EXPANSIVE LEARNING IN CONSTRUCTION PROJECTS - A CONTRADICTION IN TERMS?

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This research is a preliminary study performed as part of a primary research into expansive learning in interorganizational network set up to solve a construction project. The construction industry has long had issues about productivity, which can be an indication of lack of learning. A case study of a workshop was conducted where coordination and collaboration meetings were observed. The data was analysed using activity theory and the expansive learning model. The analysis shows that the strong focus on object by project's activity system hinders expansive learning. The students learned through acquisition and participation but not by expansive learning. The construction industry needs to accept that the learning generated from projects will be limited to learning by acquisition and participation. The interorganizational network cannot facilitate expansive learning while working on object-fixed projects. Research in construction management fails to generate and document knowledge because of the limitations of case studies.

Keywords: activity theory, construction management, interorganizational network, learning

INTRODUCTION

The productivity in the Danish Building industry compared to the consumer cost index has fallen over the last 50 years even after correction for increased standard of the projects (Nielsen, Pedersen and Haugbølle 2010). A similar situation exists in the UK construction industry where Addis (2014, 1245) finds: "*Performance […] has long been regarded as unsatisfactory [and] despite a number of reviews and policy initiatives to produce productivity, quality and competitiveness gains the industry has failed to meet improvement targets in a range of areas."* We set out to investigate if the industry is learning, as the low productivity can be a result of low level of learning within the industry.

Construction projects viewed from an organizational perspective "*are multi-actor projects in which a broad range of actors are involved with different competences and specialties are involved*" Eriksson (2013, 336). It can be considered an interorganizational network. It is difficult to find a universal accepted definition for the term interorganizational network (ION). Najafian and Colabi (2014, 58) found in their survey: *"inter-organizational networks relationships is often studied without an explicit definition of the construct."* In their review of 24 articles, they found that 26%

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Klitgaard, A, Beck, F, Buhl, H, Jeppesen, R D and Nissen, S B (2016) Expansive Learning in Construction Projects - A Contradiction in Terms?. *In*: P W Chan and C J Neilson (Eds.) *Proceedings of the 32nd Annual ARCOM Conference,* 5-7 September 2016, Manchester, UK, Association of Researchers in Construction Management, Vol 2, 709-717.

percent of the articles did not include a definition, 56 % included a conceptualization while 17% had an explicit definition.

Two main conceptualization of an ION are in Bergenholtz and Waldstrøm's (2011, 540) review defined as "[1] *the network is considered a metaphor for some kind of interaction across an organizational boundary, or [2] the term refers to the specific social structure between organizations."* The analytical perspective relies on the *"fundamental proposition that an organization's structural position in a network influences its opportunities and constraints"* (Bergenholtz and Waldstrøm 2011, 541).

This research adopts the analytical perspective to the ION. We accept an organization's position in the network influences its' *opportunities and constraints'* for learning.

Construction projects can also be viewed "*as the creation of new value in society*", states Winch (2010, 5), where the "*inputs into the process are capital and human resources - capital to cover the costs of investment; human resources to transform ideas into reality. […] The return on human resources is the learning that takes place."*

The two metaphors of knowledge, introduced by Anne Sfard helps understanding what knowledge is and how learning happens. The acquisition metaphor illustrates the mind, as *"a kind of container of knowledge and learning is a process that fills the container."* Secondly, the participation metaphor views *"learning as a process of participation in various cultural practices and shared learning activities […] Knowledge does not exist in a world of its own or in individual minds but as an aspect of participation in cultural practices* (Paavola, Lipponen and Hakkarainen 2004, 557).

However, Paavola, Lipponen and Hakkarainen (2004, 558) maintain: *"There is room - and a need - for a third metaphor of learning"*. They call this metaphor for 'the knowledge-creation-metaphor'. They find *"The knowledge-creation perspective focuses on analyzing the processes whereby new knowledge and new mediating objects of activity are collaboratively created, whether in schools or at world."* Paavola, Lipponen, & Hakkarainen (2004, 573).

Three models can be used to understand the knowledge-creation metaphor, suggests Paavola, Lipponen, & Hakkarainen (2004). They are: Nonaka and Takeuchi's model of learning-creation, Engeström's model of expansive learning and Bereiter's model of knowledge building. We chose to use Engeström's expansive learning as it has a very clear focus on interorganizational learning.

This research investigates expansive learning in construction projects. We ask the question: how does the interorganizational network create knowledge from expansive learning during a construction project?

Theoretical Framework: Activity Theory, Expansive Learning and Contradictions

The research data is analyzed using activity theory. It allows for investigation into "*what is done and learned together instead of studying only connections and collaboration of work"* (Engeström and Kerosuo 2007, 336). The unit of analysis in this research is the collective activity system. The subjects (the participants) will use mediating artefacts to reach their object while under influence from the collective set of rules, communities as well as the established division of labor. The outcome is the result of the activity, figure 1 (Engeström and Sannino 2010).

We focus on the collective activity system following Martin's (2011, 543) recommendation: "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".

An understanding of the decisions and the following actions by the collective activity system requires an understanding of its object. The object "shapes and directs the activity and determines the horizon of possible actions" (Foot 2009, 3). The object "represent and explain the collective motive of the activity" although "it is not fixed but constantly changing, constructed and re-constructed" (Toiviainen 2007, 348).

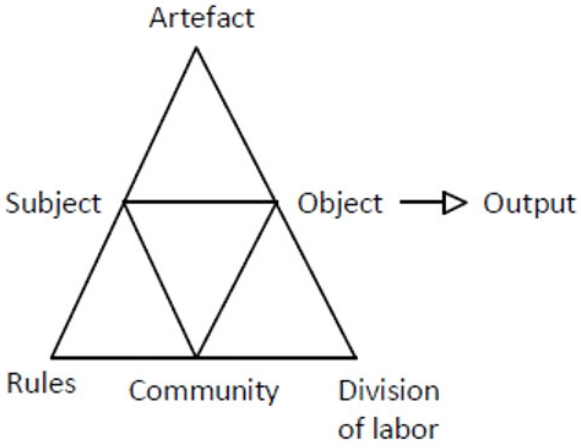


Figure 1: The collective activity system

We set out to find examples of expansive learning, which happens when: "*Learners learn something that is not there yet"* (Engeström and Sannino, 2010, 2). Expansive learning, the creation of new knowledge, can be depicted in an ideal-typical sequence in the expansive cycle, figure 2.

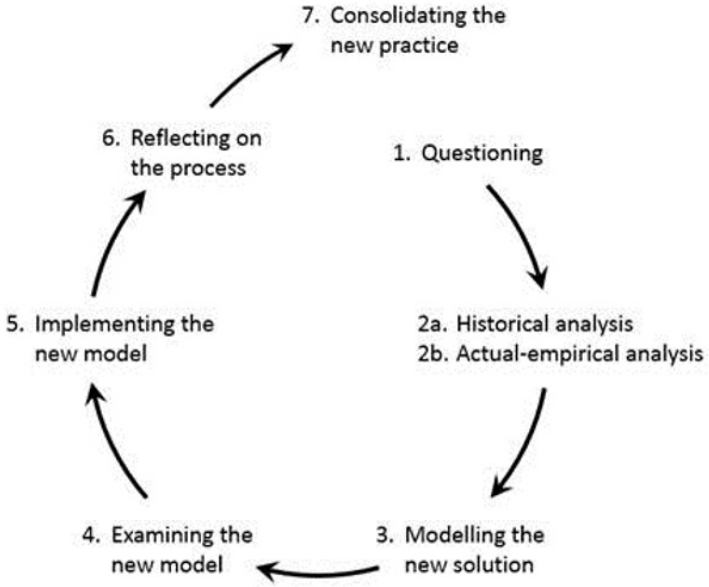


Figure 2: The expansive cycle of learning actions (Engeström 2000, 970)

Expansive learning can happen in many contexts. In their review on the subject Engeström and Sannino (2010) find expansive learning can happen as: the transformation of the object, movement in the zone of proximal development, cycles

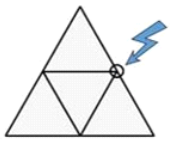
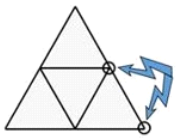
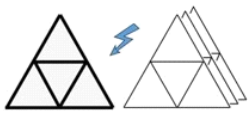
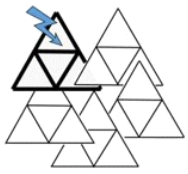
of learning actions, boundary crossing and network building, distributed and discontinuous movement and as a result of formative intervention.

In this research, we investigated, whether expansive learning as transformation of objects happens. An expansive learning event is object-oriented, so by following the object, it becomes *"possible to identify and analytically discern one [learning] event from another* (Toiviainen 2007, 348). Engeström and Sannino (2010, 2) uses object-changes to understand learning by expansion: *"The learners construct a new object and concept for their collective activity and implement this new object and concept in practice"*. Learning is not *"manifested as changes in the subject*" but as "*changes in the object of the collective activity*" (Engeström and Sannino 2010, 8).

The first stage in the expansive learning cycle (fig. 2) is, where the activity system is *"questioning, criticizing or rejecting some aspects of the accepted practice and existing wisdom"* (Engeström and Sannino 2010, 7). This questioning can happen when a contradiction occurs. In this way, a contradiction becomes the *"actual driving force of expansive learning when they are dealt with in such a way that an emerging new object is identified and turned into motive"*. (Engeström and Sannino 2010, 7).

Contradictions happen in different phases of the learning process. A description and visualization of the contradictions can be found in table 1. Identification of contradictions allows for evaluation of the activity system's reaction to expansive learning opportunity.

Table 1. Description and visualization of contradictions based on (Engeström and Sannino 210, 7)

Type	Description	Visualization
Primary	Contradiction within the nodes of the collective present activity system, typically the object's use value versus exchange value.	
Secondary	Contradiction between nodes in the collective present activity system.	
Tertiary	Contradictions between the present dominant activity system and one (or more) of the member's more cultural advanced activity system.	
Quaternary	Contradictions when changes in one of the member's activity system affects the present collective activity system.	

The expansive learning cycle can be applied to any activity system, but it is important to *"distinguish between short-lived goal-directed actions and durable, object-oriented activity systems"* (Engeström 2000, 961).

In this way we apply activity theory to an "analysis of knowledge creation processes" as suggested by Martin and Hartmann (745), who found *" activity theory seems to be appropriate to describe micro level processes, in which individuals act and respond to situations based on given historical development, but also changing their frame of reference."* They found this useful as it offers an opportunity for "*analysis of micro level processes, linking these back to macro level circumstances."*

Expansive learning in a collective activity system is problematic in three ways as pointed out by Young (2001). First, is the problem of knowledge: how does the activity system access knowledge, which is not available in the system and will new knowledge be allowed to emerge if it challenges the position of some of the members? The second problem relates to power: is the willingness to enter into the questioning phase hindered by fear of being viewed as a troublemaker? The third problem is motivation: will all members be motivated to generate new knowledge? These problems are very relevant when the ION is viewed from the analytical perspective.

This theoretical framework allows us to observe for contradictions as they indicate an expansive learning opportunity. The response of the activity system to the contradiction will clarify how the activity system is creating knowledge through expansive learning. In the next chapter, the observed project will be described and the findings will be described and discussed.

METHODOLOGY

The research design is a small-scale case study. It should provide useful insight before making the choice of research strategy for the larger research project into learning in interorganizational network.

The research is based on a case-oriented research strategy. The case study is chosen "*to contribute to our knowledge of individual, group, organizational, social, political, and related phenomena.*" (Yin 2009, 4) The use of case studies for the collection of data can be controversial. But Yin (2009) and Flyvbjerg (2006) argues that case studies can be used for collecting valid data. The data must be presented in a rigorous and objective way (Yin 2009).

The data was collected during "The digital days", which is a yearly event at a University College in Denmark. The event offers an opportunity for students to work with new technology as well as practice their collaboration skills. Students with different educational background are teamed together to act as different professions in the industry. This year they must design a refurbishment project of a school and compete to win a fictive tender. The students have the option to participate in lectures about the industry's move towards increased use of building information modelling. Eighteen students from five different educations as well as two secondary school pupils (to act as users of the final project) were observed. Mentors from the industry were available to assist the students. Nine meetings were observed and recorded (125 minutes in total). All the participants were not present at all meetings. Semi-structured interviews were conducted with two of the participants and one of their external mentors before and after the meetings.

The videotapes and the recorded dialogue were studied for signs of contradictions in the activity system consisting of the participating students.

FINDINGS AND ANALYSIS

Observations of primary and secondary contradictions in the activity system will be presented here. An example of a tertiary contradiction was also identified but is not presented here. We identified them by observation during the project meetings as well as video footage from the meetings. These terms will be used in the following; Project manager - PM, Mechanical engineering plumber - MEP, Architect - ARC and Engineer - ENG.

Examples of Primary Contradictions

The first contradiction was identified at the first project meeting, where the participants were introduced to each other for the first time. At this meeting, the students discussed their role in the project.

The project manager addressed the fulfilment of the award criteria as the goal (shared object), several times. As a response to this, one of the participants placed the question giving the first contradiction. "*Should we coordinate something in relation to the lectures?*" The PM replies:

1. Yes, yes that is right. There are held some lectures during the day […] Of course, it is annoying if all architects just stat to slip away, so that we cannot really move forward. [….] so if people are interested to participate in the meetings, then I think they should just do it. I mean - we are also here to learn.

The contradiction lies in the shared object - the conflict between the opportunity to change the object from being the fulfillment of the project to the learning made available through the lectures. It is a primary contradiction. The learning opportunity is addressed, but it is ignored and the fulfillment of the project continues to be the object.

At day two, the project group was unexpectedly informed that they were allowed to move columns in the existing structure. The ARC response was:

> 2.It could be cool to remove a column, then we could make the rooms a little bigger […] it will affect everybody. We will probably be set back if we remove a column now.

The PM chooses to ignore the option for "cool" design as it threatens the need for progress. It is an example of primary contradiction between the use value (cool design) and the exchange value (project fulfillment within the time frame). The opportunity for object changes and expansive learning is missed.

Example of Secondary Contradictions

During the first two days, a secondary contradiction evolved. Due to the fact, that the project needs to be designed, the work pressure was high on the ARCs. The MEP indicates several times, that the dimensions and the placements of the windows are important for them so they can make their calculations in order to avoid delay to the progress later.

On day one, the ARC argue that the MEP should suggest the dimensions of the windows as well as the placement. This suggestion means a small alteration to the activity system's division of labor. The ARC says:

> 3.I imagine we make a description, of where we want the windows, how large they should be, then you [addressing the MEP role] can make a suggestion which is a little more accurate […] And then we can go in and get them placed at the end. Because otherwise, I think we are going to spend too much time before we can release it to you, and then you get started too late, I think…

As the pressure for progress escalates on day two, the ARC becomes more willing to change the activity system;

> 4.[…] Yesterday we talked about that you are welcome to look in to what windows we could use - in other words to come up with suggestions for it - sizes and so on.

The change in the division of labor evolves when the MEP suggest taking over even more of that work;

> 5.We might as well place the windows and that if you would like to outsource it?

The discussion in the project group continues with the focus on the division of labor. The responsibility to find the dimensions and the placements of the windows changes from being the full responsibility of the ARC to be divided between the MEPs, the ENGs and the ARCs.

The contradiction identified is between being able to deliver the project on time (object) and the impossibility for the architect to generate the progress due to lack of man-hours. The contradiction is a secondary contradiction - between the object and the present collective activity system. They change the division of labor within the activity system to eliminate the secondary contradiction.

CONCLUDING REMARKS

It seems almost impossible for an interorganizational network surrounding a construction project to learn expansively. There are two main obstacles.

First, the goal-directedness obstructs for reacting on expansive learning opportunities. The network created to solve a construction project are performing "*short-lived goal-directed actions and* [it does not form] *durable, object-oriented activity systems"* (Engeström 2000, 961).

Second, the organizations in the project do have a "*structural position in a network [which] influences its opportunities and constraints"* (Bergenholtz and Waldstrøm 2011, 541). This means that all Young's (2001) concerns of knowledge, power and motivation in expansive learning become very relevant.

Historically, we have seen different attempt to reduce the tension and contradictions in the activity system. An example is partnering, where "*the potential of partnering as a change strategy critically depends on the ability to handle the situated tensions and contradictions that occur within and between activity systems, when existing practices and activities are destabilized and the rationalities of existing systems are called into questions."* (Gottlieb and Haugbølle 2013, 132). We question if contradictions should be 'handled' or should they be accepted, as the learning opportunities, they represent.

The construction industry is moving from one project to the next forcing changes to object and activity system (partnering, the use of ICT, new tendering criteria) in an attempt to 'handle' tensions and contradictions. Handling of the tensions may ensure a smooth path towards delivering the project, but also hinders expansive learning.

Although we agreed with Martin and Hartmann's (2010) idea of using activity system to understand the actions and re-actions in the activity system, we question the value of the learning from such analysis, as the likelihood to discover expansive learning is limited.

The construction industry needs to accept that the learning stemming from projects will be limited to learning by acquisition and participation. As a result, construction management researchers need to acknowledge that the study of cases of construction

projects will not generate the opportunity to document the creation of new knowledge - expansive learning.

Our first research results have revealed some interesting findings about construction projects and expansive learning. In our further research, we shall look into new ways of experimenting and facilitate interorganizational networks in order to create new knowledge. In summary, we ask ourselves: "Expansive learning in construction projects - a contradiction in terms?"

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