INNOVATIVE ANALYSIS

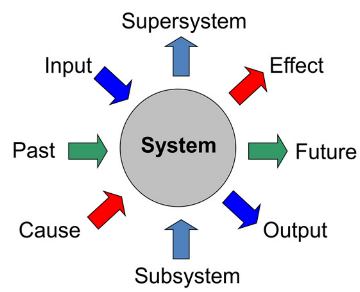
A BETTER KITE

1. BRIEF DESCRIPTION OF THE SITUATION

A kite is a tethered aircraft. The necessary lift that makes the kite wing fly is generated when air flows over and under the kite's wing, producing low pressure above the wing and high pressure below it. This deflection also generates horizontal drag along the direction of the wind. The resultant force vector from the lift and drag force components is opposed by the tension of the one or more lines or tethers. The anchor point of the kite line may be static or moving.

The challenge of this project is to design improvements to the kite. Identifying the problems will be one of the major undertakings in this project. However, you are encouraged to think about things like: difficulty in getting a kite off the ground, control over the kite once airborne, functionality of the kite while aloft, loss of the kite if the string breaks, entanglement in power lines or trees, etc. Don’t forget to consider the “fun” factor of the kite. How can we enhance the “kite” experience?

2. DETAILED DESCRIPTION OF THE SITUATION



This section contains the results of doing the "8-Way analysis." At right is the 8-Way diagram showing four pairs representing four different ways to describe your system. The brief description is one abstraction of your system. This section contains four additional abstractions. Later, the PF diagram represents yet another abstraction. Each of the four ways to view the system has its own section number (2.1 – 2.4). You can use text here, but diagrams are also useful since they convey a large amount of information. The purpose of this section is to identify important characteristics, components, features, parts, processes, and entities related to the system your are studying. This, along with the brief description should give you plenty of information with which to draw the PF diagram. In general, everything in y our PF diagram should appear somewhere in these descriptions. However, you may choose not to include something you describe here in your PF diagram. Part of the reason for doing this analysis is to help you narrow down your efforts on a part of the system.

2.1 SUPERSYTEM/SUBSYSTEM ANALYSIS

A kite is typically composed of one or more rods that a paper or fabric sail is attached to. Some kites are made of foil and have no rods at all. Classic kites use bamboo, rattan, or some other strong but flexible wood for the rods, paper or light fabrics such as silk for the sails, and are flown on string or twine. Modern kites use synthetic materials, such as ripstop nylon or more exotic fabrics for the sails. Fiberglass or carbon fiber for the rods and Dacron or dyneema for the kite lines. Kites can be designed with many different shapes, forms and sizes. They can take the form of flat geometric designs, boxes and other three-dimensional forms, or modern rod-less inflatable designs. Tails are used for some single-line kite designs to keep the kite's nose pointing into the wind. Spinners and spinsocks can be attached to the flying line for visual effect. There are rotating wind socks which spin like a turbine. On large display kites these tails, spinners and spinsocks can be 50 feet long or more.

2.2 INPUT/OUTPUT ANALYSIS

In order to fly a kite you must first have a handle to hold the kite, then a string that is connected from the handle to the kite. Holding the handle of the kite would be an input the output of this would be the kite not flying away. The next input of flying a kite would be to make sure the string is attached to the kite; the output is the kite not flying away. The controls of a kite have several different inputs that lead to different outputs. The kite can turn left, right, up, and down due to how the tethers are pulled and controlled by the user. Another input of flying a kite is wind you must place the kite into windy weather for it to fly right, the kite flying would be the output. To fly a kite you must be in an open area free of trees, buildings and power-lines so the output is not the kite getting stuck in a tree, building or hooked on the power-lines.

2.3 CAUSE/EFFECT ANALYSIS

In order to fly a kite, wind is needed to create lift with the kite's wings. The necessary lift that makes the kite's wings fly is generated when air flows over and under the kite's wing, producing low pressure above the wing and high pressure below it. Next you must have a tether attached to the kite to ensure that the kite remains stable in the air. Without a tether the kite will float at the same pace as the wind, and it will eventually fall to the ground. The tether holds the kite still so air will flow over the kite's surface and create lift. A problem with using tethers is that they are problematic to getting entangled with trees or buildings. Also the tether has a possibility of breaking. If this happens then the kite will lose its lift because it is not still in the air creating resistance to the wind. If the wind becomes stronger the kite's wings will generate even more lift. The kite could fly higher or the tether could even break.

2.4 PAST/FUTURE ANALYSIS

Kites were used approximately 2,800 years ago in China, where materials ideal for kite building were readily available: silk fabric for sail material; fine, high-tensile-strength silk for flying line; and resilient bamboo for a strong, lightweight framework. Alternatively, some people think that leaf kites existed way before then in what is now Indonesia based on their interpretation of cave paintings on Muna Island of Sulawesi. The kite was said to be the invention of the famous 5th century BC Chinese philosophers Mozi and Lu Ban. By at least 549 AD paper kites were being flown, as it was recorded in that year a paper kite was used as a message for a rescue mission. Ancient and medieval Chinese sources list other uses of kites for measuring distances, testing the wind, lifting men, signaling, and communication for military operations. The earliest known Chinese kites were flat (not bowed) and often rectangular. Later, tailless kites incorporated a stabilizing bowline. Kites were decorated with mythological motifs and legendary figures; some were fitted with strings and whistles to make musical sounds while flying. Some may say that the future of kites is still up in the air however, some experts say that kites can be a new source of energy via harnessing the wind.

3. RESOURCES, CONSTRAINTS, AND LIMITATIONS

3.1 AVAILABLE RESOURCES

Materials that are used for the kite include plastic, wood, string, nylon, twine, a handle, canvas, and cloth. Elements that are used with the kite system are wind, a person, altitude, weight, air, oxygen nitrogen, gravity, lift, and drag.

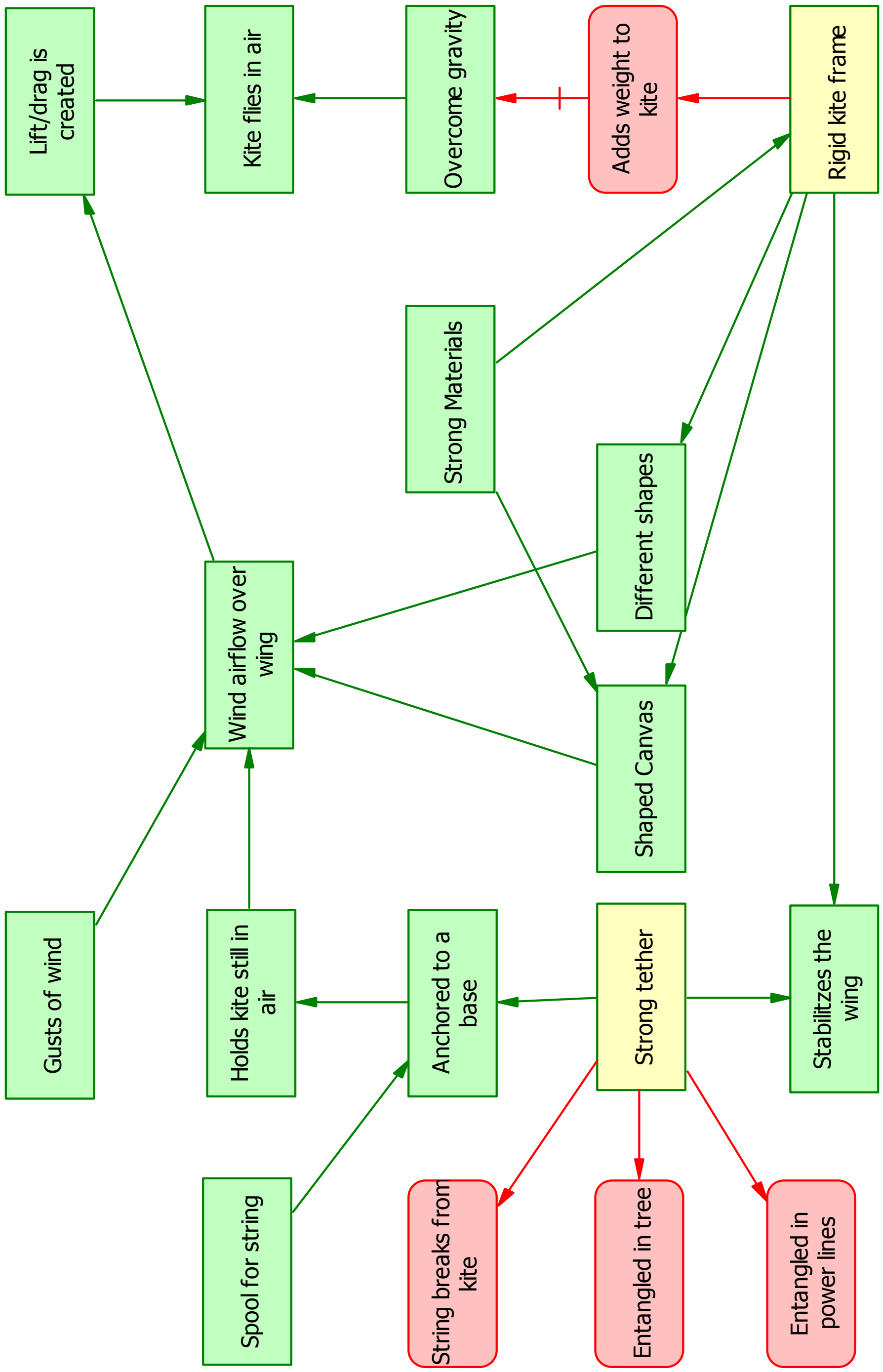
3.2 ALLOWABLE CHANGES TO THE SYSTEM

In kite building there are several different components. These components can be interchanged with different materials. The frame can be made out of more light or even heavy weight materials depending upon the weather they are going to be flown in. The cost of the materials could be minimized. The frame can also be changed into several different designs; the frame can be put into two or three dimensional shapes. The fabric can also be comprised of light or heavy weight materials depending on the severity of the wind. Some fabrics are woven tighter than others, using a more tightly woven fabric would create more air resistance in the fabric thus making the kite fly higher whereas the opposite is true with a loosely woven fabric.

3.3 CONSTRAINTS AND LIMITATIONS

Constraints with a kite are very limited. Kites are generally an inexpensive system, to keep them as an inexpensive item, materials have to be inexpensive but also be able to durable for the entire windy season. In order for a kite to fly you must have lift that is created from how the air flows over the wings, the kite has to be gradually released into the air, then a sturdy base has to be established just as long as the wind does not change directions. If the wind changes directions a base that pivots would be ideal.

4. PROBLEM FORMULATION



5. IDEAS

1. **Find an alternative way to obtain** ***Kite flies in air*** **that does not require** ***Lift/drag is created*** **and** ***Overcome gravity*****.**

Insert lighter than air gases into the frame of the kite.

2. **Find an alternative way to obtain** ***Wind airflow over wing*** **that offers the following: provides or enhances** ***Lift/drag is created*** **does not require** ***Gusts of wind*****,** ***Holds kite still in air*****,** ***Shaped Canvas*** **and** ***Different shapes*****.**

Make the kite have a motorized propeller.

3. **Find an alternative way to obtain** ***Lift/drag is created*** **that offers the following: provides or enhances** ***Kite flies in air*** **does not require** ***Wind airflow over wing*****.**

A motorized propeller will push and pull the kite through the air to continually produce lift.

4. **Find an alternative way to obtain** ***Gusts of wind*** **that provides or enhances** ***Wind airflow over wing*****.**

Have the kite automatically adjust to the position of incoming wind gusts.

5. **Find an alternative way to obtain** ***Overcome gravity*** **that offers the following: provides or enhances** ***Kite flies in air*** **is not influenced by** ***Adds weight to kite*****.**

Use lighter than air materials to make the kite weigh less.

6. **Find an alternative way to obtain** ***Rigid kite frame*** **that offers the following: provides or enhances** ***Stabilitzes the wing*****,** ***Shaped Canvas*** **and** ***Different shapes*** **does not cause** ***Adds weight to kite*** **does not require** ***Strong Materials*** **.**

Use materials that respond to electrical impulses removing the need for a physical frame. This will also allow us to change the shape of the kite dynamically as needed.

7. Resolve the contradiction: ***Rigid kite frame should be provided*** **to produce** ***Stabilitzes the wing*****,** ***Shaped Canvas*** **and** ***Different shapes*** **and** ***shouldn't be provided*** **to avoid** ***Adds weight to kite*****.**

Remove the need for a frame entirely by using dynamically changing material that will also serve as the canvas surface area.

8. Find a way to eliminate, reduce, or prevent ***Adds weight to kite*** **under the conditions of** ***Rigid kite frame*** **.**

Make the material from lighter, even lighter than air materials.

9. Find an alternative way to obtain ***Anchored to a base*** **that offers the following: provides or enhances** ***Holds kite still in air*** **does not require** ***Strong tether*** **and** ***Spool for string*****.**

Remove the physical tether entirely by replacing it with a radio transmitter and receiver combination. The kite could then be controlled wirelessly and without the need for a line of sight.

10. Find an alternative way to obtain ***Holds kite still in air*** **that offers the following: provides or enhances** ***Wind airflow over wing*** **does not require** ***Anchored to a base*****.**

Design a mechanical device that will automatically balance and level the kite. This device may also be programmed on the fly via radio control.

11. Find an alternative way to obtain ***Strong tether*** **that offers the following: provides or enhances** ***Anchored to a base*** **and** ***Stabilitzes the wing*** **does not cause** ***Entangled in tree*****,** ***String breaks from kite*** **and** ***Entangled in power lines*****.**

Control the kite via radio frequency.
Design a mechanical device that detects potential or actual entanglement and changes the shape of the kite, releases the tether, or engages a motor that will avoid the obstacle.

12. Resolve the contradiction: ***Strong tether should be provided*** **to produce** ***Anchored to a base*** **and** ***Stabilitzes the wing*** **and** ***shouldn't be provided*** **to avoid** ***Entangled in tree*****,** ***String breaks from kite*** **and** ***Entangled in power lines*****.**

Control the kite via radio frequency.
Design a mechanical device that detects potential or actual entanglement and changes the shape of the kite, releases the tether, or engages a motor that will avoid the obstacle.

13. Find an alternative way to obtain ***Stabilitzes the wing*** **that does not require** ***Rigid kite frame*** **and** ***Strong tether*****.**

Design the kite in several independent pieces that respond to the wind independently of one another.
Program the material to respond automatically to changing wind conditions under certain parameters so that the kite will, in essence, fly itself.

14. Find a way to eliminate, reduce, or prevent ***Entangled in tree*** **under the conditions of** ***Strong tether*****.**

Make the tether of a material that is not entangled easily.
Remove the tether altogether and replace with a wireless control system.

15. Find a way to eliminate, reduce, or prevent ***String breaks from kite*** **under the conditions of** ***Strong tether*****.**

Have multiple tethers attached to the kite. This will decrease the chance of the string breaking and it will add more control over the kite.

16. Find a way to eliminate, reduce, or prevent ***Entangled in power lines*** **under the conditions of** ***Strong tether*****.**

Remove the tether and replace with a wireless control system.
Remove the power lines.
Design an obstacle avoidance system to automatically detect and avoid potential entanglement.

17. Find an alternative way to obtain ***Shaped Canvas*** **that offers the following: provides or enhances** ***Wind airflow over wing*** **does not require** ***Rigid kite frame*** **and** ***Strong Materials*** **.**

Design a kite from multiple curvilinear forms that increase airflow over the wing and reduce drag. This design should minimize the relationship between the edge of the kite and the frame itself, therefore reducing the surface area exposed to the oncoming wind.

18. Find an alternative way to obtain ***Different shapes*** **that offers the following: provides or enhances** ***Wind airflow over wing*** **does not require** ***Rigid kite frame*** **.**

Have parts of the kite become inflatable to where lift is created from the shape. The inflatable parts could be filled with Helium which will also cause the kite to rise.

19. Find an alternative way to obtain ***Spool for string*** **that provides or enhances** ***Anchored to a base*****.**

Have the anchor work as a wench-like device that automatically responds to the kite's position. This could also control the tension of the tether and return the kite to the desired location in the event of entanglement or loss.

20. Find an alternative way to obtain *Strong Materials* that provides or enhances *Rigid kite frame* and *Shaped Canvas*.

Use a material that can function as both the kite frame and the canvas. This material would dynamically change its properties to fit the necessary conditions.