


## Fuzzy Delphi for Marine Space Stakeholder Framework Development: An Analytical Literature Review

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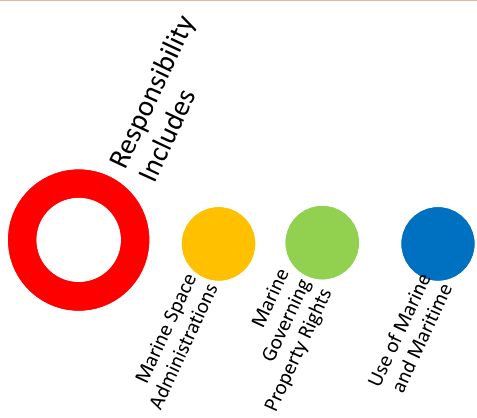


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## INTRODUCTION

The responsibility of marine area management and administrations particularly to facilitate the stakeholder effective engagement in economic perspective, social and environmental, needs participation from the rest of the world.



Responsibility Includes

- Marine Space Administrations
- Marine Governing Property Rights
- Use of Marine and Maritime



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Marine Space Administrations Issues

# Technical

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# Legal

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# Stakeholders



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**Technical**

- vertical datum, the high water mark as a jurisdictional limit and loose and overlapping jurisdictions amongst various government agencies

**legal**

- Many legislation amongst various government agencies including international and local



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# STAKEHOLDER


 **A person with an interest or concern in something, especially a business**

 **An individual or a group of people that have common characteristic of interest, who looking forward for the system or organization success**

 **In marine spaces, the stakeholder can be divided into three categories; known as national, state and local organizations**

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The diagram illustrates the relationship between Coastal and Marine Resources and Marine Space Governance Issues. At the center is a blue circle labeled "Coastal And Marine Resources". Surrounding this circle are six categories of activities, each with a small image: "areas for development, areas for recreation" (top), "areas for dumping of waste" (top right), "areas for scientific research and areas for mineral and hydrocarbon extraction" (right), "Stakeholder" (bottom right), "Legal" (bottom), and "Technical" (bottom left). Below these categories is a red box labeled "Marine Space Governance Issues". Three red arrows point upwards from this box to the "Technical", "Legal", and "Stakeholder" categories. A large orange arrow points from the text box below to the "Marine Space Governance Issues" box.

**Technical**      **Legal**      **Stakeholder**

**Marine Space Governance Issues**

**Coastal And Marine Resources**


**Technical**: Sources of food from animals, plants and fishes

**Legal**: means of transportation and communication

**Stakeholder**: areas for scientific research and areas for mineral and hydrocarbon extraction

**Other categories**: areas for development, areas for recreation; areas for dumping of waste

**In Malaysia, there are various stakeholders and activities in the marine environment such as in land development, coastal activities, agriculture, tourism related activities, native title or indigenous issues, marine parks or protected area, aquaculture, oil and gas exploration, shipping the international boat or local, waste management from industry, cable and pipelines for the water supply or electricity and heritage area such as shipwreck**


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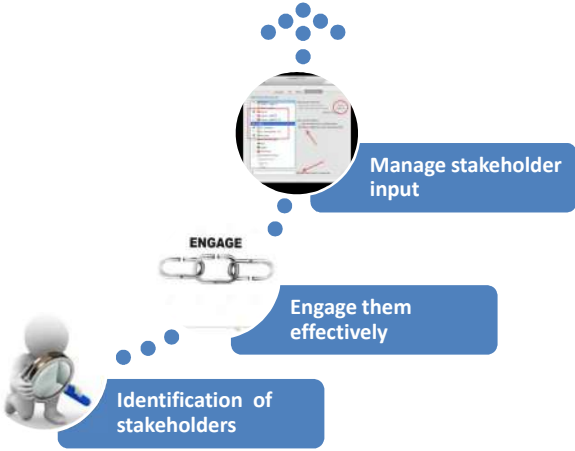
Therefore clarity is needed in the stakeholder administrative management of the marine environment



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### MARINE SPACE STAKEHOLDER ISSUES (MSSI)




Manage stakeholder input

ENGAGE

Engage them effectively

Identification of stakeholders



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to find out the recent method that been used in managing stakeholder problem



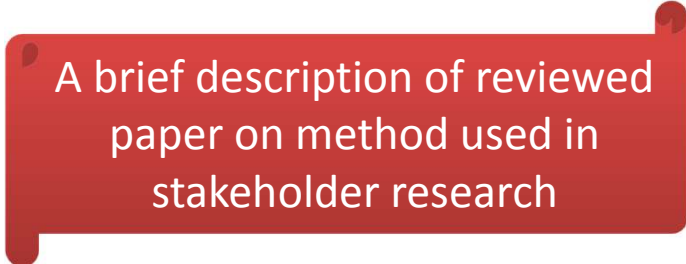
proposed the well-known method but new in marine space governance




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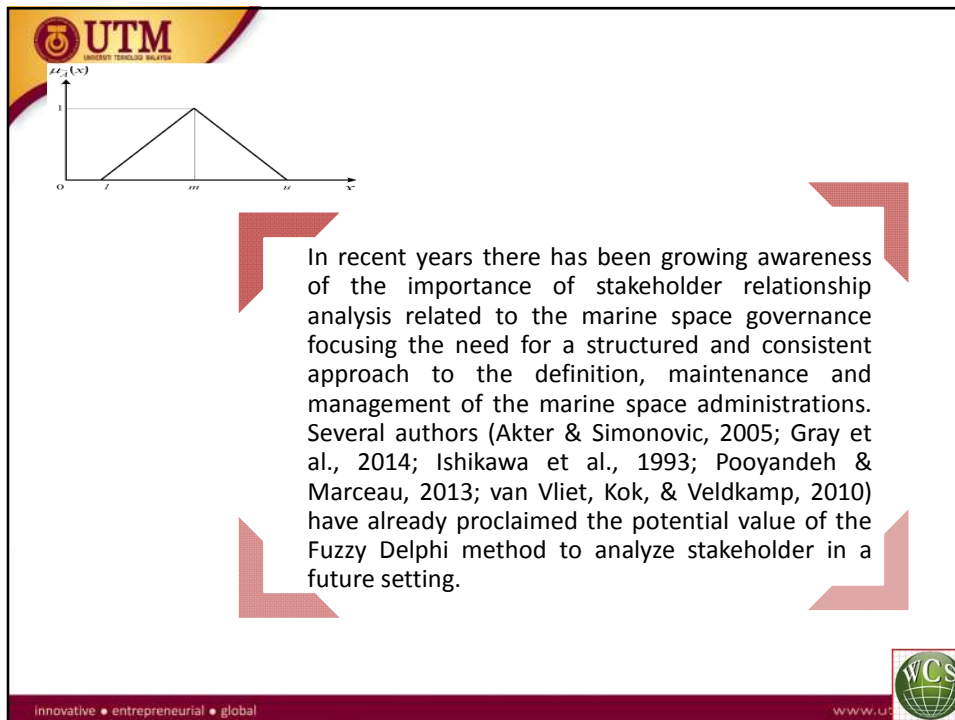
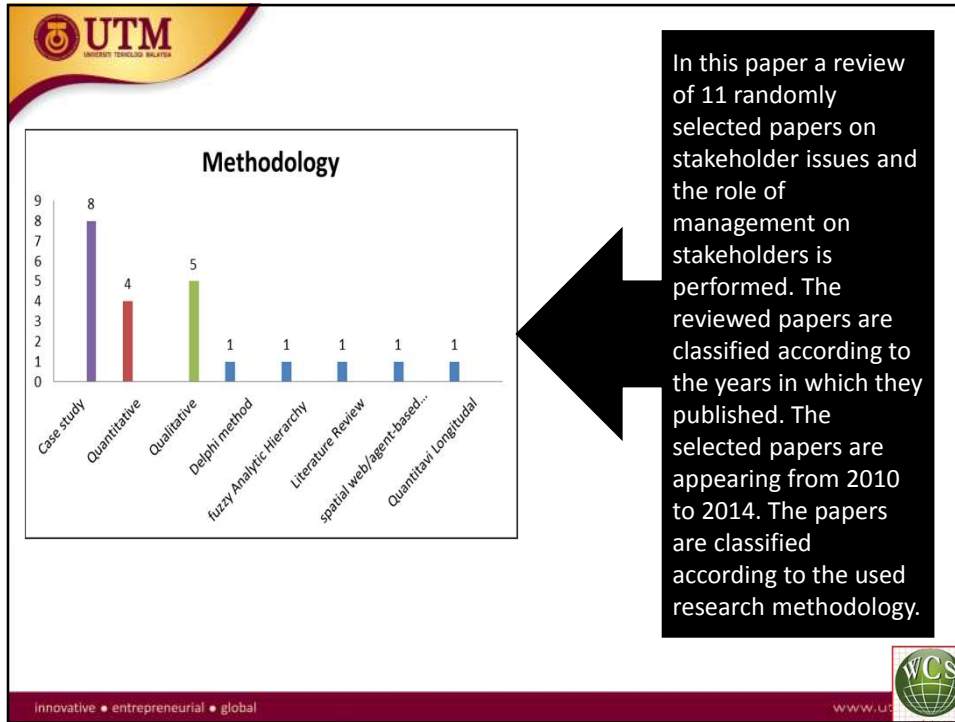
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A brief description of reviewed paper on method used in stakeholder research




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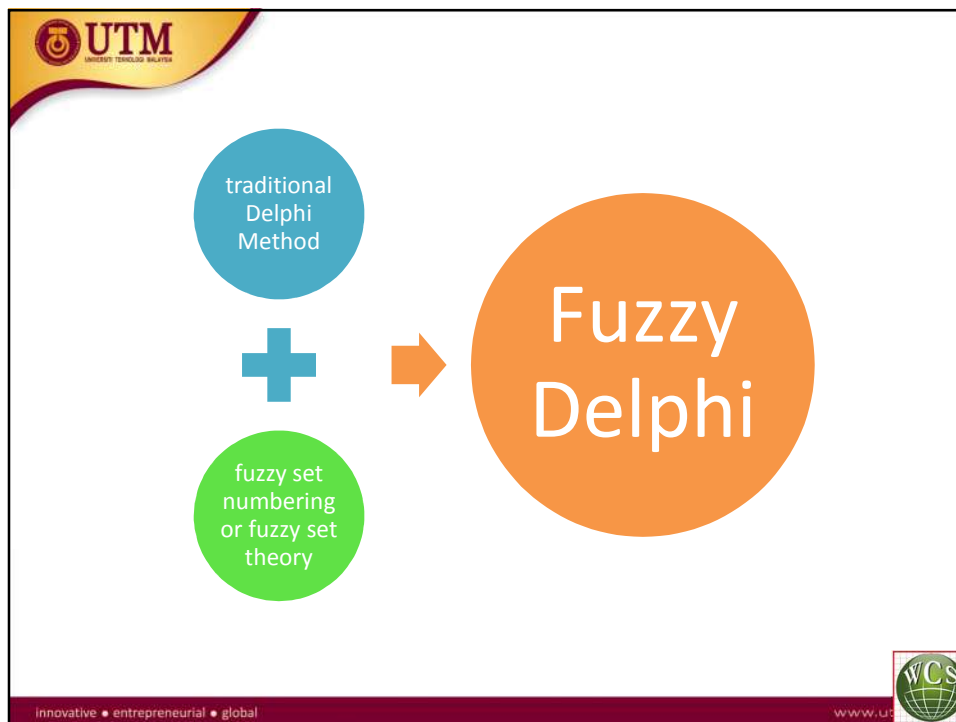





# Fuzzy Delphi

<p>Fuzzy Delphi Method introduced by Murray, Pipino and Gigch in 1985 and reviewed by Kaufman and Gupta by 1988</p>	<p>Lotfi Zadeh in 1965 a great researcher and also recognized as an expert mathematician was introducing the fuzzy set numbering or fuzzy set theory Fuzzy.</p>	<p>knew as the good method in obtain the consensus of expert</p>
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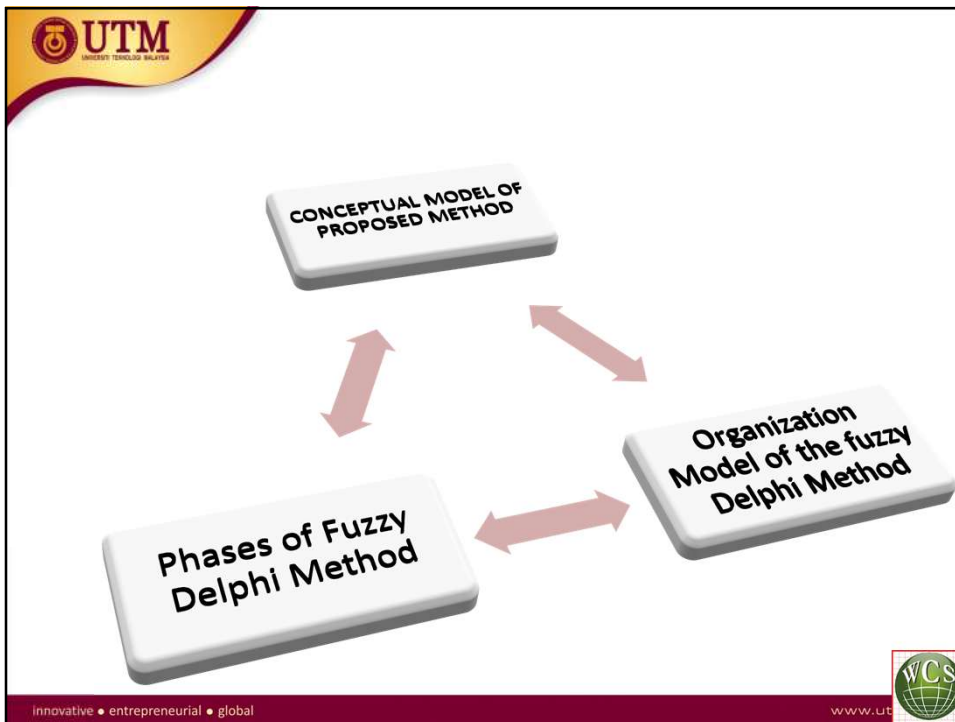
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Through this narrative review, Tables A through 9 provide summary information for each of the studies reviewed. Because many (if not most) researchers currently focused on a getting experts consensus in their type of research (e.g., consensus in teaching, management, design). The tables present information about each study, by focusing to the key result of using Fuzzy Delphi Method.



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## Phases of Fuzzy Delphi Method


- 1


- In Phase I, authors will use the interview and focus group approach to collect data to develop the constructs and items in the instrument development process.
- 2

- Assuming that the number of experts K invited to determine the importance of the evaluation criteria for the variables to be measured by using linguistic variables. Among the methods that can be done is like running a seminar or workshop and invited scientific experts involved, meet face to face against each expert and spread online like through email experts identified in the surveyed areas
- 3

- Converting to all linguistic variables into triangular fuzzy numbers. Assume the fuzzy numbers fuzzy  $r_{ij}$  is variable for each of the criteria for expert K for  $i = 1, \dots, m, j = 1, \dots, n, k = 1, \dots, k$  and  $r_{ij} = 1 / K (r_{1ij} \pm r_{2ij} \pm r_{Kij})$ . Likert scale examples that will be used in this study are as follows:


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Tier	Likert Scale	Fuzzy Scale		
Strongly Agree	5	0.60	0.80	1.00
Agree	4	0.40	0.60	0.80
Neither Agree nor Disagree	3			
Disagree		0.20	0.40	0.60
Disagree	2	0.00	0.20	0.40
Strongly Disagree	1	0.00	0.00	0.20


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4

- Threshold value (d) will be calculated after the data converted into fuzzy scale. This threshold value is calculated based on the formula set forth below (Chen, 2000).

$$d(\tilde{m}, \tilde{n}) = \sqrt{\frac{1}{3}[(m_1 - n_1)^2 + (m_2 - n_2)^2 + (m_3 - n_3)^2]}.$$


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5


- Determination of the first condition of Fuzzy Delphi if the distance between the average of the data evaluation specialists is less than or equal to the threshold, (d) = 0.2, then all the experts considered to have reached a consensus (Chu & Hwang, 2008).

6

- If among experts m x n, the percentage achieving group consensus is more or equal to the value of 75% (Chu & Hwang, 2008; Murry & Hammons, 1995), indicating that the consensus of the expert group has also been observed. The next step can be executed. Otherwise, a second round fuzzy delphi method needs to be done.



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7  
Last

- Fuzzy assessment for calculating the aggregate score and determine the position of each item as follows (Chang et al., 2011)


$$\tilde{A} = \begin{bmatrix} \tilde{A}_1 \\ \tilde{A}_2 \\ \vdots \\ \tilde{A}_m \end{bmatrix} \quad \text{where } \tilde{A} = r_{i1} \times w_1 + r_{i2} \times w_2 + \dots + r_{in} \times w_n$$

$i = 1, 2, \dots, m$

Calculation and determination of fuzzy evaluation is using the formula  $A_{max} = 1/4 (m_1 + 2m_2 + m_3)$




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## Organization Model of the fuzzy Delphi Method

```

    graph TD
      Start([Apply the first survey to experts for validating the predefined list of construct and item]) --> Dec1{Are the initial construct and items enough?}
      Dec1 -- N --> Add[Add the suggested construct and item]
      Add --> Start
      Dec1 -- Y --> Step1[Apply a second survey to collect each expert's (E) opinion on each construct/item (C)]
      Step1 --> Step2[Convert each expert's (E) opinion on a triangular fuzzy number rij]
      Step2 --> Step3[Set up the overall triangular fuzzy number for each item r through Consistency Aggregation Method, to get the group fuzzy opinion ri]
      Step3 --> Step4[Get a threshold each item to choose the relatively important construct / item]
      Step4 --> Dec2{aij < 0.2 threshold?}
      Dec2 -- N --> Remove[Remove the construct / item]
      Dec2 -- Y --> Step5[Delete the construct / item r]
      Step5 --> Dec3{Consistency expert group > 0.7?}
      Dec3 -- N --> Reject[Reject the construct / item r]
      Dec3 -- Y --> Step6[De-fuzzification process]
      Step6 --> End([Ranking construct / item])
  
```




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## CONCLUSION

- After analysis of the randomly selected research publications, it is quite evident that no study has been found in the marine space stakeholder context used fuzzy delphi methodology to developed marine space governance framework by focusing on stakeholder issues.
- Fuzzy Delphi is the ideal method in obtain consensus. In the studied papers a balance between empirical study type papers and conceptual study type papers has been observed.
- Integrating this method in their personal repertoire of research methods so that it is available to them to use as needed to accomplish their research objectives.




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*"The best way to predict your future is to create it"*  
*Abraham Lincoln*



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