LEARNING AND IMAGINATION IN CONSTRUCTION

Kristian Kreiner[1] and Lise Damkjær[2]
[1] *Centre for Management Studies of the Building Process, Copenhagen Business School*
[2] *Centre for Management Studies of the Building Process, Learning4Life*

Learning is considered a good strategy for solving the persistent problems with defects in construction. But conditions in construction are not conducive for learning. This increases the risk that experience produces lessons that are false or limited. We illustrate the inherent difficulties of making sound assessment in even simple, ordinary situations on a construction site. Building on this appreciation of high complexity we develop a perspective on the experience of construction defects as probabilistic events. From this perspective we suggest that what should he learned from experience is not only what happened but also what might have happened; and that the challenge is not to make sound assessment of defects but to finds ways of making the assessments more likely to become sound by subsequent events.

Keywords: construction defects, false learning, imagination, sense-making.

INTRODUCTION

In this paper we offer a minor, but slightly significant change in perspective on some very old and persistent problems in construction practice. Problems vary from spectacular accidents to minor defects, but apparently quality problems in general have become immune to our sound prescriptions and rational solutions. In spite of many years of experience and much well-intended effort the problems are still sticking to the industry.

If many years of experiential learning, in the form of e.g. learning-by-doing and learning-by-failure cannot be claimed to have had much adaptive effect maybe the lessons we have learned over the many years of experience are the problem! Our hypothesis is that learning has taken place within a narrow and limited imagination of the reality that construction work is part of. If we start imagining the reality differently we may learn new lessons from the same experiences, and some such new lessons might prove to have adaptive effects. We advocate a renewed effort of double-loop learning (Argyris and Schön 1996) in construction, but in a form that does not facilitate, but rather obstructs single-loop learning. Since we imagine construction work to be highly complex the reality, as we experience it, has a stochastic element. E.g. the effects which we produce or observe are nothing but examples of what might have happened. And the experiences we actually collect are samples of a larger pool of potential experiences. Maybe, learning in a traditional sense makes too much of the experiences we happened to collect and too little of all the experiences we might have collected, but due to circumstances did in fact not collect; maybe it makes too much of effects we happened to produce and too little of the effects we might have produced.

[1] kk.ioa@cbs.dk
[2] lise@learning4life.dk

Kreiner, K. and Damkjær, L. (2009) Learning and imagination in construction. *In:* Dainty, A.R.J. (Ed) *Procs 25th Annual ARCOM Conference,* 7-9 September 2009, Nottingham, UK, Association of Researchers in Construction Management, 135-44.

Imagination and theorising are the only ways in which we may access this reality of potential, but not observed or realised events.

Below we try to bridge between such very general and abstract ideas, on the one side, and some very concrete and trivial observations of work activities on construction sites. If we use imagination to place actual observations and experiences in a larger and non-empirical context of potential observations and experiences, then perhaps we may learn richer lessons.

Aim of the paper

The aim of the paper is to understand how supposedly informed judgment about reality may contribute to the persistence of the problems with defects in construction. We define a defect as some physical outcome that is in need of repair. In practice, however, it may not always be self-evident whether something needs repair or not. And in particular, when at some point it is decided that no repair is necessary, the implication is not necessarily that nothing more needs to be done in the future.

We use a single observation of a foreman assessing a specific situation. We adopt an ethnographic perspective in trying to reconstruct the sense-making that such assessments entail in the field. But we add a more analytical perspective in contrasting this with the sense we could make of the assessment if we adopted a different and more complex framework. The aim is to be able to specify alternative behavioural implications from common experience, because the current implications, while easy to make sense of, apparently do not do the job of solving the problems with construction defects.

Plan of the paper

First, we discuss the methodology of our study. We have to justify why the data we have collected can be used in a study of construction defects, when in fact we observed no defects.

Next, we present the observation of a specific sequence of events on a construction site. This leads to an analysis of the complex manner in which this task performance may relate to construction defects. Following this section, we venture to illustrate the types of strategic learning that might propose itself in the specific case. And we conclude by reviewing the type of implications that might be drawn from a mode of learning that actively builds on imagining a more complex reality than the one we experience directly.

METHODOLOGY

This paper is part of a larger study of things that go wrong in construction, including big accidents and collapses. In the present study we focus on the less spectacular and more ordinary types of mistakes. We focus on construction defects, i.e. physical achievements in need of repair.

While we focus on defects, the data we collected were not about defects as such. We have made observations on construction sites of actual, ordinary work processes. And we have analysed the ways in which such work processes may relate to future effects, some of which might be classified as defects. But for "philosophical" as well as practical reasons, we were not observing failure-bound practices on construction sites.

Data

A defect is an assessment of a situation and depends on a whole lot more than what individual actors can control and accomplish on their own (Ryle 1949/2000). In spite of their incompleteness, defects are achievements and therefore a characterisation of a situation that exists after the work has been performed. In Ryle's own words, when appreciating an achievement "… we are asserting that some state of affairs obtains over and above that which consists in the performance, if any, of the subservient task activity. For a runner to win, not only must he run but also his rivals must be at the tape later than he; for a doctor to effect a cure, his patient must both be treated and be well again …" (p. 143-44). In short, if winning is not a quality of the running, but of the reality that exists after the running, perhaps defects and mistakes are not qualities of task performance on construction sites, but qualities of the state of affairs that obtains after some task performance. We cannot in real time observe 'defects in the making', because that would mistake the task for the achievement, or the process for the outcome. We can observe the running as a progression, but not the winning. Likewise, we can observe task performance in real time, but not the defective performance. Only in retrospect can we construct the (by then completed) running as a winning run and the (by then completed) task performance as defective.

This reflection should remind us that the search for simple causes and individual mistakes in explaining and learning from defects is misguided. Simple causal explanations may be needed in placing a responsibility, but it may also misrepresent the reality in which effects are produced and therefore also inspire actors to draw highly dubious implications for future action.

Surely, the achievement, i.e. the future state of affairs, is possibly present in the minds of the runner and construction worker as a motivator and sense-giving idea or fantasy. Some kind of achievement is already present as a mental object, as a course-of-action or a program (Ryle 2000). It is the imagination of winning, or the imagination of a task that guides and informs the running and the task performance, respectively. Human action is characterised by future-perfect-thinking (Schutz 1973; Kreiner and Winch 2008; Kreiner and Winch 2008). But mistaking the imagined and projected outcome for the actual one inflates the trust in our (mental) powers and abilities to control courses of events and inspires us to conceive of reality in simple and causal terms.

We claim, probably justifiably so, that construction work is a more complicated case than running a race. By implication it is more difficulty in the former case of taking guidance from the projected outcome in acting in the present. 'Run faster' may be the appropriate answer to lacking behind in a race we intend to win, even if we lack the strength to do it. In construction, however, appropriate answers are not always similarly clear. Such answers are, as we will illustrate below, determined in processes of sense-making and judgment. Construction work takes place in an ambiguous reality in which problems as well as causalities need assessment. This fundamental ambiguity is the reason, we claim, why learning from failure in construction is so difficult and the history so ineffective.

Observation as strategy - and the problem of sampling learning cases

We might have chosen an alternative approach, namely to start with these situations in which repair work is needed and from there to move backwards in time to reconstruct the preceding processes. That is how case studies are normally conducted and how learning from failure is normally organised. However, such reconstruction and

learning is already informed by an understanding of the building process - and heavily framed by the conjecture that what happened, had to happen, given the contingencies carefully excavated in the research process. It also leads to the implications that it would not have happened, had some action at some place in the causal chain been different.

However, moving backwards in the causal tree gives you a picture of what happened, but not a picture of what might have happened - and would have happened, had the complex and interactive process of history evolved slightly differently. There is not only one route to success or failure. There are multiple routes, and the critical path may be construed and constructed in many different manners. Since we are intend to challenge the very causal interpretive framework in which the numerous construction defects have been analysed and made sense of, and to replace it with a framework that focuses more on defects as a probabilistic phenomenon, reconstruction of things already turned into defects will produce a highly biased sample.

To circumvent such problems, we have chosen to insist on observing actual action on construction sites. We make no pretention of observing failure-bound action; it is more likely that we are studying success-bound action. After all, most task performances are successful, even in a failure-ridden construction project.

But we claim that we are observing action with the potential of becoming seen as defective, wrong, and irresponsible, etc. In view of the complexity we ascribe to construction work, any action and any judgment has the potentiality to prove misguided retrospectively. There may be more or less risk involved, but the likelihood of misconstruing the situation is never nil. Thus, we are observing action that might turn into defective action, and we are analysing the multiple ways in which this may happen, whether or not it actually happens subsequently.

OBSERVATION: THE UNSTEADY INSULATION MAT

We encounter the foreman on the construction site on a normal workday. The foundation has already been completed and the terrain has been prepared and insulated with foam mats for concreting soon. The foreman is commuting from his office to another part of the site and to save time he cuts across the building footprint. He suddenly stops and returns to one of the mats which he stepped on. Presumably, the mat moved when he stepped on it. The gravel on which the mat rests is supposed to be level and the wobbling indicates that it is not. He returns to investigate how much it can move and to learn how uneven the surface is. After having tilted the mat back and forth for at while he continues his walk without further ado.

We cannot know if we happened to observe a critical moment in this particular construction project. Chances are that we did not, but the possibility exists that we did. The reason that we cannot know is the simple fact that the criticality of things can only be known retrospectively. Subsequent events may turn the unsteady insulation mat into a cause of serious problems in the future.

Neither can we know for sure what went on in the foreman's mind when tilting the mat back and forth. All we know is that he would have told us that the wobbling didn't matter, had we asked him afterwards. Otherwise, he would not have walked away. Instead of interviewing him about his retrospective rationalisations we theorise how he came to the assessment that nothing needed to be repaired.

ANALYSIS

What follows is an analysis of the observations, a guided interpretation of the events and the phenomena.

Accidental learning

The first thing to note is the fact that the foreman was stumbling over a learning opportunity. He was pursuing a different course of action and clearly not intend on controlling the quality of the work. He simply happened to step on the unsteady insulation mat when he made a shortcut in commuting from one place to another. His discovery was opportunity-driven. The unsteady mat became a learning opportunity because the foreman was undisciplined enough to divert from the designated path making a shortcut across the insulated terrain. His reaction was probably less accidental since apparently he was trained and competent enough to imagine that unsteadiness might have some significance. Furthermore, he was heedful enough to register that it moved and diligent enough to pause with his ongoing task while returning to the insulation mat to investigate the matter. Had any of these many preconditions been missing the unsteady insulation mat would not have provided an opportunity to learn, but it would still have been unsteady, of course. In the bigger picture, the learning process we observed was a chance event.

Ambiguity: imperfection or defect

The need to investigate the matter is a sign of the fact that the information he receives from stepping on the insulation mat was ambiguous. If we believe that more information makes reality better understood, here is a case to show that more information occasionally makes reality more complicated (Dörner 1996). It requires the foreman to draw implications that are apparently not self-evident, but a matter of judgment. While we cannot know how the foreman construes the issues we may suggest that he is spending time on determining whether the unsteady insulation mat is an imperfection or a defect. The implications he will draw depends on this judgment: will he require the work to be redone or will he consider the mat to be ‘as good as’ steady and do nothing? Apparently, he decides that it is ‘as good as’ steady, even if it is unsteady, why he may safely resume his other businesses.

What kind of judgment is the foreman making? How can we imagine justifying such judgments? If we assume that the foreman’s judgment is informed, what kind of knowledge and experience informs it? These questions are important, yet not so easy to answer. Especially, the common claim that making informed judgments represents a trained capacity will be challenged below.

Complexity: a challenge to experiential learning

Trained capacity is likely acquired in processes of learning-by-doing. We learn by observing the effects of acting and by adjusting the action until the actual effects correspond to the intentions. In our case, the foreman can be imagined to have assessed the unsteadiness of insulation mats many times before and slowly gained the appreciation of future consequences of different degrees of unsteadiness. But the complexity of construction work is not conducive to such learning-by-doing. As we shall suggest now, consequences are highly contingent and highly displaced in time and context.

Clearly, there is no straight causal link between a loose mat and some future defect or damage. There are numerous other intervening and concomitant factors that help co-

produce whatever effects the unsteadiness will have. The insulation mat may become steady when covered with 20 centimetres of concrete. But the imperfection may also turn into a defect if the mat moves during the concreting. If it can move under the feet of the foreman it can also move under the impact of the concreting work. Thus, if the gang works carelessly the mat may move and the concrete will run in between the insulation mats and possibly produce a thermal bridge. Cold and damp cellars may be experienced in the future use of the building. However, not even the thermal bridge will necessarily lead to cold and damp cellars, because the evidence of a thermal bridge will also be contingent upon, e.g. particular practices of future tenants. With feedback so distant and delayed, and with so many steps in the causal chain, learning-by-doing must necessarily be highly unreliable.

Might learning-by-failing be an alternative? Investigations into the cause and responsibility of poor quality might retrace the coldness and dampness of buildings to the thermal bridge and further to the displacement of the insulation mat. But the problem might also be blamed on heedlessness of the gang, on the subsoil water, etc. Few cases and the highly ambiguous causal chain would make it little likely that the judgment of the foreman was calibrated by such processes of learning-by-failing.

The fact that his judgment will soon be buried under 20 centimetres of concrete may serve as a symbol of the inaccessibility of the reality as a source of feedback and adaptation.

This might suggest that the foreman's judgment was informed in a different way, namely by the chance of being held accountable for eventual defects in the future. It will appear that this probability is small – not to say nil. Were his judgment informed by such considerations, we would not be able to explain why he paused and investigated the unsteadiness in the first place. So probably, it is not a rational calculus of one sort or the other that guides his behaviour. His response seems more understandable if we assume that a logic of appropriateness guided his action. He probably investigates such situation because that is what foremen do (March 1994). He pauses because he enacts an identity and a role. Still, when pausing and making judgments, he may easily fall victim to a natural confirmation bias. He may look for reasons to consider it an imperfection if he wants to minimise the amount of repair. And the fact is that he may find numerous reasons to believe that the unsteadiness will cause no future defects.

Probabilistic nature of defects

However, a slightly different picture emerges if we accept that future defects, while unlikely, are still possible. This might lead us to consider defects in construction as a probabilistic phenomenon. The unsteady insulation mat is unlikely to "cause" problems because many other things will have to "go wrong" before a defect materialises. For example, there is a certain (probably small) likelihood that the concrete gang will work carelessly, and a certain (probably small) likelihood that the insulation mat will move during the concreting. And if it does, there is a certain (probably small) likelihood that heat and moisture will end up travelling between cellar and ground. Each factor will probably have some small probability, but the combined probability will necessarily be even smaller. And even if the gang works carefully there is still a small likelihood that the mat will move – and even if it does not move there is still a small likelihood that concrete will flow between mats, etc.

So far, this will still inform the foreman to do exactly what he did: to consider the unsteadiness an imperfection. This is the irony of defects: their likelihood is always

above zero, but still quite low, suggesting that the expected costs of defects will not legitimise much investment in their prevention. All these contingent factors seem to constitute a source of justifications for doing nothing. And it is merely because the number of judgments is so immensely large that defects, each with a very low probability, nonetheless turns into a recurrent empirical phenomenon.

We will suggest that this probabilistic view on defects may inspire us to draw alternative implications than just walking away.

IMPLICATIONS

We have found plenty of ways of making sense of the observed practice of the foreman in response to the experience of an unsteady insulation mat. However, in view of the complexity of even the simple causal chain that we have analysed; and not least in view of the persistence of the problems in construction mentioned in the beginning of the paper, we might actively search for establishing a framework that would suggest a different response pattern.

The implications of complexity: a different learning strategy

We will give two illustrations of how to approach reality if we assume that construction is a complex process.

First, the presumption of a complex and uncertain reality implies that we are encouraged to explore what the reality may hold. We cannot easily generalise the experienced reality to cover everything. Thus, in this case the fact that he ascertains that the insulation mat, while obviously unsteady, is not a problem, leads him presumably to infer that he has literally stepped on an exception. But he might have come to a different conclusion, namely that he had happened to step on a sample of a larger population of unsteady mats. Rather than just walking away he might on such an understanding have decided to increase the sample by walking around to get a better basis for estimating the population, not the individual sample.

From the probabilistic perspective on defects we may challenge the strategy behind the foreman's action and judgment. He is making too much of the unsteady insulation mat. He is returning to learn more about that particular mat – about which there is probably little more to learn, and in particular little else to do than what he does. The probability that the unsteadiness of one single insulation mat will prove disastrous is very small. However, if it is considered a random draw from a larger population of unsteady mats, then it may inspire us to adopt a different strategy. Rather than returning to the insulation mat already established as being unsteady, the foreman should have "returned" to all the other mats, because these might actually add to his current knowledge. One being unsteady suggests the possibility that more will be unsteady. If 100 mats are unsteady, each with a small chance of causing problems, the likelihood that a defect will result is suddenly substantial.

Thus, the foreman is probably correct in assessing the insignificance of the unsteady insulation mat. But his is possibly wrong in directing his judgment towards the risk of the individual mat. He might have made judgments about the possible existence of a population of unsteady mats. Such a judgment would have initiated a search for additional information to allow him to assess the size of the population. In this sense, the judgment would initiate a process of learning rather than concluding it!

Imagining that all our experiences are random draws from a larger population of things we might have experienced, but did not experience, would likely inspire a more

exploratory attitude to work and life. What we know is nothing more than hypotheses looking for tests, not presumptions looking for confirmation.

Secondly, if reality is understood as complex it is hard to act as if it could be controlled and predicted. But it is not hard to appreciate also that many more opportunities for intervention are conceivable. For example, we cannot know if the foreman's judgment was correct or incorrect. Whether in retrospect it will prove correct will, in part, depend on the subsequent action of the gang when concreting the floor on top of the mats. Thus, by consciously guiding the action of the gang he may also actively influence the likelihood that his prior judgment will become vindicated. He could mark the mat or he could verbally instruct the gang about his discovery. If they pay heed to the unsteady mat while pouring and vibrating the concrete there is a fair chance that the mat will not move and then the unsteadiness is made irrelevant and the judgment of the foreman is made correct. If the correctness of a judgment is determined by action and processes after the judgment is made these actions and processes become opportunities for turning judgments into self-fulfilling prophecy. It is a strategy of meddling with the odds of subsequently being proven correct.

We are all forced to make judgments under conditions of uncertainty and ambiguity. There may be no way in which we can better manage the project or the organisation by improving the quality and rationality of judgments and choices. What good management may be all about is intervening into processes and guiding action subsequent to the judgment and the choice in such a way that, in retrospect, the judgment will appear sound and the choice rational.

Learning and imagination

The imagination that goes into learning under conditions of ambiguity and complexity is illustrated here in two ways. First, learning requires us to imagine the existence of a population of potential events from which the small samples of actual experience are drawn, more or less randomly. This imagination constrains us from over-learning from single events. To paraphrase Hirschman (1977), learning should be fuelled by the experience of problems and failure, but tamed by the awareness of the randomness of experience. It is not that what we actually experience is irrelevant, since that would make all experiential learning impossible. It is the fact that what we actually experience needs not be more relevant than what we might have experienced, but happened, in this particular case, not to experience. If the probabilistic nature of defects – and of all other achievements, positive and negative – were to be accepted, we would need to make sense of experience within an interpretive framework based on the consciously formulated imagination of the population of possible experiences from which the actual experiences are randomly drawn. Learning should build an understanding of the population of potential effects – including things that did not happened, but which might as well have happened, in addition to what actually occurred.

Secondly, we need to develop an imagination of the complex tree of causalities, not because it enables us to control effects and achievements narrowly, but because it gives us inspiration to a larger array of potential points of intervention. Interventions are, as illustrated above, ways of making sure that prior judgment turns out to be correct. Not only may it give inspiration to new ways of intervening, but an understanding of subsequent intervention opportunities may also allow us to imagine new types of judgments to be made.

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The wobbling insulation mat may become the symbol for the difficulties in learning form experience, in construction as well as in any other complex and interactive reality. We are always on shaky grounds when making sense of situations and drawing implications for the future. More experience, and more data, will not change this fact, even if it becomes concreted with sensibly interpreted evidence.

We have suggested a different approach, one that depends more on imagination than on evidence. As we illustrated it, imagination is important to supplement what actually happened with what might as well have happened. In complex and interactive processes, outcomes are stochastic events, and the risk is to make too much, not too little, of such events. Learning implies to put the accidental occurrences and observations into a context of a population of imaginable occurrences and observations. Not what will happen, but what is at stake when making judgments in practical situations, is the crucial question. To answer this, we need more theorising and imagination than facts and evidence.

A sensible judgment by a foreman observed in a very specific situation became our focus of theorising and imagining. Like William Blake challenges us to see "the world in a grain of sand", we have attempted to illustrate how specific evidence may become more useful when treated, not as fact of what happened, but as inspiration for seeing what might also have happened. We claim that such an inspiration may significantly change the practical and behavioural implications we draw from experience.

By illustrating the need for more imagination and theorising we have not solved the problems with defects in construction. However, we do claim to have shown that experience can be interpreted in ways different from what is dominantly guiding practice as well as research at the moment. We also claim to have shown that answers might be sought in different places than where we seek them at the moment. Experience is more important as inspiration than as fact, we claim. Similarly, we hope that our thoughts on construction defects will be taken as inspiration more than as fact. If these ideas provide inspiration to future research and for sense-making in practice they may become important.

ACKNOWLEDGEMENTS

This paper is developed as part of a collaborative project (2006-09) "Defects in construction – strategies, actions and learning", conducted by researchers from the Danish Building Research Institute/Aalborg University, the Technical University of Denmark and Centre for Management Studies of the Building Process/Copenhagen Business School.

The authors' participation in the collaborative project has been financially supported by the Danish Enterprise and Construction Authority, Realdania and Copenhagen Business School.

REFERENCES

Argyris, C. and D. A. Schön (1996) *Organisational Learning II. Theory, Methods, and Practice*. Reading, MA, Addison-Wesley.

Dörner, D. (1996) *The Logic of Failure. Recognising and Avoiding Error in Complex Situations*. New York, Metropolitan Books.

Hirschman, A.O. (1977) *The Passions and the Interests*. Princeton, N.J., Princeton University Press.

Kreiner, K. and G. Winch (2008) *Future Perfect Strategising on Major Projects*. EURAM 2009. Liverpool, UK.

Kreiner, K. and G. Winch (2008) *Future Perfect Strategy: The Role of Imagination and the Risk of Empty Horizons*. EGOS Colloquium. Amsterdam

March, J. G. (1994) *A Primer on Decision Making. How Decisions Happen*. New York, Free Press.

Ryle, G. (1949/2000) *The Concept of Mind*. London, Penguin Books.

Ryle, G. (2000) Courses of Action or the Uncatchableness of Mental Acts. *Philosophy*, **75**, 331-344.

Schutz, A. (1973) *Collected Papers I: The Problem of Social Reality*. The Hague, Martinus Nijhoff.