**USERS,CHALLENGES, AND PROPOSED SOLUTIONS: A MATRIX FOR VOLTA LAKE**

1. USERS OF LAKE VOLTA - TRANSPORT AND FISHING

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| NO | USER | PURPOSE |
| 1 | Canoe Operators | Transport, Fishing |
| 2 | VLTC Pontoons | Transport |
| 3 | Health Ferries | Transport |
| 4 | Tourism Boats | Transport |
| 5 | Personal Pleasure Craft | Transport |
| 6 | Commercial Vessels Barges | Transport |
| 7 | Fish Farmers | Farming (Farming) |
| 8 | Passengers | Transport |

1. NAVIGATIONAL CHALLENGES ON LAKE VOLTA

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| NO | CHALLENGE | PROPOSED REMEDY |
| 1 | Tree Stumps | Identification, Removal in Nav Channel, Presentation |
| 2 | Bathymetric data and Water level | Collection, Presentation |
| 3 | Navigational Channels | Creation, Marking, Presentation |
| 4 | Deplorable Landing Sites | Develop, Renovate |
| 5 | Weather | Gather, Presentation |
| 6 | Overloading, /Boat building | Identify, Advise, Instruct /Sustainable building |
| 7 | Seafarer Knowledge | Sensitize, Educate |
| 8 | Inland SAR | Train, Deploy |
| 9 | Position Location of Canoes | Locate, Rescue |
| 10 | MSI dissemination | Gather, promulgate |
| 11 | Ferry Departures Schedules | Collect, promulgate |
| 12 | Passenger and Goods data | Collect, Presentation |
| 13 | Accident data | Collect, Presentation |

1. DATA COLLECTION AND SOLUTION DEPLOYMENT

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| NO | AGENCIES | SOLUTIONS/ DATA |
| 1 | GMA | Satellite tree stump identification, Bathymetric data- (Nav Channels) |
| 2 | GMA-DMA | GPS Route tracking of VLTC Ferries - (Verified Routes) |
| 3 | GMet-DMA | Weather Data |
| 4 | GMA | Tree Stump Removal areas – (Hazards Removal Navigation) |
| 5 | MoT | Landing Sites Development |
| 6 | GMA | Load Line Marking, Sensitization, Life Jackets, Naval detachment |
| 7 | VRA | Water Levels |
| 8 | GMA/DMA/DGA | Testing of Technology (Future) |
| 9 |  | Fish Species Data |
| 10 |  | Tourism Stie |

1. SOLUTIONS

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| NO | TYPE OF VESSELS | NATURE OF PROPOSED SOLUTION |
| 1 | Small Craft Users/Pleasure, Transport, Fishing | Mobile App [Map, Data from C, specific solution to B, intended user for A] |
| A System that (Guide in Navigation, Alert of deviation, inform of location, Assist in investigations) |
| Characteristics: User acceptance, affordable, |
| Should be used to collect more data and further refine the service |
|  |  |  |
| 2 | Commercial Vessels [VLTC, Barges, health Ferries] | ECDIS App [Map, Data from C, specific solution to B, intended user for A] |
| A System that (Guide in Navigation, Alert of deviation, inform of location, Assist in investigations) |
| Characteristics: User acceptance, affordable, |
| Should be used to collect more data and further refine the service |
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1. USER - SOLUTION MAPPING

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| NO | USER | PROPOSED SOLUTION |
| 1 | Canoe Operators Transport | Handheld Device, Mobile App, Ghana Nautical Web |
| 2 | Canoe Operators Fishing | Handheld Device, Mobile App, Ghana Nautical Web |
| 3 | VLTC Pontoons | ECDIS, Mobile App, Ghana Nautical Web, Aid to Navigation (ATON) |
| 4 | Health Ferries | ECDIS, Mobile App, Ghana Nautical Web, Aid to Navigation (ATON) |
| 5 | Tourism Boats | Handheld Device, Mobile App, Ghana Nautical Web |
| 6 | Personal Pleasure Craft | Handheld Device, Mobile App, Ghana Nautical Web |
| 7 | Commercial Vessels Barges | ECDIS, Mobile App, Ghana Nautical Web, Aid to Navigation (ATON) |
| 8 | Fish Farmers | Handheld Device, Mobile App, Ghana Nautical Web |

1. SOLUTIONS AND PRODUCTS DEVELOPMENT

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| NO |  | TYPE | STATUS |
| 1 | Data | \*Satellite hazard Map  \*Weather  \*etc. | \*Partially Collected  \*Fully Covered  \*etc. |
| 2 | Web App | Web | Developed and Operational |
| 3 | Mobile App | Mobile Device | Not Developed |
| 4 | Mobile Device | GPS Mobile Device | Not decided |
| 5 | Marker buoys | Navigational Buoys | Not Decided /Not deployed |
| 6 | Desktop Computers | Computers /Tablets | Not developed /Not deployed |

1. CURRENT GMA-DMA SSC

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| C.2.3  *Upscaling and refining satellite data products* | **Purpose:** Refine the satellite products and prepare the danger/hazard maps for delivery  **Content:** Based on the results from the Inception phase, further develop on the methods and prepare data delivery  **Product:** Satellite product that can used for safety of navigation and be implemented in an e-navigation system. |

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| C.4.2  *Assisting Ghana in establishing marine aids to navigation on Lake Volta (subject to outcome of output C.4.1)* | **Purpose** – Establishing buoys and leading lines/day boards  **Content** – Assisting relevant Ghanaian partners on establishing marine aids to navigation on Lake Volta through meetings and written instruction materials.  **Product** – Establishment of marine navigational aids on Lake Volta | Meetings between two senior experts from the Danish Maritime Authority and relevant Ghanaian partners |

1. **Application Interface and Users (Mobile and Desktop)** 
   1. **Maritime Monitoring Centres** 
      1. GMA
      2. VLTC
      3. \*Ghana Navy
      4. \*NADMO
   2. **Navigators on the Lake** 
      1. VLTC Vessels
      2. Canoe Operators
      3. MoH (vessels)
      4. \*Naval Vessels
      5. \*GMA (research vessels)
      6. \*Merchant Vessels (Private)
   3. **Layers or Components of the Application**
      1. Maritime Safety Information Layer (NW/NM)
      2. AIS layer
      3. Weather layer
      4. Lake Volta Routes (VLTC)
      5. Vessel Track Routes (Seasonal)
      6. Hydrological Layer
      7. Satellite Layer
      8. Naval Detachment Layer
      9. Data portal (passenger transport, goods transport, accident)
      10. Landing sites layer
      11. Harvested tree stumps area layer
      12. Aids to navigation Layer
   4. **Capabilities of the Application** 
      1. Collect voyage data from users’ mobile devices
      2. Collect bathymetric data from research vessel
      3. Collect VLTC passenger and goods transport data
      4. Collect accident data
      5. Collect water level data
      6. Collect weather data
      7. Promulgate warnings (from monitoring units) to intended users
      8. Input externally analysed data (such as satellite data)
   5. **Hosting (Cost and Maintenance)**
      1. AWS, Digital Oceans
      2. Support