**Objective Concept Generation**

**Product Criteria**
- In the sport of rowing, one’s technique is critical
- Primary rigger system in use impairs the rower’s rowing technique
- Improved range of motion
- Enhanced control during operation
- Improved oar rotation
- Decreased vibration in the system

**Description & Market Size**
- Approximately 220,000 people (US)
  - University and Competition
  - Club (beginners – professionals)

**TOP CONCEPTS**
- Death Roll
- Duel Axis
- Cyclone

**DEVELOPMENT & SELECTION**
- Improved Range Of Motion
- Improved Control
- Efficient Design
- Increased amount of failure modes
- Increased intricacy

**DEVELOPMENT & SELECTION**
- Increased Cost
- Higher cost

**TOP RATED**
- Final design is a combination of the top rated components examined.

**PRODUCT CRITERIA**

**CUSTOMER REQUIREMENTS**
- Durability
- Controllability
- Rigidity
- Range of Motion
- Rotation Ease
- Ease of Assembly
- Leverage
- Material
- Complexity
- Comfort
- Weight

**CONTRAINDS**
- Volume & Size
- Performance

**ENGINEERING CHARACTERISTICS**
- Load: \( L = E \times (\text{Torque}) \)
- Force: \( F = L + E \)

**PHYSICS OF TASK**
- Fulcrum Analysis
- Moment Analysis

**DESIGN**
- Mounts to existing out-rigger
- Allows rotation of oar around all axis
- Rotation of oar is unimpeded by geometrical configuration

**KEY FUNCTIONALITIES**
- Interchangeable with current oarlock
- Increased range of motion
- Increased rotational ease

**TRADE-OFFS**
- Increased number of components
- Increased modes of failure

**CUSTOMER REQUIREMENTS**

**RESULTS & FUTURE DEVELOPMENTS**

**PERFORMANCE ANALYSIS**
- Technical Development
- Corporate Performance
- Recreational Rowing

**FEA RESULTS**
- 3.00
- 3.20
- 3.40
- 3.60
- 3.80
- 4.00

**ENME472 - Integrated Product and Process Design and Development**

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