

Brigham Young University AUVSI Capstone Team (Team 45)

Failure Modes and Effects Analysis

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		creation			



Introduction 1

To mitigate risk of failure within the competition a Failure Modes and Effects Analysis (FMEA) was performed. Many deficiencies were found that where then corrected to an acceptable level.

Analysis 2

	Functional Purpose	Failure Mode*	Failure Effect	Failure Cause	Cu	ırrent	Situat	ion	Assistant Aution	Impi	oved	Situ
Component	Functional Purpose	Fallure Mode	Failure Effect		S	L	D	RPN	Assigned Action	S	٦	D
	Communicate Manual Commands from the RC	Hardware Failure*	Mission Failure Aircraft Loiters	Poorly Connected Electrical Joint	8	1	7			8	1	7
RC Reciver	Transmittor to F4	Transmits incorrect data	Crash	Internal Code	9	1	10		Extensive testing prior to use**	9		10
		Loss of Connection	Mission Failure Aircraft Loiters	Interfearance	8	4	9		FFCL*** range test	8	4	3
		Hardware Failure	Mission Failure Aircraft Loiters Crash	Poorly Connected Electrical Joint	9	2		112		9	2	3
RC Transmittor Communicate Commands from the RC Pilot to	Transmits incorrect data	Crash	Settings Incorrect Settings Incorrect	8	6	8		FFCL FFCL	8	4	6	
ne manamitta	the RC Reciver	Loss of Connection	Mission Failure Aircraft Loiters	Interfearance	8	4			FFCL FFCL	8		3
		inission randre vinciare Esiters	Battery Dead	8	6			FFCL	8		2	
WIFI antenna	Allow communitation with grounstation over	Hardware Failure	Mission Failure Manual Landing	Poorly Connected Electrical Joint	6	1	7			6	1	7
Wiri antenna	ROS network	Loss of Connection	Mission Failure Manual Landing	Antanna Incorrectly Pointed	6	7	3	126	Assigne someone to point antenna	6	3	3
Odroid Run ROS, generate high level commands, process images, & estimate state		Hardware failure	Mission Failure Manual Landing	Poorly Connected Electrical Joint	6	2	7			6	2	7
			Crash	Poorly Connected Electrical Joint	9	1	7			9	1	3
F4 Flight Computer & Mount	Turn high level (Odroid & RC) commands into	Software Failure	Crash	Internal Code	9	3		162		9	3	3
	low level servo commands	Hardware Failure Software Failure	Crash Flight Less Smooth	Poorly Connected Electrical Joint Internal Code	9	3	10	189 40	Extensive testing prior to use	9	3	10
		Software Failure	Flight Less Smooth	Plugged Pito Tube	4	4				4	4	5
Airspeed Sensor	Measure Va	Inaccurate Readings	Flight Less Smooth	High Angle of Attack	4	4	2			4	4	2
				Incorrect Mounting	4	2	2			4	2	2
		Hardware Failure	Flight Less Smooth	Poorly Connected Electrical Joint	4	1	7	28		4	1	7
		Software Failure	Crash	Internal Code	9	1	10	90	Extensive testing prior to use	9	1	3 3 3 4 7 2
Inertial Sense	Measure acceleration, barometter data, and magnetic heading	Inaccurate Readings	Crash	Interfearance	9	3	8			9	3	
	magnetic neating	Hardware Failure	Crash	Poorly Connected Electrical Joint	9	1	7	63		9	1	
		Software Failure	Crash	Internal Code	9	3	10			9	3	
GPS	Measure global position	Inaccurate Readings	Crash	Interfearance	9	4	5		FFCL	9	4	
		Hardware Failure	Mission Failure Manual Landing	Poorly Connected Electrical Joint	6	1	7	42		6	1	
			l	Battery Not Charged Correctly	9	5	3		FFCL .	9	5	
Battery	Provide current to all systems in the air	Loss of Power	Crash	Chemical Misshap	9	2	3		Assign battery saftey officer	9	1	
				Battery Degridation	9	1	1	9	FFCL	9	1	
ESCs	BEC and convert digital logic PWM to high voltage/current motor inputs	Hardware Failure	Crash	Poorly Connected Electrical Joint	9	1	7	63	Extensive testing prior to use	9	1	
		Overheat	Fire and Crash	Overstressing the Motors	10	3	5	150	Add warning to FFCL	10	2	
Motors	Rotate Props	Does Not Transmit Tourque	Mission Failure Glide to Safe Landing	Props Unsecured	7	8	3	168	FFCL	7	5	
	•	Rotates the Wrong Way	Mission Does Not Start	Wires Connected Backwards	6	3	2			6	3	3 2 5 10 2 7 2 3 7 4 3 10 3 8 8 7 1 7 5 9
	D 11 71 .	Hardware Failure	Mission Failure Glide to Safe Landing	Poorly Connected Electrical Joint	7	1	7			7	1	
Props	Provide Thrust	Does Not Provide Thrust	Mission Failure Glide to Safe Landing	Chipped/broken prop	9	5 7	8	105 504	FFCL	7	5	
Wiring	Transmit power and signals	Provides Electricty to Incorrect Location	Crash	Wires Connected to Incorrect Ports	9		8	216		9 3 3 8		
wiiiig	Transmit power and signals	Does Not Transmit Electricity	Crash Crash	Electrical Short Circuit Electrical Open Circuit	9	8	5	210	Shrink wrap all exposed wires FFCL	9	8	
				Poorly Assembled	9	2	8	144		9	2	
		Linkage Breaks	Crash	Large Controll Inputs at High Velocity	9	1	3		Train saftey pilot	9	1	3
			1	Aerobatic Flight that Saturates Controller	9	5	8			9	1	4
Servos		Mechanical Limits Exceeded	Crash	Poorly Assembled	9	6				9	2	
Servos	Move control surfaces	Software Failure	Crash	Internal Code	mbled 9 6 4 216 Extensive testing prior to use 9 2 4							
		Hardware Failure	Crash	Poorly Connected Electrical Joint	9	1	7		Extensive testing prior to use	9	1	3
		Internal Mechanics Broken	Crash	Overuse	9	2	5		Train saftey pilot	9	2	5
		Servo Burns Out	Crash	Overuse	9	2	5	90	Train saftey pilot	9	2	5
UGV System	Deliver water bottle to both ground locations			See UGV Documentation for UGV FMEA								
Imaging System	Capture, interperate, and report ground targets			ee Imaging Documentation for Imaging FN								
				See Control Documentation for Control FMI	EA							
Control Software	Pilot aircraft autonomusly										_	
Control Software Communication Software				munication Documentation for Communica								1
	Pilot aircraft autonomusly	Flight Charictoristics Change		munication Documentation for Communica Icing	9	1	1		Only fly in good weather	9	1	3
Communication Software	Pilot aircraft autonomusly Allow communication of all components	Flight Charictoristics Change	See Com	munication Documentation for Communica lcing Components Move	9	1 5	5	225	Strap down all components	9	3	``
Communication Software	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide		See Com Crash	munication Documentation for Communica lcing Components Move Flight Envelop Exceeded	9 9	1 5 2	5 3	225 54	Strap down all components Train saftey pilot	9	3	2
Communication Software	Pilot aircraft autonomusly Allow communication of all components	Flight Charictoristics Change Parts Breaks Off	See Com	munication Documentation for Communica lcing Components Move Flight Envelop Exceeded Poor Manufacturing	9 9 9	1 5 2 6	5 3 7	225 54 378	Strap down all components Train saftey pilot Extensive testing prior to use	9	3 2 6	2
Communication Software	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide		See Com Crash	munication Documentation for Communica Icing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached	9 9 9 9	1 5 2 6 2	5 3 7 7	225 54 378 126	Strap down all components Train saftey pilot Extensive testing prior to use FFCL	9 9 9	3 2 6 2	3
Communication Software	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs	Parts Breaks Off	See Com Crash Crash	munication Documentation for Communica licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact	9 9 9 9	1 5 2 6 2	5 3 7 7 3	225 54 378 126 27	Strap down all components Train saftey pilot Extensive testing prior to use FFCL	9 9 9	3 2 6 2	3
Communication Software	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between	Parts Breaks Off Battery Dies	Crash Crash Mission Failure Manual Landing	munication Documentation for Communica lcing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected	9 9 9 9 9	1 5 2 6 2 1	5 3 7 7 3	225 54 378 126 27 6	Strap down all components Train saftey pilot Extensive testing prior to use FFCL	9 9 9 9 9	3 2 6 2 1	2 3 3
Communication Software Airframe Body	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs	Parts Breaks Off Battery Dies Hardware Failure	See Com Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing	munication Documentation for Communica Licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint	9 9 9 9	1 5 2 6 2 1 1	5 3 7 7 3 1	225 54 378 126 27 6 42	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot	9 9 9	3 2 6 2	2 3 3 1 7
Communication Software Airframe Body	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFi router	Parts Breaks Off Battery Dies	Crash Crash Mission Failure Manual Landing	imunication Documentation for Communica Licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance	9 9 9 9 9 9 6 6	1 5 2 6 2 1 1 1	5 3 7 7 3	225 54 378 126 27 6 42 630	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot	9 9 9 9 9 6 6	3 2 6 2 1 1	2 3 3
Communication Software Airframe Body Ground stations WIEL Router	Pilot aircraft autonomusiy Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFI router Trasmit data over ROS network between	Parts Breaks Off Battery Dies Hardware Failure	Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing Mission Failure Manual Landing Mission Failure Manual Landing	munication Documentation for Communica Loing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code	9 9 9 9 9 9 9 6 6	1 5 2 6 2 1 1 1	5 3 7 7 3 1 7	225 54 378 126 27 6 42 630 84	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot	9 9 9 9 9 6 6	3 2 6 2 1 1 4 2	2 3 3 1 7
Communication Software Airframe Body Ground stations WIEL Router	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFi router	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Software Failure	Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing Mission Failure Manual Landing Mission Failure Manual Landing Mission Failure Manual Landing	imunication Documentation for Communica Liding Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Oharger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code	9 9 9 9 9 9 6 6 6 6	1 5 2 6 2 1 1 1 7 2 1	5 3 7 7 3 1 7 10 7	225 54 378 126 27 6 42 630 84 42	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use	9 9 9 9 9 6 6 6	3 2 6 2 1 1 1 4 2	2 3 3 1 7 3 7 7
Communication Software Airframe Body Ground stations WIFI Router	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFi router Trasmit data over ROS network between groundstations to light beam	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Loss of Connection	Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing	munication Documentation for Communica Licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code Internal Code Internal Code	9 9 9 9 9 9 6 6 6 6 6	1 5 2 6 2 1 1 7 2 1 1 1 7 2	5 3 7 7 3 1 7 10 7 7 10	225 54 378 126 27 6 42 630 84 42 60	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use	9 9 9 9 9 6 6 6 6	3 2 6 2 1 1 4 2 1	2 3 3 1 7 3 7 7 10
Communication Software Airframe Body Ground stations	Pilot aircraft autonomusiy Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFI router Trasmit data over ROS network between	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Software Failure Loss of Connection Hardware Failure	Crash Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing	munication Documentation for Communica Lcing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code interfearance Poorly Connected Electrical Joint Internal Code interfearance Poorly Connected Electrical Joint	9 9 9 9 9 9 6 6 6 6 6 6	1 5 2 6 2 1 1 1 7 2 1 1 8	5 3 7 7 3 1 7 10 7 7 10 7	225 54 378 126 27 6 42 630 84 42 60 336	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use	9 9 9 9 9 6 6 6 6	3 2 6 2 1 1 1 4 2 1 1 5	2 3 3 1 7 3 7 7 10 7
Communication Software Airframe Body Ground stations WIFI Router	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFI router Trasmit data over ROS network between groundstations to light beam Transmit data over ROS network between WiFI Transmit data over ROS network between WiFI	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Software Failure Software Failure	Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing	munication Documentation for Communica Licing Components Move Flight Kneilop Exceeded Poor Manufacturing Part poorly Attached Unidentified Pinjing Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance	9 9 9 9 9 9 6 6 6 6 6 6	1 5 2 6 2 1 1 1 7 2 1 1 8 1	5 3 7 7 3 1 7 10 7 7 10 7 7	225 54 378 126 27 6 42 630 84 42 60 336 42	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use	9 9 9 9 9 6 6 6 6 6	3 2 6 2 1 1 1 4 2 1 1 5 1	2 3 3 1 7 3 7 7 10 7
Communication Software Airframe Body Ground stations WIFI Router WIFI Light Beam	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFI router Trasmit data over ROS network between groundstations to light beam Transmit data over ROS network between WiFI Transmit data over ROS network between WiFI	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Software Failure Not Brought with US	Crash Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing	imunication Documentation for Communica Loing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code	9 9 9 9 9 9 6 6 6 6 6 6 6 6	1 5 2 6 2 1 1 1 7 2 1 1 8 1 1	5 3 7 7 3 1 7 10 7 10 7 7 10 7	225 54 378 126 27 6 42 630 84 42 60 336 42 60 200	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use	9 9 9 9 9 6 6 6 6 6 6 6	3 2 6 2 1 1 4 2 1 1 5 1 1 3	2 3 3 1 7 3 7 7 10 7 10 4
Communication Software Airframe Body Ground stations WIFI Router WIFI Light Beam	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WIFI router Trasmit data over ROS network between groundstations to light beam Transmit data over ROS network between wiFII router and the WIFI antenna on the aircraft	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Software Failure Software Failure	Crash Crash Mission Failure Manual Landing Mission Does Not Start Mission Failure Manual Landing Mission Does Not Start	munication Documentation for Communication Communication Documents Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Piping Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint internal Code Interfearance Poorly Connected Electrical Joint internal Code Interfearance Poorly Connected Electrical Joint internal Code Poor Planning Poorly Connected Electrical Joint internal Code Poor Planning Poor Manufacturing	9 9 9 9 9 9 6 6 6 6 6 6 6 6	1 5 2 6 2 1 1 1 7 2 1 1 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 3 7 7 3 1 7 10 7 7 10 7 7 10 4	225 54 378 126 27 6 42 630 84 42 60 336 42 60 200 42	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use	9 9 9 6 6 6 6 6 6 6 5 6	3 2 6 2 1 1 1 4 2 1 1 5 1 1 3	2 3 3 1 7 7 7 10 7 7 10 4 7
Communication Software Airframe Body Ground stations WIFI Router WIFI Light Beam Ground Power Source	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFi router Trasmit data over ROS network between groundstations to light beam Transmit data over ROS network between wiFi router and the WiFi antenna on the aircraft Provide current to all ground systems	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Not Brought with Us Mechanical Failure Sick	Crash Crash Mission Failure Manual Landing	imunication Documentation for Communica Licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poorly Annual Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poor Planning Poor Manufacturing Bacteria or Vinses	9 9 9 9 9 9 6 6 6 6 6 6 6 5	1 5 2 6 2 1 1 1 7 2 1 1 1 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 3 7 7 7 3 1 1 7 10 7 7 10 7 10 7 10 7 1	225 54 378 126 27 6 42 630 84 42 60 336 42 60 200 42 45	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use	9 9 9 6 6 6 6 6 6 5 6 5 6 5	3 2 6 2 1 1 1 4 2 1 1 5 1 1 3	2 3 3 1 7 7 7 10 7 7 10 4 7
Airframe Body Ground stations WIFI Router WIFI Light Beam Ground Power Source	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFI router Transmit data over ROS network between groundstations to light beam Transmit data over ROS network between WiFI router and the WiFI antenna on the aircraft Provide current to all ground systems Give high level commands & ensure saftey of	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Software Failure Not Brought with US	Crash Crash Crash Mission Failure Manual Landing Mission Failure Manual Landing Crash Mission Failure Manual Landing Mission Des Not Start Mission Does Not Start Mission Does Not Start Mission Does Not Start Mission Does Not Start	munication Documentation for Communica Lcing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Boor Planning Poor Manufacturing Bacteria or Viruses Otther Plans	9 9 9 9 9 9 6 6 6 6 6 6 6 6 5 5	1 5 2 6 2 1 1 1 7 2 1 1 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 3 7 7 3 1 7 10 7 7 10 7 7 10 4 7	225 54 378 126 27 6 42 630 84 42 60 336 42 60 200 42 45 5	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use Perform BPS bange test	9 9 9 6 6 6 6 6 6 5 5 5 5	3 2 6 2 1 1 1 4 2 1 1 5 1 1 3 1 3	2 3 3 1 7 7 7 10 7 7 10 4 7 3 1
Communication Software Airframe Body Ground stations WIFI Router WIFI Light Beam Ground Power Source	Pilot aircraft autonomusly Allow communication of all components Contain components, provide lift, provide stability, & respond to control inputs Transmit high level commands between operators and WiFi router Trasmit data over ROS network between groundstations to light beam Transmit data over ROS network between wiFi router and the WiFi antenna on the aircraft Provide current to all ground systems	Parts Breaks Off Battery Dies Hardware Failure Software Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Loss of Connection Hardware Failure Software Failure Not Brought with Us Mechanical Failure Sick	Crash Crash Mission Failure Manual Landing	imunication Documentation for Communica Licing Components Move Flight Envelop Exceeded Poor Manufacturing Part poorly Attached Unidentified Flying Object (UFO) Impact Charger Not Connected Poorly Connected Electrical Joint Bug in Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Interfearance Poorly Connected Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poorly Annual Electrical Joint Internal Code Poorly Connected Electrical Joint Internal Code Poor Planning Poor Manufacturing Bacteria or Vinses	9 9 9 9 9 9 6 6 6 6 6 6 6 5	1 5 2 6 2 1 1 1 7 2 1 1 8 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	5 3 7 7 3 1 1 7 10 7 7 10 7 7 10 4 7 7	225 54 378 126 42 630 84 42 60 200 42 45 5 162	Strap down all components Train saftey pilot Extensive testing prior to use FFCL Train saftey pilot Extensive testing prior to use Extensive testing prior to use	9 9 9 6 6 6 6 6 6 5 6 5 5	3 2 6 2 1 1 1 4 2 1 1 5 1 1 3	2 3 3 1 7 7 7 10 7 7 10 4 7

verity of failure effect
L: Likelihood of failure occurring
D: Dectability of cause before failure occurs
RPN: Risk Priority number (S*L*D)

^{*} In this analysis "Hardware Failure" refers only to electrical hardware (e.g. USB port breaks or sold ** FFCL is the Field Flight Checklist to which we will add items to test and do before flight *** Extensive testing before use refers to extensive flight tests before the competition. We currently perform flight tests a couple times a week.



3 Discussion

As can be seen from this analysis, most of the concerning issues were addressed. We are now confident in our ability to fly a failure free mission with the exception of one issues: we continue to see communication drop out for a couple systems. We do not completely understand this issue. It seems to be location dependent and caused by interfering signals. It does not usually affect our missions, but it's risk priority number (RPN) is high enough that we would like to address it. We will perform tests in several locations to see if we can identify the root cause and solution to these communication issues. We would like to be confident that this issue will not arise at the competition.