

LEARNING IN THE CONSTRUCTION INDUSTRY – AN ANALYSIS BASED ON THE ACTIVITY THEORY

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Cultural historical activity theory is a social-constructivist theory applied in knowledge creation and learning settings. It sees interactions among groups and individuals as governed by their respective histories, enshrined in their activity systems. With its origin in Russian psychology, it informed much educational research and is now also found in organizational learning research. Using this theory interactions between established and small emerging (sub-)contractors leading to learning by the latter are analyzed. Multiple case studies with the emerging small subcontractors at their core were conducted focusing on these contractors' interactions with their established main contractors. Nine case studies were conducted throughout South Africa. The analysis using the activity theory highlights some interesting aspects of interactions and resulting learning. The degree of familiarity (common history) between the actors impacts on the learning event and success. Yet differing learning content exists. Some content does not appear to be dependent on the level of common history, and tension between activity systems does not play a major role in learning. In some cases assimilation, rather than joint adoption of knowledge within activity systems are noted. The activity theory thus can assist in explaining some observed phenomena, yet complementing mechanisms of learning exist.

Keywords: contractor interaction, organizational learning, South Africa.

INTRODUCTION

Social-constructivist theories are commonly found and applied in organizational learning research. Many theories exist, and some appear to dominate the arena. Commonly found social-constructivist theories include the SECI-Model of Nonaka and Takeuchi (1995), Levitt and March's 'Learning by experience' (1988), or Etienne Wenger's 'Communities of practice' (2005). And albeit the cultural historical activity theory having already been developed in Russia in the, 1920s and, 1930s by Lev Vygotsky (Engeström, 2001), it had this far little impact on organizational learning research in general and on organizational learning research conducted in the construction management domain in particular. Its popularity is however rising (Roth and Lee, 2007), and an assessment of its usability for construction management research is thus in order. Through an exploration of the cultural historical activity theory, activity theory for short, and a sample application of it on particular learning events which were documented during conducting case studies, the use and applicability of the activity theory can be judged.

In order to do so the concepts of social-constructivist learning theories as well as the activity theory itself are briefly introduced. This will assist the reader to ascertain the

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commonalities, differences and possible advantages of activity theory compared to other social-constructivist theories. The application of the activity theory in case studies conducted investigating learning among civil engineering contractors will then highlight specific aspects in which activity theory can be used as a base for analysis and discussion of recorded events.

The case studies are based on small emerging contractors working as subcontractors in the South African civil engineering sector. These small contractors struggle to emerge as sustainable businesses and a general lack of knowledge within these organizations are often cited as a reason for their failure to develop. Thus interactions with established contractors in which emerging contractors possibly gain knowledge through knowledge transfers, improving their respective knowledge base, were mapped out using nine case studies. Since it were the interactions between organizations with its individual members, set in contractual frameworks governing their engagements, and influenced by many differing factors a social-constructivist approach was deemed to be appropriate for an analysis thereof. Initially the SECI-Model of Nonaka and Takeuchi (1995) with its extension of the Ba and Basho (Nonaka and Konno, 1998) was applied and used for the analysis of knowledge transfers.

The main aim of this paper is to develop a better understanding of the cultural historical activity theory and its applicability in knowledge management, or more specific the inter-organizational learning research in the construction management field. Improved inter-organizational learning among the various parties involved in construction projects, will ultimately lead to successful project delivery. The analysis of documented interactions and knowledge transfers using the activity theory as the basis might thus in particular be beneficial to the advancement of understanding of organizational learning applied in construction in two ways. Firstly, it might reveal more insights into the documented and previously analyzed knowledge transfers per se. And secondly, it may allow for an improved understanding of this theory's strengths and weaknesses when applied to circumstances such as construction projects with multiple and changing actors.

ORGANIZATIONAL AND SOCIAL-CONSTRUCTIVIST LEARNING THEORIES

Competence is the main factor for the competitiveness of an organization in a changing business environment (Prahalad and Hamel, 1990). Acquiring competencies, which are essentially skills and knowledge available to the organization, and enhancing these is the main aim of learning organizations (Easterby-Smith and Araujo, 1999). Learning organizations are the 'product' of organizational learning – the 'desired end' (Schwandt and Marquardt, 2000) of applying the theories of organizational learning to practice. Learning organizations can thus be described as organizations who actively implement systems in practice which will enable learning. When using such a description the mix of two parts becomes prevalent: It is the learning itself as well as the system enabling it which plays a role in organizational learning. Easterby-Smith and Araujo (1999) point out the two different streams of literature which have developed: one around organizational learning and the other around learning organizations. Simplified, the former literature informs about learning processes and experiences at work (Easterby-Smith and Araujo, 1999). The latter stream of literature is concerned with changing organizations in order to improve learning processes or experiences within these (Easterby-Smith and Araujo, 1999).

Tsang (1997) sees the former as the product of academic work, and the latter the product of authors basing their work on their experiences as consultants in the field. The former informs the latter aiming to assist with improvements of the organizations concerned. However a certain degree of confusion in differentiating these two concepts exists (Fiol and Lyles, 1985). The two concepts are interwoven as learning is context dependent (Dodgson, 1993) and the context is the very learning organizations.

Organizational learning is often linked with knowledge management. The many examples of books published bearing both concepts in their title is evidence of this (e.g. Easterby-Smith and Lyles, 2003a). Within the wider field these two topics are interlinked, yet differences are present. While the former, as mentioned above, is seeking to develop theories about processes linked to learning, literature dealing with the latter topic tends to deal with the outcome of learning – knowledge – and how it can be managed. Authors in the knowledge management domain are thus more concerned with the actual knowledge and how organizations can capitalize on this asset. Hence knowledge management literature further tends to focus on formal systems of managing knowledge such as knowledge databases etc. (Easterby-Smith and Lyles, 2003b).

Focusing now on organizational learning, DeFillippi and Ornstein (2003) in their analysis of organizational learning theories based on psychological perspectives identified four theoretical perspectives of organizational learning: The first perspective is concerned with how organizations process information, the second introduces a behavioural perspective, the third perspective identified by DeFillippi and Ornstein is an action learning or applied learning perspective, and the fourth sees organizational learning as social construction. While these four perspectives differ from the psychological learning theories when applied to individuals, some concepts found there appear to be replicated and intertwined.

It is the fourth social construction perspective which of interest here. In general this theory is closely related to learning through social interaction when applied at an individual level. Situated learning processes in communities of practice are at the core of this perspective (Elkjaer, 1999). The individuals and their contexts are seen as the learning entities. The individuals shape the community and the community shapes its members in return. This interaction is reflected in the learning process. Individuals articulate knowledge when engaging with others at their place of work, through which the parties involved learn again. A social constructivist perspective thus emphasises this ongoing interaction leading to learning within communities (Elkjaer, 1999). Brown and Duguid (1991) refer to this as 'learning-in-working'. This concept is based on the use of social interaction of individuals to mobilize the non-canonical knowledge embedded in activities of the communities and its members. Following Brown and Duguid (1991) a social constructivist perspective is thus one way to access the tacit knowledge embedded in organizations. This social constructivist view also introduces the question of what the organization actually is. The organization, when viewed in this perspective, is something organic, evolving and constantly changing its identity (Nicolini and Meznar, 1995). It is not only shaped by its individual members learning, but is also part of a bigger social learning system (Wenger, 2005). Context is a very important concept when applying a social constructivist perspective to organizational learning. Culture, language, technological system, cognitive distance, similarity, routines, and strategic plans are all part of the context of learning. A social constructivist perspective allows for addressing the complexity of learning in its entirety. Learning is participation in a complex social environment. Wenger (2005)

points out the importance of boundaries in a social learning perspective. Communities of practice / organizations have boundaries; utilizing these boundaries to the advantage of the community / organization is important. Boundaries are the interface to the bigger social learning system, and as such these interfaces bear the opportunity to learn from the engagement with this bigger system (Wenger, 2005). This learning will not only occur through transfers but also through impulses for self-reflections of the community itself. Established theories falling into this social-constructivist cluster include Nonaka and Konno's extended SECI-Model (Nonaka and Konno, 1998), the mentioned 'Communities of practice' (Wenger, 2005), but also Levitt and March's 'Learning by experience' (1988). Vygotsky's cultural historical activity theory falls well within this cluster too.

CULTURAL HISTORICAL ACTIVITY THEORY

Based in Russian psychology of the, 1920s and, 1930s Vygotsky argued that mental processes of individuals find their basis in societal processes (Blackler, 1993). Activity theory promulgates an interconnection of the creation of (new) rules, based on existing, and the deep tacit entrenchment of such rules within the actors in a community, which guides the creation of new rules. The term activity can have many meanings. Activity is understood to be actions (of an individual) and operations (of a community), set in a surrounding wider community.

Blackler (1993) identified five key aspects to activity theory. Firstly, people do not just think, they act within communities. Secondly, mediating mechanisms (tools, rules, languages...) change relations between actors and within communities. Thirdly, newcomers to activity systems learn through interactions within the tension-matrix – assumed to be highly tacit. Fourthly, activities are evolving over time. And lastly, the tension articulated through inconsistencies and conflict within the activity system is at the core of the theory as this is the driving force for learning.

Individuals, or rather their behaviour, within activity systems are understood to be products of their own cultural-historical pasts; yet influencing their respective activity systems. Rules are set in organizational processes, in which tools (e.g. language), are used to create artefacts – deliverables of activity systems. These rules developed through socialization, and as such they have explicit but also tacit components. The rules are based on a common understanding within the community, allowing individuals to act according to their own interpretation. And the respective activity system of a community might form part of a larger activity system of a community. Activity systems can thus be multi-layered.

Accordingly knowledge can be created in two ways. In cases in which events within a community do not fit their set rules and understanding, the created tension gets accommodated by creating an improved understanding of the situation. The common rules or understanding is changed. In other cases tension and disturbance can occur due to connections with other activity systems. Induced ideas, values, or objects in general need to be absorbed through a re-configuration of the activity systems and its rules and understanding on how the system works. Engström's (1999, 2001) extension of the Activity theory, also referred to as the second generation activity theory (Roth and Lee, 2007), gives insights here - Figure 1. The ultimate product of activity systems are objects. And it is these objects which allow differing activity systems to 'interact'. This scenario implies learning through induction of knowledge from outside is possible; and a subsequent realignment of the multi-layered activity

system to accommodate the modified or new object is needed. This is thus the focus of the empirical work conducted through case studies.

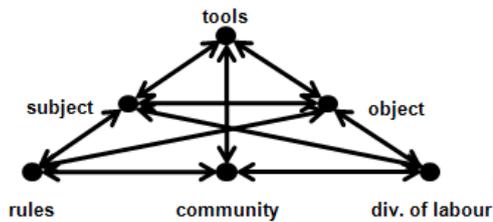


Figure 1: Activity system (after: Engeström, 2001)

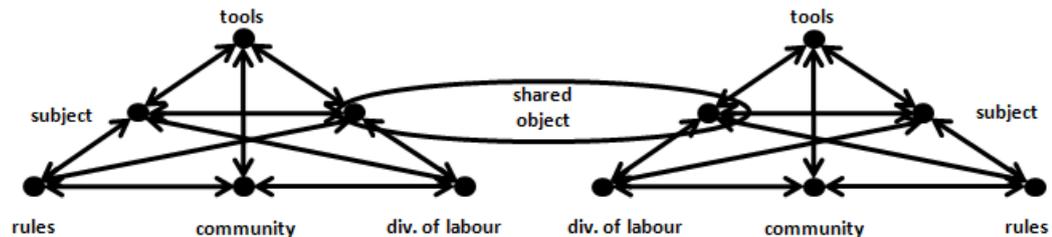


Figure 2: Interacting activity systems with shared object (after: Engeström, 2001)

According to the activity theory it is objects which can be used by various activity systems in line with their own system (Figure 2); the objects are common points of connection. Engeström (2001) refers to knowledge which is shared through these objects as boundary crossing. An underlying tension of the interacting parties, both aiming to work and improve the object, is typically present.

METHODOLOGY

The work presented here is mainly concerned with the usability of the activity theory when applied to inter-organizational learning in construction management. It is thus to a lesser extent of concern of how the empirical work was conducted but rather how the analysis of the documented data and the application of the activity theory is performed. The empirical work included nine case studies with South African emerging civil engineering contractors at their core. Emerging contractors were defined as companies not older than five years, owned and managed by historically disadvantaged individuals. However their periphery and interactions with established main contractors, and expected knowledge gains by the emerging subcontractors were of particular interest. Various sources for the data collection during conducting the case studies were used; these included contract documentation, site observations as well as interviews (interviews being the main source used). Separate interviews with the emerging contractors' owner/managers, their respective contract managers at current subcontracts, clients as well as client representatives (e.g. engineer) were conducted. A total of 18 interviews, some of them group interviews with various interview partners with the same background (i.e. client), were recorded and transcribed. A total of 44 respondents / interview partners were thus heard. In some cases contract documentation as well as procurement policies of the clients' were consulted too. Through the multiple data collection points, various views and experiences regarding the emerging contractor and experienced knowledge transfers to these could be ensured. This assists in a well rounded presentation of the various cases. The analysis of the data is driven by the activity theory. The interface between engaging parties, including their own inherent characteristics, as well as the content of knowledge transfers are of interest. Thus the analysis of the data is based on a mix of

content analysis as well as evaluations of reported interfaces leading to knowledge transfers between emerging and established contractors. NVivo 7 software was used to assist with the analysis of the data.

RESULTS AND DISCUSSION

In the presentation of interactions with knowledge transfers in the light of activity theory it is envisaged to depict the wide spectrum of interactions. This will lead to an understanding of the activity theory's usability but also its limitations. Recorded knowledge transfers are briefly introduced and identified by means of their content and general circumstances. Then focusing on the extremes will allow for an overview of knowledge transfers in the light of activity theory.

Learning and knowledge transfer scenarios

In general knowledge transfer content could be grouped in three main themes: Financial, Managerial, and Technical content. Taking the recorded data to a finer level some sub-themes or knowledge content were identified. These sub-themes are listed in Table. An example of such a scenario could be:

"...Usually [clarifications of problems] are done on site meetings or I'll phone him and say I've got a [site] problem, can you come and have look here, he pops in his car and comes to look." (Emerging contractor 6)

Table 1: Knowledge content transferred

Financial		Managerial			Technical		
tender rates	cash-flow / progress payments	resource management	business acumen	Health and Safety	supply chain	basic tasks	in-sights

Examining the recorded data some first deductions can be made. Financial knowledge was always transferred in an office setting. The data reveals that paper (e.g. contract documentation) and pen were used to relate knowledge. A typical scenario is depicted by one main contractor like:

"Then I'll sit down with him and I'll help him do the tender, but what I then do for him is I say come sit next to me, look this is how I do the tender, this is how I break it up, how many guys do you use in doing that specific task, and then he tells me no so many, and I start jotting down what he's telling me." (Main contractor 3)

Guidance in the office, or instructions and explanations on site by the established contractor to benefit the emerging contractor were recorded with regards to resource management issues. Knowledge transfers changing business acumen of the emerging contractor appeared to be unbound by any locality and specific interaction.

Furthermore, Health and Safety issues were relayed in various ways. As example in a scenario for resource management, the following excerpt of an interview can be used:

"I will tell him at times that he's got too many people for a particular section of work, you know, and he's got to explain to his supervisors and his charge, you know, that they've got to maybe spread out, you know, you can do ... don't have everybody situated in one section, you know spread your guys. You will be able to produce more." (Main contractor 5 and 6)

From the data collected it appears that any transfer of knowledge relating to technical aspects of subcontracting work was relayed on site. Typically on site encounters were

reported upon by the interviewees; like this emerging contractor explaining how they learnt to lift concrete pipes with an excavator:

"He [main contractor] did show me with my operator, because my operator was still there, and then he showed how to do it, how to swing those things..." (Emerging contractor 4)

Connecting activity systems - boundary crossing

In order to showcase the usability of the activity theory to the above reported knowledge transfer scenarios some scenarios are scrutinized. With the emerging and the established contractor representing each their respective activity system, the systems and the connection points (shared objects) leading to a change of knowledge with the emerging contractor are of interest.

In each of the recorded knowledge transfers two parties, the emerging contractor (typically the owner/manager) and the established contractor (either site staff or contracts managers as representatives), were involved. Using the activity theory, each of these parties represents an activity system with its six distinguishing characteristics (rules, community, division of labour, subject, tools and the object).

In the case of knowledge transfers relating to progress payment some observations were made, which can be related to the activity theory. Progress payment claims submitted by emerging contractors often failed to adhere to common standards, and a lack of knowledge on how to produce correct claims was evident. Thus the two parties jointly acted in order to solve this problem. Table 2 summarizes the two respective activity systems as they engaged in improving the understanding of the general progress payment and claim procedure.

Table 2: Activity systems and knowledge transfer (progress payment: claim procedure)

	Activity system Emerging contractor	Activity system Established contractor
Object	improved claim procedure	improved claim procedure
Tools	pen/paper	pen/paper/template
Subject	owner/manager	contracts manager
Div. of labour	owner/manager	accounts dept./ contracts manager
Community	company	company and profession
Rules	maximizing claim	correctness, empowering

Knowledge transfers with basic technical knowledge at their core were recorded too. Typically the emerging contractor struggled on-site with a particular task. A representative of the main contractor would then assist in getting the emerging contractor to complete the task. In Table the respective activity systems in such scenario are summarized. Here the emerging contractor struggled to move and lay stormwater pipes. This resulted in learning on how to use an excavator to handle and lift the concrete pipes.

The above two exemplary knowledge transfer scenarios are easily explained using the activity theory. Each scenario sees both parties as active participants in making the object work. All six characteristics of activity systems are clearly evident for both interacting activity systems. The objects are clearly identifiable and the tools used to create the objects were explicitly mentioned in respective interviews. Common histories between the two activity systems were not evident. Yet some form of tension between the two parties is evident. In the first scenario conflicting financial interest

and standards are the set-off point; in the second scenario efficiency and Health and Safety issues were the driving force.

Table3: Activity systems and knowledge transfer (basic technical: moving pipes)

	Activity system Emerging contractor	Activity system Established contractor
Object	moving of pipes	safely moving of pipe
Tools	excavator and slings	excavator and slings
Subject	operator	foreman
Div. of labour	operator / owner	foreman / contracts manager
Community	On-site staff	company
Rules	getting it done	safe, efficient, empowering

Knowledge transfers with content relating to business acumen in general were identified too (see Table). This mostly related to general business knowledge, best practices of engaging with others, or simple time keeping of managers. In many cases emerging contractor reported that they had learnt from established companies such elements of running a business. But neither the locality nor the actual interactions were usually clarified. Table thus represents one particular scenario of two contractors' interactions leading, according to both parties, to improved business acumen by the emerging contractor. Through the analysis of the interviews it became evident that no concrete object could be found relating to particular interactions, also no concrete tools were used to create objects used for learning about business per se. The insistence of the established contractor of having regular meetings with the emerging contractor was clear, however the intention of meetings were not necessarily to improve business acumen, but might have partially resulted in such improvements.

Table4: Activity systems and knowledge transfer (business acumen - general)

	Activity system Emerging contractor	Activity system Established contractor
Object	-	-
Tools	-	(regular meetings?)
Subject	owner/manager	owner
Div. of labour	owner/manager and staff	owner / company
Community	company	company
Rules	learn	empowering, mentoring

The scenarios of emerging contractor learning about business acumen are difficult to put into the template of interacting activity systems. Objects and tools are difficult to identify, and actual boundary crossing by means of interacting work with objects seems missing. In the cases in which knowledge relating to business acumen was transferred some characteristics seemed more prevalent. Here high personalized contact between the parties, similar company historic developments, and similar education of the actors, in short a common history, were noted. It can be argued that historically grown rules and community of the interacting parties were very similar. And possibly many of the rules of the emerging party were induced by the established party, yet no clear object based interaction could be identified. Further no apparent tension between the activity systems is noted. It appeared that in such cases a form of assimilation rather than learning took place. An existing (seemingly successful) system appears to be copied over a long period of time by the emerging contractor. This is done through the development of an understanding of the established contractors' routines, and transferring these into the emerging contractor's system.

CONCLUSIONS

Knowledge is the key to success and in order for companies to remain or become competitive these need to adopt routines allowing them to swiftly learn and improve their organization. Many organizational learning theories exist, focusing on the matter of the processes involved in companies' learning. Activity theory is a socio-constructivist theory. Its use in the domain of construction management, and particularly work related to knowledge management and improvement of construction business processes, is thus far limited. Using case studies of small emerging contractors learning while engaging as subcontractors with established companies, some features of knowledge transfers in the light of activity theory were highlighted. Activity theory appears to be adequate to explain some of the circumstances involved in transferring knowledge; yet not all recorded knowledge transfers could be explained through Activity theory. Underlying tensions between interacting parties, and focused efforts (objects) are needed to explain knowledge transfers through Activity theory. The application of Activity theory could thus be particularly interesting in explanations of project-based interactions among the role-players in construction projects. For instance contractual conflicts (tension) and their resolutions (shared object) could be mapped out and explained through Activity theory (e.g. Hartmann and Bresnen, 2011). Further by understanding organizations as activity systems, with clear characteristics, changes to these activity systems can be made, enabling these activity systems to improve their object based operations. An example here could be the creation of an ethos of partnering in construction, which would possibly require differing rules and less boundaries with others.

However long-term processes of knowledge transfer with no clear common point of interaction, yet possibly a shared history of parties, cannot be explained through the model of two activity systems interacting. Here alternative models, such as Nonaka model of the Basho, or Wenger's Community of Practice, might be more advantageous in explaining observed behaviours. The application of the Activity theory is only possible, if the entirety of interacting parties (e.g. subcontractor and contractor) is seen as one system. The Activity theory, and in particular the offered extensions by Engeström, can be successfully used to explain organizational learning in construction. Through the understanding of multi-layered activity systems a wide usability of the theory can be ensured; yet the boundaries with competing theories (e.g. Nonaka's Basho) then become blurred.

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