CHALMERS

FOR A SUSTAINABLE FUTURE

Rickard Bensow

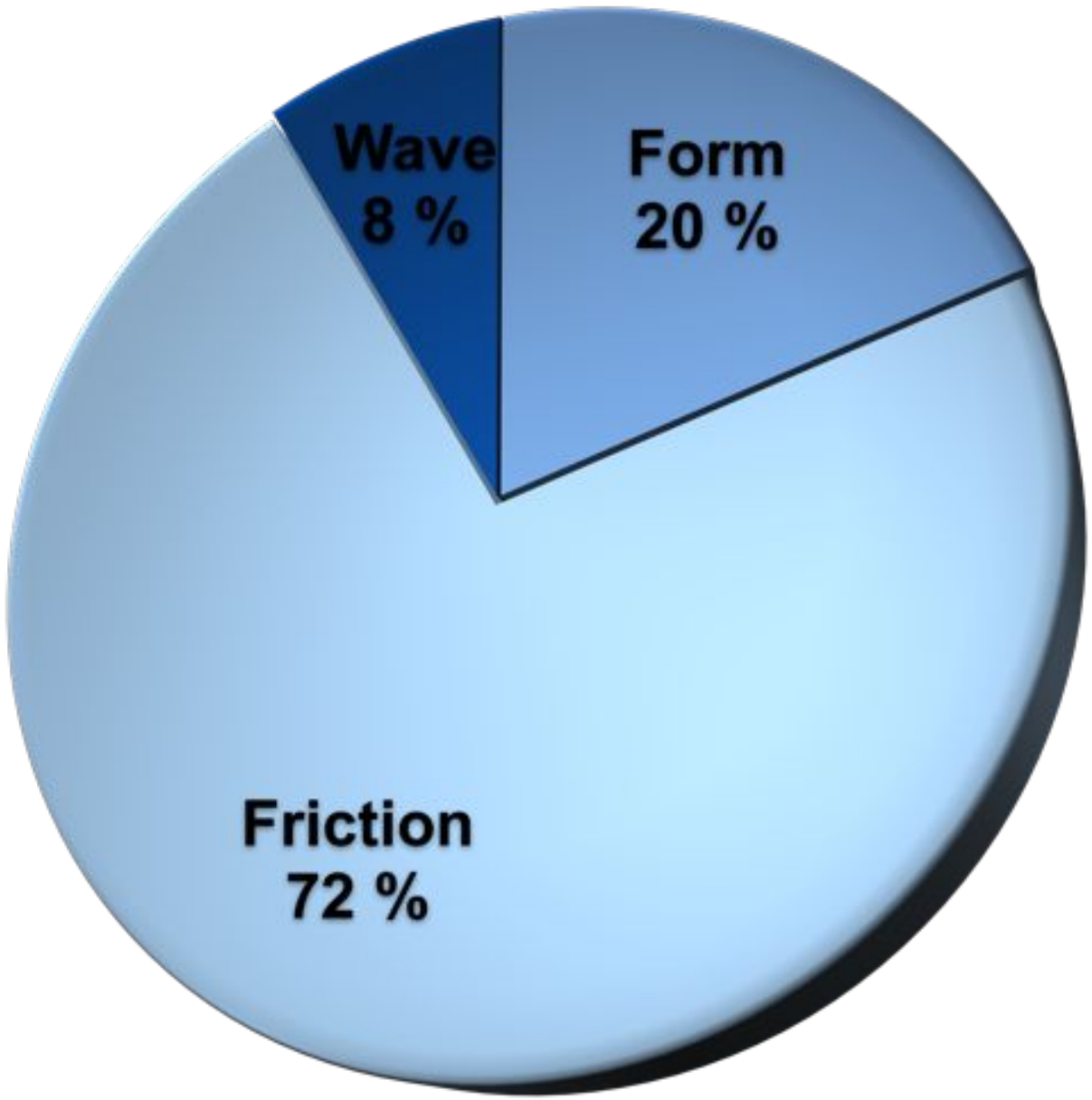
Shipping and Marine Technology

Chalmers University of Technology

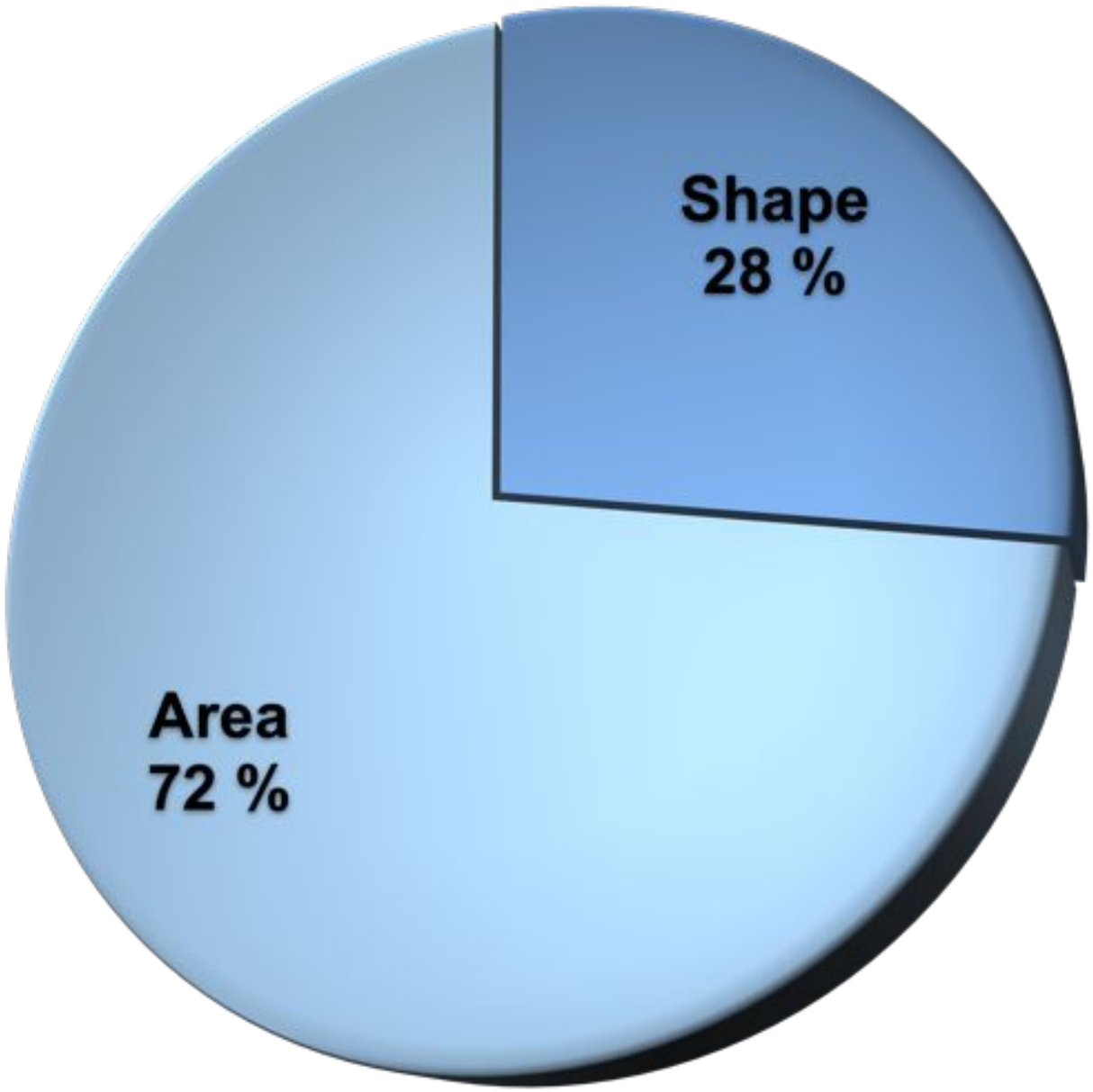
ENERGY EFFICIENT AIR CAVITY SHIPS

ENERGIEFFEKTIVA FARTYG MED LUFTKAMMARE

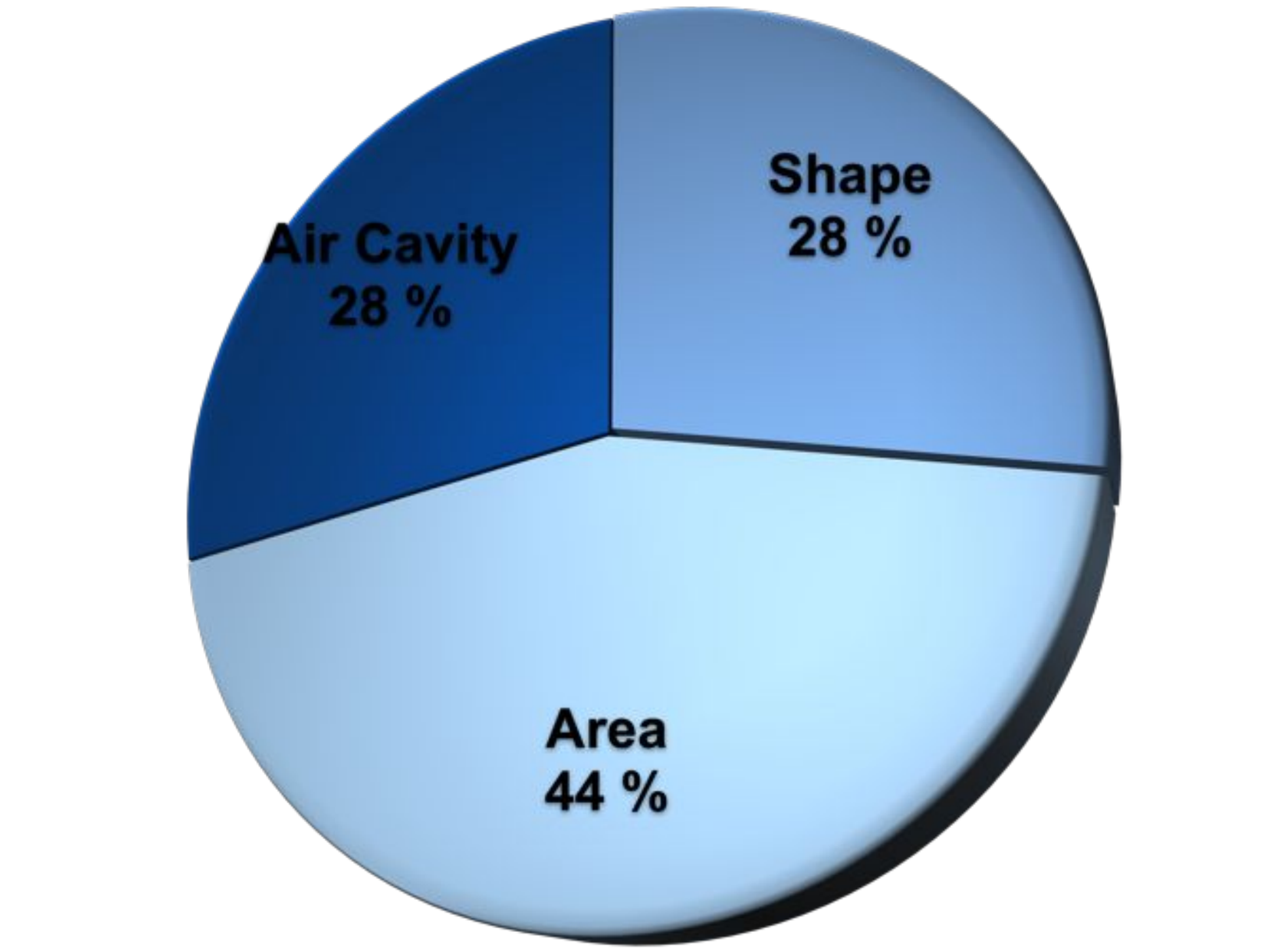
Resistance of a tanker



Resistance of a tanker



Resistance of a tanker



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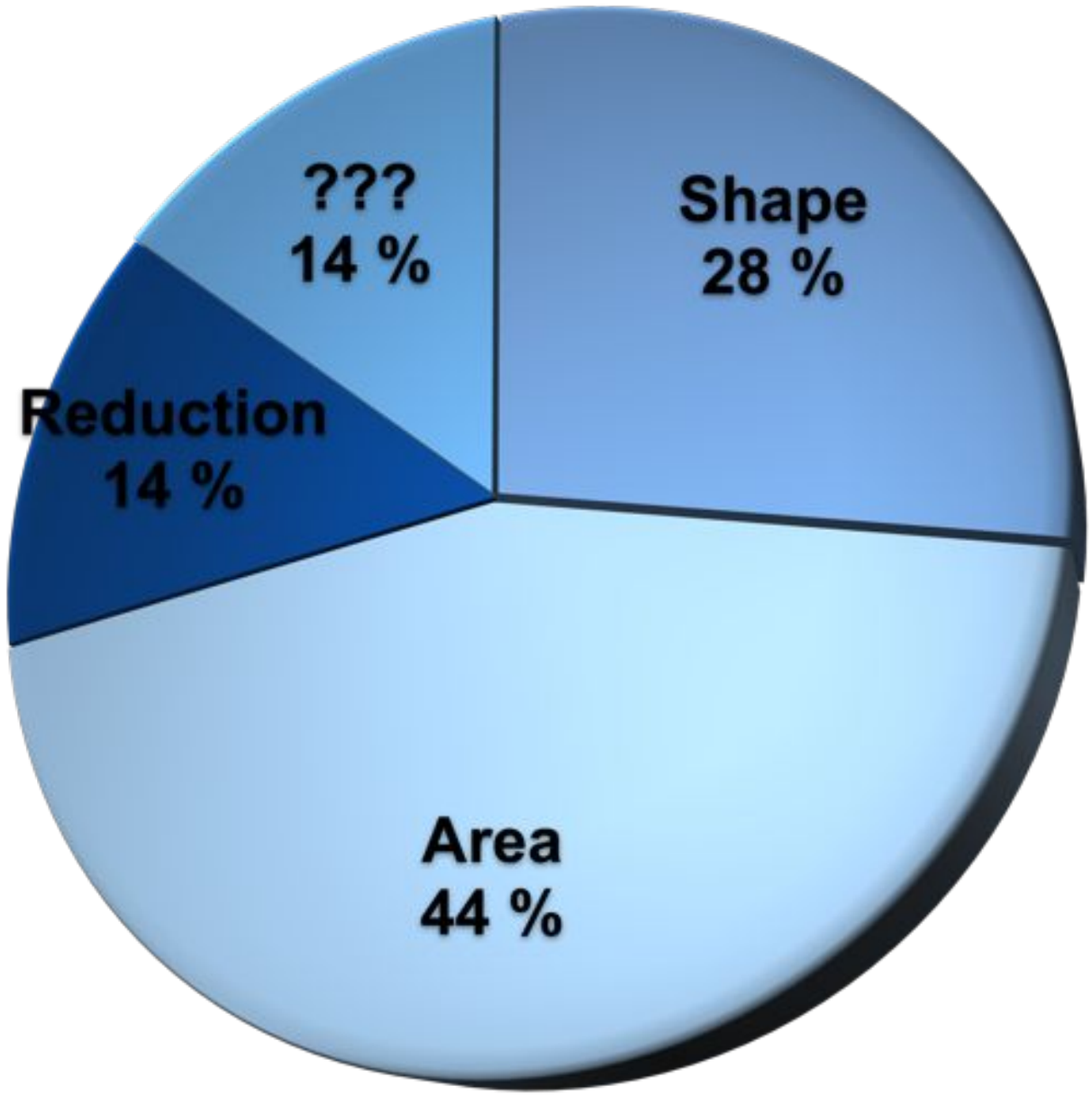

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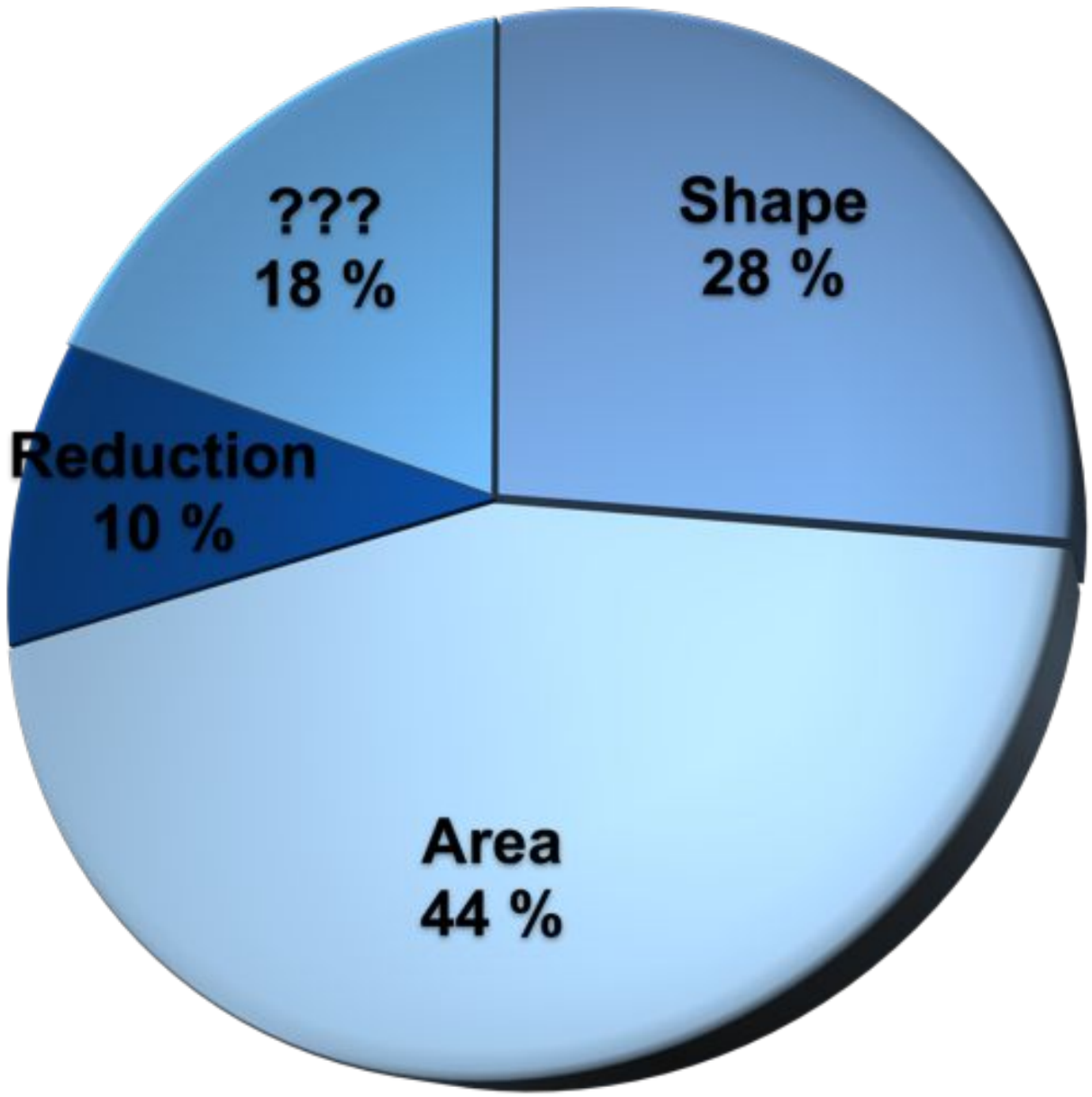

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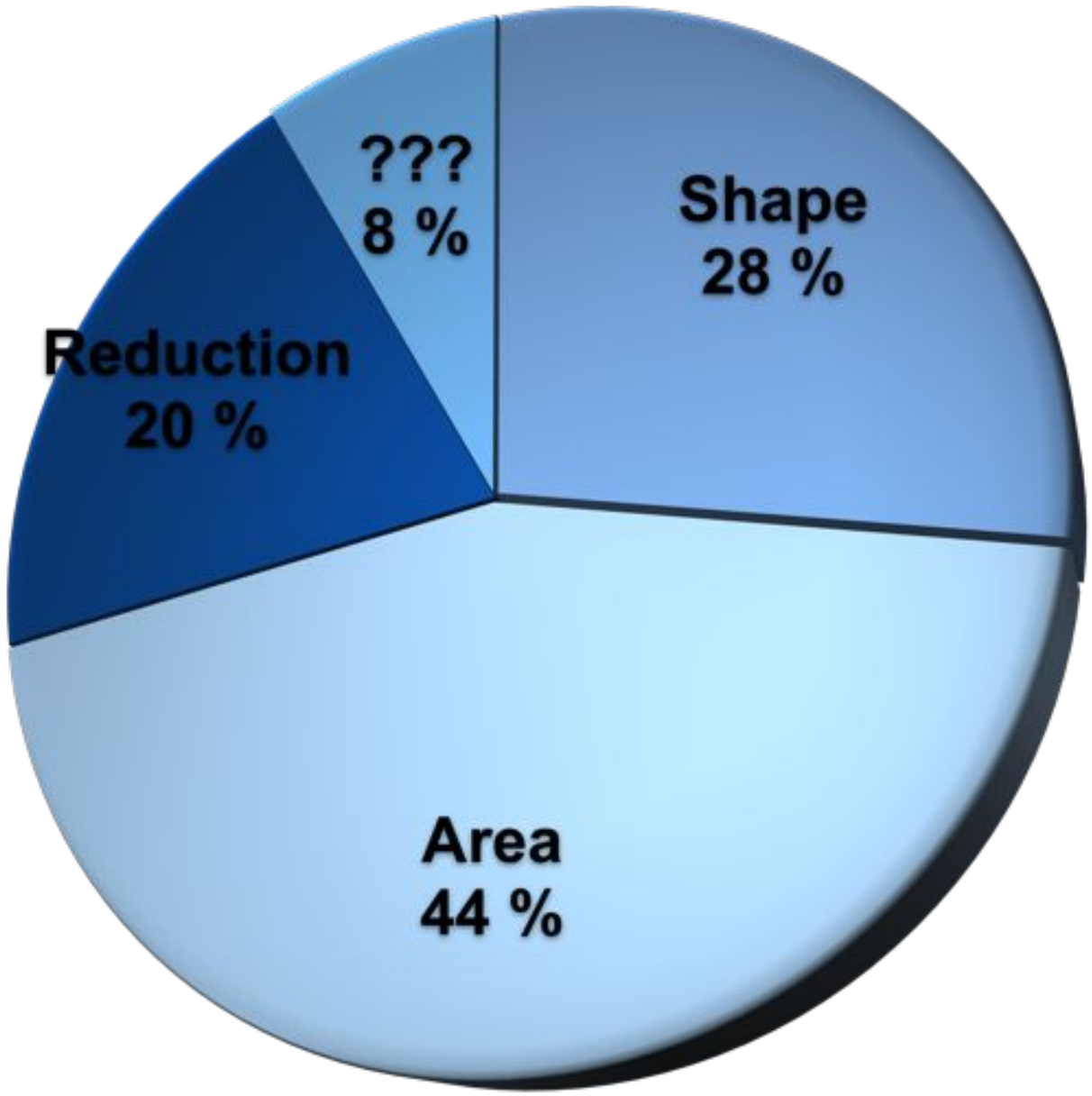

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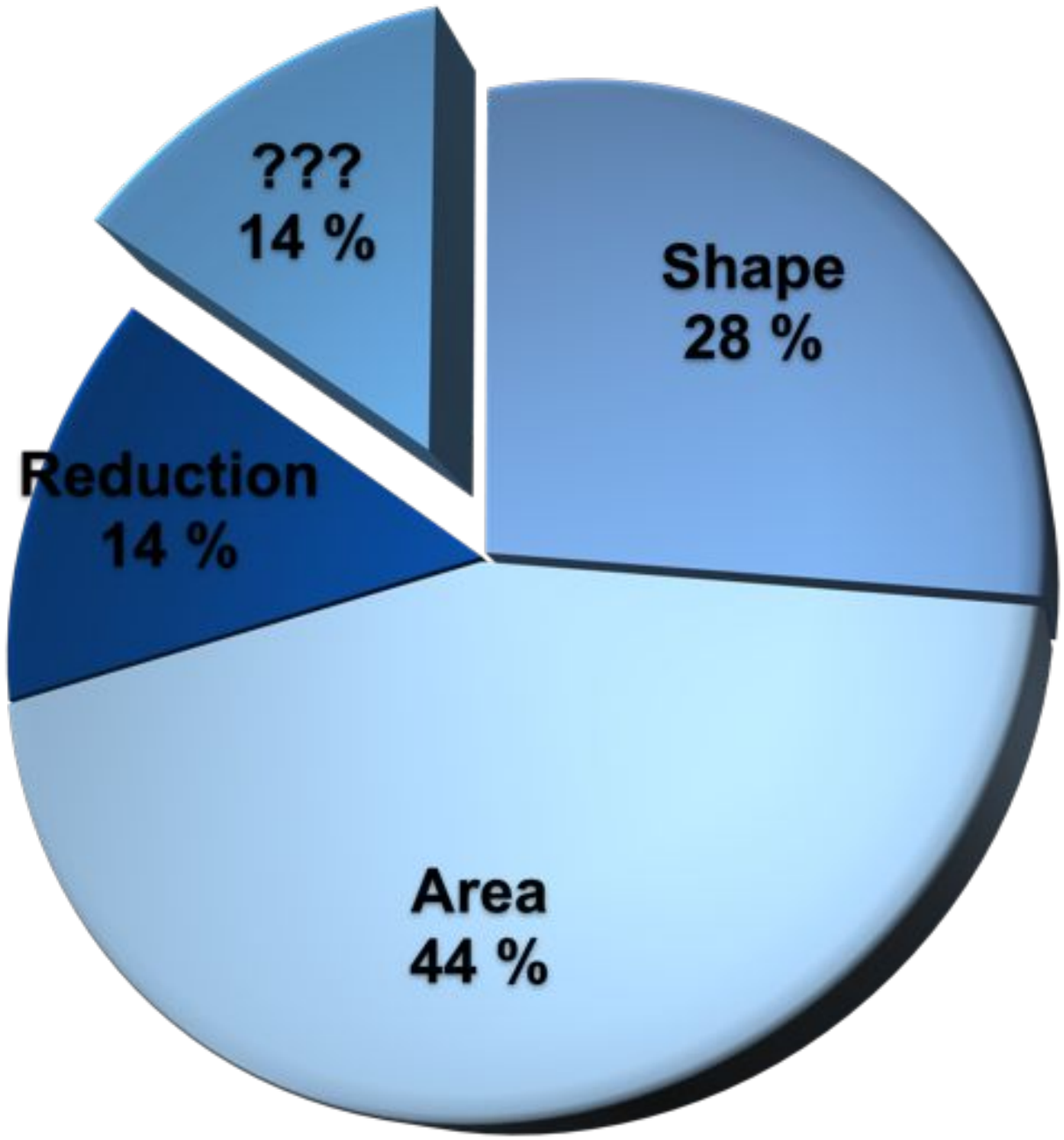

$$P_{D,VLCC} \cdot T \cdot 0.72 \cdot 0.40 \cdot 0.50 \approx 25000\text{MWh/year}$$

Why not a realised ACS yet?

- **Concept not efficient enough**
  - Large discrepancy between ideal drag reduction and measured
  - No obvious reasons for this discrepancy
  - Risky to negotiate and launch a new ship type
- **Scatter in tests**
  - New types of tests
  - Difficult to perform and get reliable data
- **Scaling**
  - If above is resolved, does the results hold for a full scale ship?
- **Performance in seaway and during manoeuvring**
  - If we can make it work in still water, what happens during operation?

Project operation

- **Monthly meetings**
  - Stena teknik
    - 2-3 project managers responsible within Stena
  - SSPA
    - 1-2 engineers
  - Chalmers
    - 1-2 researchers
- **Research tasks**
  - Recruited post-doc researcher
    - Planned and performed simulations
    - Planned and took part in experiments
- **Experiments**
  - Designed and performed at SSPA

Research outcome - ACS

- **I. Generic Cavity**
  - Discrepancy explained
  - Flow behaviour at cavity closure essential
- **II. Develop concept**
  - Recessed cavity developed which yields much more robust flow behaviour
    - Possible to improve cavity closure design
    - More robust in operation
- **III. Full ship tests**
  - Flow behaviour improved
  - Drag reduction behaviour inconsistent
- **IIIb. Hull shape comparison**
  - Different bow shape improves drag reduction
  - Captured by CFD

Research outcome - ACS

- **Most main objectives reached**
  - Scaling behaviour got lower priority, needs further studies
- **Outcome however not positive enough to bring to market**
  - In combination with current market situation
- **But good enough to keep the interest**
  - Several options for continued studies are currently being discussed
    - One year extension approved
      - Varying hull shapes and types
    - PhD project application submitted
      - Tools, analysis, and design of closure and aft ship

Outlook for future

- **Improved computational models**
  - Faster and more accurate closure prediction
- **Improved cavity closure design**
  - To utilise the more robust cavity interface shape
  - How counter act the momentum loss of the restarted BL?
  - Scaling behaviour
- **Better control system for operation in seaway**
  - Improvement of control of air inflow
- **Impact on total propulsive efficiency**
  - Effects on the propulsion system
- **Other ship types**
  - ACS most suitable for bulk carriers, but economics may be elsewhere
- **Ship design**
  - GA, classification, strength, etc.