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Component Unit Pricing Theory Applied to Construction Work

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Published: 01/09/2012

Document Version:
Publisher's PDF, also known as Version of record

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Recommended citation(APA):
Cattell, D. (2012). *Component Unit Pricing Theory Applied to Construction Work*. Poster session presented at Research Week 2012, Gold Coast, Australia.

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Component Unit Pricing Theory Applied to Construction Work ARC DECRA Application DE130101529 (2012)

OVERVIEW

Construction work is often having to be competed for on the basis of prices for projects as a whole. However, once awarded, these projects are usually administered on the basis of the prices for each of the many constituent items of work. It is the item prices that govern how much contractors are paid on an interim basis as they progress. These prices also determine how much contractors receive for variations to the contracts, which are inevitable. Item prices are therefore of fundamental significance to construction contracts yet they are not used as the basis of the competition by which work is won. This is because principally it would be far more difficult to accomplish than the far simpler comparison between contractors' overall bids (Skitmore and Cattell, 2011). Therefore item prices are freed from the constraint of the economic forces of competition and provide contractors considerable scope by which to decide these prices to reap several significant benefits. An initial test (Cattell, 2012) showed an instance of a construction contractor more than doubling profits by way of mathematically optimizing item prices whilst keeping the overall bid price the same.

Prior research done by Cattell (2012) has led to the formulation of component unit pricing (CUP) theory, introducing a novel perspective on the role of item prices and the risks involved in deciding their values. Further research is now required to translate this theory into practice.

Prototype software has already been written in Java to test the theory, and these tests have proved encouraging. However, they also showed the extent to which the process is computationally intensive: taking around four days to do a Monte Carlo simulation guided by a novel hybrid mix of artificial intelligence (AI) techniques. Further research is now underway that instead uses particle swarm optimization. Other methods of genetic algorithms may also be tested. These new methods of AI-guided optimization will also be designed to embrace parallel processing whereby a large network of computers can be used (for instance, available by way of resources that could be hosted through commercial cloud computing services such as the Amazon Web Service) so as to significantly reduce the processing time required.



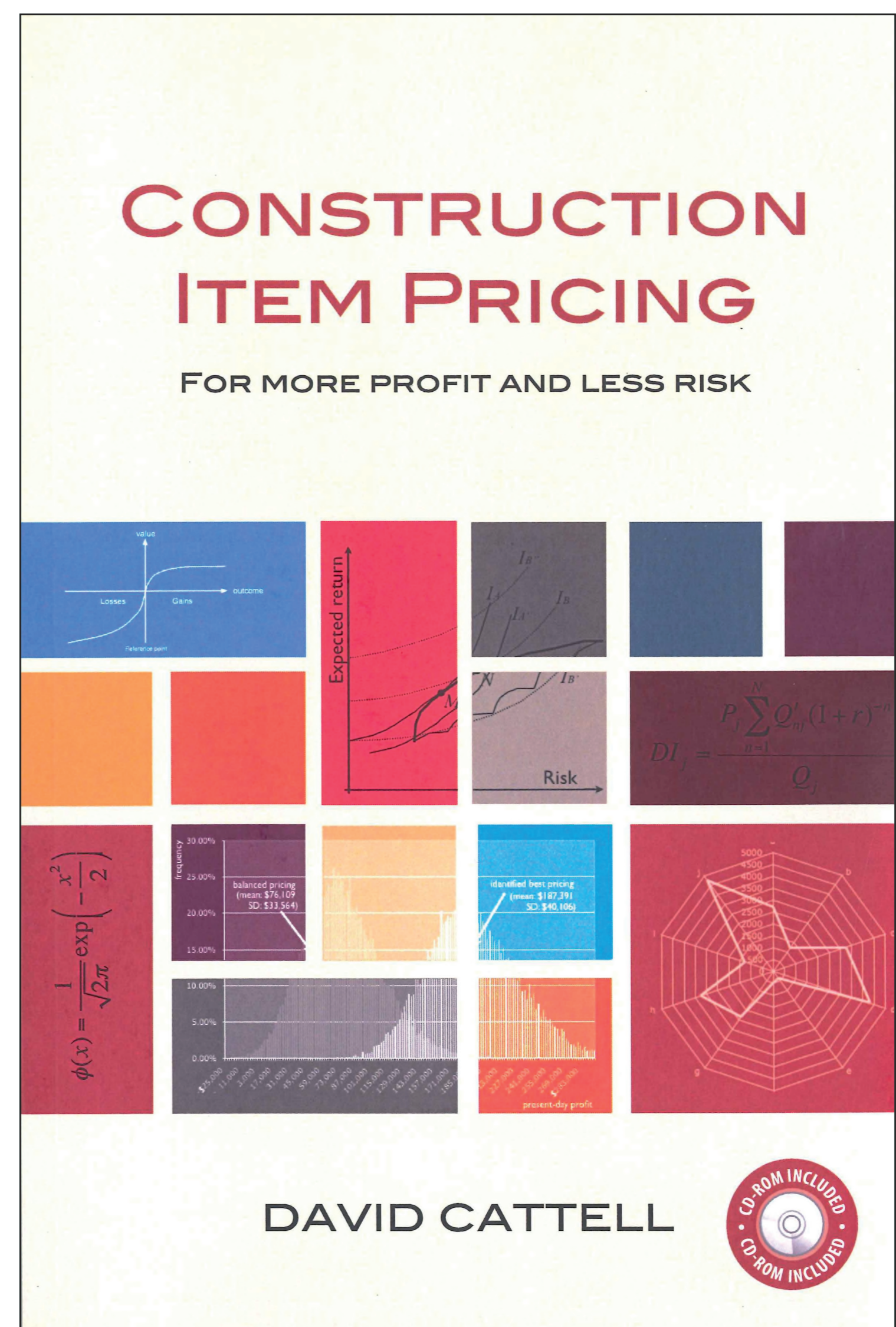
Research will also be conducted on the sensitivity to the outcome of the data quality required as an input to the process. The initial tests of the theory were not constrained by practical concerns regarding the availability of data, nor the time taken to gather and capture it. It is hypothesized that much of this data will, however, already be captured in contractors' cost estimating systems and can therefore be pumped across and adapted for reuse in the new pricing system. Research is required on this process of adaptation, without which it would likely prove to be a barrier to the practical adoption of any item pricing system by contractors.

A further aspect of the research involves the field of behavioural economics: assessing contractors' attitude to risk and hence identifying their risk profiles. CUP theory facilitates that prices can be found that correspond to an optimization of a contractor's *utility*, rather than their *profit*, taking account of their assessed, unique appetite for risk.

This project is a progressive step following several years of research on this topic by the candidate. The next phase will be focussed on the challenge of adapting the new theory so as to bring it out of the academic domain and make it of practical value to the construction industry.

KEY REFERENCES

- Cattell, DW. (2012), Construction item pricing: for more profit and less risk, Cape Town, UCT Press (see below).
Skitmore, RM. and Cattell, DW. (2011), 'On being balanced in an unbalanced world', Journal of the Operational Research Society, published online (in advance of the printed journal): <http://www.palgrave-journals.com/doi/10.1057/jors.2012.29>.



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