KGCOE MSD Design Review Agenda

P11562 - MIS Frame and Stabilization Module

Meeting Purpose:

1. Overview of the project
2. Confirm Engineering Specifications and Customer Needs
3. Review concepts
4. Propose a design approach and confirm its functionality

Group Members:

Karen Smith: Project Lead
Matt Moore: Structural Engineer
Rob Bingham: Vibrations Engineer

Meeting Date: January 14, 2011

Meeting Location: 78-2130

Meeting time: 8:00 - 9:30 am

Timeline:

Start Time	Topic
8:00 AM	Introduction for the project
8:10 AM	Function Tree
8:12 AM	Customer Needs
8:15 AM	Customer Specifications & Design Schematic
8:20 AM	Questions and Discussion
8:25 AM	Concept Development & Proposed Concept
8:40 AM	Questions and Discussion
8:55 AM	Project Plan
9:00 AM	Questions and Discussion
9:05 AM	Risk Assessment
9:15 AM	Questions and Discussion

Project Background:

The goal of the Modular Imaging System Family of projects is to make an imaging system. The system will be designed for use by the faculty and students of College of Imaging Science, who will use it for research purposes. The mission is to create a camera that can be mounted on a UAV (un-manned aerial vehicle) and can be operated remotely. In order to have a more mobile imaging system that can be operated remotely via a UAV, the Modular Imaging System (MIS) track will develop an imaging system that will fit into the RIT UAV platforms. The imaging that is intended to be built this year will be mounted on UAV airframe C and therefore must meet its payload requirements.

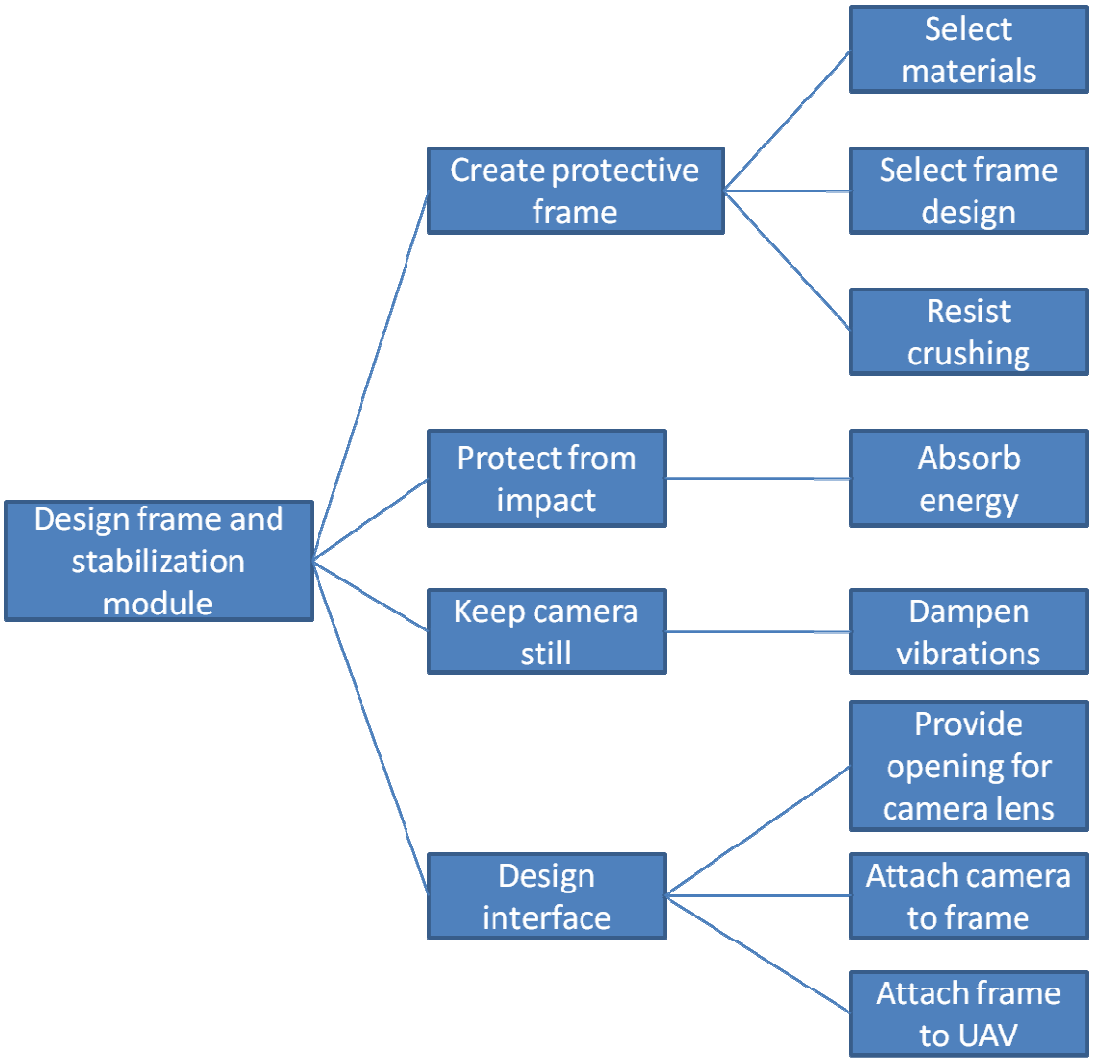
Project Objectives:

- Create UAV C airframe interface for MIS
- Integrate vibration isolation into the interface.
- Integrate impact survivability into the interface.

Assumptions and Constraints:

- Volume of UAV C payload compartment (16.5"x6.5"x5")
- UAV bolt pattern
- UAV payload max weight (15lbs)

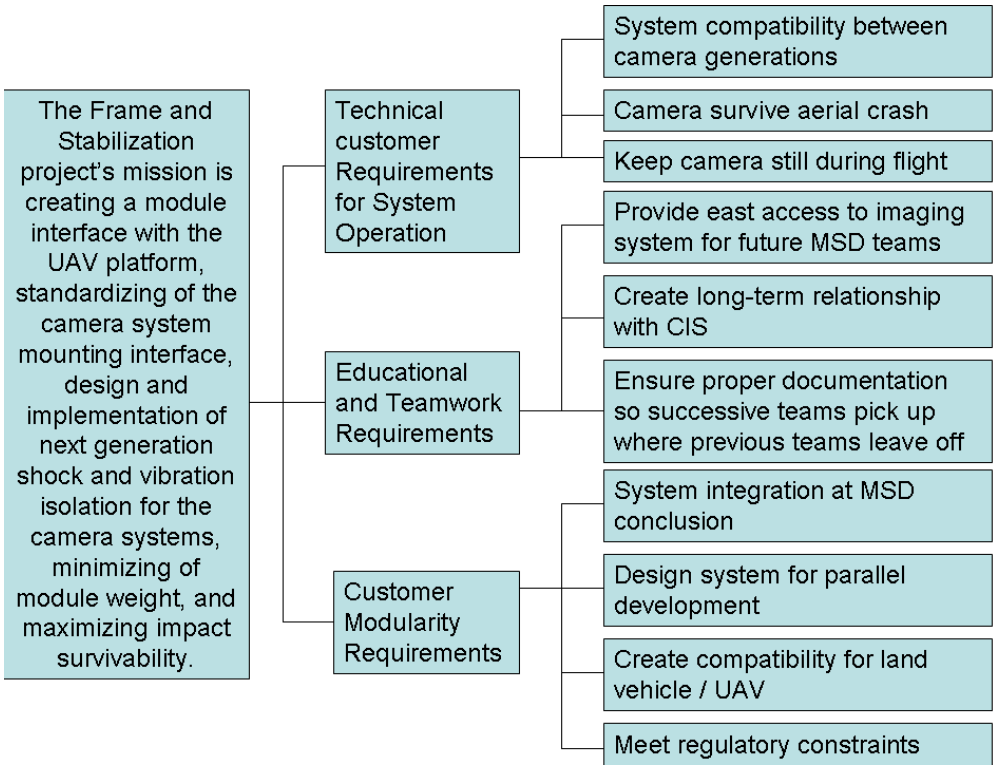
Function Tree:



Customer Needs:

	Create a module interface with the UAV platform, standardizing of the camera system mounting interface, design and implementation of next generation shock and vibration isolation for the camera systems, minimizing of module weight, and maximizing impact survivability.	Mechanical Isolation	Interfaces	Total System Weight	Total System Volume	Withstand atmospheric conditions	Impact Isolation	Documentation Package
1	System compatability between camera generations	■	■	■	■		■	■
2	Camera survive aerial crash	■				■	■	
3	Isolate vibrations affecting camera clarity	■	■					
4	Provide easy access to imaging system for future MSD teams		■					■
5	Create long-term relationship with CIS		■					■
6	Ensure proper documentation so successive teams pick up where previous teams leave off							■
7	System integration at MSD conclusion	■	■	■	■	■	■	
8	Design system for parallel development		■	■	■			■
9	Create compatibility for land vehicle and UAV		■	■	■			
10	Meet regulatory constraints			■	■			■

Objective Tree:



Customer Specifications:

Metric No.	Metric	Importance	Units	Marginal value	Ideal Value
1	Mechanical Isolation	9	Hz	50	2
2	Interfaces	3	Proper Fit	Everything Fits	Everything Fits
3	Total System Weight	9	lbs, kg	15	<15
4	Total System Volume	9	Inches	16.5 x 6.5 x 5	16.5 x 6.5 x 5
5	Withstand Atmospheric Conditions	1	Degrees F	40 to 100	-20 to 120
6	Impact Isolation	3	G	20	>20
7	Documentation	1	Completion	Fully Completed	Fully Completed

House of Quality:

Create a module interface with the UAV platform, standardizing of the camera system mounting interface, design and implementation of next generation shock and vibration isolation for the camera systems, minimizing of module weight, and maximizing impact survivability.	Customer Weights	Mechanical Isolation	Interfaces	Total System Weight	Total System Volume	Withstand atmospheric condition	Impact Isolation	Documentation Package
System compatability between camera generations	3	1	9	3	3		3	1
Camera survive aerial crash	9	1				1	9	
Keep camera still during flight	9	9	1					
Provide easy access to imaging system for future MSD teams	3		3					9
Create long-term relationship with CIS	3		1					3
Ensure proper documentation so successive teams pick up where previous teams leave off	3							9
System integration at MSD conclusion	1	3	3	3	3	1	3	
Design system for parallel development	1		9	1	1			1
Create compatibility for land vehicle and UAV	3		3	9	9			
Meet regulatory constraints	1			3	3			1
Technical Targets		Hz	Proper Fit	Lbs	Inches	Degrees F	G	Completion
Marginal Values		50	Everything Fits	15	16.5x6.5x5	40 to 100	20	Fully Completed
Ideal Value		2	Everything Fits	<15	16.5x6.5x5	-20 to 120	>20	Fully Completed

Level of Importance:

9: Significant

3: Normal

1: Minimal

Concept Development and Proposed Concept:

Functions	Concepts									
Protect Camera	Plastic	Composite	Titanium	Duct Tape	Bone	Aluminum	Steel	Balsa wood	Clay	Cardboard
	Amorphous	Geodesic Shell	Lattice	Rectangle	Pyrimid	Sphere	Prism			
Stabilize Camera	Non-newtonian fluid	Dash Pot	Semi-solid fluid (clay/foam)	Gyroscope	Suspension in fluid	Shock Mounts	Springs	Magnetic Levitation	Hydraulics	
Create Interface	Rope/String	Magnets	Clamps	Glue/adhesives	Duct Tape	Zip Ties	Pins	Bolts		
Document Process	Stone tablet	Typewriter	Crayons/ Markers/ Chalk	Google Groups	Video/voice recording	Adobe	Command Prompt	MS project	Edge	Notebook paper
Protect from Impact	Non-newtonian fluid	Packing Peanuts/ bubble wrap/ crinkled cardboard	Semi-solid fluid (clay/foam)	Elastic Compound	Springs	Collapsible Frame	Parachute	Inflatable Cushion	Suspension in fluid	

Highlighted boxes signify that the concept will be further analyzed. White boxes signifies that the concept will be dropped.

Pugh Charts:

Level of Importance:

9: Significant

3: Normal

1: Minimal

Green (1): Concept advantageous to datum

White (0): No advantage

Red (-1): Datum advantageous to concept

Protect from Impact	Values	Non-newtonian fluid	Packing Peanuts/ bubble wrap/ crinkled cardboard	Semi-solid fluid (clay/foam)	Elastic Compound	Springs	Collapsible Frame	Parachute	Inflatable Cushion	Suspension in fluid
Mechanical Isolation	9	1		1	0	1	-1	-1	1	1
Interfaces	3	-1		0	0	0	0	0	0	-1
Total System Weight	9	-1	**D**	0	0	-1	-1	0	1	-1
Total System Volume	9	-1	**a**	0	0	-1	-1	0	0	-1
Withstand Atmospheric Conditions	1	-1	**t**	0	0	-1	-1	-1	0	-1
Impact Isolation	3	1	**u**	1	1	1	1	1	1	1
Documentation	1	-1	**m**	0	0	0	-1	-1	0	-1
Endurance	1	0		0	0	1	1	0	0	0
Cost	3	-1		0	-1	-1	-1	-1	0	-1
Score		**-14**	**0**	**12**	**0**	**-9**	**-28**	**-11**	**21**	**-14**

Frame Structure	Values	Amorphous	Geodesic Shell	Lattice	Rectangle	Pyrimid	Sphere	Prism
Mechanical Isolation	9	0	0	0		0	0	0
Interfaces	3	-1	-1	1		0	-1	0
Total System Weight	9	0	1	1	**D**	0	0	0
Total System Volume	9	0	-1	0	**a**	-1	-1	-1
Withstand Atmospheric Conditions	1	0	0	0	**t**	0	0	0
Impact Isolation	3	0	-1	0	**u**	1	-1	1
Documentation	1	-1	-1	-1	**m**	-1	-1	-1
Endurance	1	0	0	0		0	0	0
Cost	3	-1	-1	-1		-1	-1	-1
Score		**-7**	**-10**	**8**	**0**	**-10**	**-19**	**-10**

Frame Material	Values	Plastic	Composite	Titanium	Duct Tape	Bone	Aluminum	Steel	Balsa Wood	Clay	Cardboard
Mechanical Isolation	9	0	1	1	-1	0	1		1	0	0
Interfaces	3	0	0	-1	-1	-1	0		-1	-1	0
Total System Weight	9	1	1	1	1	1	1	D	1	1	1
Total System Volume	9	0	0	0	0	0	0	A	0	0	0
Withstand Atmospheric Conditions	1	0	0	0	-1	0	0	T	-1	-1	-1
Impact Isolation	3	-1	0	0	-1	-1	0	U	-1	-1	-1
Documentation	1	0	0	0	0	0	0	M	0	0	0
Endurance	1	-1	0	0	-1	-1	0		-1	-1	-1
Cost	3	1	-1	-1	1	1	0		1	1	1
Score		8	15	12	-5	5	18	0	13	4	7

Stabilization Pugh Chart # 1

	Values		Packing Peanuts	Semi-Solid Fluid (clay)	Shock Mounts	Springs	Hydraulics
Mechanical Isolation	9	D	1	1	1	0
Interfaces	3	A	0	0	0	0
Impact Isolation	3		0	0	0	0
Total System Weight	3	T	-1	-1	-1	-1
Total System Volume	3		0	-1	-1	-1
Withstand Atmospheric Conditions	1	U	0	1	1	0
Documentation	1		0	0	0	0
Endurance	1	M	1	1	1	1
Cost	3		-1	-1	-1	-1
Score			4	2	2	-8
Total Scores			-4	4	11	14	-21

Stabilization Pugh Chart # 2

	Values		Packing Peanuts	Semi-Solid Fluid (clay)	Shock Mounts	Springs	Hydraulics
Mechanical Isolation	9	-1	D	1	1	-1
Interfaces	3	0	A	0	0	0
Impact Isolation	3	0		0	0	0
Total System Weight	3	1	T	1	1	1
Total System Volume	3	0		-1	-1	-1
Withstand Atmospheric Conditions	1	0	U	1	1	0
Documentation	1	0		0	0	0
Endurance	1	-1	M	-1	-1	-1
Cost	3	1		0	1	-1
Score			-4	9	12	-13

Interface Pugh Chart # 1

	Values		Packing Peanuts	Rope / String	Zip Ties	Pins	Bolts
Interfaces	3	D	1	1	1	1
Impact Isolation	3	A	0	0	0	0
Mechanical Isolation	9		0	0	0	0
Total System Weight	3	T	0	0	0	-1
Total System Volume	3		0	0	-1	-1
Withstand Atmospheric Conditions	1	U	0	0	1	1
Documentation	1		0	1	1	1
Endurance	1	M	0	0	1	1
Cost	1		-1	-1	-1	-1
Score			2	3	2	-1
Total Scores			1	3	7	2	-5

Interface Pugh Chart # 2

	Values		Packing Peanuts	Rope / String	Zip Ties	Pins	Bolts
Interfaces	3	-1	0	1	D	0
Impact Isolation	3	0	0	0	A	0
Mechanical Isolation	9	0	0	0		0
Total System Weight	3	1	0	0	T	-1
Total System Volume	3	1	1	1		0
Withstand Atmospheric Conditions	1	-1	-1	-1	U	0
Documentation	1	-1	-1	-1		0
Endurance	1	-1	-1	-1	M	0
Cost	1	1	1	1		-1
Score			1	1	4	-4

A datum was chosen and each alternative was rated as 1, 0, or -1. The specification value was multiplied by this rating and the totals were added together for each alternative.

Concept Chosen:

Interface: Zip Ties

Stabilization: Shock Mounts

Frame Structure: Rectangular Prism w/ Triangular Lattice

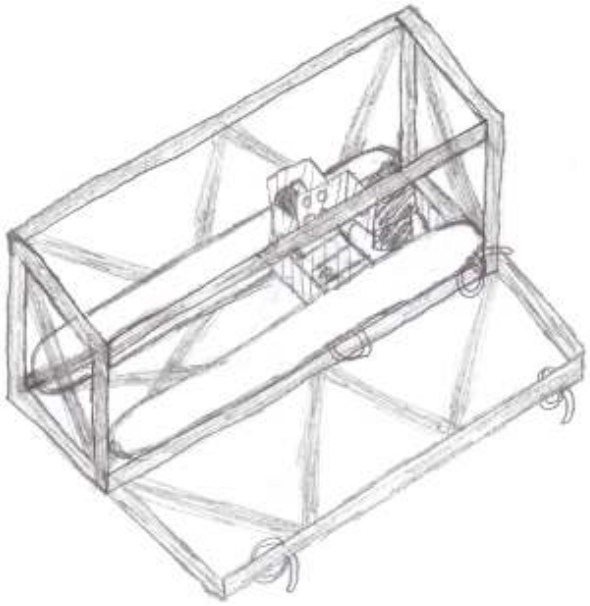
Frame Material: Aluminum

Impact Protection: Inflatable Cushion

System Weight (with camera) <10 lbs

Dimensions: 16.5 x 6.5 x 5 inches

Conceptual Drawing:



Project Plan:

Activity	Week 1	2	3	4	5	6	7	8	9	10	11
Team Dynamics											
Team Norms / Values		↔									
Create Meeting Schedule		↔									
Assign Team Roles		↔									
Weekly Update w/ Dr. Raisanen	←	—	→								
Team Member Contact Information		↔									
Needs and Specs											
Get Specs from UAV C Team											
Get Specs for Camera				↔							
Customer Needs			↔								
Engineering Specs			↔								
Interview Jason Faulring				↔							
Interview Jason Kolodziej											
Interview Carl Salvaggio				↔							
Needs and Specs Review w/ Stakeholders											
Develop Mission Statement			↔								
Planning											
Make a Project Plan			↔								
Update Log Book			←	—	→						
MSD II Log Book											
Concept Generation and Evaluation			↔								
Concept Improvement and Selection			↔								
Risk Assesment											
Bill of Materials											
Preliminary Test Plan											
Resources for MSD II											
Design											
System Analysis											
System Design											
Assembly Drawings											
Feasibility Analysis											
Documentation											
System Design Review											
Detailed Design Review											
Update EDGE			←	—	→						

Risk Assessment:

ID	Risk Item	Effect	Cause	Likelihood	Severity	Importance	Action to Minimize Risk	Owner
1	Team runs out of time	Project not completed	Poor planning	3	3	9	Manage all other Risks	Team Lead
2	Design does not meet customer needs	Customer not satisfied	Poor communication with customer	2	3	6	Communicate with customer	Team
3	Parts arrive late	Project delayed	Vendor / Shipping	2	2	4	Order parts early	Lead Engineer
4	Requirements change during the project	Redesign required	Poor Communication with customer	2	2	4	Communicate requirements with customer often	Team
5	Parts are ordered too late	Project delayed	Poor planning	2	2	4	Order parts early	Lead Engineer
6	Parts need to be reworked	Project delayed	Various	2	2	4	Design parts properly	Lead Engineer
7	Tools not available	Project delayed	Various	2	2	4	Reserve ahead of time	Team
8	Testing equipment not available	Project delayed	Various	2	2	4	Reserve ahead of time	Team
9	Airframe / Camera become non-functional	Testing delayed	Various	2	2	4	Uncontrollable	N / A
10	Design does not work with P11231	Project not completed	Poor communication with P11231	1	3	3	Communication line with team	Team
11	Miscommunication among teammates	Leads to confusion misdirection of project	Poor communication	3	1	3	Frequent communication	Team Lead
12	Getting wrong information from customer	Customer not satisfied with end product	Poor communication	1	3	3	Ask customer to confirm all information	Team
13	Project scope is too large	Project not completed	Project inapropriately scoped	1	3	3	Analyze scope ASAP	Team
14	Necessary technology not available	Redesign required	Poor planning	1	3	3	Check technology during early design	Lead Engineer
15	Funds Exhausted	Project not completed	Poor planning	1	3	3	Manage budget properly	Team
16	Team member becomes unavailable for extended period of time	Team member workload increased	Illness / Injury	1	3	3	Proper Personal Protective Equipment and Sanitation	Team
17	Teammates do not do assigned work	Project delayed	Apathetic team members	2	1	2	Enforcing team values and norms	Team Lead
18	Teammates do not arrive prepared	Project delayed	Apathetic team members	2	1	2	Enforcing team values and norms	Team Lead
19	The setup is too difficult to install into Airframe C	Customer not satisfied	Poor design	1	2	2	Communicate with Airframe C team and customer	Lead Structure Engineer
20	Inability to contact the customer or guide	Poor communication	Various	1	2	2	Contact ASAP	Team
21	Arguments between teammates	Project delayed	Various	1	2	2	Create healthy team environment	Team
22	Ideal analysis not comparable to real conditions	Customer not satisfied	Poor Analysis	1	2	2	Verify analysis with project guide	Lead Engineer
23	Materials become unavailable	Redesign required	Vendor / Budget	1	2	2	Allot additional time	Lead Engineer
24	Documentation loss	Project delayed / re-documentation	User / Computer fail	2	1	2	Backup all files	Team