



*Advanced Design Tools for Ocean Energy Systems Innovation, Development and Deployment*

# Ocean Energy Europe Workshop

## Structured Innovation tool

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# Contents

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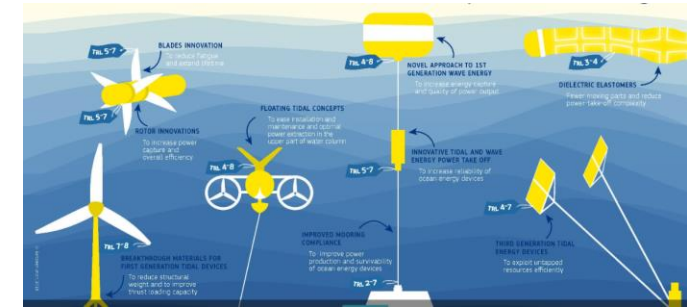
1. Introduction to the SI tool ( 5 mins)
2. Tool Demo/ walkthrough (7 mins)
3. Q&A (15 mins)



# Introduction to the SI tool

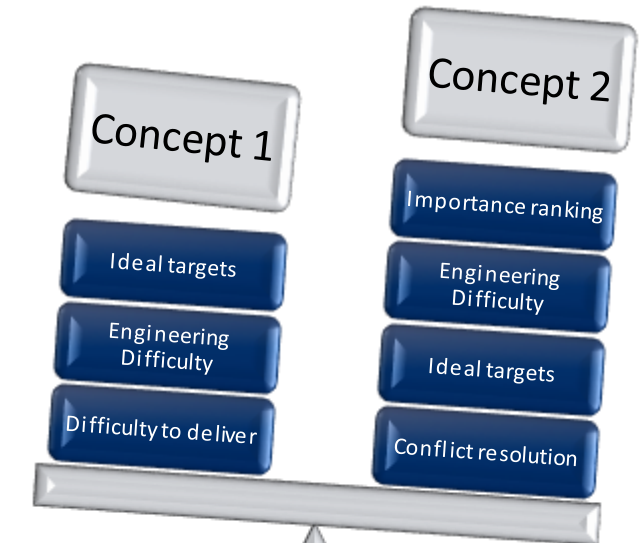
The Structured Innovation tool aims to:

- Help represent the voice of the customer
- Allow the design to understand the art-of-the possible for concept targets
- Enable objective comparisons between various technologies.
- Enhance systematic thinking for design beyond the current state-of-the-art.
- Provoke innovation by creating new or improve concepts



Who benefits from it?

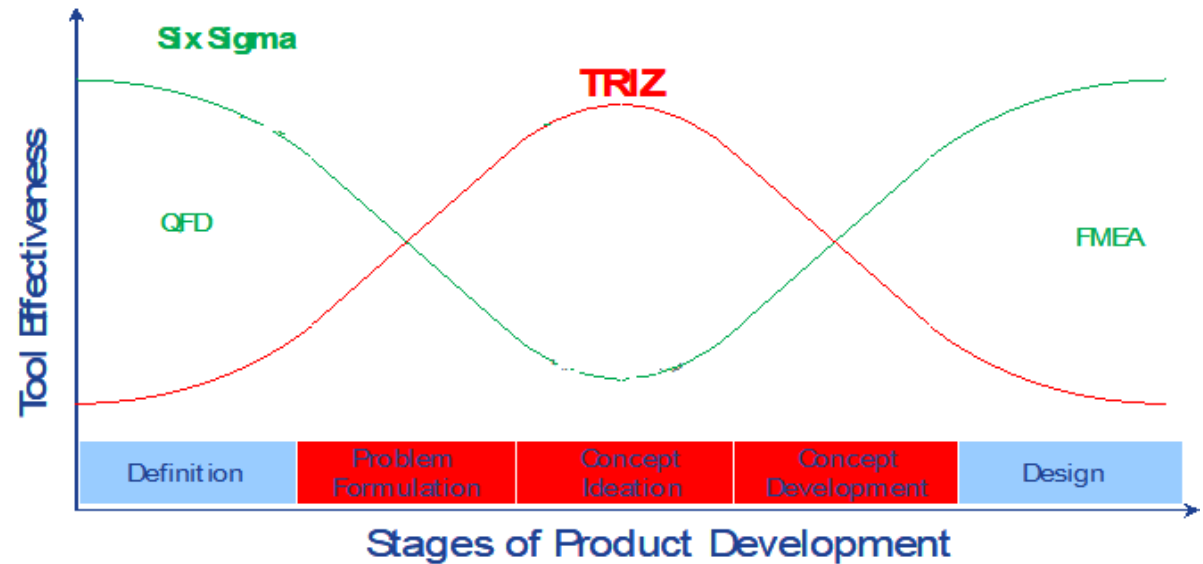
- Technology developers ~ to assess areas of improvement and technical challenges
- Funders & Investors ~ to identify attractive areas of innovation for investment
- Innovators & Developers ~ to assess novelty in technology



# Introduction to the SI tool

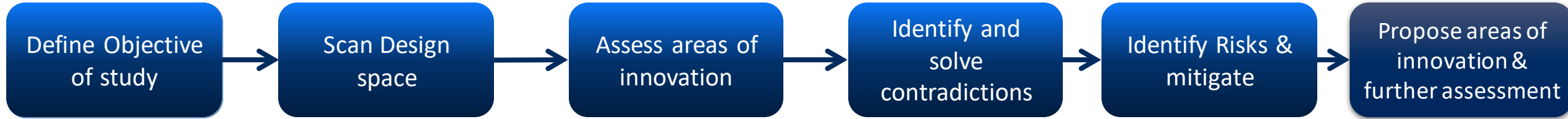
Innovation at the heart of concept creation, using **QFD**, **TRIZ** and **FMEA**

- Captures and prioritises requirements
- Assesses solutions for impact
- Provides problem solving for contradictions
- Encourages risk assessment and mitigation
- Gives development direction and impact
- Improve commercial acceptability



*Adapted from BS 7000-1 Design Management systems*

# Introduction to the SI tool



## Project details:

- Customer needs
- Mission statement
- Prioritisation

## QFD Process

- Functional requirements
- Relation & interrelationships
- Development impact
- Prioritisation

## Target/ideal values:

- SG thresholds
- Commercial targets

## TRIZ Process

- Synergies & conflicts
- Contradiction matrix
- Inventive principles

## FMEA Process

- Concept/Design
- Threshold/Actions
- Mitigation

## Report:

- Prioritised functions
- Development impacts
- Ideality assessment
- Conflicts and alternative solutions
- Risk mitigation measures

## Innovation :

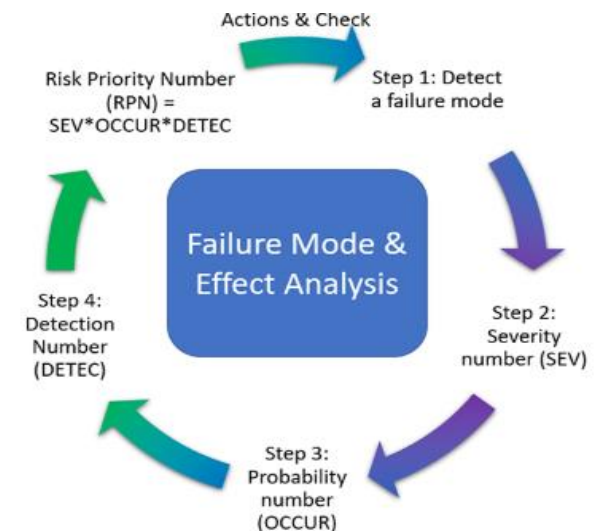
- Improvement (SG)
- New concepts

## Competitive assessments

Assessed SoTA achievement against targets	Resource available	Efficiency	CAPEX	Hull Scale
Concept-1 (heave- Barge-Concrete)	100%	1%	13%	4%
Concept-2 (heave barge-GRP)	5%	82%	104%	100%
Concept-3 (Surge-Barge-GRP)	79%	1%	52%	7%
Concept 4 (Surge-Barge-PU Nylon)	47%	59%	18%	100%



Solution Importance Ranking (Least- to- Most impactful)



# SI Tool demo/ walkthrough

## Structured Innovation Tool

Three established methods to assess novelty, risk and feature iterations for your Ocean Energy innovation.

### FMEA

#### Failure Modes and Effects Analysis

A Structured approach applied early in development to help designers identifying and analysing all possible ways a design, process or product can fail and designing a strategy to prioritise and mitigate the biggest risks.

Start Here

30-40 mins, 6 sections

### QFD

#### Quality-Function-Deployment

A Structured methodology used to identify, prioritise customer requirements and translate them into suitable technical requirements for each stage of product development and production. It is achieved using the House of Quality (HoQ) which is a matrix used to describe the most important product or service attributes.

Start Here

20-30 mins, 5 sections

### TRIZ

#### Theory of Inventive Problem Solving

A systematic problem-solving approach based on principles of creativity, patents and research. The methodology looks to identify the generic concept problems and solutions and to eliminate the technical and/or physical contradictions.

THIS IS EMBEDDED WITHIN QFD

# Structured Innovation & Stage Gate design tools



Thank you for your attention!

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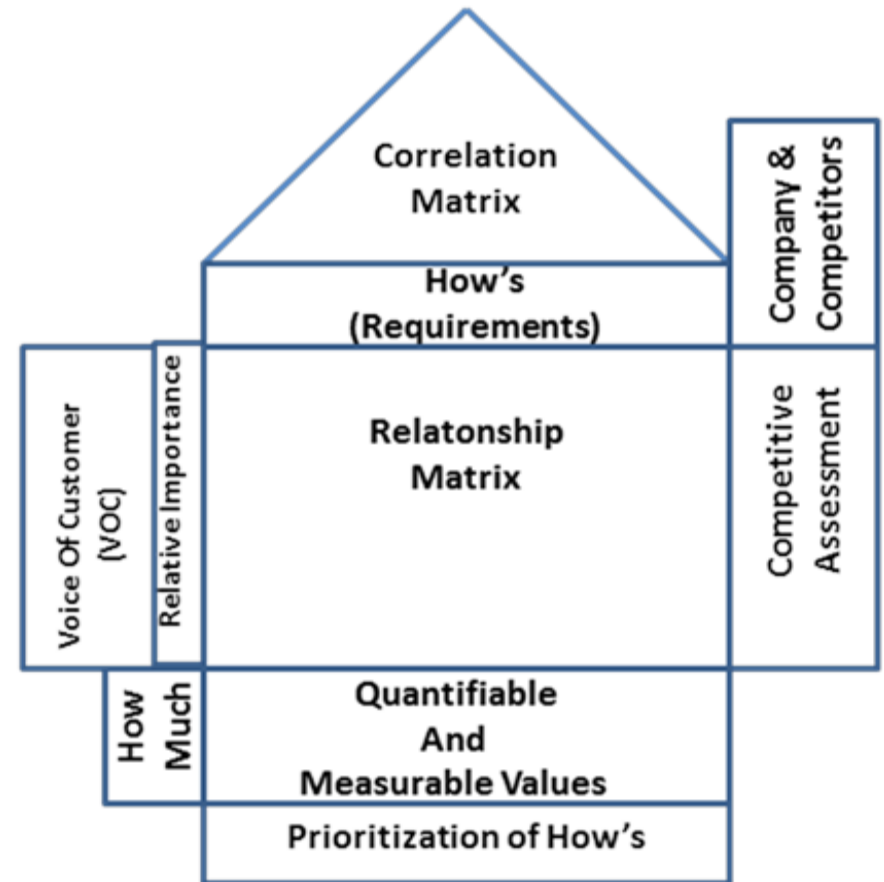




# 3. DTOcean+ Structured Innovation tool (IV)

## Quality Function Deployment

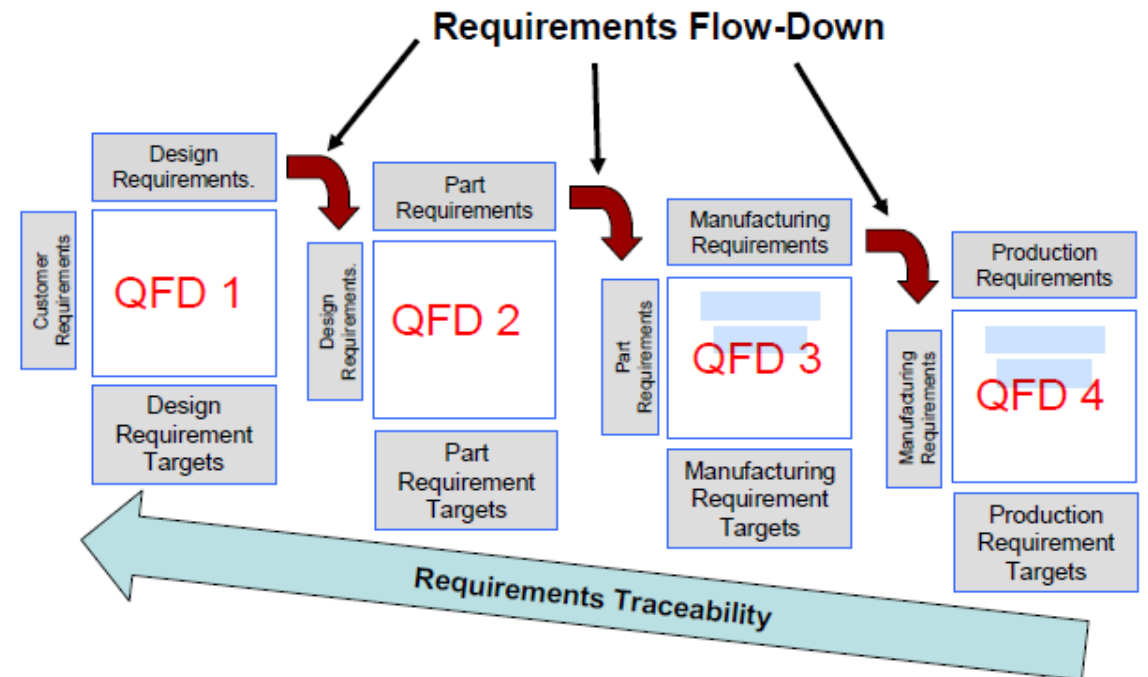
- Concept selection methods
  - Prioritise product requirements
  - Gain insights into conflicts
  - Understand relationships and impact
  - Assess difficulty in engineering and delivering
  - Impact and organisational efforts
  - Potential for Ideality



# 3. DTOcean+ Structured Innovation tool (V)

## Quality Function Deployment

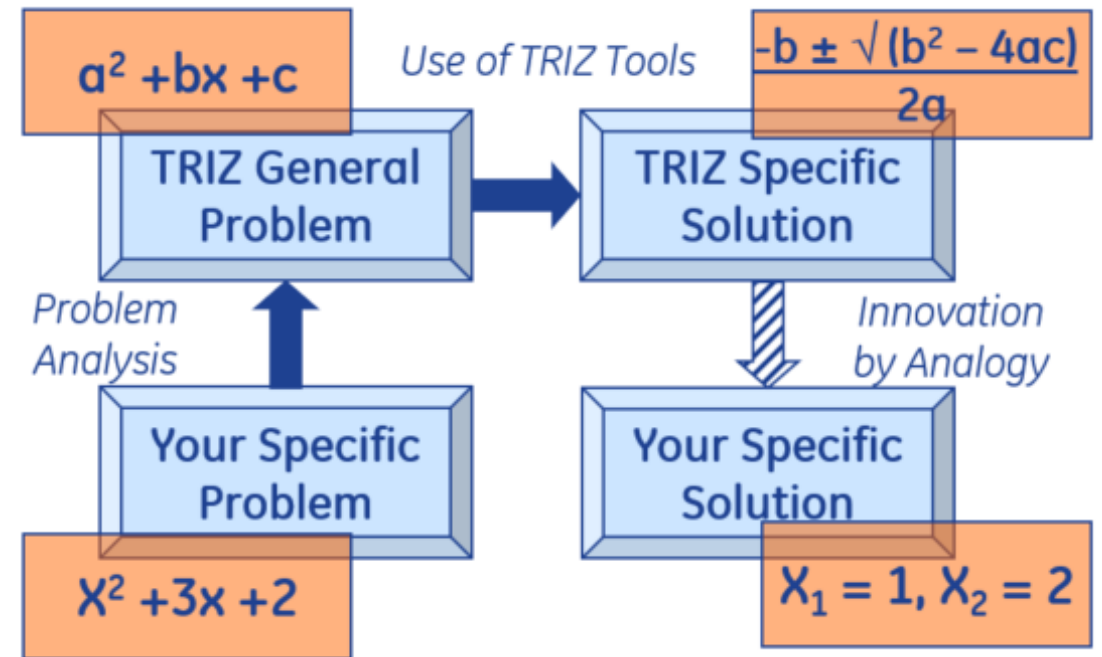
- Strengths
  - Multi level analysis
  - Multiple solutions to Needs
  - Subjective and Objectives measures
  - Impact and Organisation Efforts
- Weaknesses
  - No direct inventive thinking tool
  - Functional fixedness



# 3. DTOcean+ Structured Innovation tool (VI)

## TRIZ- Theory of Inventive Problem Solving

- Library of problems & solutions
- Engineering field patents
- Evolution of technical systems
- Impact analysis (quality)
- Functional performance Vs conflicts
- State of ideality



# 3. DTOcean+ Structured Innovation tool (VII)

## Failure Modes and Effect Analysis (FMEA)

- Concept & design evaluation
- Possible causes & failures
- Risk Priority Number
- Threshold for mitigation
- Criteria for corrective actions

Warning - Occ higher than 4  
MUST be mitigated

RPN Action Level 70

Remedial Action

Requirements	Failure Mode(s)	Effect(s) of Failure	SEV	Cause(s) of Failure	OCC	Design & Process Control(s)	DET	RPN	Recommended Solution(s)	SEV	OCC	DET	RPN
To provide wind assisted thrust to the ship	Thrust produced incorrect, lack of lift vs drag	Increased fuel consumption, loss of profit, increased emissions, loss of confidence, reputation, operational on-costs,	6	Electrical power loss and failure to restart <b>one</b> Rotor	3	Electrical system test	3	54					
				Electrical power loss and failure to restart <b>all</b> Rotors	3	Electrical system test	3	54					
				Electrical sensor loss	3	Electrical system test	3	54					
				Rotor Seizure	2	Root Cause Investigation	3	36					
				Device not able to use to wind resource (Direction)	4	Design Review	3	72	Minimum 2 wind sensors installed. Control system reverts to "idle mode" to reduce drag. No thrust produced from FRS.	6	3	2	36
				Device not able to			3	72	Minimum 2 wind sensors installed. Control system reverts to "idle mode" to reduce drag. No thrust produced from FRS.	6	3	2	36
				Main Bearing system (SRB) failure	2	Design Review	3	36					
				Main Bearing system (ASRB) failure	2	Design Review	3	36					

RPN= Severity X Occurrence X Detection

