

The use of Real Options and Multi-Objective Optimisation in Flood Risk Management

Submitted by

Michelle Woodward

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Abstract

The development of suitable long term flood risk intervention strategies is a challenge. Climate change alone is a significant complication but in addition complexities exist trying to identify the most appropriate set of interventions, the area with the highest economical benefit and the most opportune time for implementation. All of these elements pose difficulties to decision makers. Recently, there has been a shift in the current practice for appraising potential strategies and consideration is now being given to ensure flexible, adaptive strategies to account for the uncertain climatic conditions. Real Options in particular is becoming an acknowledged approach to account for the future uncertainties inherent in a flood risk investment decision.

Real Options facilitates adaptive strategies as it enables the value of flexibility to be explicitly included within the decision making process. Opportunities are provided for the decision maker to modify and update investments when knowledge of the future state comes to light. In this thesis the use of Real Options in flood risk management is investigated as a method to account for the uncertainties of climate change.

In addition to Real Options, this thesis also explores the use of optimisation techniques to aid the decision making process when identifying the most appropriate long term intervention strategies. Methods are required which can search for the most optimal solutions whilst accounting for a range of performance metrics. Single and multi-objective genetic algorithms are therefore investigated in this thesis.

The Real Options concepts are combined with a multi-objective optimisation algorithm to create a decision support methodology which is capable of searching for the most appropriate long term economical yet robust intervention strategies which are flexible to future change. A state of the art flood risk analysis model is employed to evaluate the risk associated to each strategy.

The methodology is applied to a section of the Thames Estuary as a case study to demonstrate the techniques above. The results show the inclusion of flexibility is advantageous while the outputs provide decision makers with supplementary knowledge which previously has not been considered.

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