Team 16: Kite Generator

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Table 2.
Pugh Matrix Selection of Oscillation Method

Criterion	Scale 1-5	Oscillation Method		
		Gravity Forced	Spring Forced	Dual Kite System
Efficiency	5	1	3	5
Weight	5	3	4	3
Power Output	5	1	3	5
Safety	4	2	3	2
Part Standardization	3	3	2	3
Maintenance	4	4	3	2
Cost	2	5	4	1
Score		68	88	**92**

Table 3.
Pugh Matrix Selection of Mechanical to Electrical Energy Conversion Method

Criterion	Scale 1-5	Energy Conversion Method	
		Solenoid	Alternator
Efficiency	5	2	4
Weight	5	2	3
Power Output	5	2	4
Safety	4	3	3
Part Standardization	3	2	3
Maintenance	4	4	2
Cost	2	2	3
Score		68	**90**

Table 4.
Pugh Matrix Selection of Mechanical Energy Handling Method

Criterion	**Scale 1-5**	**Mechanical Energy Conditioning**	
		Transmission	No Transmission
Efficiency	5	4	2
Weight	5	2	5
Power Output	5	5	2
Safety	4	4	4
Part Standardization	3	4	5
Maintenance	4	2	3
Cost	2	2	3
Score		**95**	94

Table 5.
Pugh Matrix Selection of Airfoil Type

Criterion	**Scale 1-5**	**AUAV**	**Balloon**	**Chute**	**Propeller Glider**
Cost	3	1	4	3	1
Weight	5	1	5	4	3
Size	3	2	2	4	3
Autonomous Capability	2	5	1	3	3
Flight Path Control	4	5	1	3	2
Detachable from Tether	1	3	3	3	3
Power Gen Capacity	5	3	1	3	3
Max allowable wind force	4	3	1	2	2
Durability	3	3	1	2	2
Reparability	2	1	0	1	1
Score		85	64	**93**	75

1.7 Elimination and Selection Concepts

Concept Elimination

After making the pugh chart and evaluating all the different design options, the team moved to the elimination process. Decisions were made based off of the weighted total scores. Concepts that did not score highly on the weighted criteria lost significant points on their respective scores. Concepts with the lowest score in their respective category were eliminated. It should be noted that all concepts that scored the lowest in their respectives systems for efficiency, weight, and power were eliminated. With efficiency, weight, and power acting as the most vital functions and targets, the team feels that the matrices accurately represent the best concept for the customer and the project.

While the design selection for power generation does align with our customer needs, system functions, and targets defined by our group, it should be noted that our team is still running simulations on Jeff Phipps' patent. Significant time has been spent researching the phenomena of an induced electromotive force (emf) but finding suitable and conclusive equations to model the solenoid and moving magnet application has been difficult. However, there is a simulation software, COMSOL, which can accommodate the increased complexity of the design while providing a suitable approximation of the emf generated. Once the simulation is concluded, the decision matrices will be updated accordingly and the optimal concept will be selected.

Concept Selection

For the power generation selection, we split this up into three different sections; oscillation method, energy conversion method, and mechanical energy conditioning. This is important because we wanted to choose one design from each method with the highest score based on the criteria selected. After creating the pugh matrix we ended up with three different designs. Each design had the best efficiency and power output for each individual method which are the most important factors. The dual kite was chosen for the oscillation method, the alternator for the energy conversion and lastly the transmission for the mechanical energy.

For the airfoil selection, we only had one section so we chose the type of airfoil with the highest score based on selected criterion. After conducting the pugh chart, we saw that the chute was the best option. This has the highest score because it has the highest combined score of the two most important criterion, weight and power generation capacity.

The customer's needs specifically are focused on the efficiency, weight and power output for both the power generation selection and airfoil selection. For all the selected designs, these needs were met.