

# The Arctic Challenge for Men

Alex W. Vredevelde

TNO

Natalia P. Lebedeva

TNO

Hein Daanen

TNO, VU Amsterdam



KIVI NIRIA

170

34<sup>e</sup> lustrum  
170 jaar TU Delft

## Arctic Battle

Symposium - 8 March 2012



$$R = p E$$

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Why, What's new, Implications, Evidence, R, Way ahead

## Contents

1. Why on earth?
2. What's (new)?
3. Implications.
4. Technical evidence
5. Risk based vs regulation based.
6. Way ahead



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and full of iconic species....



And the disaster tolerance is zero!





$$R = p E$$

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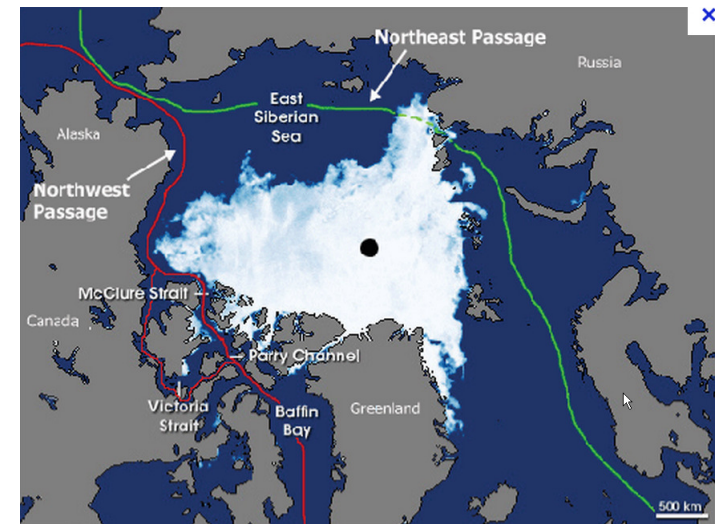
Why, What's new, Implications, Evidence, R, Way ahead

## Why on earth?



1. Tourism
2. Oil/ Gas
3. Northern passage
4. Technically feasible

The United States Geological Survey estimates that 22 percent of the world's oil and natural gas could be located beneath the Arctic.<sup>[1]</sup>





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What's new





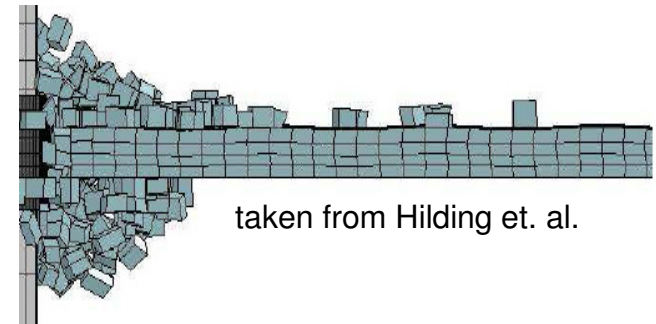


$$R = p E$$

## Ice crash

The ship was “maneuvering through ice during high winds,” the cruise line said, resulting in a “mild indentation in the hull.” The damage was about 15 feet below the waterline, according to the U.S. Coast Guard.

1. Head on collision
2. Beam collision
3. Raking damage
4. Crushed



taken from Hilding et. al.



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- 1. Icing
- 2. Ice loads



Chemgas BV



TNO



Daily Telegraph



$$R = p E$$

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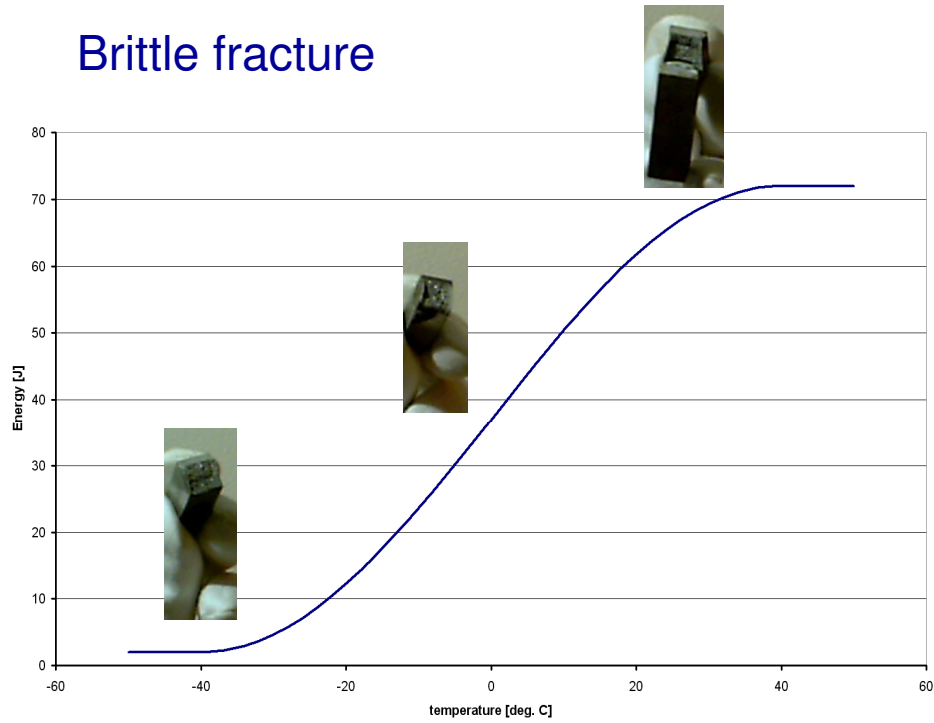
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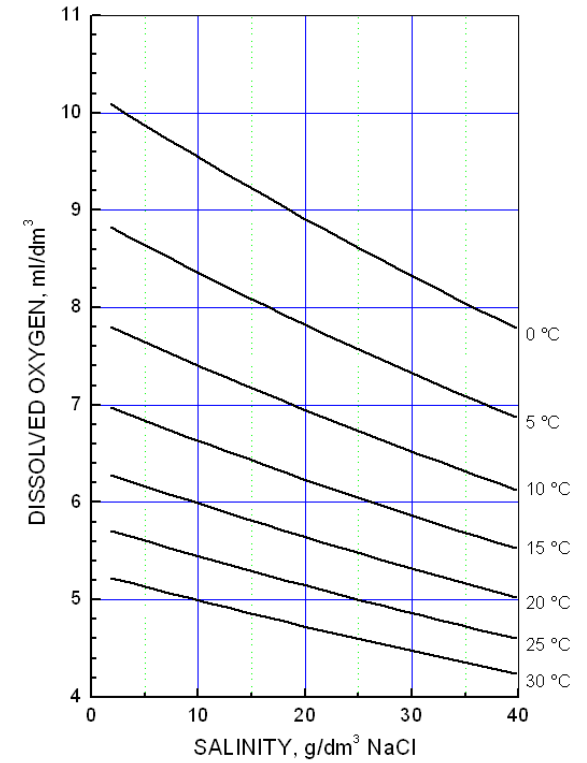
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## Brittle fracture



## Corrosion





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**BODY SIGNS/SYMPTOMS  
TEMP. (rectal)**

37.5°C NORMAL

36 FEEL COLD

35 SHIVERING

BODY CORE TEMPERATURE BELOW 35°C = HYPOTHERMIA = HOSPITAL

34 CLUMSY  
IRRATIONAL  
CONFUSED  
(may appear drunk)  
33 MUSCLE STIFFNESS

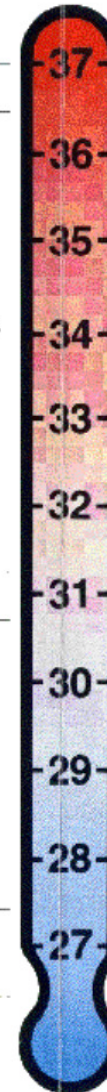
32 SHIVERING STOPS, COLLAPSE. TRANSFER TO HOSPITAL. URGENT.

31 SEMI CONSCIOUS  
30 UNCONSCIOUS  
No response to painful stimuli

29 SLOW PULSE AND BREATHING

28 CARDIAC ARREST  
No obvious pulse or breathing  
Pupils dilated

BELOW 28°C. NO VITAL SIGNS, COLD. DO NOT GIVE UP TREATMENT.

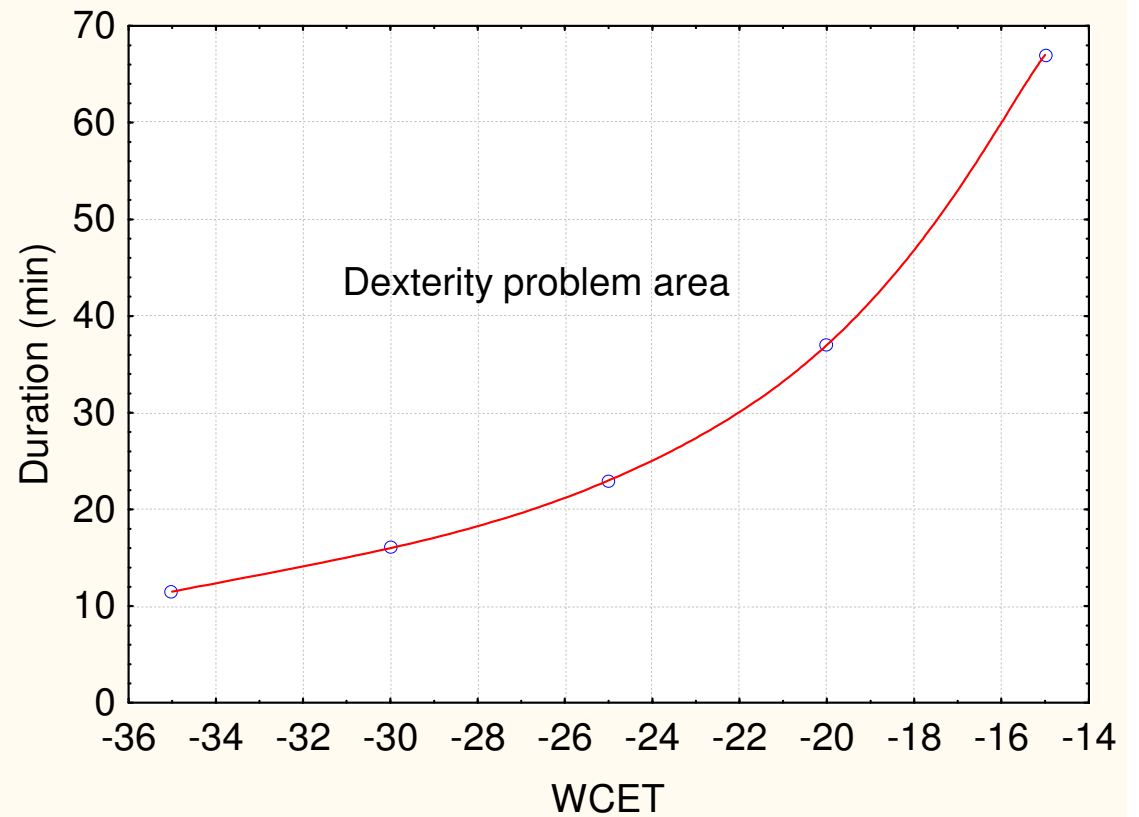






$$R = p E$$

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$$R = p E$$

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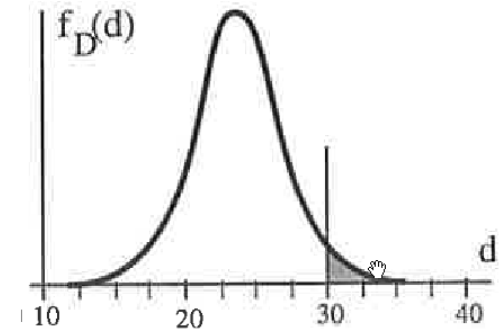
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## 2. Risk

### 1. $R = p E$

p probability of incident occurring  
E effect of incident

2. Probability is prob. collision/ grounding/ fire
3. Effects are loss of life, injury, spills, loss of property
4. FSA, QRA, HAZID, HASOP
5. Calculate and test **no guesstimating**
6. Parameters
  - a) structural reliability
  - b) equipment reliability
  - c) human reliability
  - d) ...
  - e) incidents/ calamities



$$R = p E$$



$$R = p E$$

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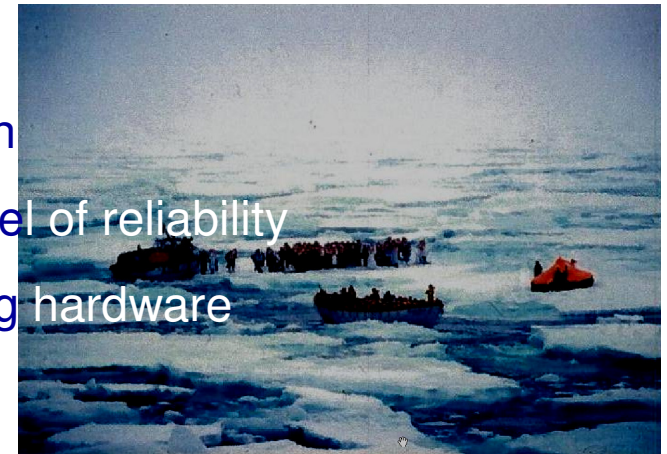
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## Way ahead

1. Adopt/ accept risk based approach
2. Decide on a much higher reqrd. level of reliability
3. Generate enhanced understanding hardware
  - a. reliability statistics
  - b. material data
4. Generate enhanced understanding human-ware
  - a. physically
  - b. psychologically
5. Develop safety cases
6. Explore fresh ideas
7. Educate







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## Acknowledgements

Further reading

SSC-461 Structural Challenges faced by Arctic ships, Ship Structures Committee, 2011

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