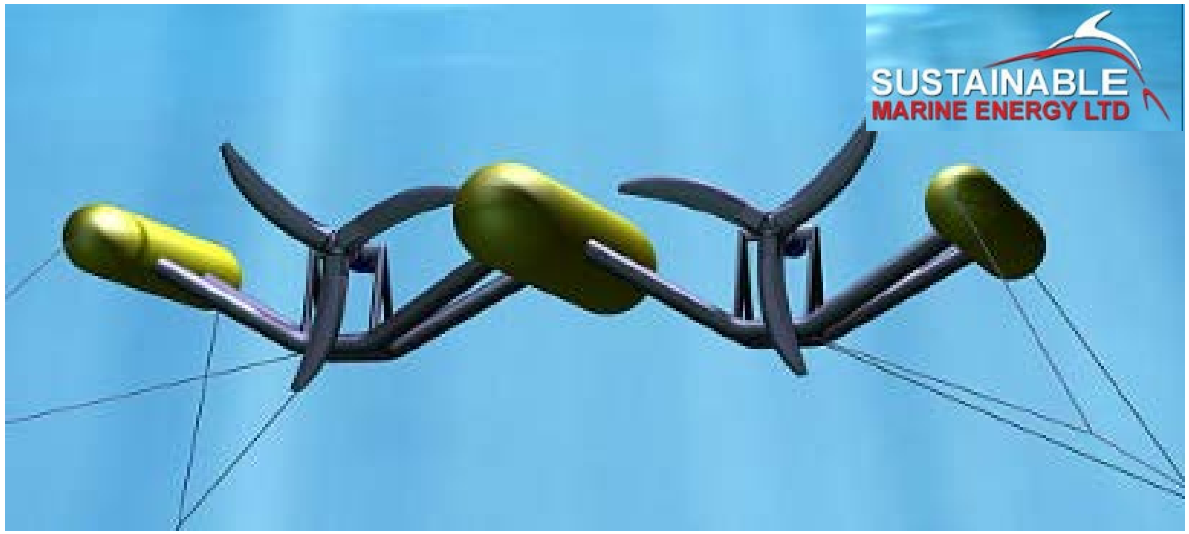
MULTI-DISCIPLINARY RISK IDENTIFICATION AND EVALUATION FOR THE TIDAL INDUSTRY

Cranfield UNIVERSITY



Plat-o Systems Integration Platform by SME

Athanasios J Kolios
Lecturer in Engineering Risk Analysis
George W. Read
Researcher
Anastasia K. Ioannou
Researcher

Department of Offshore and Process Engineering

http://www.cranfield.ac.uk

Introduction/Overview

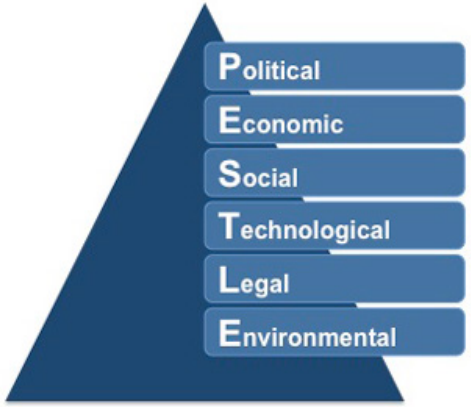
- Aim of the study
- Methodology
- PESTLE analysis
- Stakeholder identification
- Risk identification
- Multidisciplinary risk assessment
- Results
- Conclusions
- Future work

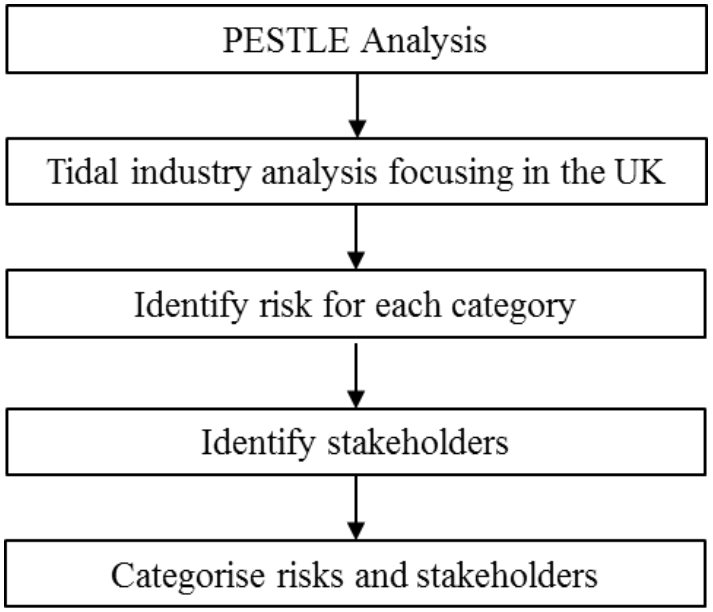
Aim of the study

- **Identify** stakeholders and risks of in-stream tidal industry, based on a **PESTLE** segmentation analysis
- **Prioritise** risks through establishing a generic multi-disciplinary analysis **framework**
- Highlight **key risks** that should be **mitigated** towards further development of the industry

PESTLE approach

- Despite there being numerous reports focusing on individual or just a few aspects of risk, there is a **lack of a comprehensive risk register** covering all of the PESTLE factors.
- Similar approaches have been compiled for competing industries
- A thorough PESTLE analysis allows the **greater picture** (macro-environmental) to be looked at instead of focusing on certain aspects of projects





Stakeholder identification (cont.)

- *Political stakeholders:* International, European and UK national
- *Economic Stakeholders:* Public, private sector, investors etc
- *Social Stakeholders:* Communities, fishing, shipping etc
- *Technological Stakeholders:* Developers and researchers
- *Legal Stakeholders:* National and EU level directives
- *Environmental Stakeholders:* Government departments, charities etc

Stakeholder identification

Cranfield UNIVERSITY

POLITICAL	ECONOMIC	SOCIAL
ACER	Competing conventional energy	RNLI
Department of Energy Northern Ireland	CORDIS	Commercial Shipping
EU-Ocean Energy Association	DOENI	Dredging Communities
European Commission	Energy Technologies Inst.	Emergency Services
International Energy Agency	European Commission	Fishing Communities
IRENA	Green Investment Bank	Local Communities
Local Councils	Insurers	National Support
RenewableUK	Market Competition	Royal Yaught Association
Scottish Government	Other Public Investors	Tourism
Scottish Ministers (W&T)	Private Banks	Surfers
The Carbon Trust	Private Investors	
The Energy Community	Scottish Ministers	
UK Government - DECC	Technology Strategy Board	
UNESCO	The Carbon Trust	
United Nations - DESA	The Crown Estates	
Welsh Assembly Government	UK Government - DECC	
TECHNOLOGICAL	**LEGAL**	**ENVIRONMENTAL**
CORDIS	DEFRA	CEFAS
Classification e.g. Lloyd's Register & DNV	European Commission	DEFRA
ICEPT/UKERC	Marine licensing Scotland	Environment Agency
Manufacturers	Marine Licensing Wales	Environment and Countryside Dpt.
Marine Installation & Commissioners	Marine Management Org.	EU-OEA
National Grid	National Grid	European Commission
Other Industries e.g. Offshore Wind	Renewable Energy Lawyers	JNCC
RenewableUK	The Crown Estates	Marine Management Org
Suppliers & Supply Chain	UK Government	Natural England
Technology Strategy Board	United Nations (Law of the Sea)	RAFTS
Test Sites e.g. EMEC & Wavehub		RSPB
UK Tidal Developers*		Scottish Heritage
UK Research Organisations e.g. Universities		WWF

Risk Identification

POLITICAL

European level politics
Environmental related politics
UN not supporting future renewable energy developments
Politicians may focus on proven renewable energy sources
National level politics – insecurity of part in power
Government cut backs in spending for renewables
Difference in regional political support within the UK

ECONOMIC

Securing (private) capital investment
Financing through banking system
High cost of technology at current
True cost of tidal developments (CAPEX & OPEX)
Unit and array deployment
Current projection for investment pay off
Global recession and uncertainty of future economy
Public sector investment/involvement including R&D funding
Cost of electricity from tidal energy
Government incentives (subsidies)
Competing renewable technologies
Competing conventional technologies
Insurer risk
Cost effective technology

SOCIAL

Social groups being ignored/not being involved
Social groups delaying/stopping a project
Local scale opposition
National level opposition
Public acceptance
Public support
Awareness of technology
Fishing communities – incentive schemes
Commercial and recreational boating
Emergency services
Tourism
Resistance of existing technology

Risk Identification (cont.)

Cranfield UNIVERSITY

TECHNOLOGICAL

Maturity of technology
Understanding the engineering of the technology
Engineering design uncertainty
Engineering design of components
Supply chain
Reliability (component & system)
Effective power output
Fragmented industry (no widely accepted configuration)
Support methods
Anchoring & mooring
Design variability based on depth and conditions
Restriction in prototyping and lack of numerical tools
System efficiency on array scale development
Availability of design standards and certification guidelines
Installation & commissioning
Grid connection
Maintenance
Removal and decommissioning
Transferability of knowledge from similar industries

LEGAL

Changes in legislation
Complicated legislation
Commitment to legally bound renewable targets
Strategic Environmental Assessments
Environmental Impact Assessments
Difference in legislation between different countries
Overlooking details of legislation
Planning permission
Licensing
Intellectual property
Costs associated with legal battles

ENVIRONMENTAL

Carbon footprint and lifecycle assessment
Short term Environmental damage
Long term environmental damage
Unknown environmental impacts
Environmentalists causing delays
Indirect environmental damage
Collision risk
Sound and light emissions
Farm scale impact

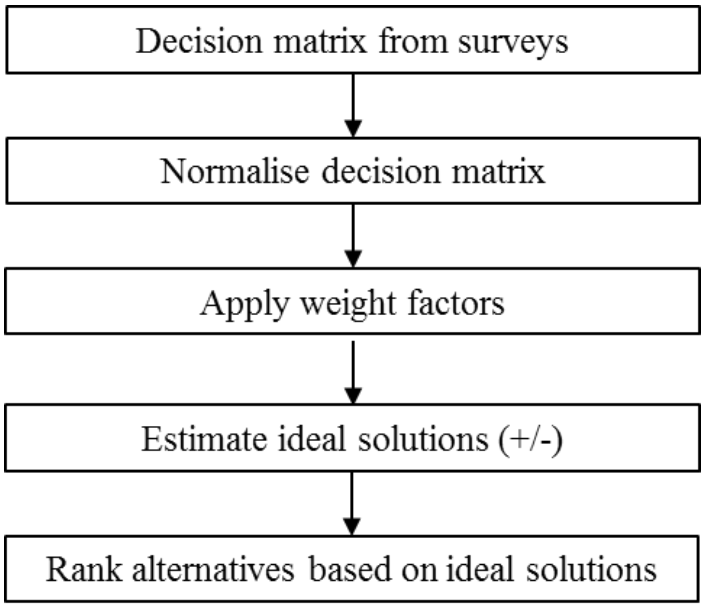
Stakeholder survey

- **Web-based** survey with anonymity of responses
- Limited **number of questions** and **LIKERT** scale
- Input requested:
  - Evaluate risks (list of 72 risks)
  - Provide category of activity
  - Perceived level of importance of each category
  - Perceived level of expertise
- In total **68** responses; 30 industrial and 38 academics stakeholders
- **Response rate** above **15%** across both categories
- Industry had a very effective **spread of results** across the PESTLE categories with the exception of legal stakeholders
- Majority of **academic responses** were technological, with sufficient responses in environmental and economic

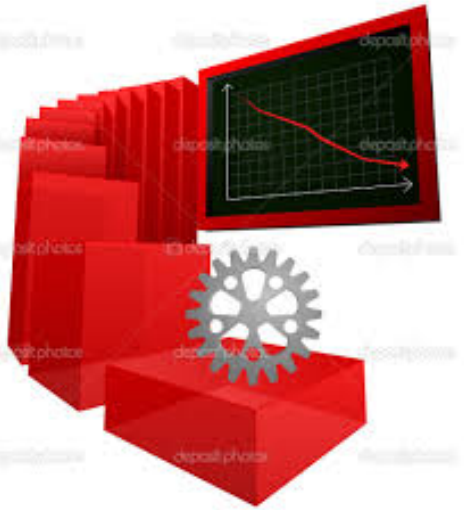
Multidisciplinary risk assessment

Cranfield UNIVERSITY

- **MCDM** methods are widely applied in decision making for ranking of different options subject to different **criteria**
- In this instance criteria are considered the cumulative scores of each risk from each category of stakeholders
- Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) has been selected here, normalising the results and ranking them based on their relative distance from a **theoretical ideal** positive and negative ideal solutions

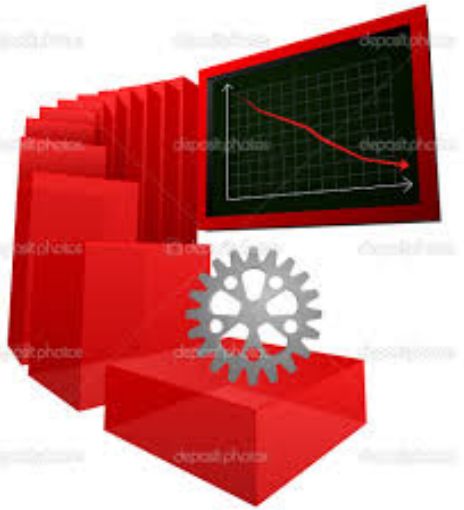


Industry Survey Results



- Risk analysis ranked **'private investment', 'investment pay off period' and 'reliability'** as the most critical risks in the sector.
- **Top 10** of risks comprised of 4 economic, 5 technological and 1 political risk.
- No **legal or social issues** were regarded as critical risks (top 10) with the majority of these three categories of risk featuring in the bottom half of the ranking.
- The current average of PESTLE sectors weighting factors marked **political as 25%, economic 26%,** social 6%, **technological 26%** and environmental 13%.

Industry Survey Results (cont.)



- *Political stakeholders* identified '**grid connection**' as most critical, as well as 'public acceptance' and 'support' alongside technological and economic risks.
- *Economic stakeholders* identified '**UN support**' as most critical.
- *Social stakeholders* identified legal, social and environmental risks as the most critical. The most critical risks were '**international legislation**'.
- '**Support structure**' was the critical risks for *technological stakeholders* with technological, economic and political factors making up the remaining top 10 risks.
- *Environmental stakeholders* ranked '**International legislation**' as the most critical risk.
- The *legal stakeholder* group were omitted from this part of the analysis as there were only 2 responses from this stakeholders' group.

Results for Academics

- Analysis ranked **'cut backs in spending', 'maintenance' and 'true cost'** highest with 5 economic risks, 4 technological risks and 1 environmental on the top 10.
- Due to the majority of the responses coming from technological academics, it was not possible to conduct a valid analysis for each individual category.
- This lack of participation of different stakeholder groups was down to the fact that the **majority of academic work** in the tidal energy industry is **focusing on technological aspects** (with a number of environmental also), with many engineers currently working with tidal energy developers and not many having expertise in the other sectors.

Results/Observations

- **Overall** economic and technological risks are deemed most critical over both of academic and industrial results, with the academics placing more emphasis on economic risks.
- Both ranked political **risks third, environmental fourth and social and legal risks the least critical**.
- The average **industry expertise score** stood at 5.2, perhaps not reflecting the true knowledge and expertise of the stakeholders who participated, as this type of self-assessment remains subjective.
- It is interesting to note that the highest expertise weighting group overall were the technological stakeholders, with the lowest comprising of the social and legal stakeholders.
- The corresponding overall **average weighting for academics** was lower than that of industry at only 4.0.

Conclusions

- This study has looked into the *stakeholder perception of risks* that the in –stream tidal industry faces
- Through a survey **risks were ranked** based on their respective criticality as well as the importance of each sector.
- TOPSIS multi-criteria analysis revealed overall the **economic and technological factors** to be the highest priority for both academics and industry.
- Within the **industrial stakeholders**, individual analysis revealed that *4 of the 6 groups agree with the overall critical risks*.
- The biggest difference between industry and academic stakeholders was that academics gave more of an overall score to the environmental, social and legal risks.

Current/Future Work

- **Expand** the survey in other *renewable energy technologies* as well as the *industry* as a whole
- Introduce interviews (**2 stage** data collection) on ranking and assessing the critical risks
- **Analyse** *critical risks* and potentially suggest analytical approached to ranking their criticality
- **Workshop**

Questions…

Cranfield UNIVERSITY

Thank you very much for your attention

a.kolios@cranfield.ac.uk