

# The Joy of Reliable Scour Protections

## A PhD survival guide – the lessons I took.

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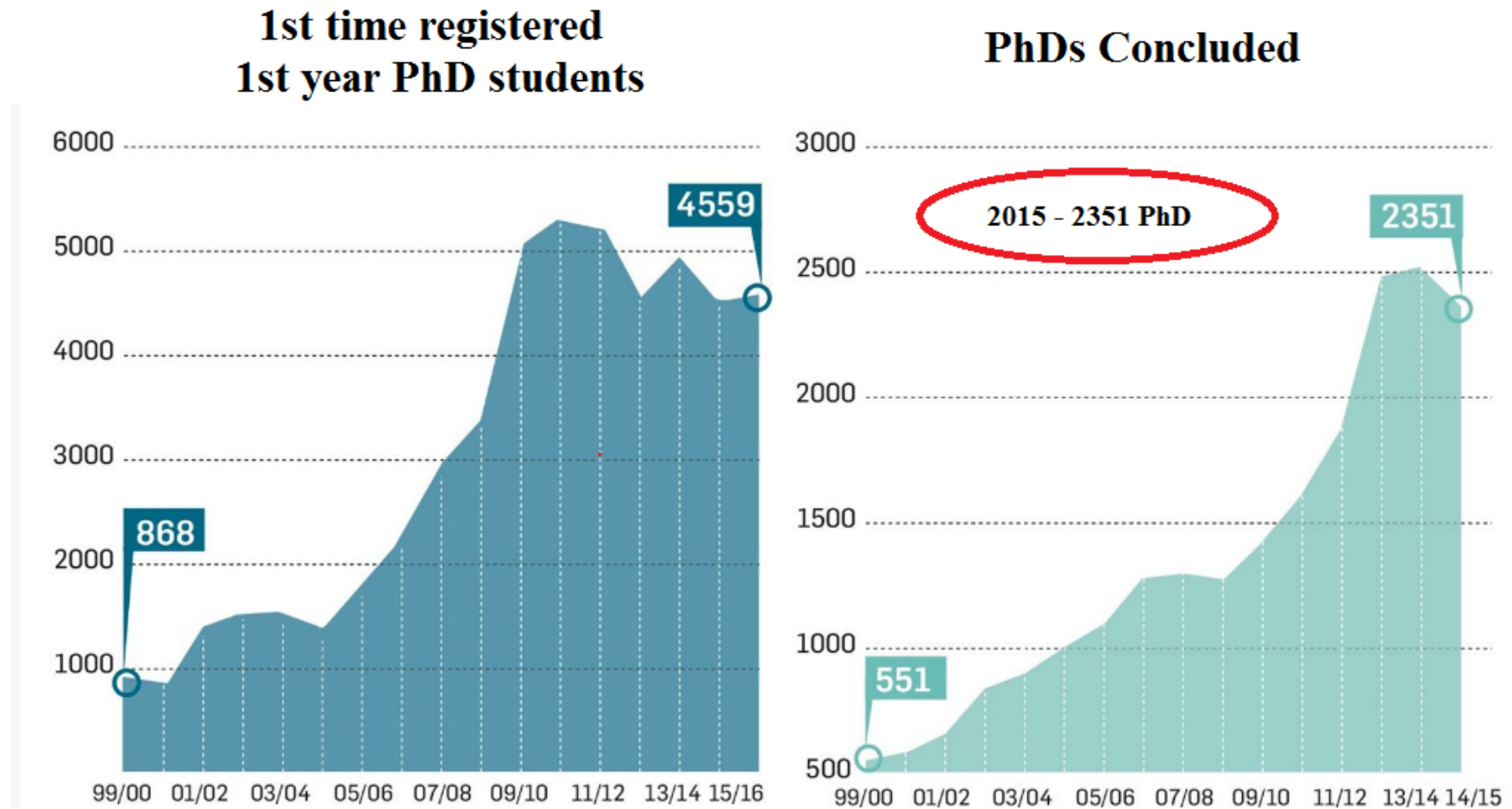
**Supervisor:** Francisco Taveira Pinto (FEUP)

**Co-Supervisors:** Teresa Reis (LNEC)

Luciana das Neves (IMDC)



# Survival rule N° 1 – It is never too late to get the PhD straight!



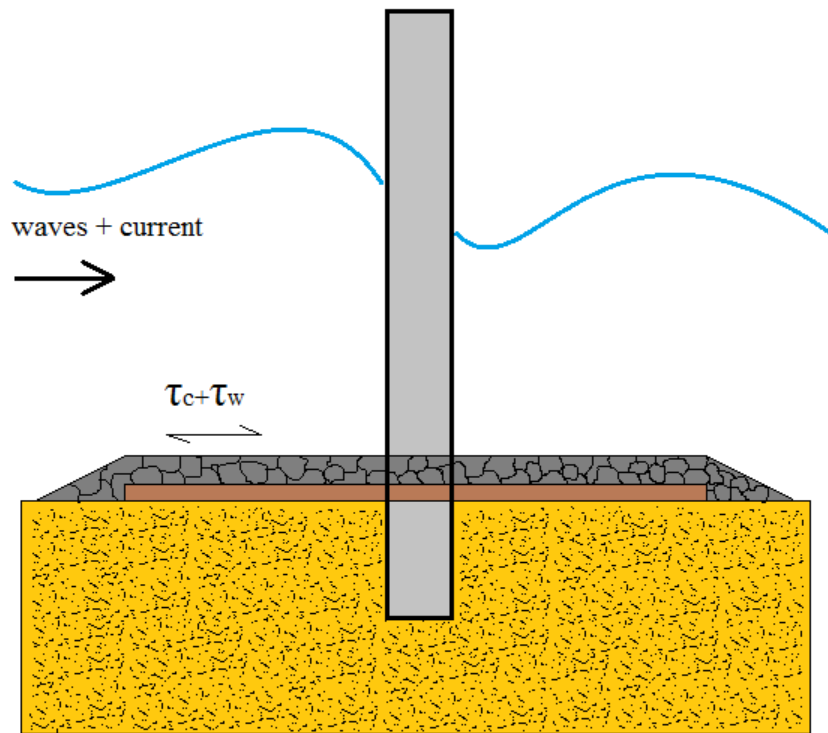
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## The PhD is completed by the endurance not by the intelligence!

# Survival rule N° 2 – It is important to have a clear vision.

Vision?

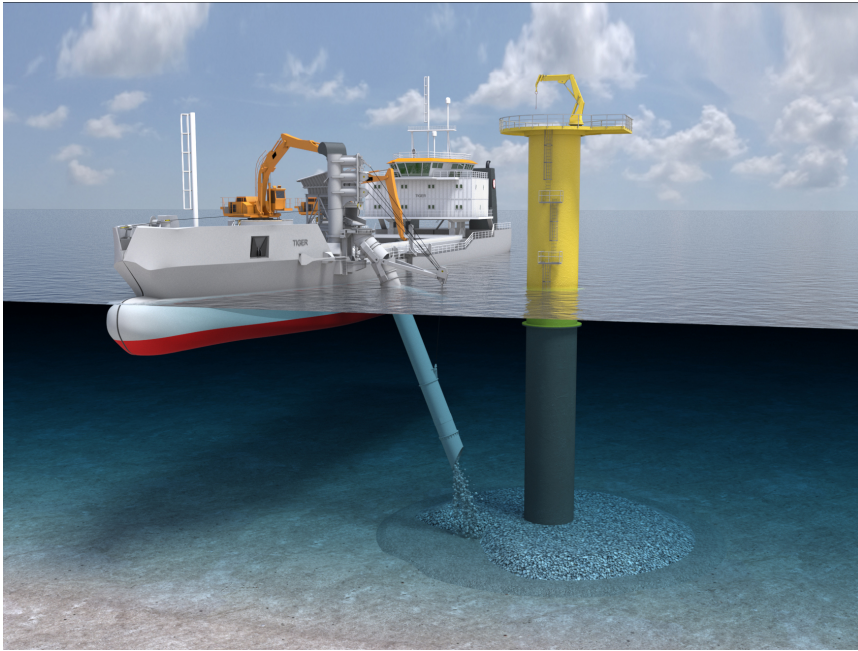
- Yes, know the problem to be solved.
- Make sure that this problem should be solved.
- Be clear and objective on the solution you propose and the output.



**Problem – The industry spends too much money on scour protections, due to uncertainty and empiric design.**

**Solution – Reliability design methodology applied to the optimisation of scour protections.**

**Output –  $P_f = f(D_{50})$**



**Optimisation:**  
**Dynamic scour protections**

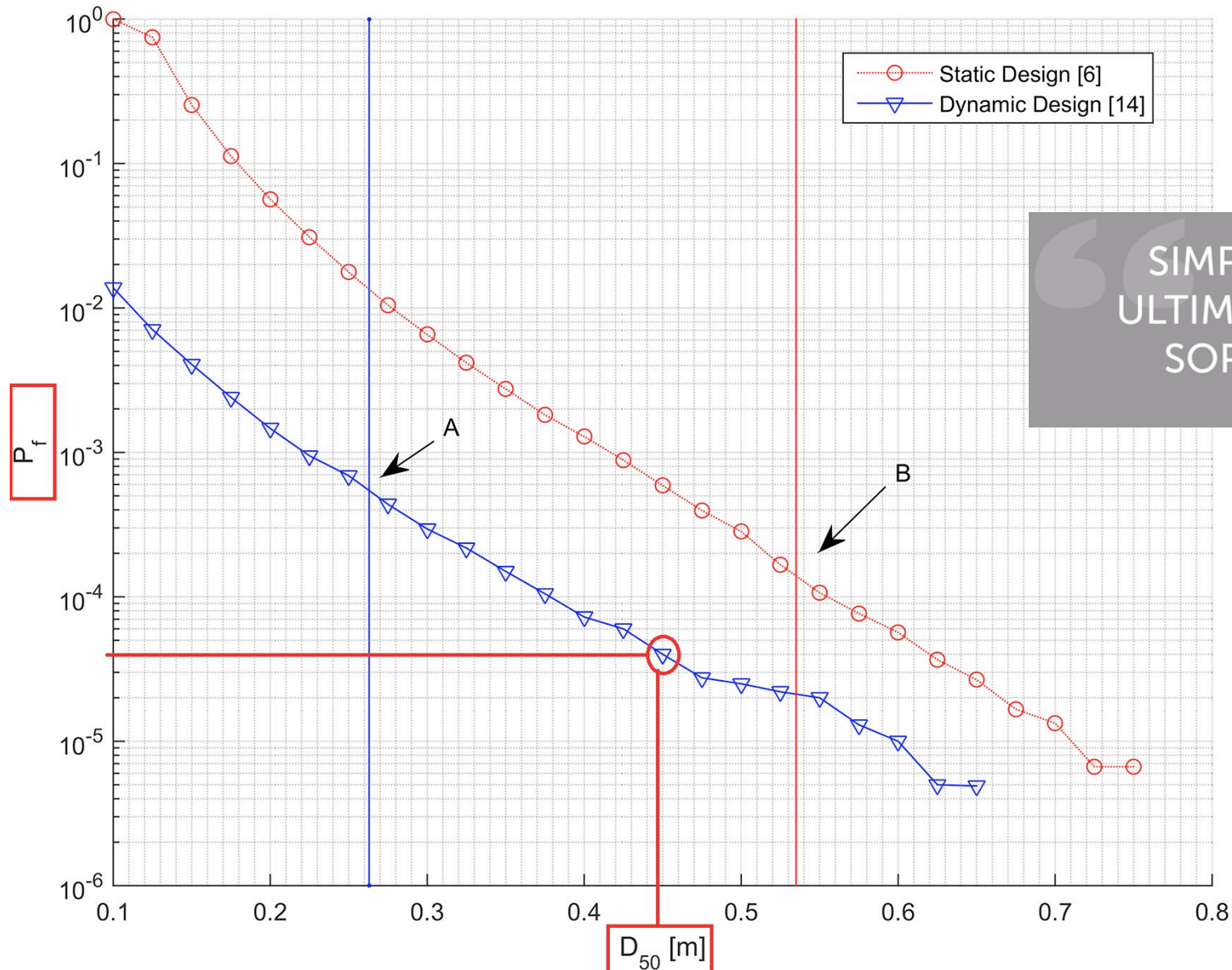
**How are we saving money?**  
**Transport, installation and material**

**Target variable:**  
**Mean stone diameter**

**How reliable is a  
dynamic scour  
protection?**



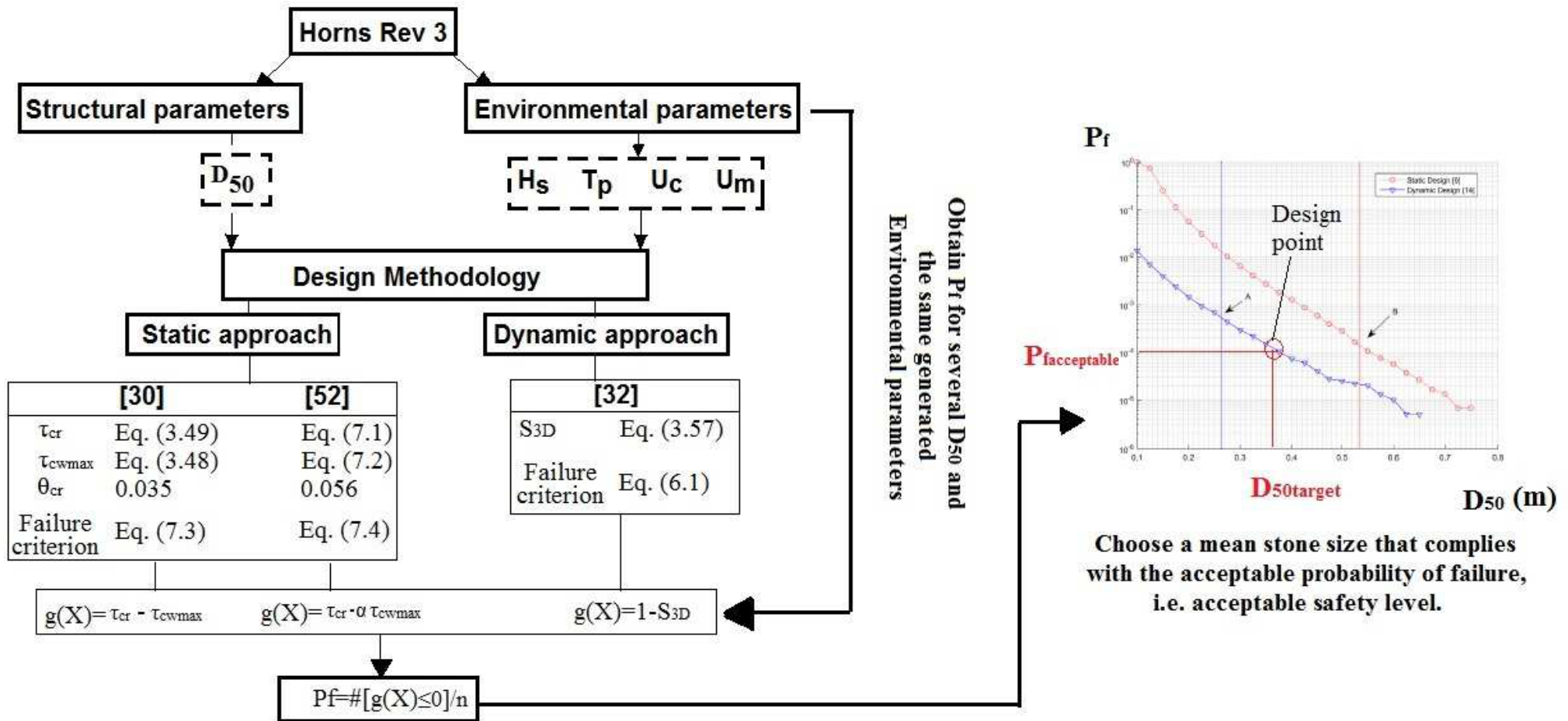
# What is the final product of the solution? Make it clear and simple!



SIMPLICITY IS THE  
ULTIMATE FORM OF  
SOPHISTICATION

LEONARDO DA VINCI

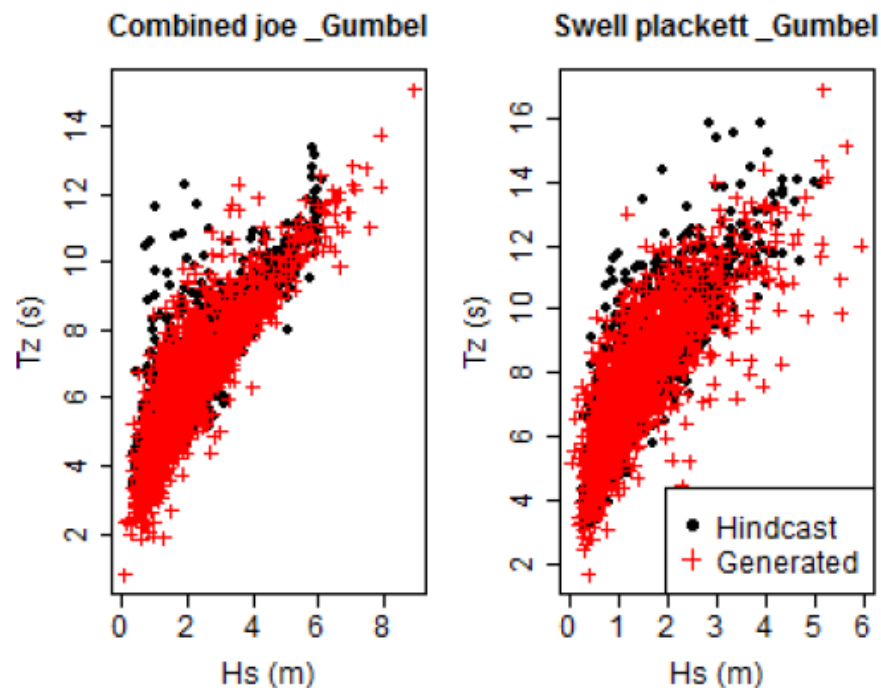
Although it will never be clear and simple to get to the solution!



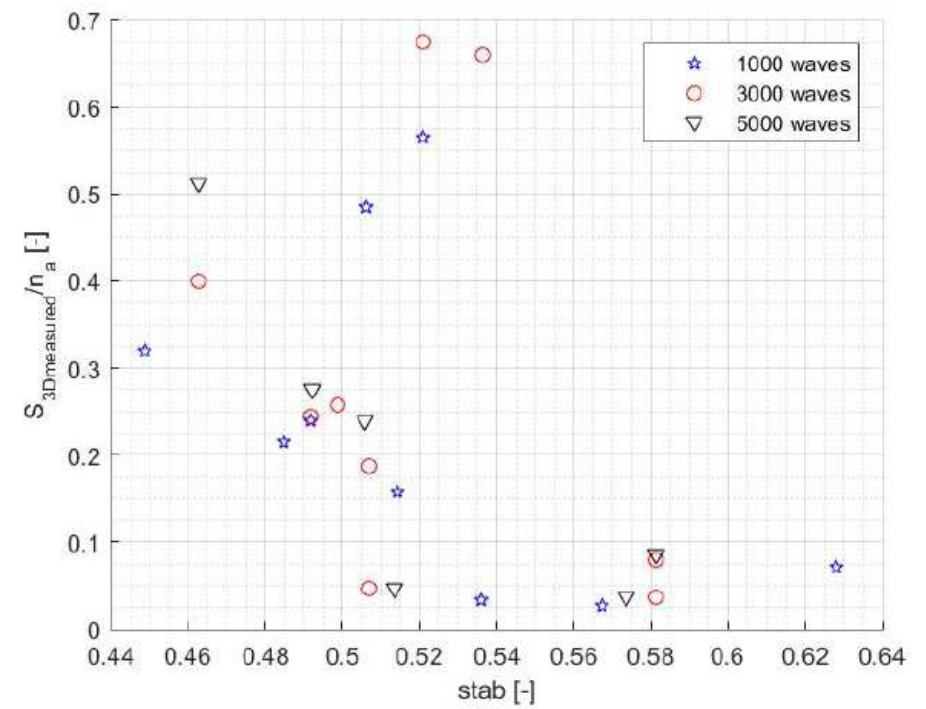
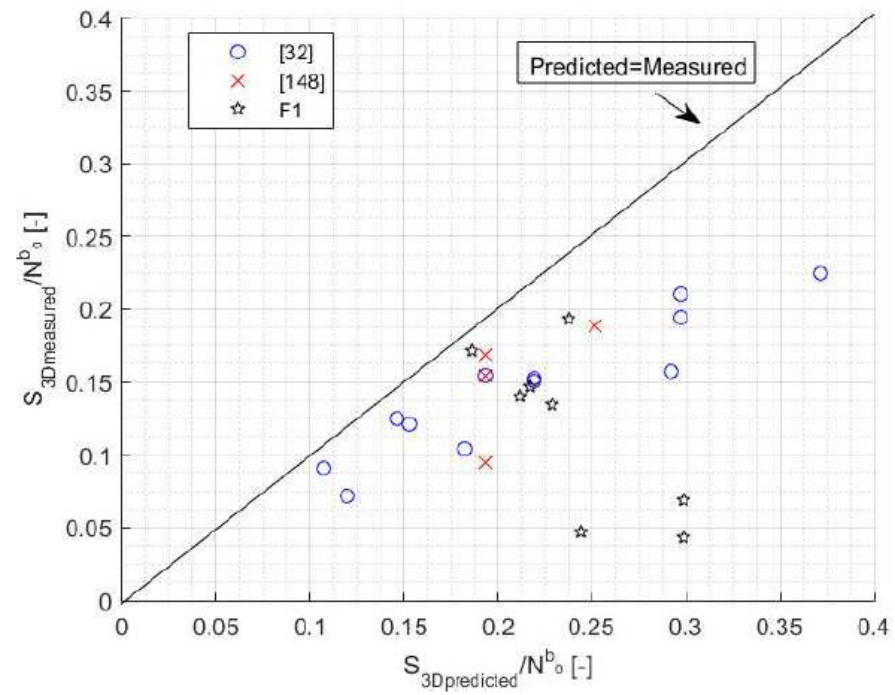
“If I had only one hour to save the world, I would spend fifty-five minutes defining the problem, and only five minutes finding the solution.” - Einstein

## Survival rule N° 3 – Murphy's law: Anything that can possibly go wrong, does.

- In the lab, equipment won't work;
- The software licence will expire;
- The scripts will not run;
- And most of all, you will find out that the problem that you wanted to solve, comes after solving several other problems that may not have solution.



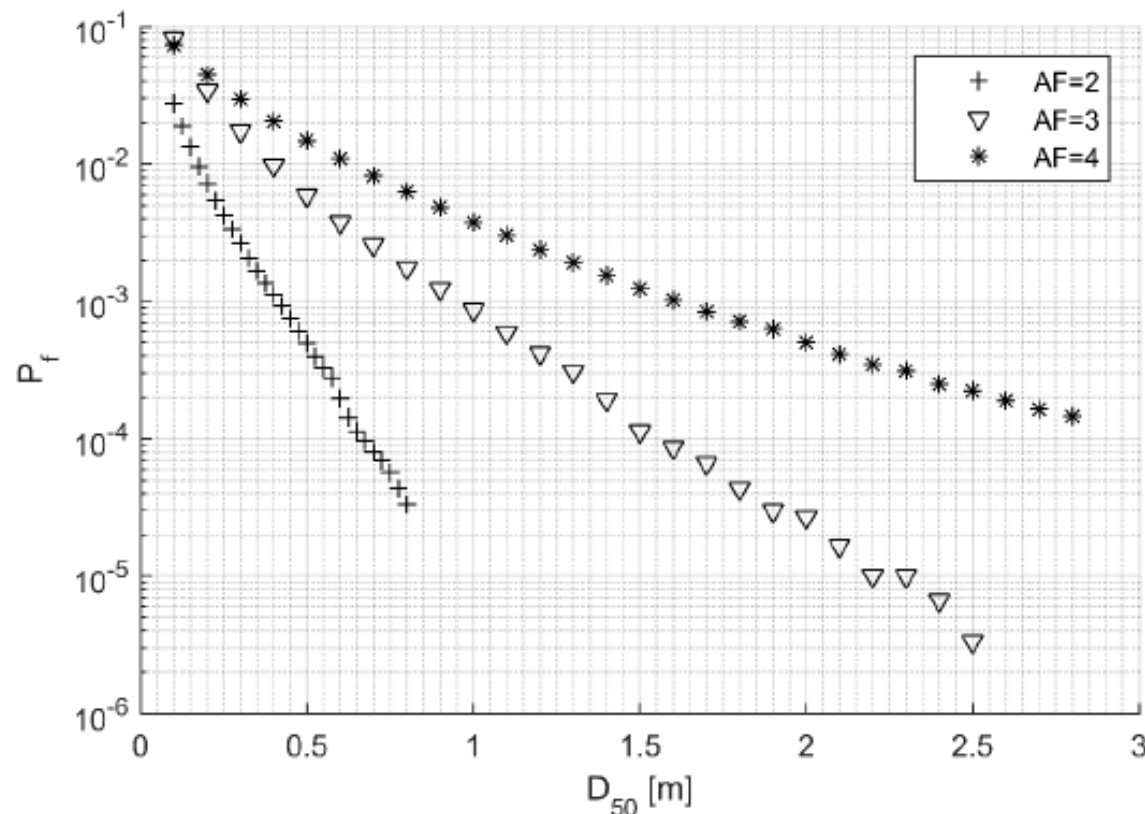
**Find alternative solutions,  
identify the problems that you  
did not solve, recognise them,  
comment them, just do not  
ignore them.  
Simplify and leave the rest for  
new PhD students.**





## Survival rule N° 4 – Ockham's razor.

Also known as *lex parsimoniae* "law of parsimony" - is the problem-solving principle that the simplest solution tends to be the right one. When presented with competing hypotheses to solve a problem, one should select the solution with the fewest assumptions.

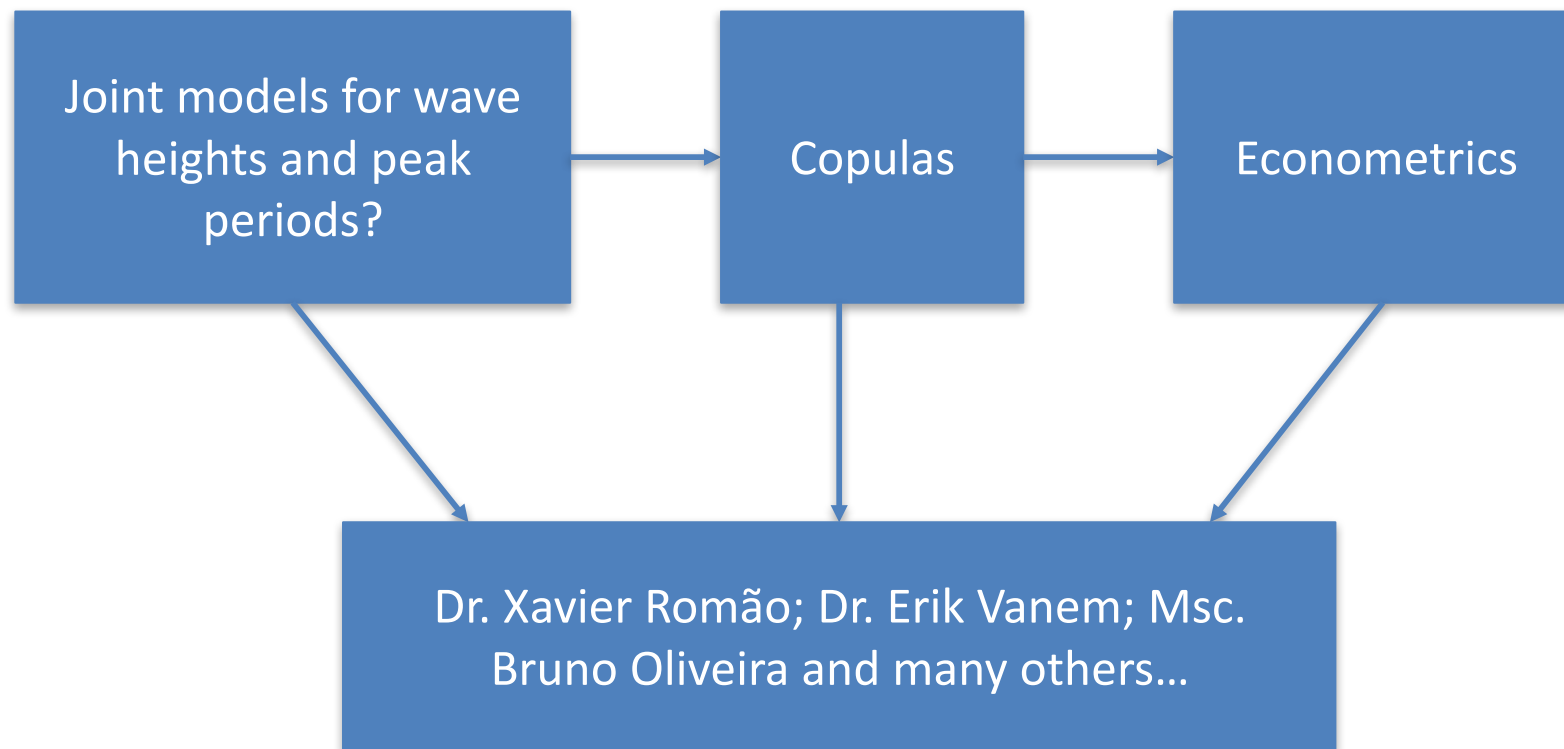


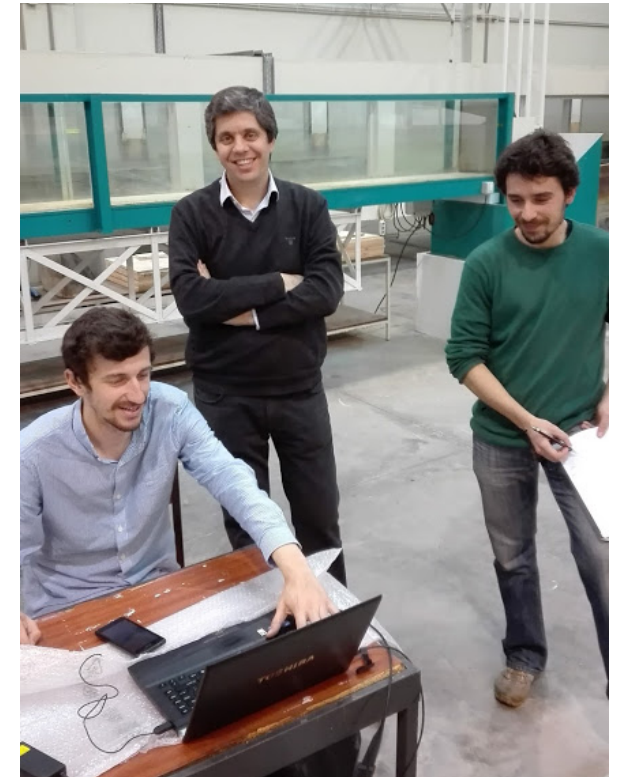
Scour Protections imply several empirical choices and variables correlation:

- Be clear about the choices made;
- Justify them the best you can;
- You have to start somewhere.
- Read the literature and use it in your advantage.

## Survival rule N° 5 – Don't do the PhD alone! Talk to people!

Some of the problems faced in a PhD have already been addressed by other fields of research, other researchers and colleagues. An example:







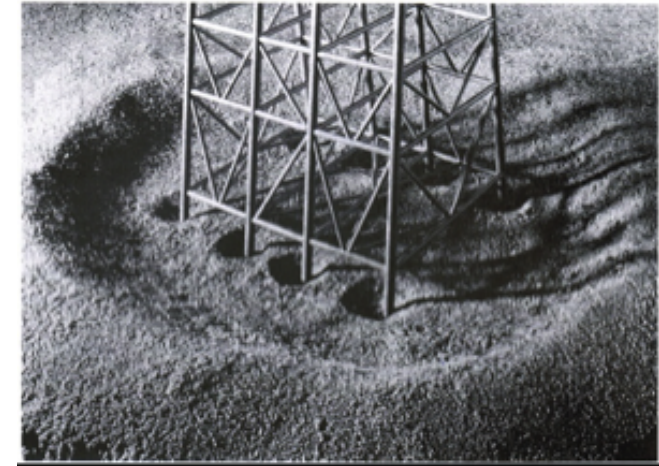
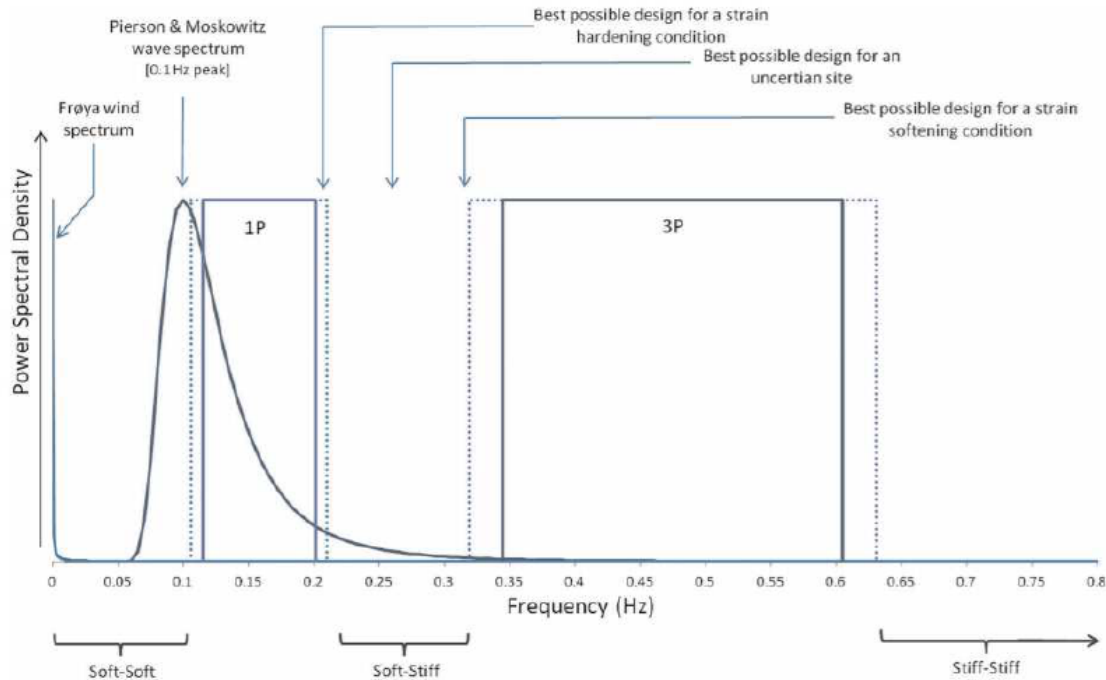
# Survival rule N° 6 – Get it written, not perfect!

- Act everyday as if you were doing laboratory experiments:
  - Pay attention to details;
  - Spend some time planning, it is time you will save in the future;
  - Discipline is the key;
  - The largest mistakes I've made in the PhD came from ignorance and lack of planning. **ASSESS THE RISK!**

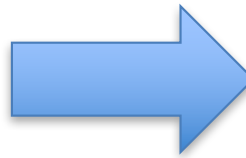
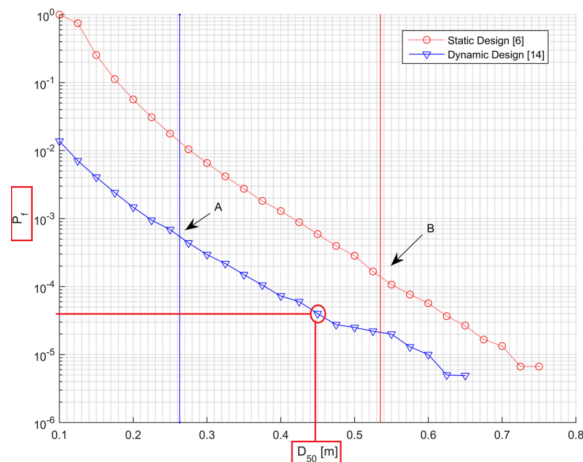




# Survival rule N° 7 – Tell the story behind the PhD.



Scour leads to a decrease of  $f_0$  towards the wave and wind spectra



# Survival rule N° 8 – Newton's three laws of graduation.



## NEWTON'S THREE LAWS OF GRADUATION

Though famous for his seminal work in Mechanics, Isaac Newton's theories on the prediction of a doctoral graduation formulated while still a grad student at Cambridge remain his most important contribution to academia.

### FIRST LAW

*"A grad student in procrastination tends to stay in procrastination unless an external force is applied to it"*



### SECOND LAW

*"The age,  $a$ , of a doctoral process is directly proportional to the flexibility,  $f$ , given by the advisor and inversely proportional to the student's motivation,  $m$ "*

Mathematically, this postulate translates to:

$$age_{PhD} = \frac{flexibility}{motivation}$$

$$a = F / m$$

$$\therefore F = m a$$



## NEWTON'S THREE LAWS OF GRADUATION

### THIRD LAW

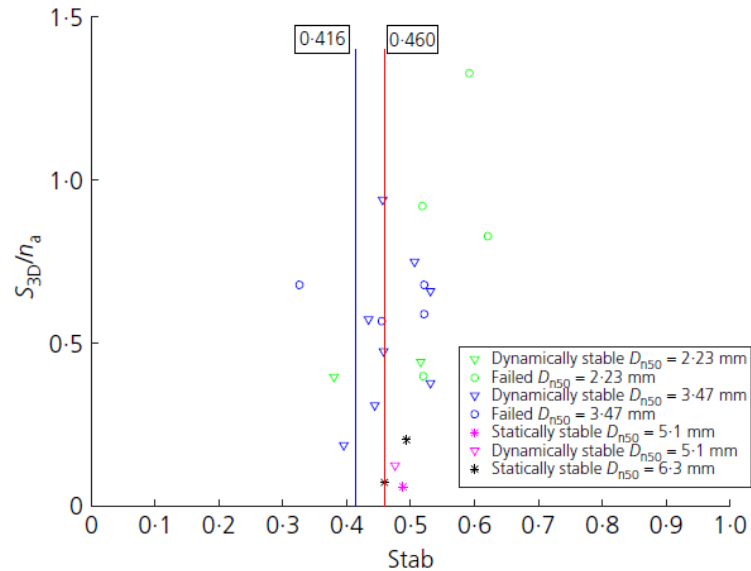
*"For every action towards graduation there is an equal and opposite distraction"*

# Survival rule N° 9 – Bad results are good results.

Maritime Engineering

ice publishing

## Physical modelling of dynamic scour protections: analysis of the damage number



Contents lists available at ScienceDirect

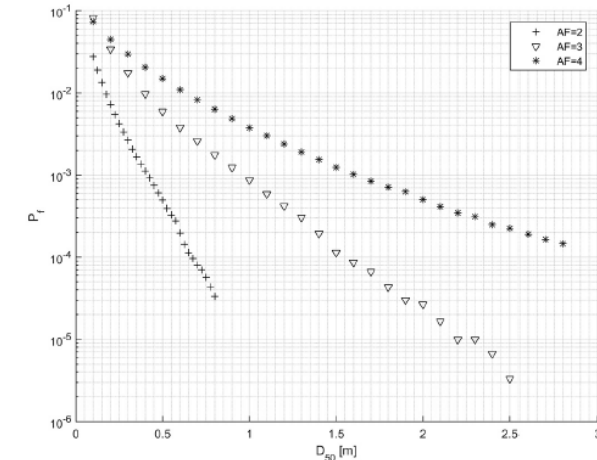
Engineering Failure Analysis

journal homepage: [www.elsevier.com/locate/engfailanal](http://www.elsevier.com/locate/engfailanal)



## Probabilistic design and reliability analysis of scour protections for offshore windfarms

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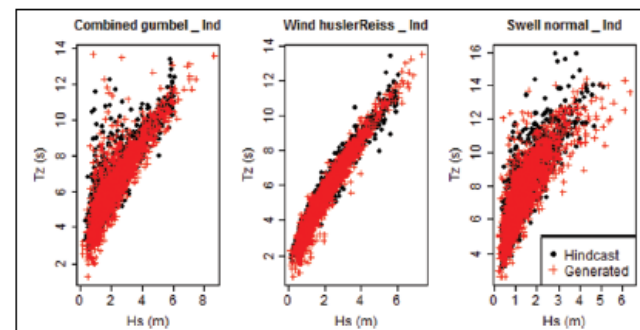


Special Issue Article

## WIND ENGINEERING

## Asymmetric copula-based distribution models for met-ocean data in offshore wind engineering applications

Wind Engineering  
2018, Vol. 42(4) 304–334  
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# Survival rule N° 10 – Appreciate people and enjoy the journey.





Conclusions:

# The Joy of Reliable Scour Protections

Survival rules!

*RELIABILITY ANALYSIS APPLIED TO THE  
OPTIMIZATION OF DYNAMIC SCOUR  
PROTECTIONS FOR OFFSHORE WIND  
FOUNDATIONS*

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Doctoral Program in Civil Engineering

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