. Such culture set barriers to changes in thinking and action patterns.

This paper is concerned with ways to communicate concepts and principles from the Lean Construction theory so as to allow construction site managers to apply and analyse the results of this new approach. It emphasizes the learning process as a fundamental point to put down the barriers mentioned above, and consequently to make the application of the Lean Construction principles and approaches more feasible.

ROLE OF MANAGERS

Based on Lillrank studies, Koskela believes that a fully understanding of the Lean Construction theory, depends on the feedback from site experiences on the application of the Lean Production principles and tools (Koskela 1998). The difficulties that might appear from it and the analysis of its results must drive the learning process on lean construction. But Lean Production requires a quite different approach to the management of the construction process, which means changing the focus on conversion activities to a

balanced focus on both conversion and flow activities: it means changing paradigm in the construction management.

In addition, Beer, Eisenstat, and Spector (1995) state that the most effective way to get behaviour changes is to put people into new contexts which impose new roles, responsibilities and relationships between the members of a team. Those authors have analysed several organizations that have developed culture, process and structure changing programmes. These programmes were based on the idea that individual behaviour is a consequence of people's knowledge, attitudes and beliefs. The conclusions of the authors lead to the contrary: individual knowledge, attitudes and beliefs are actually shaped by recurring patterns of behavioural interactions.

The same authors stress that the start point for a change is to act on a clearly defined problem and not to shape individual behaviour by the introduction of a programme, based on abstractions like "culture" and "partnership". They also believe that it should start in a small peripheral unit but it should go on steadily towards the corporate core.

In this respect, managers play a central role in the changing process: they should not be too dependent on top management directions but they must drive changes and get commitment from the employees to continuous improvement. According to Mintzberg (1995) no job is more vital to our society than that of the manager. Mintzberg (1995) and Senge (1995) define manager as a professional who deals with information and communication. According to those authors, decision making under risky conditions is the essence of the task of managers. Mintzberg has studied managerial work, concerning characteristics and content of the work and concluded that the classical definition of manager as the professional who deals with planning, co-ordination and controlling is a mistake. He thinks that it is important to recognize this mistake so as to be effective on management education.

Therefore, it is important to explore and analyse training programmes which aims to change paradigm and stress leadership as a important feature in managers profile in order to contribute to the application and dissemination of Lean Construction.

THE CONDITIONS OF LEARNING

In order to study the main difficulties and the required conditions to the learning process of the Lean Construction theory, an exploratory study was carried out with final year students civil engineering undergraduates. This study was based on the analysis of the Education Theory and a literature review on teaching methods adopted in civil engineering undergraduate programmes as well as in training programmes.

The literature review has indicated that the main objective of education must be to make students (or professionals in training programmes) learn how to learn. Generally speaking, one of the reasons for this requirement is the fact that knowledge and information is increasing very fast and the professional must have ability to get profit of this great amount of information and at this speed (ASEE 1997). The other reason, specially related to management education, is that managers must drive learning within organizations. Senge (1995) stresses that this is one of the most important roles of a manager in competitive companies.

Studies developed by Russel and McCulloch (1990) and by Bett and Liow (1993) point out case studies as the most efficient approach for developing creativity, self confidence, ability to deal with multidisciplinary matters and with decision making from their own experiences and knowledge. Newton and Ormerod (1997) analysed the

difficulties of cost engineers on learning from their own experiences. The authors concluded that these difficulties come from the flaws in lifelong learning abilities and recommend an action learning approach to develop this ability, since it integrates education, work and the personal development.

The arguments of the authors converge to the importance of the contact with real problems, simulated or in real time, and the challenge to look for solutions to these problems. This approach is known as problem based learning (PBL). It is a constructivist approach to learning, where the students start the exploration of a new content with the observation of the reality, identification of key factors that leads to the structuring of the theory. Based on the theory, the students are asked to formulate hypotheses to solve the problem, then apply and observe the consequences of it. By going through this process, the student can learn by acting on what he already knows and building new concepts and ideas through the interaction with experience, literature (theory) and the analysis of different point of views.

Therefore, this approach was adopted in the exploratory study which was structured in four steps:

1. The students were asked to analyse a construction process in site, like masonry or formwork, and present it to the group, pointing out the incidence of waste and giving some directions for the solution of the problems observed; during the presentation, the key points of the problems were discussed with the lecturer; until then they knew nothing about the Lean Construction theory;
2. After the first assignment, the lecturer presented the concepts and principles of the Lean Construction to the students; he tried to make links between the problems observed and discussed earlier, and the theory;
3. The next step was the development of an analysis of the same process, through data collection on building site, using tools such as process mapping, flowchart, check list of site conditions, work sample and production chart; the students were also asked to identify wastes and its causes; it took 45 days on average for the students to complete the second assignment.
4. Finally, there was a presentation of the case studies developed, and discussion of the results; the objective at this step was to evaluate whether the students were able to apply the Lean Construction principles for understanding the problems and devising the solutions for avoiding the waste observed.

On the whole, the development of this learning experiment showed that:

- Both students and the lecturer were relatively conservatives on the way they have approached the learning process: the students presented a fairly passive behaviour and the lecturer thought it was important to teach something and transmit his knowledge about the theme and did not give the students the opportunity to look for theoretical support themselves;
- The development of the case study motivated the students to understand abstract concepts and to discuss real problems with the support of the theory; the process of collecting and analysing data helped them to understand some management concepts that were presented to them earlier in the course.

- The students enjoyed the activity, in spite of complaining about the amount of data that should be collected. This was due to the coincidence of this activity with the end-of-year exams. They suggested the development of this activity along one semester which would allow more commitment and attention;
- It was not difficult for them to understand some basic concepts, such as process, operation, conversion and flow activities: they easily identified them through process mapping and flowchart;
- But neither of them could apply the lean construction principles and approaches to explain or to solve the problems observed on site: the theme is complex and requires a detailed observation of processes with a systemic view.

In order to analyse the reasons for the difficulties observed in understanding the principles and approaches of lean construction, it is important to understand the learning process.

Ausubel is a constructivist theorist well known by his Meaningful Learning Theory. This theory states that learning is not an arbitrary nor literal process and it is a result of the arrangement and integration of concepts and ideas in the cognitive structure. According to Ausubel, new concepts are learnt only when they meet clear concepts in the cognitive structure which will subsume the new one. When this happens, the new concept becomes meaningful and integrates the cognitive structure. This new concept can also modify the subsumers concepts (Moreira and Masini 1982).

This relationship between the new and the existing concepts in the cognitive structure is called not arbitrary because it happens consciously and only with those concepts which are really relevant: Ausubel named them *subsumers concepts*. That is why he says learning is not a literal process, it is substantive. Moreira (1997) compares it with the mechanical learning. In mechanical learning the new information is memorized, with little or no relationship with relevant concepts already known by the student. This process just keeps new information for a while in the memory and then it is forgotten.

Moreira (1997) stresses that meaningful learning does not imply that the meaning that has been learnt is the right one. The student can keep a misunderstood concept because of failures in the presentation of the concept or because the subsumers concepts had been previously misunderstood.

Besides the content, another aspect influencing learning is the communication between teacher and students. Novak (apud Moreira 1997) has introduced the humanist approach to the Ausubel theory. According to Novak, learning results from a process of exchanging meanings and feelings between the teacher and the students. This exchange of meanings happens due to the content which should be structured according to the subsumers concepts. The exchange of feelings, is characterized by the student's motivation to learn and the enthusiasm of the teacher about the theme as well as for the teaching activity (Moreira 1997, Moreira and Masini 1982).

Based on the Meaningful Learning Theory, the activity developed with the undergraduate students had two basic flaws:

- The principles and approaches of Lean Construction were not adequately structured to be presented to the students; because of the complexity of the theme, it would be necessary to identify and clearly define all the concepts so

as to design a structure to them; one suggestion is to distinguish them into three categories: subsumers concepts, the more inclusive concepts and those which depends on changes of thinking patterns of the professionals.

- The students have not been sufficiently motivated for the lecture about the Lean Construction theory; during the presentation, the lecturer showed some images to give examples of the approaches and principles but, actually it was not taken into account what the students knew about those problems and what they wanted to know.

It is important to stress what Ausubel considers the fundamental aspect in the learning process: "*the most important factor influencing learning is what the learner already knows*" (Moreira 1997), because the knowledge is built upon it. Furthermore, according to Vygotsky theory about learning, the influence of the culture determines the symbols and meanings attributed by the individual to the concepts. The cognitive structure is built based on the values and past experiences of the learner (Bruner 1997). These two factors are seldom considered in a plan for teaching or training activity.

FINAL COMMENTS

Through this exploratory study it was possible to analyse the difficulties on the communication of the Lean Construction theory in a management training programme. The most significant contribution of this study for the ongoing research project was the awareness of how ignorance about the learning process can prevent communication.

One of the aspects that must drive the ongoing research project is the focus on the communication of new ideas based on a clearer understanding of learning. The study showed that it is helpful to use symbols, metaphors and images to make people understand the concepts and principles of the new production philosophy. In this way, the Construction Management in Engineering Research Group from NORIE[3] is engaged in a discussion through intranet in order to clear up concepts and match examples, images, metaphors and symbols to be used in a training programme. One of the aims of this activity is to supply a homepage that is going to connect the University of Salford and NORIE, at first, to allow an in depth study about learning and communication. After the period of preliminary tests, which is hoped to be short, this homepage shall be available to others researchers. This tool is intended to support the development of Lean Construction theory.

Besides the content and communication aspects, the research project includes an analysis of the method adopted in the training programme, specially concerned with the profile required for a manager, according to Mintzberg (1995) and Senge (1995), as presented earlier. The application of the Problem Based Learning to undergraduate students has showed positive aspects but, as the objective of the training programme is to deal with professionals, the method to be used must be more proactive and must allow the trainees to improve their ability to learn how to learn. This is one of the requirements of a learning organization, which has been pointed out as an important characteristic of a competitive company.

Finally, it must be stressed that the issues presented here, as well as of the ongoing study, are intended to improve the application of the Lean Production principles and

[3] NORIE is a research group on Building Engineering, at the Universidade Federal do Rio Grande do Sul, Brazil.

approaches in the construction industry in order to contribute to the consolidation of the theory. In this respect, as far as the theory is still under discussion, so is the directions of this research project. But there is one aspect that might remain unchanged: the need for putting ideas and knowledge into action so as to learn from it.

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