

ON EPISTEMOLOGY OF CONSTRUCTION ENGINEERING AND MANAGEMENT

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1 BACKGROUND AND IDENTIFICATION OF PROBLEM

The ubiquity of the problems in construction – both managerial and technical – is well known. For tackling these problems, it is necessary to know whether the root causes for them are abundant and scattered over many domains or whether there are some major root causes that could be remedied through a few concentrated efforts.

2 RESEARCH AIM AND METHODOLOGY

We aim at showing that there indeed exists one major root cause for problems in construction that has hardly attracted attention, namely unhelpful epistemological (i.e., how we acquire knowledge) choices in engineering and management. The argument is developed as follows. First, the intellectual origins of engineering and management are examined. The findings made allude to the influence of the time-honoured epistemological contradiction between Plato and Aristotle. An analysis of the problems caused by inappropriate epistemological views follows. A brief discussion on conclusions completes the argument.

3 RESEARCH FINDINGS

The Scot William Rankine consolidated the engineering field of structural mechanics in his books published in the 1850s and 1860s. The novelty he propagated was to utilize natural science, especially physics, for practical purposes in engineering – earlier these two fields had been considered separate. According to Rankine, this new engineering contrasts with purely practical knowledge, providing only approximate solutions, based on prompt and sound judgment or an established practical rule. Interestingly, all the hallmarks of scientific engineering, as promoted by Rankine, exist still today in teaching and research of engineering: basing engineering on physical laws, definition of engineering predominantly as design, emphasis on optimal solutions, and use of deduction as the primary form of reasoning.

The American Walter Shewhart is considered as the seminal contributor to statistical quality control, which later evolved into total quality control. His work was stimulated in the 1920s by the rapidly evolving mass production, which needed methods for ensuring consistent quality of products. Shewhart's main concern was to reduce the gap between the intended and the achieved through the method of science. These ideas were later transformed into the PDCA cycle (Plan-Do-Check-Act). The basic ideas of Shewhart are today widely used in industrial engineering, especially in practices of quality and lean production: basing industrial engineering on the scientific method, focusing industrial engineering on production, emphasis on improvement and use of induction (from empirical experimentation) as the primary form of reasoning.

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Now, the difference between Rankine and Shewhart has interesting initial similarities to a much older opposition, namely views on science by Plato and Aristotle (Fig. 1). Plato believed that full understanding of the world cannot rely only on perception, which provides only a limited and naive view of Nature. Proper scientific reasoning occurs only via deduction from axioms to something that can be compared to observations. Thus, according to Plato, the most fundamental essence of reality does not belong to the material world, but to the realm of abstract concepts, the world of ideas. In contrast, Plato's pupil Aristotle is convinced that proper scientific knowledge is grounded on perception. Aristotelian science is about explanation, namely, discovering causes behind observed phenomena. His scientific method always begins with specific cases, via observations, and seeks for explanation through induction. This is then applied to other particular cases by deduction.

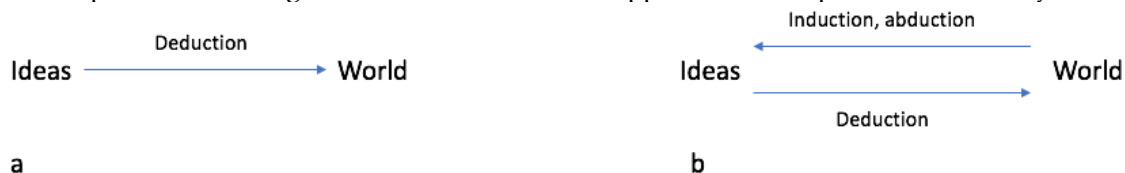


Figure 1. a) Platonic and b) Aristotelian epistemology

It is argued that in the realm of productive activities, engineering, production and management, Platonic approaches have provided the dominant worldview in the latter half of the 20th century, and still in the beginning of this century. Unfortunately, a number of problems, related to this overly Platonic orientation, have been transmitted to construction engineering:

- Preoccupation with design at the cost of other stages
- Preoccupation with optimality at the cost of gap between optimal solution and what is achieved
- Preoccupation with pre-existing knowledge at the cost of contextually captured knowledge
- Preoccupation with the viewpoint of one discipline
- Preoccupation with deduction at the cost of other types of reasoning

Also in terms of construction management, a number of root causes for problems derive from the Platonic approach. In production planning and management, the dominance of the push approach, as embodied in the critical path network method, is argued to represent Platonic thinking, whereas its Aristotelian counterpart is the Last Planner method. Another case is provided by construction economics, which accepts the axiomatic (and thus Platonic) assumption of optimal productive efficiency of firms, as postulated in the mainstream economic doctrine; in so doing, it denies the existence of waste, a concept compatible with the Aristotelian approach.

4 CONCLUSIONS

The Platonic epistemology has dominated in construction engineering and management, leading to various problems. However, the common cause for the problems, namely inappropriate epistemological choices in the form of overuse and misuse of Platonism, has not been explicitly discussed and identified. Thus, a better balance between the Platonic and Aristotelian tendencies in construction engineering and management is needed. For realizing that, a wide discussion in the relevant disciplines and professions is requisite. For enabling future generations of engineers to avoid related problems, it is also suggested that the foundations of epistemology and philosophy of science should be introduced into university teaching.

