



# Flexible Port

## Why Flexible Port?

Ports deal with a volatile world market. They are confronted with unforeseen changes in demand, function, and operating environment. If a port cannot meet these requirements, the result is inefficiency, loss of competitive position, and obsolescence. The prevailing uncertainty demands new ways of thinking, and new tools for port planning, design, and project appraisal. The research question is: How can we design ports so that they meet the changing requirements and ensure functionality, capacity and service quality over their entire lifetime?



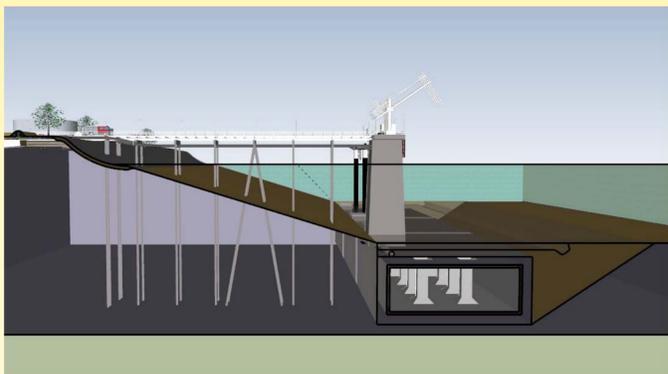
Uncertainty surrounding ports



Physical flexibility: Caisson being towed

## Defining Flexibility

Flexibility is defined as the ready ability of a system to change in response to external forces. Flexibility represents the ease with which a port can respond to uncertainty in a timely and cost-effective manner. Flexibility can be introduced at many levels in a port system: physically in infrastructures, in operations, management procedures and decision making, and in products and services. Ultimately flexibility is required in the entire supply chain.



Spatial flexibility: Underground storage

## How can we match the economic lifetime of ports with their technical lifetime thus minimizing risks on investments?

*Basic port infrastructure is immobile with few alternative uses. Both initial construction and port expansion require large amounts of capital. Increase in infrastructure capacity can only be realized in 'quantum chunks'. The technical or design lifespan of port infrastructure projects can be as much as 100 years. The economic lifetime or the useful lifetime of infrastructure without adaptation, is becoming increasingly shorter.*



Flexibility in decision making: Phased construction Maasvlakte 2

## Evaluating Flexibility

Flexibility involves extra costs and risks, but enhances the value of a project in the face of uncertainty. Traditional evaluation techniques such as Discounted Cash Flow do not consider uncertainty or factor in the value of flexibility. The Real Options approach originated in the financial world, and is now being applied for evaluating flexibility in terms of its future benefits. Thus, investments in flexibility, and innovation in general, can be justified with these methods.

## Expected Results

- ◆ A typology of uncertainty and flexibility in relation to ports
- ◆ A framework known as Adaptive Port Planning, which includes uncertainty and flexibility considerations
- ◆ A framework for Project Appraisal and Decision making under uncertainty
- ◆ Illustration of decision support tools, such as Decision Tree Analysis and Real Options Analysis, for the port sector
- ◆ A statistical method for monitoring external developments so that timely action can be taken
- ◆ Evaluation of some innovative flexible designs for infrastructures
- ◆ Examination of barriers to innovation in ports (and specifically to incorporation of flexibility)