KGCOE MSD Technical Review Agenda

P10201: LV1 Platform Integration

Meeting Purpose:

1. Overview of the Project
2. Confirm Engineering Specifications and Customer Needs
3. Review Concepts
4. Propose a design and confirm functionality
5. Cross-disciplinary review: generate further ideas

Materials to be Reviewed:

1. Project Description
2. Work Breakdown Structure (R#1)
3. Project Plan
4. Customer Needs
5. Engineering Specifications
6. Interface Specifications
7. Functional Breakdown
8. Concept Development and Proposed Design
    a. Chassis
    b. Power Supply
    c. Payload Interface
9. Risk Assessment

Meeting Date: January 15, 2010

Meeting Location: Room 09-4435

Meeting time: 10:30AM – 12:00PM

Timeline:

Meeting Timeline		
Start time	**Topic of Review**	**Required Attendees**
10:30	Project Overview	Phil Bryan, Leo Farnand, Dr. Hensel
10:40	Work Breakdown Structure	Phil Bryan, Leo Farnand, Dr. Hensel
10:42	Customer Needs	Phil Bryan, Leo Farnand, Dr. Hensel
10:45	Engineering Specifications and Interface Specifications	Phil Bryan, Leo Farnand, Dr. Hensel
10:50	Questions, Concerns, Ideas	Phil Bryan, Leo Farnand, Dr. Hensel
10:55	Functional Breakdown	Phil Bryan, Leo Farnand, Dr. Hensel
11:00	Concept Development and Proposed Designs	Phil Bryan, Leo Farnand, Dr. Hensel
11:20	Questions, Concerns, Ideas	Phil Bryan, Leo Farnand, Dr. Hensel
11:30	Project Plan	Phil Bryan, Leo Farnand, Dr. Hensel
11:35	Questions, Concerns, Ideas	Phil Bryan, Leo Farnand, Dr. Hensel
11:40	Risk Assessment	Phil Bryan, Leo Farnand, Dr. Hensel
11:45	Questions, Concerns, Ideas	Phil Bryan, Leo Farnand, Dr. Hensel

Project Description

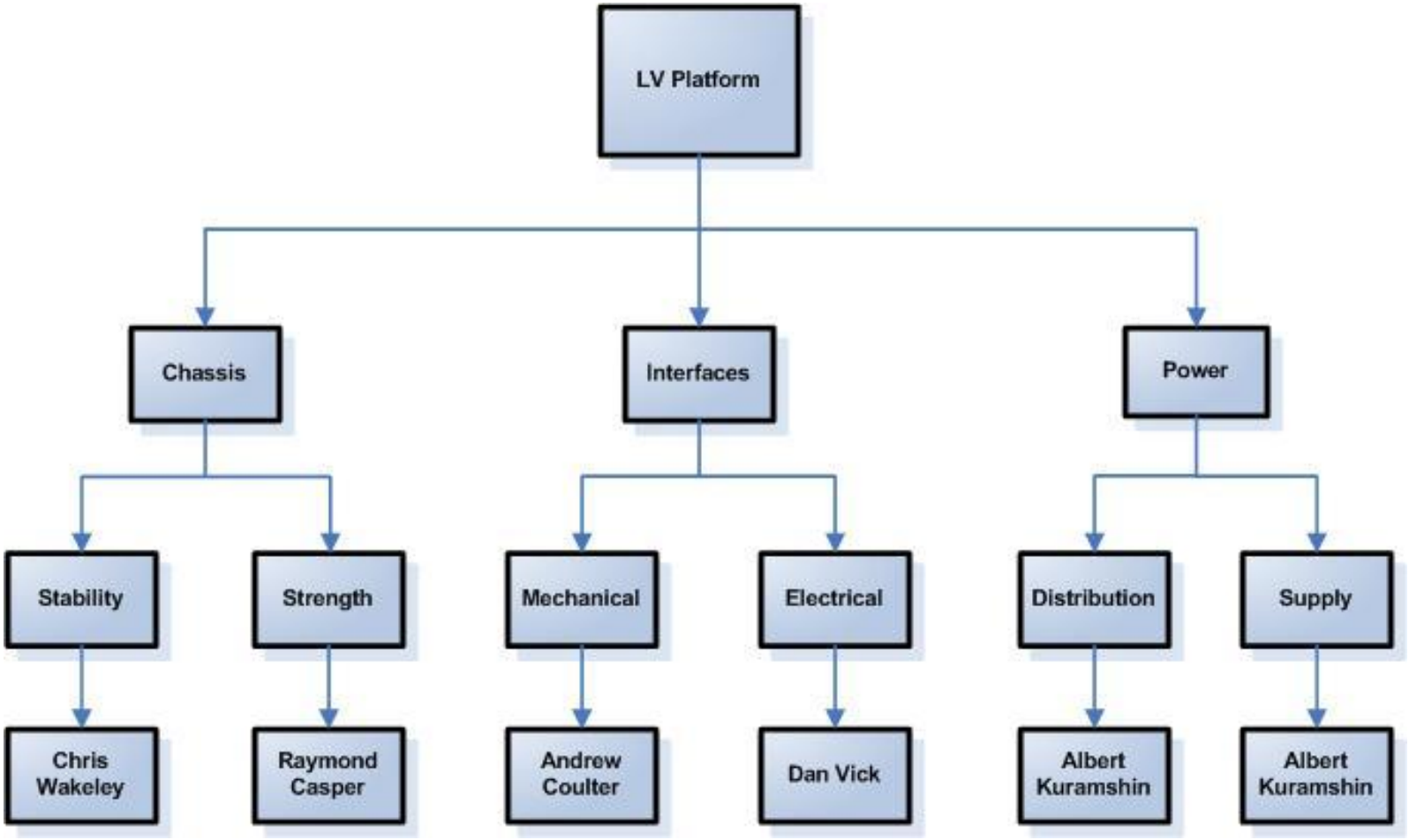
Project Background:

Namely this project provides a robot to be utilized by first year students to draw interest and provide hands on activities. In addition its use extends to a wide range of faculty and graduate research projects, and sales of kits to the public at large. This project also provides the opportunity to showcase the engineering talents of RIT students to companies interested in hiring them.

Problem Statement:

Work closely with LV1 motor module manufacturability project (P10202) and LV1 motor controller manufacturability project (P10203) in order to create an easy-to-use,1 KG, modular robotics platform or platforms to be used initially by freshman engineering students as a learning tool.

P10201 Work Breakdown Structure

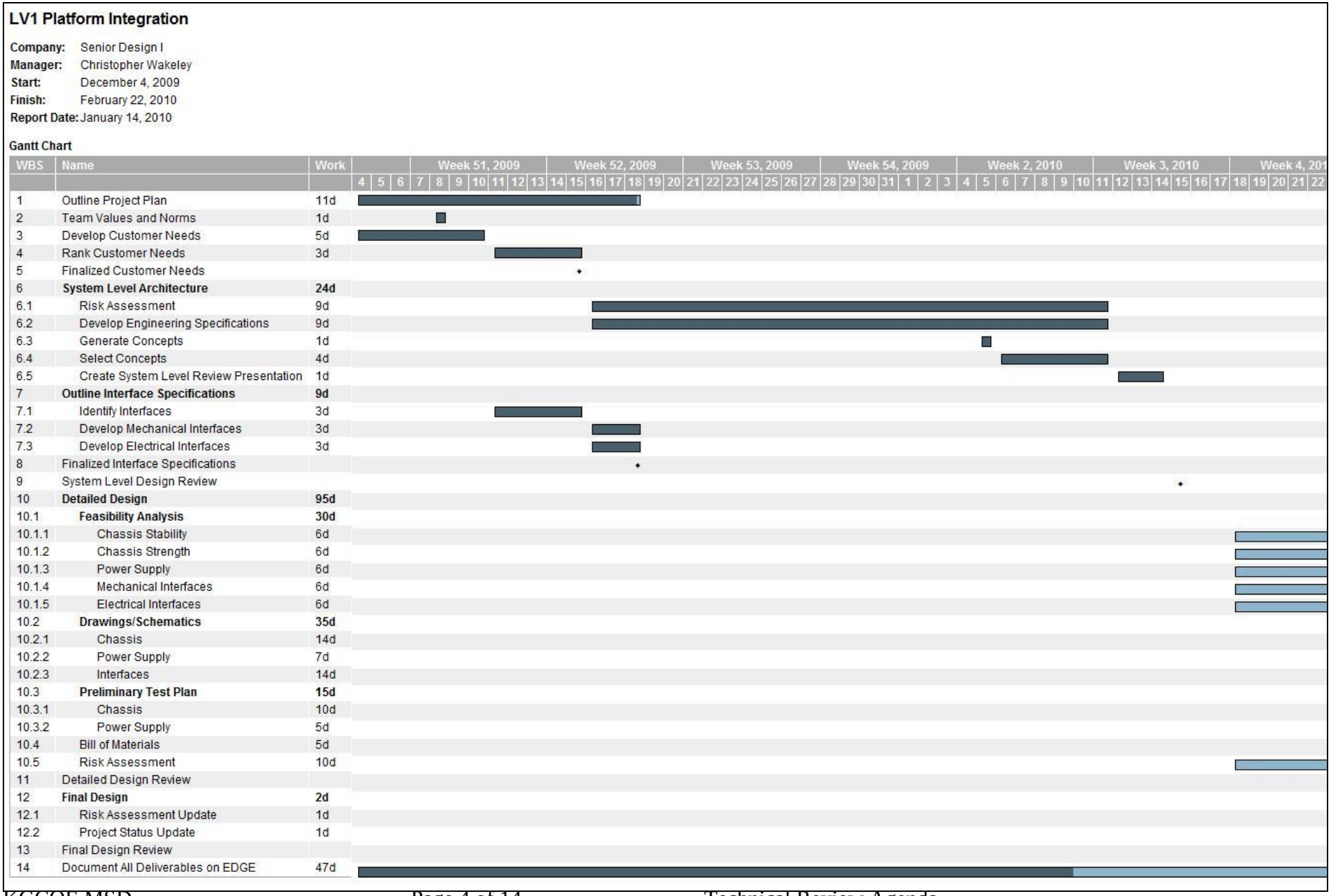


P10201 Project Plan

LV1 Platform Integration

Company: Senior Design I
Manager: Christopher Wakeley
Start: December 4, 2009
Finish: February 22, 2010
Report Date: January 14, 2010

Gantt Chart



WBS	Name	Work
1	Outline Project Plan	11d
2	Team Values and Norms	1d
3	Develop Customer Needs	5d
4	Rank Customer Needs	3d
5	Finalized Customer Needs	
6	**System Level Architecture**	**24d**
6.1	Risk Assessment	9d
6.2	Develop Engineering Specifications	9d
6.3	Generate Concepts	1d
6.4	Select Concepts	4d
6.5	Create System Level Review Presentation	1d
7	**Outline Interface Specifications**	**9d**
7.1	Identify Interfaces	3d
7.2	Develop Mechanical Interfaces	3d
7.3	Develop Electrical Interfaces	3d
8	Finalized Interface Specifications	
9	System Level Design Review	
10	**Detailed Design**	**95d**
10.1	**Feasibility Analysis**	**30d**
10.1.1	Chassis Stability	6d
10.1.2	Chassis Strength	6d
10.1.3	Power Supply	6d
10.1.4	Mechanical Interfaces	6d
10.1.5	Electrical Interfaces	6d
10.2	**Drawings/Schematics**	**35d**
10.2.1	Chassis	14d
10.2.2	Power Supply	7d
10.2.3	Interfaces	14d
10.3	**Preliminary Test Plan**	**15d**
10.3.1	Chassis	10d
10.3.2	Power Supply	5d
10.4	Bill of Materials	5d
10.5	Risk Assessment	10d
11	Detailed Design Review	
12	**Final Design**	**2d**
12.1	Risk Assessment Update	1d
12.2	Project Status Update	1d
13	Final Design Review	
14	Document All Deliverables on EDGE	47d

P10201 Customer Needs

Customer Need #	Importance	Description	Comments/Status
CN1	9	Use with multiple generations of components/modules.	
CN2	3	Look professionally constructed and well organized.	
CN3	3	Be as equal in weight or lighter than the previous generation.	
CN4	3	Be equal in size or smaller than the previous generation.	
CN5	9	Must be stable on a flat surface (i.e. tabletop) throughout its operating range for a variety of payloads.	
CN6	9	Needs to carry and secure a 1kg payload.	
CN7	9	Be open source.	
CN8	9	Be open architecture.	
CN9	9	Provide a portable power source.	
CN10	9	Operate for a useful period of time on power source.	
CN11	9	Deliver 1 platform.	
CN12	3	Deliver 5 platforms.	
CN13	1	Deliver 25 platforms.	
CN14	1	Configurable ground clearance.	
CN15	9	Easy for a first year engineering student to assemble and use.	
CN16	9	Can be assembled in more than one configuration.	

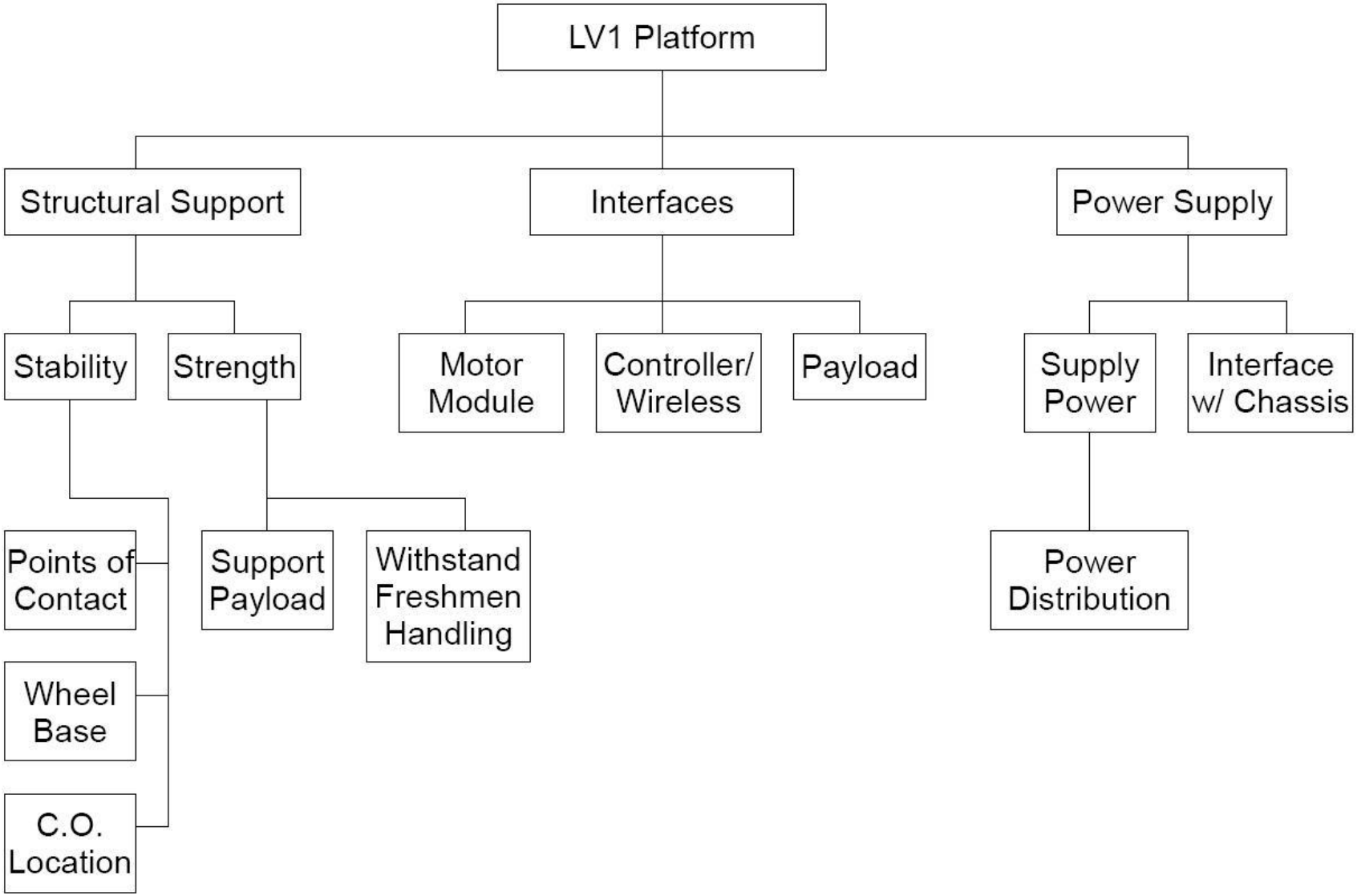
P10201 Engineering Specifications

Engr. Spec. #	Importance	Source	Specification (description)	Unit of Measure	Marginal Value	Ideal Value	Comments/Status
ES1		CN1	Physically compatible with Gen 2 and newer hardware.	Binary	Compatible with only 1.	Compatible with Both.	
ES2		CN1	Electrically Compatible with Gen 2 and newer hardware	Binary	Compatible with only 1.	Compatible with Both.	
ES3		CN3	Mass	kg	= current generation	< Current Generation	
ES4		CN4	Length	in	11.75	<11.75	
ES5		CN4	Width	in	7	<7	
ES6		CN4	Height	in	4.375	<4.375	
ES7		CN11,CN12, CN13	Quantity Delivered	LV1s	1	5	25 units is a stretch goal
ES8		CN10	Operating time	Hrs	0.5	>1	
ES9		CN15	Assembly time	Hrs	<1	<0.5	
ES10		CN7,CN8	Can be constructed from documentation.	Binary			
ES11		CN6	Payload Capacity	kg	1	>1	
ES12		CN9	Power Source is portable	Binary	Limited Range	Self Contained	
ES13		CN14	Ground Clearance adjustment range	in	2	4	
ES14		CN14	Minimum ground clearance	in	1	0.5	
ES15		CN5	Negotiate a certain radius turn at full speed (1m/s) without tipping over	ft	6	4	
ES16		Functionality	Survive being dropped from a height without changing form.	ft	0.5	1	
ES17		Functionality	Lifetime	load cycles	800	1000	
ES18		Functionality	Lifetime	asssemblies	800	1000	
ES19		Functionality	Points of contact with ground	#	3	>3	
ES20		Functionality	Size of openings to sensitive components	in	< fingertip	no exposure	
ES21		Functionality	Supply voltage	V	8-16	11-13	
ES22		Functionality	Power supplied	W	25	30	
ES23		CN3	Power supply weight	kg	0.5	0.4	
ES24		Functionality	Operating temperature	degrees F	70+-10	70+-20	
ES25		Functionality	Controller and wireless cards fit within chassis	Binary			
ES26		Functionality	Conform to interface specification document	Binary			

P10201 Interface Specifications

			Motor Module				Controller						Payload			Power Supply	
			Mount	Electrical	Encoder	Servo	Mount	Power	Comm	Motor Electric	Motor	Servo	Mount	Power	Comm.	Mount	Power
Electrical	Power	Voltage (V)		x	x	x		12	x	x	x	x		12	x		12
		Current (A)		x	x	x		x	x	x	x	x		x	x		x
		Qty (#)		x	x	x		x	x	x	x	x		x	x		x
	Connector	Type		x	x	x		x	x	x	x	x		x	x		x
		Qty (#)		x	x	x		x	x	x	x	x		x	x		x
	Wires	Gauge (AWG)		x	x	x		x	x	x	x	x		x	x		x
		Length (in)		x	x	x		x	x	x	x	x		x	x		x
		Qty (#)		x	x	x		x	x	x	x	x		x	x		x
Mechanical	Size	H x L x W (in)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		Location/Layout (in)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
		Orientation	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	Hardware	Fasteners	x				x						x			x	
		Qty (#)	x				x						x			x	
		Adapter (Design Ref)	x				x						x			x	

P10201 Functional Breakdown



P10201 Concept Development and Proposed Design
Chassis

		Material				Base Shape				Other			
Importance	**Selection Criteria**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**
3	**Material cost**	1	0	1	1	0	0	0	0	0	0	0	0
9	**Manufacturing cost**	1	0	0	0	0	1	0	-1	-1	0	-1	0
3	**Weight (CN3)**	1	1	0	1	0	0	0	1	-1	0	1	0
9	**Durability/Strength (CN6)**	0	0	1	-1	0	1	0	0	0	0	0	1
9	**Modularity (CN1, CN16)**	1	0	0	0	1	0	1	0	1	0	-1	0
9	**Ease of Assembly (CN15)**	1	0	0	0	0	1	0	-1	-1	0	1	1
9	**Stability (CN5)**	0	0	0	0	1	1	1	1	0	0	0	0
3	**Appearance (CN2)**	1	1	0	1	0	1	0	-1	-1	0	1	0
	Total score	36	6	12	0	18	39	18	-9	-15	0	-3	18
	Decision	consider	discard	discard	discard	discard	consider	discard	discard	discard	discard	discard	consider

		Concepts for Chassis
Material	**A**	T-Frame
	B	Aluminum
	C	Steel
	D	Wood
Base Shape	**E**	Hexagon
	F	Rectangle
	G	Octagon
	H	Enclosed thin-walled container
Other	**I**	Multi-Layered (current design)
	J	Single Layer
	K	Moulded 'skin'
	L	Gantry/Skeleton over base frame

P10201 Concept Development and Proposed Design
Power Supply

IDEA	CN1	CN2	CN3	CN4	CN9	CN10	CN15	Cost Ranking	TOTAL
Fuel Cell	0	1	0	0	9	9	0	1	20
RC gen.	0	0	0	0	9	0	0	2	11
Li-Ion	9	3	3	3	9	9	9	5	50
NiCd	9	3	3	3	9	9	9	7	52
NiMH	9	3	3	3	9	9	9	6	51
Solar	9	3	3	3	9	0	9	3	39
Alkaline	9	3	0	3	9	0	9	8	41
LiMnNiO3	9	3	3	3	9	9	9	3	48
LiFeP04	9	3	3	3	9	9	9	4	49

	NiMH	NiCd	LiFePO4
Cost	$ 30.00	$ 29.05	$ 49.95
Size (in)			
L	2.8	2.7	2.9
W	1.98	1.3	1.5
H	1.12	7.5	2.7
Weight (lbs)	0.7	1.5	0.8
Voltage (V)	12	12	12.8
Current (Ah)	2.6	2.6	3
Life (cycles)	1000	750	2000
Max Dis (A)	5	5	7
	5.5	**2**	**3.5**

P10201 Concept Development and Proposed Design
Payload Interface

Importance of Criteria	Selection Criteria	A	B	C	D	E	F	G	H	I	J with A C E or G
9	**Can secure the load properly**	1	1	0	0	1	-1	1	1	1	1
3	**Can secure various loads in various locations**	0	-1	-1	0	0	1	1	0	0	1
9	**Cheap**	1	-1	0	0	0	1	1	-1	-1	0
9	**Does not reduce maneuvarability**	0	-1	0	0	0	0	0	0	-1	1
3	**Can secure multiple loads**	0	1	1	0	0	0	0	0	1	1
3	**Easy to assemble**	1	1	0	0	0	1	0	0	-1	1
3	**Easy to place the payload**	1	1	1	-1	1	-1	0	-1	1	0
3	**Easy take the container off if needed**	0	0	0	0	0	0	0	0	0	1
	Total score	24	-3	3	-3	12	3	21	-3	-6	30
	Decission	consider	discard	discard	discard	consider	discard	consider	discard	discard	consider

Concepts for Payload

A Tray with railings
B Trailer
C Side containers
D Undercarriage container
E Strap ties
F Velcro
G Tie down points
H Reconfigurable shelf
I Pockets
J Multiple bolt pattern on the roof to place custom container

Option J was selected, since it contained A, C E and G options within and would add to modularity of the vehicle

P10201 Risk Assessment

ID	Risk Item	Effect	Cause	Likelihood	Severity	Importance	Action to Minimize Risk	Owner
	Describe the risk briefly	*What is the effect on any or all of the project deliverables if the cause actually happens?*	*What are the possible cause(s) of this risk?*			*L*S*	*What action(s) will you take (and by when) to prevent, reduce the impact of, or transfer the risk of this occurring?*	*Who is responsible for following through on mitigation?*
1	Difficult to Assemble	Takes long time for first year engineering students to assemble	Complex design Too many little modules Inner parts of modules are fragile Many adapters needed to enforce modularity	2	2	4	Make it user friendly to assemble Write good assembling manual Decrease number of modules Make modules more durable Make it impossible to fit modules the wrong way Make colored markings on modules themselves to aid the assembling Make sure there are not many adapters needed for interfaces	Entire 10201 Team
2	The modules cannot interface with one another	The vehicle cannot be Assembled The vehicle is not functional when assembled	Modules need different interfaces than ones provided	1	3	3	Ensure other teams are using the same type of connection Provide adapters if necessary	Interface Manager Of 10201
3	Payload cannot be secured	The vehicle cannot carry the payload	The payload holder is not big enough Payload has non-tradition shape or is big in volume	2	2	4	Make payload mounting plate big enough to secure standard payload Make it possible to add straps or belts later on if it is necessary to secure non-standard payload	Entire 10201 Team
4	The vehicle is not esthetically pleasing	The vehicle does not look professionally constructed or well organized	Esthetics part has been left out in a design	1	1	1	Run wires more efficiently Incase non-esthetically pleasing parts	Entire 10201 Team
5	The vehicle is not stable With or without the load	Vehicle is not maneuverable Vehicle cannot travel through uneven terrain Vehicle cannot accelerate or move fast	The mass point is too high Base of the vehicle is too small Mass point is skewed	2	2	4	Make sure the mass point is low enough in any configurations. Make sure chassis can provide large enough area to have a big base. Make sure that vertical projection of the mass point is as close to the	Entire 10201 Team

		enough without losing balance					center of the base as possible Make it possible to rearrange the modules to provide for better stability	
6	Vehicle has a bigger mass than a previous generation	The Vehicle is too heavy	The chasse is heavy The power pack is heavy The adapters are heavy	2	1	2	Use less material Use more lightweight material Use less heavy parts	Entire 10201 Team
7	Vehicle has a bigger volume than a previous generation	The Vehicle is too large	The chasse is too tall The chasse is too wide The power pack takes too much space The modules cannot be integrated more closely	2	1	2	Make chasse smaller Ensure the modules can be integrated more closely to save more space Make power pack smaller	Entire 10201 Team
8	Vehicle cannot run for a long period of time	Cannot operate for a useful period of time on power source	The battery cannot provide desired power long enough The voltage dividers on interface adapters consume too much power	2	3	6	Use less and more efficient voltage dividers Ensure other teams make their modules run on the same voltage that is being provided Make sure enough power can be provided for modules for long enough time	Interface Manager Of 10201
9	The vehicle is too costly to manufacture	The vehicle cannot be manufactured at desired price	Teams miscommunicated on amount of money they allowed to spend The chasse, power pack or adapters are too expensive Very little money is allocated for the chasse and power pack	3	2	6	Discuss the money distribution with other teams. Make sure enough money is allocated for the chasse, power pack and interfaces Use cheaper materials	Interface Manager Of 10201
10	Parts are ordered too late	The prototype cannot be manufactured and tested in time	Long lead time parts are not ordered and identified in time	3	2	6	Long lead parts are identified and ordered early enough	Project Manager Of 10201
12	Wrong parts delivered	The prototype cannot be manufactured and tested in time	The manufacturer shipped wrong package Wrong parts are ordered	1	3	3	Contact distributor to make sure they send correct parts Make sure correct parts are ordered	Project Manager Of 10201
13	Parts not delivered or damaged in delivery	The prototype cannot be manufactured and tested in time	The package got lost in shipment The package got damaged in shipment	1	3	3	Use more reliable shipment method	Project Manager Of 10201
14	The modules are damaged during assembly or disassembly	The vehicle is damaged and cannot operate properly	The modules are fragile The inner parts of modules are not protected from outside The modules are fitted	2	2	4	Make modules more durable Make it impossible to fit modules the wrong way	Entire 10201 Team

			wrong way and got damaged The adapters or interfaces are too fragile				Make colored markings on modules themselves to aid the assembling Incase the fragile modules Make more durable interfaces	
15	The vehicle is damaged during operation	The vehicle is damaged and cannot operate properly	Fragile parts of vehicle are not protected from the environment The adapters or interfaces are too fragile	1	2	2	Incase the fragile modules Use more durable adapters Make more durable interfaces	Entire 10201 Team
16	Power surge Too much power is supplied from a test bench	The vehicle is damaged and cannot operate properly	Too much power supplied to modules and damaged them	1	3	3	Protect the vehicle from power supply with a fuse	Entire 10201 Team