Critical Design Review: Traybot

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Scope

- Introduction-recap
- Project goals
- Feedback from PDR
- Design with justification
- Simulation
- Gantt Chart so far

- Hold all questions until the end

Mission Statement

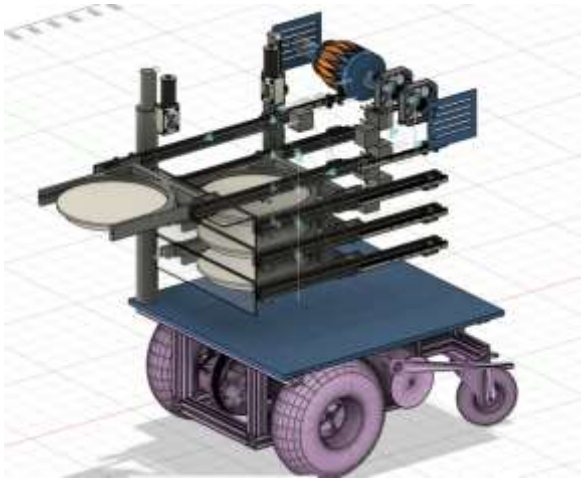
"Traybot is to be used for logistical purposes including delivery of food or medical supplies to patients suffering from infectious diseases in order to reduce the risk to Doctors/nurses as well as freeing valuable time allowing the hospital staff to conduct more important tasks. The Traybot should be easy to sanitise as well as create a healthy Robot-Patient and Robot-Hospital relationship."

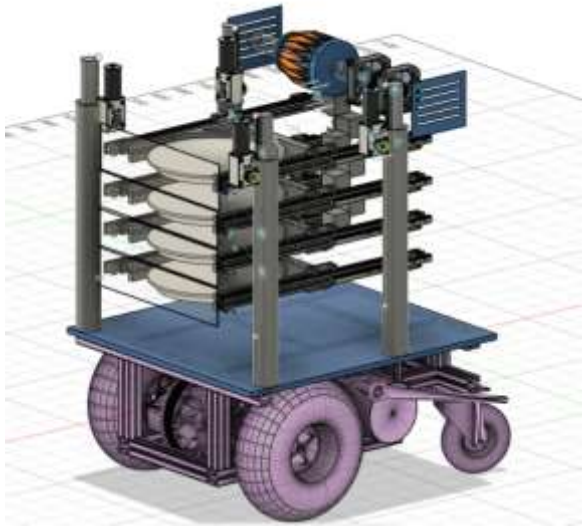
The Main goals

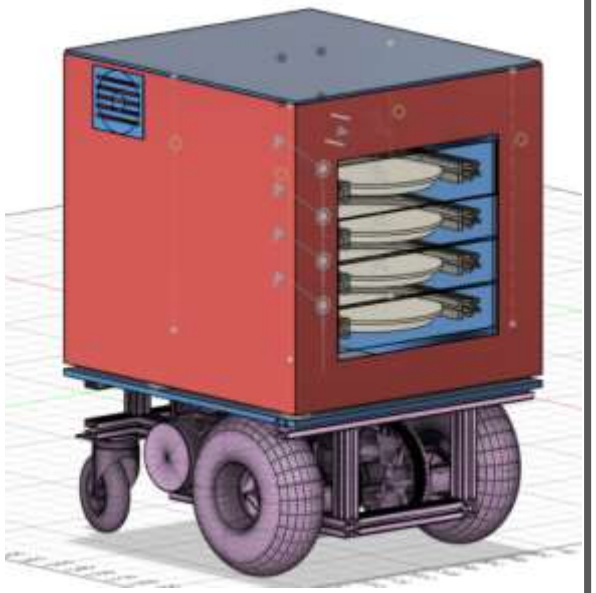
1. Create a Mechanism for the Robot to vertically in order to reach various tray heights - Linear actuators.
2. Create a tray mechanism which can retrieve as well as dispense trays – unique tray mechanism.
3. Create a Wheelbase which can cope with smooth floor surface, which will allow the robot to be as agile as possible- Two differential drive wheels + two caster wheels
4. Create a simple air filtration system- V6 air filter and two fans along with UVC light.

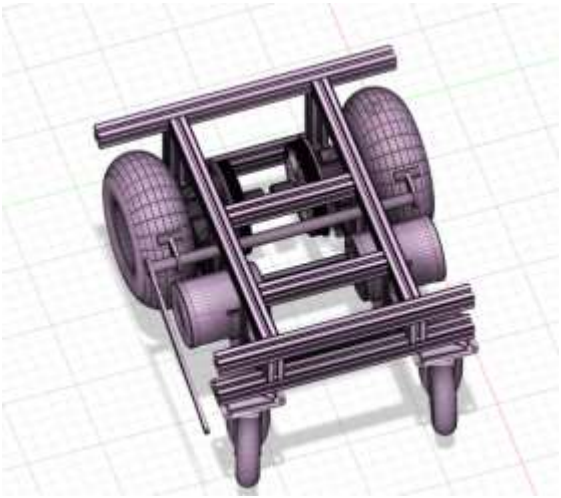
PDR feedback

- Breaking issue for wheelbase
- Tray mechanism
- Finishing touches-add rails, vent covers etc...



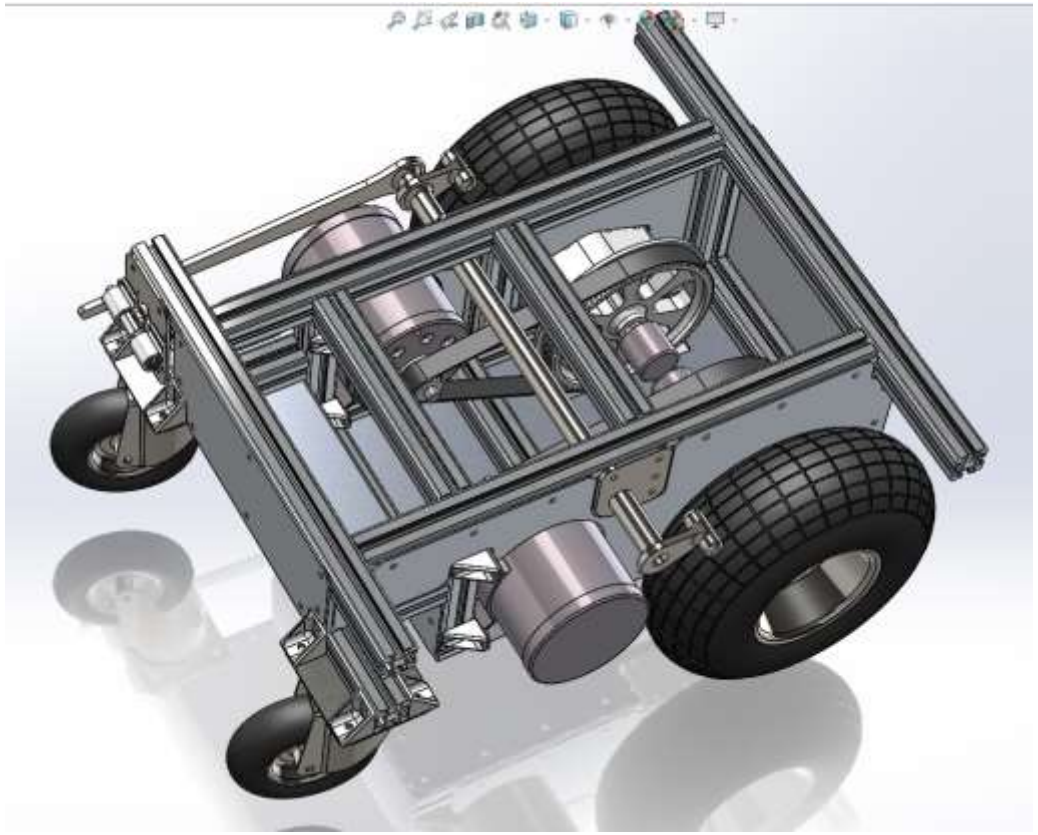




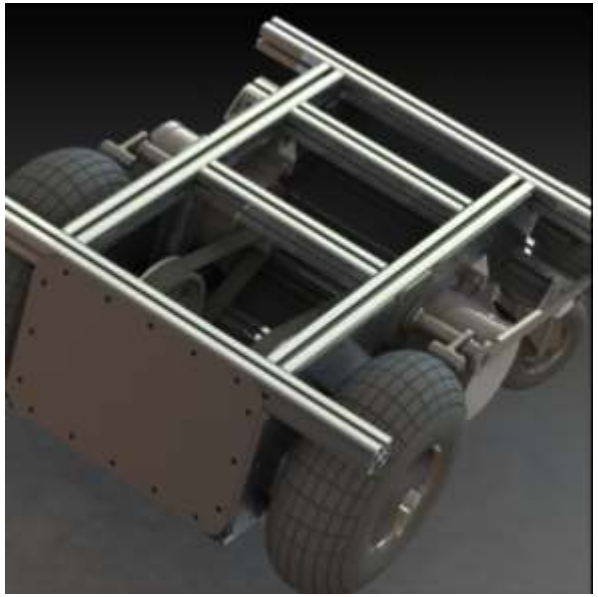


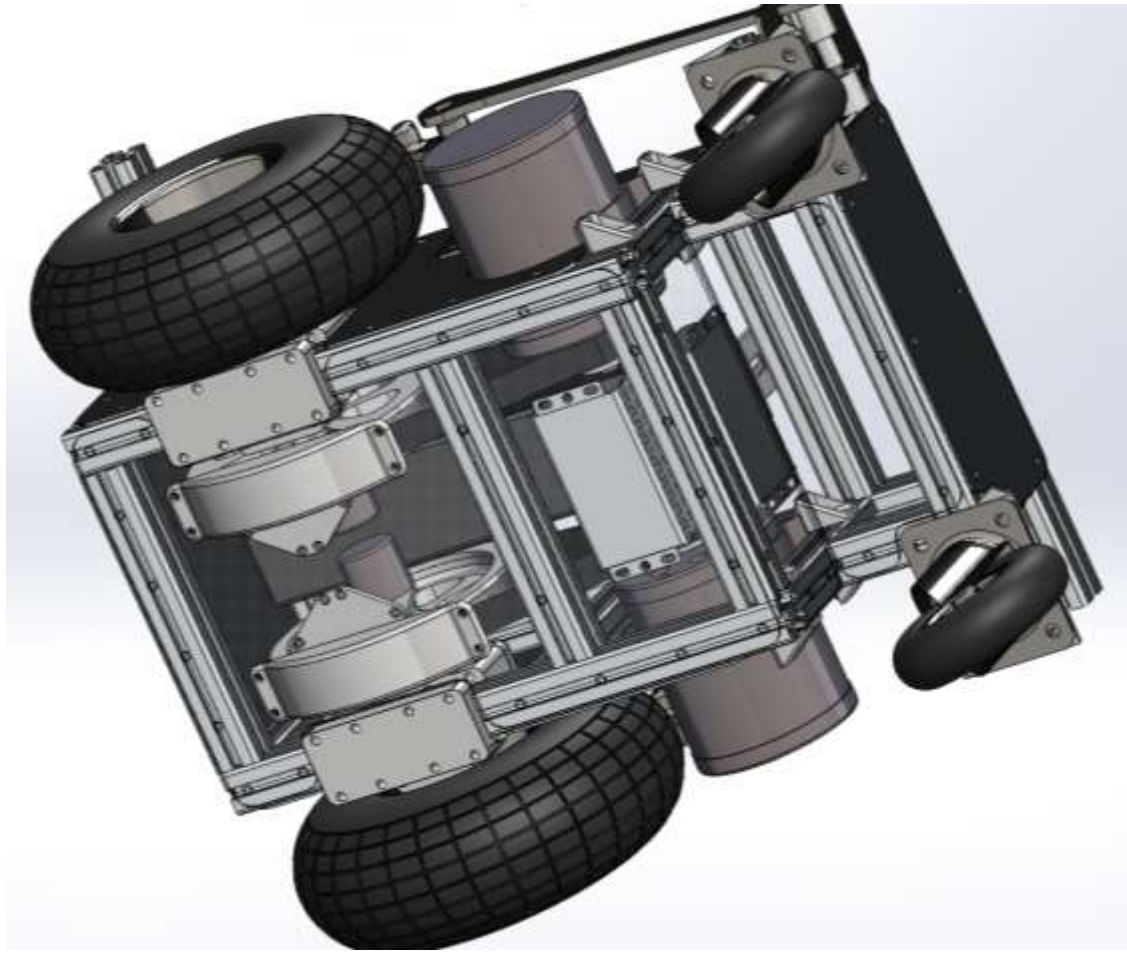
Design

Mobile base

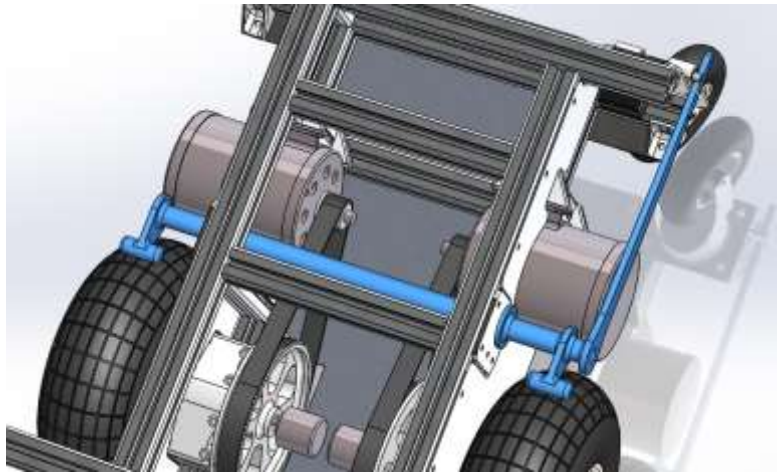


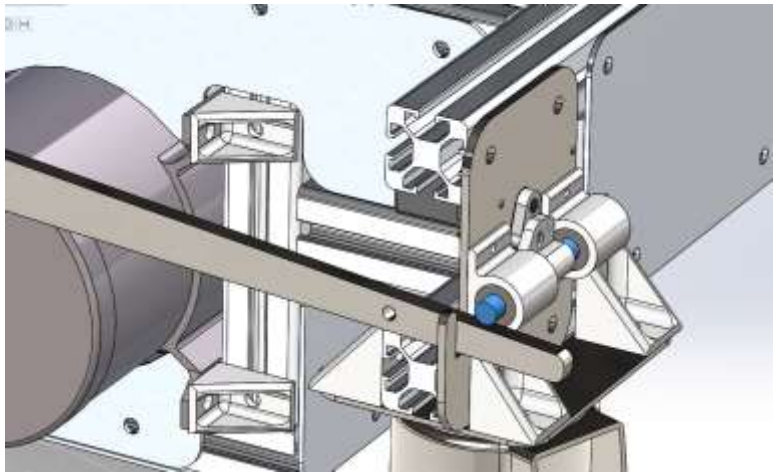
- Functional components affordable and widely available
- Removable outer panels allow easy access
- Quadrature encoders provide ~0.68mm positioning
- >106 N force per driven wheel





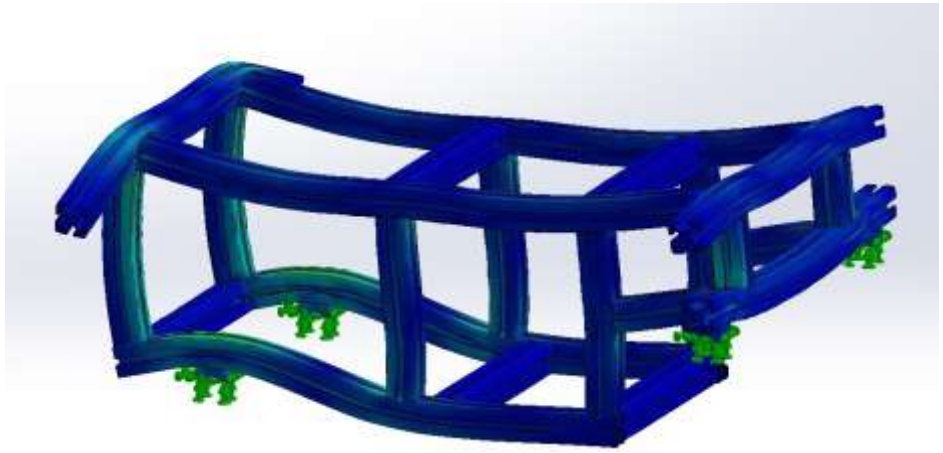
Failsafe breaking

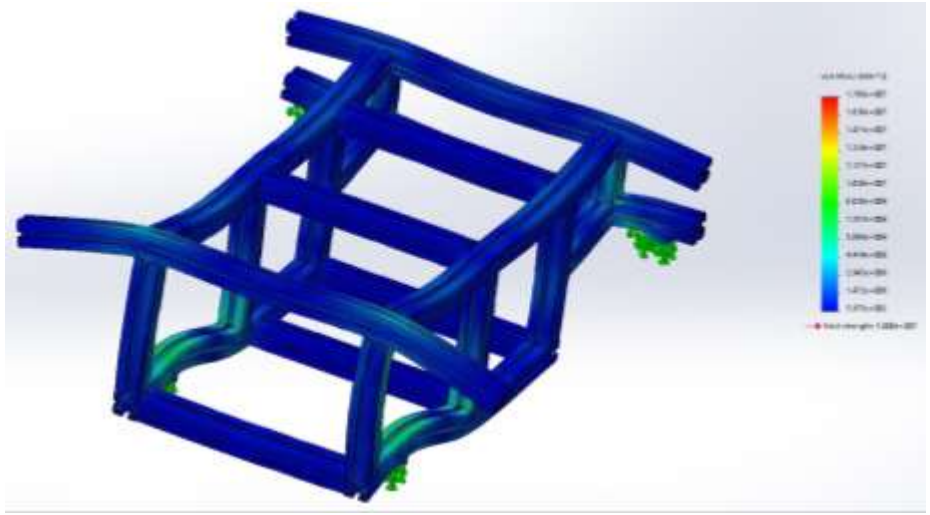




- Sprung braking bar applies friction directly to tyres
- Set manually, powerful actuators are not required
- Locking pin releases upon interruption of power, or software trigger
- System unaffected by belt/pulley failure

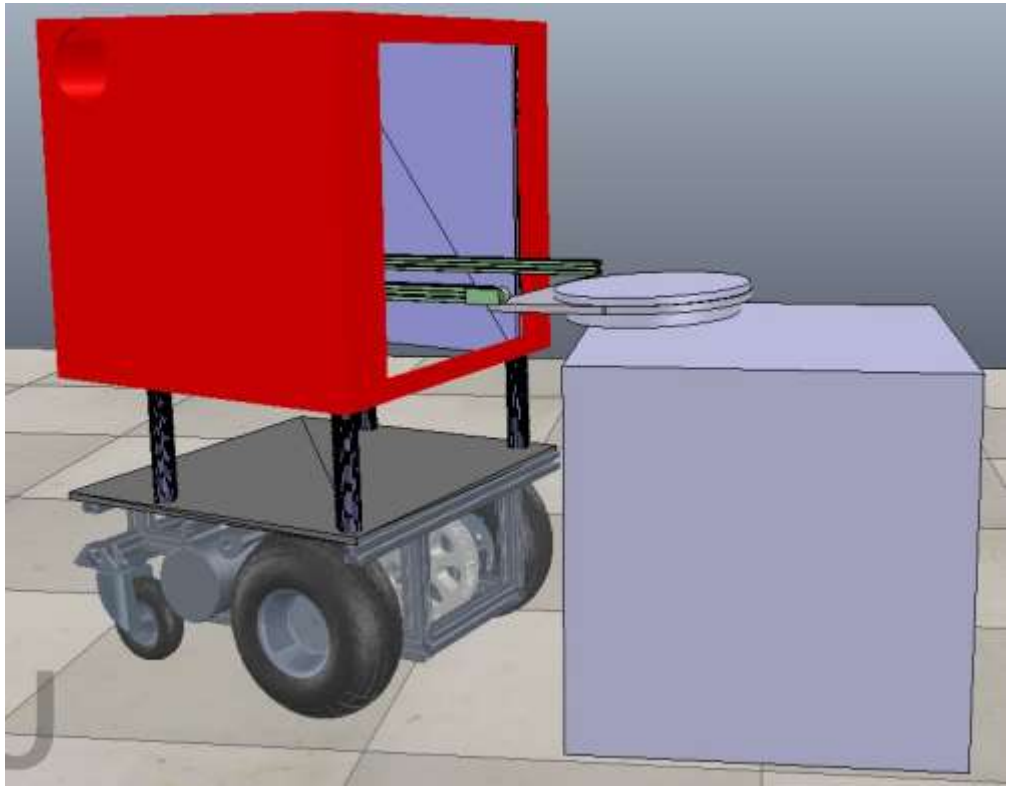
FEA





- Aluminum frame bears a 200kg load within safe limits

Simulation



- Proof of concept- Design can reliably pick and place trays
- Differential drive acts as yaw positioning
- Telescoping arm allows further reach

Fail safes and other safety issues.

Some mechanical and others are down to the programming.

- Wheelbase breaking mechanism
- Centre of mass as low as possible- e.g. Lead batteries in the base
- Offload one tray at a time
- Do not pick up overloaded trays
- When moving around the environment (hospital) use a flashing beacon.

Cost and materials

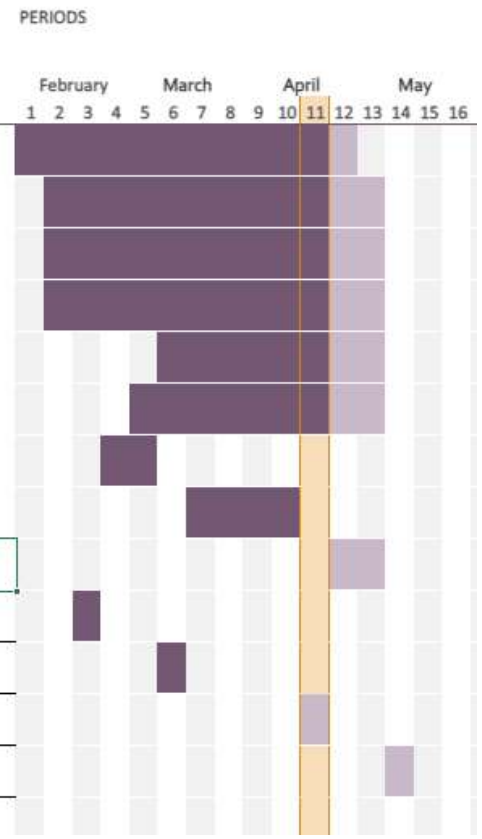
Base Prototype Components	QTY	Unit Cost	Cost
RS pro 30x30 extrusion/metre	6	£21.34	£128.04
sack truck wheel	2	9.11	£18.22
castor	2	16.65	£33.30
dc motor	2	46.99	£93.98
encoders	2	18.37	£36.74
battery	1	140.22	£140.22
dc motor controller	2	19.99	£39.98
PLA filament kg	2	£18.50	£37.00
2mm Aluminium sheet 2/m sq	2	£71.28	£142.56
lasercut mild steel plate estimate	1	£150.00	£150.00
MG995 servo	1	£7.79	£7.79
mild steel rod 2m 20mm	1	£29.86	£29.86
Base Total			£527.48

Cabinet Prototype Components	QTY	Unit Cost	Cost
RS pro 30x30 extrusion/metre	10	21.34	213.4
2mm Aluminium sheet 2/m sq	3	£71.28	£213.84
stepper drivers 10pcs	2	7.56	£15.12
Air filter	1	20	20
Fans	2	10	20
extrusion 20x20 per m	4	7.54	30.16
UVC lamp	1	24.99	24.99
mgn12 linear rail 400 + block	8	14.75	118
stepper motors	16	10.47	167.52
belts 5m	1	4.18	4.18
belt tensioner	2	8.66	17.32
carriage plates	8	8.26	66.08
thin steppers	4	8.08	32.32
acrylic	1	10	10
linear actuators	4	49.25	197
PLA filament kg	2	£18.50	£37.00
Cabinet Total			£1,186.93

Control and Sensors			
RGBD camera	1	£54	£54.00
Ultrasound	8	£2	£16.00
Raspberry Pi 4	1	£53.22	£53.22
2D lidar	1	£95.80	£95.80
Control Total			£123.22
Major components robot total			£1,837.63
Rough Robot cost estimate			£2,756.45

Gantt Char

ACTIVITY	Responsibility	PLAN START	PLAN DURATION	ACTUAL START	ACTUAL DURATION	PERCENT COMPLETE
Research	J + B	1	12	1	12	95%
Concepts/mechanisms	J + B	2	12	2	12	90%
Design (main body)	J	2	12	2	12	90%
Design (wheelbase)	B	2	12	2	12	90%
Simulation (fusion)	J	6	8	6	8	80%
Simulation (CoppeliaSim)	B	5	9	5	9	80%
Evaluation (Proposal)	J + B	4	2	4	2	100%
Evaluation (PDR)	J + B	7	4	7	4	100%
Evaluation (CDR)	J + B	12	2	12	2	0%
Project proposal	J + B	3	1	3	1	100%
PDR	J + B	6	1	6	1	100%
CDR	J + B	11	1	11	1	0%
Final presentation	J + B	14	1	14	1	0%



Thank you for listening. Questions??