

CONSTRUCTION ENGINEERING MASTERS DISSERTATION ABSTRACT

Understanding how 3D vs 2D design information influences skilled operatives' productivity through a series of field trials

With the advancement in affordable mobile computing systems, viewing construction information in 3D space on a construction site has been viable for several years. Nonetheless, this technology is still broadly overlooked for construction operatives on the front line. Other than isolated contrary examples, the industry still favours conveying design intent by providing construction operatives with 2D or isometric printed drawings. By analysing empirical data collected during a series of field trials, this research determines the statistically significant differences in the performance of operatives when using 3D vs 2D design information. The aim was to provide a representative insight into the potential productivity gains the UK construction industry could realise by utilising 3D design information on the front line. The study is UK based but also informed by international research; subsequently, the findings may also provide some interesting insight for international industries and researchers.

The literature review captures the state of the relevant existing research and critiques the relevance to the UK construction industry and the reliability of the potential improvements the existing literature claim. The field trial design builds upon research completed at the University of Colorado, through discussions with the American researchers, this research removes some limitations restraining their studies. A series of field trials were conducted in two live offsite bespoke metalwork fabrication workshops supplying the UK construction industry; the assemblies fabricated during the trials are being used across three major UK infrastructure projects. Twenty-eight metal work fabricators participated, fabricating two similar assemblies, while several performance metrics were measured. Each participant used 2D traditional fabrication drawings in one trial and a 3D model on a touchscreen device during a separate trial.

Analysis of the results showed 3D design information allowed the most efficient use of working time, the least number of errors and the quickest time to completion. However, the improvements were slight when the whole population was considered without any demographic grouping. The results were sorted and re-analysed using ANOVA (Analysis of variance) tests to understand if the cognitive ability, age & experience of participants correlated with improvements in performance when using 3D design information. This analysis confirmed 3D design information formats could compensate for low spatial cognition and significantly improve younger and less experienced participants performance across all metrics.

The results suggest a targeted effort to provide design information, to operatives on the front line who could realise the most improved performance, in a 3D format using simple viable hardware and software, could capture elusive productivity gains for the UK construction industry.

Benjamin Corlett

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