Mars One Raw Notes					
					Reference
Goals	Establish a permanent human settlement on Mars				http://www.mars-one.com/about-mars-one
	Primarily for a reality TV show - No science to be performed				
		Time			
Mission Plan	Demonstration Mission (lander)	5/1/2018	launched to Mars in May 2018 - proof of concept of some key technologies (specific technologies are not given)		http://www.mars-one.com/mission/roadmap#sthash.SaTSzEJi.dpuf
			Contracted with Lockheed Martin and Surrey Satellite Technology for this mission (currently at mission concept study level)		http://www.theguardian.com/science/2013/dec/11/mars-one-ethical-questions-bas-lansdorp
			Crowdfunding effort on Indiegogo.com to raise $400000 failed to meet its target		https://www.indiegogo.com/projects/mars-one-first-private-mars-mission-in-2018
			Concept looks like the Mars Phoenix lander		
			Estimated completion date of conceptual studies is August 2014		https://www.indiegogo.com/projects/mars-one-first-private-mars-mission-in-2018#activity
	First communications satellite		Communication satellite also launched into Mars areostationary orbit in May 2018 - Indiegogo campaign is also trying to fund this effort		http://www.mars-one.com/mission/roadmap
	Two rovers - "one intelligent rover and one trailer"		Launched in 2020 - robotically prospects for and prepares the settlement site		http://www.mars-one.com/mission/roadmap
			a trailer used for transporting the landing capsules		http://www.mars-one.com/mission/the-technology
	Second communications satellite		Second communications satellite is launched into heliocentric orbit (in Sun-Earth L5)		http://www.mars-one.com/mission/roadmap
			"Together with the ComSat around Mars it enables 24/7 communication with Mars, even when the sun is in between the two planets."		
	Six Cargo Missions, landing up to 10km away from outpost		"Two Living Units, two Life Support Systems, and two Supply Units are sent to Mars in July 2022. In February 2023 all units land on Mars using a Rover signal as a beacon."		http://www.mars-one.com/mission/roadmap
	Unmanned preparation of a habitable settlement	2023	The Rover picks up the first Life Support unit using the trailer. It places the Life Support unit in the right place and deploys the thin film Solar Panel of the Life Support unit. The Rover can now connect to the Life Support unit to recharge its batteries much faster than using only its own panels, allowing it to do much more work. The Rover picks up all the other Cargo units and then deploys the thin film Solar Panel of the second Life Support unit and the Inflatable sections of the living units. The Life Support unit is connected to the Living Units by a hose that can transport water, air and electricity. The Life Support System (LSS) is now activated.		http://www.mars-one.com/mission/roadmap
			Before the first crew starts their journey, the life support system has produced a breathable atmosphere of 0.7 bar pressure, 3000 liters of water and 120 kg of Oxygen that is in storage. The Rover also deposits Martian soil on top of the inflatable sections of the habitat for Radiation Shielding.		http://www.mars-one.com/mission/roadmap
	Departure of Crew One (as well as cargo - on a separate launch)		In April 2024, the components of the Mars Transit Vehicle are launched to Earth orbit on receiving the green light on the status of the systems on Mars. First, a Transit Habitat and a Mars Lander with an assembly crew on-board are launched into an orbit around the Earth. The assembly crew docks the Mars Lander to the Transit Habitat. Two propellant stages are launched a month later and are also connected. The first Mars crew, now fully trained, is launched into the same Earth orbit. In orbit the Mars One crew switches places with the Assembly Crew, who descend back to Earth. After a final check of systems on Mars and of the Transit Vehicle, engines of the Propellant Stages are fired and the Transit Vehicle is launched on a Mars Transit Trajectory. This is the point of no return; the crew is now bound to a 210-day flight to Mars. The Cargo for the second crew is launched to Mars in the same month		http://www.mars-one.com/mission/roadmap
	Landing of Crew One	2025	About 24 hours before landing, the crew move from the Transit Habitat into the landing module, bringing some of the supplies from the Transit Habitat. The landing module detaches from the Transit habitat, which is too large to land on Mars. The Transit habitat is discarded and stays in orbit around the sun. The Lander is exactly the same as those used for previous unmanned missions. This ensures the human crew land in a system that has been tested eight times. Upon landing, the crew takes up to 48 hours to recover from experiencing gravity again after spending a long time in space. In their Marssuits they leave the Lander and are picked up by the Rover. They enter the settlement through the airlock in one of the Living units and spend the next few days recovering and settling in the new environment. After their acclimatisation period, the settlers deploy the rest of the Solar Panels. They install the hallways between the Landers and set up Food Production units. The Cargo for the second crew lands within a few weeks after the first crew lands; it is picked up and installed, adding to the redundancy in the settlement.		http://www.mars-one.com/mission/roadmap
	Expansion with new crew arriving every two years		The second crew departs from Earth on October 2026 on a 240 day trajectory. With the secno crew, the Cargo for the third crew is also launched		http://www.mars-one.com/mission/roadmap
			The second crew lands On Mars in July 2027. They are welcomed by the first crew, who has already prepared their living quarters. The hardware for crew three will land a few weeks later and added to the settlement. This process continues as additional crews land every two years.		http://www.mars-one.com/mission/roadmap
			A new group of four astronauts will land on Mars every two years, steadily increasing the settlement's size. Eventually, a living unit will be built from local materials, large enough to grow trees. As more astronauts arrive, the creativity applied to settlement expansion will certainly give way to ideas and innovation that we cannot conceive now.		http://www.mars-one.com/mission/humankind-on-mars
Surface Activities	During their working hours, our astronauts will be busy performing three main tasks: construction, maintenance and research. Besides work, they will also have time to relax. Construction: They will install the corridors between the landers, they will deploy extra solar panels, and they will install equipment, such as greenhouses, inside the habitat. They will spend time on the crops and food preparation. They will also prepare the hardware for the second crew: the second crew hardware will be delivered with the first crew astronauts. Regular maintenance Geological and astrobiological research				http://www.mars-one.com/faq/mission-to-mars/what-will-the-astronauts-do-on-mars#sthash.0RxfP1FV.dpuf
	Our goal is to enable them to construct a space 10 meters wide by 50 meters long. This will be a spacious environment in which to live, where they can also grow trees. Such a large living volume will make Mars a much nicer place to live				http://www.mars-one.com/faq/mission-to-mars/what-will-the-astronauts-do-on-mars#sthash.0RxfP1FV.dpuf
History	In 2011, the founding members of the Mars One team came together to develop a strategic plan for taking humanity to Mars. That first year yielded the completion of a feasibility study after calling upon experts from space agencies and private aerospace corporations around the world. Written letters of interest in support of the Mars One plan were received. In this first-stage analysis, Mars One incorporated technical, financial, social-psychological and ethical components into its foundation plan. - See more at: http://www.mars-one.com/about-mars-one#sthash.y4isC4sK.dpuf				
	In 2011 Bas Lansdorp and Arno Wielders lay the foundation of the Mars One mission plan. Discussion meetings are held with potential suppliers of aerospace components in USA, Canada, Italy and United Kingdom. Mission architecture, budgets and timelines are solidified from feedback of supplier engineers and business developers. A baseline design for a mission of permanent human settlement on Mars achievable with existing technology is the result. - See more at: http://www.mars-one.com/mission/roadmap#sthash.SaTSzEJi.dpuf			http://www.mars-one.com/mission/roadmap	
Astronaut Selection	Started April 2013				
	Will select six teams of four individuals			http://www.mars-one.com/mission/roadmap	
	An analogue of the Mars habitat is to be constructed on Earth for technology testing and training purposes. - See more at: http://www.mars-one.com/mission/roadmap#sthash.SaTSzEJi.dpuf			http://www.mars-one.com/mission/roadmap	
Budget	$6 Billion		Mars One estimates the cost of putting the first four people on Mars at six billion US$. The six billion figure is the cost of all the hardware combined, plus the operational expenditures, plus margins. For every next manned mission, Mars One estimates the costs at four billion US$.		http://www.mars-one.com/faq/finance-and-feasibility/how-much-does-the-mission-cost
			Mars One has developed a detailed risk analysis profile which guides both its internal technical development as well as the relationships it builds with its aerospace suppliers. This risk analysis profile will continue to evolve and improve over the years prior to the first humans walking on the planet Mars.		
Crew Selection	This concludes with the selection six teams of four people (two men and two women, representing four different continents) from which the initial group would be picked.			http://www.thespacereview.com/article/2303/1	

Person	"Mars One mission plan integrates components that are well tested and readily available from industry leaders worldwide - See more at: http://www.mars-one.com/about-mars-one#sthash.y4isC4sK.dpuf				
	"No new technology developments are required to establish a human settlement on Mars."				
	PRECURSOR MISSIONS				
	Rover				
	In contrast to the scientific rovers dispatched to Mars to date, the Mars One Rovers' tasks will be focused more on utility, the deployment and maintenance of the human Settlement on Mars:				http://www.mars-one.com/technology/the-rover
	Autonomous travel to locate the most suitable location for settlement.				
	Measure the amount of water in the soil.				
	Move the Landers to the preferred locations on the trailer.				
	Remove protective panels from the Landers.				
	Unroll and lay down the thin film solar panels.				
	Extract (from the Lander) and assist with inflation of the Living Unit.				
	Connect the air tube between the Life Support Unit and the Living Unit.				
	Deposit soil in the Support Unit for water extraction and remove the dry soil.				
	Power	Solar			
	CREWED SEGMENT				
	Launch System				
	Function	**Choice**	**Quote**	**Further Comments**	**Reference**
Koki	Launch vehicle	SpaceX Falcon Heavy	Mars One anticipates using Space X Falcon Heavy, an upgraded version of the Falcon 9, which is in use by Space X currently. The Falcon Heavy is slated to undergo test flights in 2014, granting ample time for fine-tuning prior to the Mars One missions.		http://www.mars-one.com/mission/the-technology
	TRANSIT SYSTEM				
	Function	**Choice**	**Quote**	**Further Comments**	**Reference**
	Propulsion				
Koki	Architecture	Two propellant stages, transit habitat, and landing module	Human crew will travel through space for around seven months. The transit vehicle will consist of two propellent stages-- a landing module and transit habitat. On reaching Mars the crew in their Marsuits will descend to the Mars surface in the landing module, leaving their living quarters behind, which is too heavy to land.		http://www.mars-one.com/mission/the-technology
Koki	Lander	TBD - SpaceX Dragon seems baselined	Mars One will secure the landing capsule from one of the experienced suppliers in the world, for example Lockheed Martin or SpaceX. The SpaceX capsule under consideration is a variant of the Dragon Capsule, tested on several occasions since 2010. Similar Landers will be equipped to perform different functions		http://www.mars-one.com/mission/the-technology
	Common lander bus		· Carrying Life Support Units that generate energy, water and breathable air for the settlement.		http://www.mars-one.com/mission/the-technology
			· Carrying Supply Unit with food, solar panels, spare parts and other components.		http://www.mars-one.com/mission/the-technology
			· Carrying Living Units that are outfitted with deployable inflatable habitats.		http://www.mars-one.com/mission/the-technology
			· Carrying Humans to the surface of Mars		http://www.mars-one.com/mission/the-technology
			· Carrying Rovers to the surface of Mars		http://www.mars-one.com/mission/the-technology
	EDL	Not yet addressed			http://www.mars-one.com/mission/the-technology
					http://www.mars-one.com/mission/the-technology
Sydney	ECLSS	Open loop system	The Transit habitat has a mass of about 20,000 kg. It will carry close to 800 kg of dry food, 3000 liters of water and 700 kg of oxygen on board. No water or Oxygen will be recycled, because the trip lasts only 210 days. Not recycling these components eliminates the need for recycling systems, backups, spare components and reduces power and cooling requirements. The 3000 liters of water is also used for radiation shielding.		http://www.mars-one.com/technology/mars-transit-
			Freeze dried and canned food is the only option. There will be constant noise from the ventilators, computer and life support systems, and a regimented routine of 3 hours daily exercise in order to maintain muscle mass. If the astronauts are hit by a solar storm, they must take refuge in the even smaller, sheltered area of the rocket which provides the best protection, for up to several days.		http://www.mars-one.com/mission/humankind-on-
	SURFACE SYSTEM				
	Function	**Choice**	**Quote**	**Further Comments**	**Reference**
Nice to h	Location	Near polar region for ISRU water extraction, flat area for landings, well lit for PV power	An ideal location for the settlement is far enough North for the soil to contain enough water, equatorial enough for maximum solar power and flat enough to facilitate construction of the settlement.	Location determined via a precursor mission with a rover in 2018	http://www.mars-one.com/mission/roadmap#sthas
Sydney	Habitat architecture	Inflatable modules attached to a "Living Unit"	The Living Unit is a Lander that has a unique, inflatable living section and an airlock used by the astronauts when leaving the sealed, habitable settlement. The Living Unit will be set in place by the Rovers and filled with breathable air by the Life Support Unit prior to the arrival of the astronauts. In addition, the Lander contains construction materials for the astronauts to construct rooms, floors and install electrical outlets. The Lander itself contains the 'wet areas', such as the shower and kitchen		http://www.mars-one.com/technology/living-unit
Sam	Power	Thin film solar panels	When the settlement location is determined, the Rover prepares the surface for arrival of the Cargo missions. It also clears large areas where solar panels will lie.		http://www.mars-one.com/mission/roadmap#sthas
			The Rover picks up the first Life Support unit using the trailer. It places the Life Support unit in the right place and deploys the thin film Solar Panel of the Life Support unit. The Rover can now connect to the Life Support unit to recharge its batteries much faster than using only its own panels, allowing it to do much more work.		
			The first settlement will install approximately 3000 square meters of power generating surface area.		http://www.mars-one.com/mission/technical-feasibi
Sam	ISRU	Architecture	Potable water will be created through the heating of water ice in the local ground soil. About 60 kilograms of soil is loaded into a container within the Life Support Unit by the Rover and heated to evaporate the water. The water is condensed and the dry soil returned to its origin. A portion of the water is stored while a portion is used to produce oxygen. The Life Support Unit is able to collect 1500 liters water and 120 kilograms oxygen in 500 days time.		http://www.mars-one.com/technology/life-support-
Sam		Water	Water is extracted from the Martian soil by evaporating the subsurface ice particles in an oven		http://www.mars-one.com/technology/life-support-
Sam		Oxygen	The evaporated water is condensed back to its liquid state and stored. Part of the water is used for producing Oxygen		
Sam		Nitrogen and Argon	Nitrogen and Argon, filtered from the Martian atmosphere make up the other components of the breathable air inside the habitat.		
			Before the first crew starts their journey, the life support system has produced a breathable atmosphere of 0.7 bar pressure, 3000 liters of water and 120 kg of Oxygen that is in storage		
			The second major component of the Living Units' atmosphere, nitrogen, will be extracted directly from the Martian atmosphere by the Life Support Unit.		http://www.mars-one.com/faq/health-and-ethics/will-the-astronauts-have-enough-water-food-and-oxygen#sthash.aCFnUUFk.dpuf
		Radiation shielding	The Rover also deposits Martian soil on top of the inflatable sections of the habitat for Radiation Shielding.		
	Habitable Volume		Once they arrive on Mars, the astronauts will begin making use of their relatively spacious living units; over 50 m2 per person, and a total of more than 200 m2 combined interior space.		http://www.mars-one.com/mission/humankind-on-
Sydney	Atmosphere	Earth Sea Level	Nitrogen and argon gas are extracted from the Mars atmosphere and injected into the habitable space as inert gases. Remember, 80% of what we breathe on Earth is the element nitrogen.		http://www.mars-one.com/technology/life-support-
Sydney	ECLSS Strategy	Complete second copy	When the first crew lands they find the habitat with a good level of redundancy already: two Living units-- each large enough to house the crew of four and two Life Support units--each capable of providing enough water, power and breathable air for the entire crew. When the hardware for the second crew is incorporated to the settlement, it features four Living units and four Life Support units, enough to sustain a crew of 16 astronauts.		
			The Life Support Unit is hosted inside a Lander. This system will be very similar to those units which are fully functional on-board the International Space Station.		http://www.mars-one.com/technology/life-support-
			Storage of waste that is not easily recycled until more technology is available in the settlement		http://www.mars-one.com/mission/technical-feasibi
		Buffer size	Enough to support crew for one month (O2, Potable Water, and Food) due to global dust storms reducing available power Also dirty water stores and dry waste stores will be sized to hold one month's worth of waste. Direct quote from below		
			"The astronauts will have enough water stored for 15 days of normal water usage, and for 150 days if usage is limited. The oxygen storage tanks will contain enough oxygen for 60 days"		
		Potable Water Tank Size	"About 1500 liters of reserve water will be stored in each Life Support Unit, which will be consumed primarily at night, and during periods of protracted low power availability, for example during dust storms."		http://www.mars-one.com/faq/health-and-ethics/will-the-astronauts-have-enough-water-food-and-oxygen#sthash.aCFnUUFk.dpuf
		Water budget	Each astronaut will be able to use about 50 liters of water per day. The water will be recycled, which takes much less energy than extracting it from the Martian soil. Only water that can not be recycled will be replaced by water extracted from the soil.		http://www.mars-one.com/faq/health-and-ethics/will-the-astronauts-have-enough-water-food-and-oxygen#sthash.aCFnUUFk.dpuf
Sydney	Food	Unclear - it looks like they're leaning towards "farming"	Water can be made available to the settlement for hygiene, drinking and farming		http://www.mars-one.com/mission/technical-feasibi
			When the astronauts land, there will be limited rations of food available for them to use. Food from Earth will only serve as emergency rations, the astronauts will eat fresh food that they produce on Mars. Mars One will make use of high efficiency plant growing methods that require much less space (e.g. PlantLab). Food production will be hydroponic, eliminating the need for soil. Food production will happen indoor, lighted by LED lighting. By providing the plants with only the frequencies of light that they use most efficiently, power consumption is limited. Some of the plants will be grown in multiple levels on top of each other, limiting space requirements. In total there will be about 50 m2 available for plant growth. A thick layer of Martian soil on top of the inflatable habitat will protect the plants (and the astronauts) from radiation. CO2 for the plants is available from the Mars atmosphere and water is available through recycling and from the soil of Mars. There will be sufficient plant production capacity to feed about three crews of four. Any plant production surplus will be stored as emergency rations for the second crew, and for other emergencies. Non-edible parts of the plants will be recycled, or will be stored until more advanced recycling equipment is shipped from Earth.		http://www.mars-one.com/faq/health-and-ethics/will-the-astronauts-have-enough-water-food-and-oxygen#sthash.aCFnUUFk.dpuf
			Within the settlement are inflatable components which contain bedrooms, working areas, a living room and a 'plant production unit', where they will grow greenery. They will also be able to shower as normal, prepare fresh food (that they themselves grew and harvested) in the kitchen, wear regular clothes, and, in essence, lead typical day-to-day lives.		http://www.mars-one.com/mission/humankind-on-
	Medical Facilities	Minimal - likely to be similar to ISS	Medical equipment will be present on Mars and on the way to Mars to treat the most common injuries and illnesses. Two of the four astronauts will have received comprehensive medical training, and the other two will have extensive knowledge of first-aid. All these elements together will provide the group with the tools to help itself.		http://www.mars-one.com/faq/health-and-ethics/what-kind-of-medical-facilities-will-be-available-on-mars#sthash.TC6j5FKp.dpuf
	Physiological countermeasures	ISS-like exercise equipment to be included	Mars One astronauts will be well prepared with a scientifically valid countermeasures program that will keep them healthy, not only for the mission to Mars, but also as they become adjusted to life under gravity on the Mars surface.		http://www.mars-one.com/faq/health-and-ethics/how-will-the-mars-mission-physically-affect-the-astronauts#sthash.ZZlPMNgf.dpuf
	EVA Strategy	Required shortly after landing to transit from lander to habitat (most likely due to limited consumables on the lander)		Spacesuit is refered to as a "Mars Suit" - no info is provided beyond identification of a need for it	http://www.mars-one.com/technology/the-mars-sui
	Crew training		In addition to the expertise and work experience they must already possess, they have to learn quite a few new skills: physical and electrical repairs to the settlement structures, cultivating crops in confined spaces, and addressing both routine and serious medical issues such as dental upkeep, muscle tears and bone fractures.		http://www.mars-one.com/mission/humankind-on-
	Activities		There will be a great deal of research conducted on Mars. The astronauts will research how their bodies respond and change when living in a 38% gravitational field, and how food crops and other plants grow in hydroponic plant production units. Research will include extra-settlement exploration to learn about the ancient and current geology on Mars. Of course, much research will be dedicated to the determination if life was once present or now exists on Mars		http://www.mars-one.com/mission/humankind-on-
NICE TO HAVE					
Communication			Affects power requirements		
Probabilistic Analysis - P(LOC)			Given uncertainty driven by low TRL's		

Source	Quotes
http://scienceblogs.com/startswithabang/2014/01/18/ask-ethan-20-is-the-mars-one-crew-doomed/	What Mars One is counting on is that they can safely land a heavier payload than ever before, that they can do it more precisely than ever before (as in, within just a few hundred meters of previous successful landings), and they can do it for only 12% of the projected costs, with a total estimated budget of just $6 billion instead of the $50 billion price tag to do it right.
http://physicsfocus.org/amy-shira-teitel-mars-one-mission-could-go-horribly-wrong-if-it-ever-gets-off-the-ground/	The team behind the mission claims that the mission is feasible with existing hardware. That may be true, but "existing" does not necessarily mean flight ready, let alone suitable for a manned mission. Only the Russian Soyuz is currently able to take humans into space, and that's not a spacecraft equipped to land on Mars. And the landing is another issue. Mars One says it will use retrorocket (rockets that fire to slow the spacecraft for a soft touchdown) and no parachute to land its crew on Mars. That's a method that's never been done. NASA's Viking landers use retrorockets, but they also used a parachute in the early stage of their descent and weighed far less than a manned spacecraft. I can only imagine how much the fuel for a powered descent would weigh for a spacecraft not taking advantage of a parachute-assisted descent.
	If you're between 20 and 40 years old and healthy, you're qualified to fly on Mars One. Education and background doesn't matter. Instead, a sense of humour and the ability to work well with others are key characteristics Mars One is looking for in astronaut hopefuls. It's such an inclusive selection criteria because science isn't the focus of Mars One, colonization is. There will be little to no science on the mission, said the Mars One team.
	The first manned mission, they said, will cost six billion US dollars. They didn't say whether that figure includes research and development or any of the early cargo missions, nor did they say what levels of funding they have secured. They only said that they will raise the money for the mission by broadcasting the whole process on TV. Their model for this decision is the Olympics. Last year's Summer Olympics in London turned a profit of about $4 billion through TV broadcast rights and ad revenue. And as the Mars One team pointed out, that was only a three week event. The Mars One mission will be broadcast over years. The idea is that as we get to know the crews, we'll be taken into their stories. It's the human side of this mission that is so important
	The problem with the reality TV funding model is that the money will come after the mission has started, not before, which is when missions like this really need money. Mars One didn't say anything about how they will deal with cost overruns, which are inevitable with an undertaking of this magnitude.
http://www.purduereview.com/133/the-early-failure-of-mars-one-and-why-it-matters/	According to the organization's master plan, the biggest issue going forth will be convincing potential investors and broadcasters of the technical feasibility of the venture. Beyond that, it's all just a matter of advertising.
	Fast forward to today, and the first stage of the project is coming to a close. The application period for Mars One is ending, and the potential names of Mar's future permanent residences are in. The downside? Mars One fell short of its expected total applicant goal… by a lot. When the sign-up page opened in April of this year, the organization projected that at least 1,000,000 people would apply. In reality, that number was more like 165,000.
	Group officials downplayed the problem, pointing out that 165,000 is still quite a large number of applicants. They remain confident in their timeline, standing by 2023 is the date for the first landing. Still, this under performance could throw off Mars One's plans, as much of the project's funding was expected to come from application fees.
http://www.marssociety-europa.eu/mars-one-iniatiative-reality-or-hoax/	

Analyze only surface segment? Or launch and transit segment as well?					
They claim \$6B for the mission				Check feasibility of just the launch costs?	

Preliminary N2 Diagram				
Legend: Rows = Input; Columns = Output				
Design Decisions				
- Number of Crew (4) - Mission Duration (26months) - Habitable volume (assume Earth Sea Level atm) - Technology Choices (ISS based)	**ECLSS Architecture**			
- Settlement site - ISRU technologies (Mars One baseline)	- Makeup gas (O2, N2, Argon) requirement - Makeup water requirement - Power requirement	**ISRU Architecture**		
- Launch vehicles - Propulsive elements	- Emplaced system mass by type - Emplaced system volume by type - Spares mass, volume and required frequency by type	- Emplaced system mass by type - Emplaced system volume by type - Spares mass, volume and required frequency by type	**Space Logistics**	
- $/kg launched - $DDT&E/TRL for each technology	- Emplaced system DDT&E cost	- Emplaced system DDT&E cost	- Cost of total launched mass and frequency (Cost of IMLEO) - DDT&E of system propulsive elements	**Cost Analysis (Specific Cost Function TBD)**
				Aggregated cost over time
Things to possibly consider				
Comms				

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Work Breakdown Structure						
			Sydney	Sam	Koki	Andrew
Task	Comments	Deadline				
Tag-Up - Interface Definition	Want to come out with inputs and outputs to models (DSM)	May 20th				
			ECLSS Sizing	ISRU Sizing	Space Logistics	Sparing
			Crew Demands	Power		
Have individual functional modules ready to start integrating		June 23rd, 10am				
Paper Submission Deadline		Sep 10th				

Open Questions			
Question	Owner		Complete?
Dimensions of hardware? (ISRU and ECLSS)	Koki		
Tank Buffer Sizing?			
NASA Constellation Acceptable P(LOC)			
Crew Metabolic Requirements from Syd to Koki			
Sort out flow rates between ISRU and ECLSS			
Find ECLSS Leakage Rates and Technology Efficiencies	Nominal spaceflight cabin leakage rate = 0.05%/day	Source: BVAD Table 4.1.1	Yes
Airlocks connected to Living Units are also a source of atmospheric loss - what is the loss rate? (driven by number of EVAs)			
Does sublimation work for thermal control within a Mars space suit?			

Item	Quantity	Location	Mass (kg)	Volume (m^3)	Power Requirement	Failure Rate	Repair Rate?	Status	Owner	Left To Do	Comments
ECLSS			---	---							
Water Cleanup											
Water Electrolyzer											
Water Tank											
Oxygen Tank											Need to determine tank capacities first
Common Cabin Air Assembly (CCAA) (ISS-Based)	1 per module (4 total)	Life Support Units, Living Units and Inflatable Habitats	93.6		467.5W (continuous)				Sydney		Data from Chapter 2, Section 3.2, "Living Together in Space..."
Crew and Health Care System (CHeCS)											
Clothing									Koki	Determine value for trip to Mars. Upon arrival, laundry system cleans clothes for reuse	Sources of data include BVAD, NASA HIDH (preferred), NASA STD 3000 (superseded by HIDH), and HSMAD
Hygiene Materials											
Laundry System		Living Units							Sydney		
Shower and Kitchen		Living Units								Get data from HIDH?	
Waste & Hygiene Compartment		Living Units								Assume ISS-based?	
Exercise equipment (ARED, Bicycle, and Treadmill)		Living Units									
EVA Support											
Space suits											
Airlocks			631.1	4.25	0.133kWhr for 30minutes (on ISS)						
Standard 4.25m^3 airlock mass	510kg (631.1kg total when pumps are included - breakdown is ISS Pump: 79.4kg [b] Equalization Valve: 6.9kg [b] Controls: 14.8kg [b] Tanks: 20kg [c])	From: Chapter 17 - Out of this World - The New Field of Space Architecture b. from: Space Station Freedom Airlock Depress/Repress System. Design and Performance, SAE 921378, D. James, July 13-16, 1992. c. Estimate from Out of this World...									
Power for Pumping (Airlock)	0.133kWhr for 30minutes (on ISS)	From Chapter 17 - Out of this World - The New Field of Space Architecture									
ISRU System			---	---		---	---		Sam		
Mars Soil Oven			~100	~0.15				80%	Sam	*Failure Rate, better data on water distribution, dimensions*	
Atmospheric Processing								10%	Sam		
Power System								80%	Sam	*Doule check kg/m^2 numbers*	

Implemented in Code?	Attribute	Value	Source	Notes		
	Baseline metallic-walled module leakage rate	0.05% by mass/day	BVAD Table 4.1.1	Note that in reality, leakage for ISS is measured in lb per day (typically between 0.1 and 0.7lb/day) Ref: Trending of Overboard Leakage of ISS Cabin Atmosphere		Analysis of on-orbit data is conducted in order to determine the total daily cabin air loss. The total cabin air loss ranged between 0.006 kg (0.013 lbm) per day and 0.149 kg (0.329 lbm) per day for the dates from July 1, 2004 to February 1, 2006. The average total cabin air loss for the October 1, 2005 to February 1, 2006 period was 0.067 kg (0.148 lbm) per day. The gas loss value is the amount of gas lost from the ISS per day that includes steady state structural leakages, Vozdukh, Micropurification Unit (BMP), and other component losses. The value does not include EVA, visiting vehicle docking, or calibration gas losses. In addition to the total cabin air loss a theoretical value of gas loss due to CDRA operations is 0.035 lbm per day. This being added to the analysis is still a small enough number in the scope of the CSCS range of days that this air loss poses an insignificant impact to the CSCS oxygen duration.
	Operating atmosphere	0.7bar, O2, N2, Ar	http://www.mars-one.com/mission/roadmap/2023			
		70.3kPa (10.2psi) baseline within BVAD - Section 4.1.1 26.5% oxygen concentration (according to EAWG) All atmospheres are within a control box of +/-0.2psia total pressure, and +/-2% O2 concentration (EAWG), Note that for 10.2.psia/26% O2, upper bound can be extended to 30% oxygen - see direct quote from EAWG report in attached comment	This corresponds to the space shuttle EVA preparation atmosphere - requires 40minute pre-breathe time - performed in-suit From Table 3.1-1 EAWG Report	10.2psi is the recommendation for lunar and Mars landers to support a high number of EVAs. Lunar and Mars surface habitats are recommended to operate at atmospheres of 8 and 7.6psia (nominal). The lower value is for frequent EVA Section 5.1 EAWG	Note that default BioSim atmospheric compsition is 8psia 33% O2, which corresponds to	Note that EAWG results were revisited in Molly Anderson's 2012 ICES paper. EAWG results still hold
	Habitable volume	1000m^3 total (so 500m^3 per inflatable? = 25.5m long for cylindrical habs with 5m dia.) --> this appears to be a good estimate	The Mars habitat will be a modular environment made up of multiple inflatable units, and will comprise about 1000 m3 of total living space, which equates to 250 m3 per inhabitant for a team of four	http://www.mars-one.com/faq/health-and-ethics/how-much-living-space-will-the-astronauts-have#sthash.k4S9nv8Z.dpuf		
	EVA surface suit pressure	4.3psia 100% O2 for dexterous tasks (Section 5.1 EAWG) 6psia 100% O2 for non-dexterous tasks (nominal - for rapid EVA with minimal DCS risk) (Section 5.1 EAWG)				
	EVA suit O2 losses (leakage)	Oxygen leakage alone accounts for a loss rate of 0.02 kg per 4-hour EVA sortie, or 0.005 kg/h. If the spacesuit PLSS employs a swing bed carbon dioxide removal technology to reject carbon dioxide and water to the Martian environment, then some additional oxygen is lost as a sweep gas to aid the bed's operation. In this case, oxygen loss rates are 0.6 kg per 4-hour EVA sortie, or 0.15 kg/h. If cryogenic oxygen is used for thermal energy management as well as breathing, the overall oxygen usage rates are 4.0 kg per 4-hour EVA sortie, or 1.0 kg/h.	BVAD pg 138/171	the surface of Luna or Mars, but rather to compare the effects of suits with similar mass. The current Shuttle Program EMU is inappropriate for surface operations, while the historical Apollo EMU has many limitations and would be inappropriate for Martian surface operations.		
	EVA suit volume	Get from Hamilton Sundstrand Handbook				
	Airlock losses	"The USOS EVAs vent less gas due to the use of the Depress Pump that pumps air out of the US Airlock to the cabin. However, the Depress Pump can only be operated down to 13.8 kPa (2 psia) so the rest of the air is vented overboard." (NOTE: this is for vacuum - may be entirely different within Martian atmosphere)	Useful reference: pg 229, Out of this World - The New Field of Space Architecture	Based on the images of the living units, the airlocks appear to be incorporated into the living units. This observation is based on the stair cases extending from the living units.		They enter the settlement through the airlock in one of the Living units and spend the next few days recovering and settling in the new environment REF: http://www.mars-one.com/mission/roadmap/2025
	Airlock gas losses according to BVAD	About 10% of the free gas within the airlock is lost to space and not recovered by the airlock compression pump during depressurization. These losses could be reduced to 5 % at the expense of additional time and power consumption for the airlock pump. Other advanced concepts, however, may reduce the gas losses without corresponding time and power penalties	The AL air save pump package is provided by the Russians and is located in the AL. It reduces the pressure in the entire AL from 101.3 to 70.3 kPa (14.7 to 10.2 psia) for the EVA campout prior to EVA's. For EVA's, it will pump down the crew lock to 3.4 kPa (0.5 psia).	The amount of predicted O2 in the US Joint Airlock tanks is identified by subtracting known usage quantities for events leading up to the docking timeframe. Usually this gas is used only for EVAs, payloads, and contingency. There are two Airlock (A/L) tanks, a high pressure tank and lowpressure tank. A/L gas quantities are calculated based off telemetry pressure with a temperature assumption of 70 degrees Fahrenheit and compressibility taken into account. O2 USED FOR EVAS DURING FLIGHT "Depending on which A/L is assumed for the EVAs, whether the Shuttle is docked or not, and which prebreathe protocol is used, determines the amount of O2 used in support of the EVA." (ie. Airlock O2 is used for prebreathe)... For the one EVA with Shuttle undocked, O2 will be used from the ISS A/L. If an exercise pre-breathe protocol is planned, 11.34 kg (25-lbm) of O2 will be used and if an in-suit pre-breathe is planned, 4.53 kg (10-lbm) will be used."	PLSS O2 tanks are not recharged on orbit, but rather recharged on the ground then sent up to orbit	From: "Evolution of the Baseline ISS ECLSS Technologies - The Next Logical Steps" - SAE 2004-01-2385: "High Pressure Oxygen Supply - The high pressure oxygen gas storage system onboard ISS primarily supports EVA and if necessary provide makeup metabolic oxygen. The Shuttle system maintains its high pressure cryogenic oxygen storage around 900 psi and the ISS stores its oxygen up to 2400 psi. To enable the Shuttle's residual oxygen to be scavenged and stored within the ISS high pressure gas storage system, an oxygen recharge compressor assembly (ORCA) is used.... Alternatively, a high pressure water electrolysis system capable of generating oxygen at 2400 psi directly from an ambient pressure water source, would provide useful operational flexibility without the need for a separate oxygen compressor."
	ISS Quest Airlock Volume	11.95m^3				
	Minimum Contingency Airlock volume for Mars Transit Vehicle	3.7m^3 (corresponds to baseline volume used within BioSim) 3.7m^3 accomodates two cremembers at a time (current mission rules mandate this) 3.7m^3 corresponds to the Shuttle airlock volume Note empty volume of 4.25m^3, 3.7m^3 of gas when two crew members are present within the airlock (see cell to the right) 4.25m^3 is also the baseline volume described on pg 230 of "The New Field of Space Architecture"	Although the hatch size increases in an environment with gravity, the required airlock volume remains constant. A two-crewmember airlock has an empty volume of 4.25 m³. During use, the free gas volume within the airlock is 3.7 m³ and two suited crewmembers fill the remaining volume			
	Because EVA uses the buddy system, airlocks should accommodate at least two crew members at once.	Related to above reference: Chapter 17 - Out of the World - The New Field of Space Architecture				
	Standard 4.25m^3 airlock mass	510kg (631.1kg total when pumps are included - breakdown is ISS Pump: 79.4kg [b] Equalization Valve: 6.9kg [b] Controls: 14.8kg [b] Tanks: 20kg [c])	From: Chapter 17 - Out of this World - The New Field of Space Architecture b. from: Space Station Freedom Airlock Depress/Repress System. Design and Performance, SAE 921378, D. James, July 13-16, 1992. c. Estimate from Out of this World...			
	Power for Pumping (Airlock)	0.133kWhr for 30minutes (on ISS)	From Chapter 17 - Out of this World - The New Field of Space Architecture			
	Note that mission rules mandate two points of entry into any habitat					
	Exploration Atmospheres recommended by EAWG					
	Mars Transit	14.7psia/21%O2 nominal, 10.2psia/26.5%O2 EVA and during approach to Mars				
	Mars Lander	10.2psia/26.5%O2 nominal (docked operations) , 8psia/32%O2 planetary operations				
	Mars Habitat	8psia/32%O2 initial extended period, adjustment to 7.6psia/32%O2 for greater EVA preparation and egress efficiency				
	Airlock vs suitlock vs suitport? - drives atmosphere selection and leakage	Airlock dominates trade between suitlock and suitports based on minimizing loss of reosurces, minimizing overall mass, maximizing commonality, minimizing intrusion of surface dust, and accomodating transfer of crew, cargo, and an incapacitated crew member				
	Clothing Needs	get numbers from HIDH				
	Sources of Atmospheric Loss					
	Leakage through habitat walls					
	Airlock losses	"The USOS EVAs vent less gas due to the use of the Depress Pump that pumps air out of the US Airlock to the cabin. However, the Depress Pump can only be operated down to 13.8 kPa (2 psia) so the rest of the air is vented overboard." (NOTE: this is for vacuum - may be entirely different within Martian atmosphere)	Useful reference: pg 229, Out of this World - The New Field of Space Architecture			
	ISS Quest Airlock Volume	11.95m^3				
	Losses in CO2 removal (affects total O2) and TCC removal technologies (affects total pressure)					
	No. of EVAs (through CO2 adsorption) - may be regenerated in cabin with METOX regeneration)	1 every 2-3 days (in exploration mode) according to Figure 4.2-1 EAWG. At least two cre wmembers on each EVA and at least 1 remaining in the habitat				
	Payload losses	The final operational loss is from Payloads. Some Payload experiments will pressurize their experiments with cabin air and will vent it through the Vacuum Exhaust System (VES) to space after completing experiments				
	Sources of ISS Operational Atmospheric Losses					
	Operation	**Loss**				
	Shuttle Undocking	16.5 lbm air per mission				
	Progress/Soyuz/ATV	0.64 lbm air per mission				
	HTV/MPLM	3.5 lbm air per mission				
	CDRA	0.048 lbm O2/day, 0.084 lbm N2/day				
	Vozdukh	Up to 0.13 lbm/day air				
	БМП	0.002 lbm/day air				
	Payloads	Up to 78 lbm/year N2 (can be cabin atmosphere and/or Airlock nitrogen)				
	RS EVAs	35.3 lbm air per EVA				
	US EVAs	3.6 lbm air per EVA				
	Sources of Water Loss					
	Inefficient UPA and WPA					
	Hygiene water (showering and washwater)					
	Biomass production?	Becomes water content within food				
	No. of EVAs (through sublimator)	Does sublimation work for a Mars PLSS?				
	Laundry system (if we decide to close the clothing loop)					
	The astronauts will be staying on Mars for a long time, and they will need as much comfort as possible there. - See more at: http://www.mars-one.com/faq/health-and-ethics/how-much-living-space-will-the-astronauts-have#sthash.k4S9nv8Z.dpuf	This implies that laundering and showering facilities will be available				
	Note that wet areas (showers, kitchen, and laundry) will be located within Living Unit Landers					
	Atmospheric Control Equipment					
DONE	Fans	Find Power and Flow Rates - or determine flow rates necessary for mixing				
DONE	**BVAD Atmospheric Ventilation Requirements From Table 4.4.2**	Low: 0.076m/s, Nominal: 0.347m/s We can determine volumetric flow rates by assuming a duct cross sectional area and using Vdot = V.A				
	ISS IMV Fan Data (from BVAD Appendix)	**Mass (kg)**	**Volume (m^3)**			
	Damper Valve Assembly	2.7215	0.006125			
	Intermodule Ventilation Muffler		0.000237			
	Intermodule Ventilation Cap - IMV Cap - IMV Cap Flange Saver - IMV Leak Check Cap	1.9 - 0.635 - 0.4989 - 0.7257	 - 0.00192 - 0.00192 - 0.00192			
	Intermodule Ventilation Fan	4.1657	0.009283			
	Intermodule Ventilation Valve	5.2162	0.008284			
DONE	Read Corresponding Section in "Living Together In Space..." for more details	The rate of flow between adjacent modules is in the range 3,823 to 4,106 L/min (135 to 145 cfm). Note that existing Fan model moves moles of air rather than volumes	IMV fan characteristics include: • Air flowrate: 3,964 L/min (140 cfm) to cabin • DP: 2.54 cm (1.0 in) water column • Power (120 Vdc): 55W continuous • Mass: 4.7 kg (10.5 lb).			
	Function	**ISS Hardware Used**				
	Temperature and Humidity Control	The THC subsystem ensures that the temperature and humidity levels in the atmosphere are within the design specifications. Heat enters the atmosphere from the crew (metabolically generated heat) and equipment (lights, etc., although, much of the equipment-generated heat is removed by cold-plates). Humidity enters the atmosphere primarily from crew respiration and perspiration. The THC subsystem includes the CCAA, the AAA, and the IMV assembly. The CCAA provides adequate ventilation, and temperature and humidity control for the cabin. The AAA provides air cooling and air flow required for FDS in the racks. The IMV provides ventilation between modules for distributing oxygen to and removing CO2 and trace contaminants from modules that do not have ARS and ACS equipment. Particulates and microorganisms are removed from the atmosphere by HEPA filters.				

DONE		The requirements that must be met by the THC and the conditions that affect its design and performance are: • Heat removal capacity – 3.5 kW (including 1.0 kW latent capacity) • Ventilation flowrate – 194 L/sec (410 cfm) within the Lab or Hab with 9.4 L/sec (20 cfm) to AR – 142 L/s (300 cfm) within Node 1 with the Cupola closed off – 66 L/sec (140 cfm) between modules • Temperature control range – 18.3 to 26.7 °C ±4 °C (65 to 80 °F ±2 °F) • Dewpoint control range – 4.4 to 15.6 °C (40 to 60 °F) (RH 25 to 70 percent) • Coolant flowrate – 558 kg/hr (1,230 lb/hr) in the Lab and Hab – 273 kg/hr (600 lb/hr) in Node 2 and the AL • Mass – 93.6 kg (206.4 lb) • Power consumption – 467.5 W continuous at 203 L/sec (430 cfm) • Three settings – 142, 208, 264 L/sec (300, 440, 560 cfm).				
DONE	Intramodule Ventilation	Common Cabin Air Assembly (CCAA)				
DONE	Atmospheric Heat Removal	The CCAA's—located in the Lab, Hab, Node 2, and AL—remove excess heat and excess moisture from the atmosphere in order to maintain a safe and comfortable environment for the crew and equipment. Depending on the module heat loads, the atmosphere flowrate can range from 8,490 to 14,150 L/min (300 to 500 cfm).	Note that CHX (dehumidifier) is part of CCAA	For Mars One, there will likely be a CCAA in the inflatable modules and the living units		
		CCAA fan assembly characteristics are: (note that we probably want MPV of the entire CCAA for our purposes)				
		• Mass				
		– 12.7 kg (27.9 lb)				
		• Power consumption				
		– 410 W				
		• Volume				
		– 0.04 m3 (1.43 ft3).				

EVA Options

We explore EVA options as these drive the consumables demand that has to be met by ECLSS

Data below is from Section 5.2 of BVAD	**Summary**	**Raw Data**
Proposed CONOPS	Upper bound: 4 hour long EVAs, 2 EVA shifts per day, 2 crewpersons per EVA 5 workdays per week = 520 4-hr EVAs per year This is the expected number of airlock cycles per year	Because the gravity on Mars is about twice that of Luna and about a third of that on Earth, the overall mass of a Mars spacesuit is extremely critical. A likely mission design to mitigate this problem is to reduce the standard EVA duration to 4 hours and plan to recharge the spacesuit consumables at midday. Thus, to maintain the same time outside the vehicle during exploration, two 4-hour, or "half-day," EVA sorties per workday could replace the more traditional 8-hour EVA sortie. Assuming five workdays per week allows 520 half-day EVA sorties of two crewmembers per year without any allowance for holidays. This is also the expected number of airlock cycles per year. Each EVA sortie normally requires at least two crewmembers outside.

PLSS Concepts to Reduce Consumables		
Concept 1	Radiator to reject thermal loads, rather than relying on sublimation of water to reject thermal loads	This could reduce cooling water usage to 0.19 kg/h from 0.57 kg/h, which is a typical value when a radiator is not used. The calculation here assumes a human metabolic rate of 1.06 MJ/h (295 W). Water, which remains within the spacesuit, also provides the thermal working fluid to transport heat from the astronaut's skin to heat rejection equipment in the portable life support system (PLSS).
Concept 2	Cryogenic spacesuit backpack	Could potentially completely eliminate loss of water to the environment for cooling The cryogenic spacesuit backpack rejects thermal loads both to the environment, via a radiator, and to vaporize cryogenically-stored oxygen for metabolic consumption. As above, water still provides the heat transport working fluid.
Concept 3 (Syd's Concept)	Umbilical	Thermal management is still a problem here!
CO2 Swing Bed	Current concept for PLSS2.0 - CO2 Amine Swingbed technology	If the spacesuit PLSS employs a swing bed carbon dioxide removal technology to reject carbon dioxide and water to the Martian environment, then some additional oxygen is lost as a sweep gas to aid the bed's operation. In this case, oxygen loss rates are 0.6 kg per 4-hour EVA sortie, or 0.15 kg/h.

EVA PLSS Consumption sources (per 4 hour sortie)		
O2 consumed metabolically	0.3kg/4hr sortie, or 0.076kg/h	If a completely closed-loop system is used, oxygen is only consumed by metabolic activity and leakage. Under such conditions, oxygen usage is 0.3 kg per 4-hour EVA sortie, or 0.076 kg/h. If carbon dioxide generated while on EVA is stored by the PLSS and recycled once the crewmembers return to the vehicle actual oxygen loss is associated only with leakage
O2 leakage	0.02kg/4hr sortie, or 0.005kg/h	
CO2 Swing Bed (mentioned above)	0.6kg O2 lost/4hr sortie, or 0.15kg/h	
Cryogenic O2 for thermal energy management	4.0 kg O2 consumed/ 4hr EVA sortie, or 1.0 kg/h.	If cryogenic oxygen is used for thermal energy management as well as breathing, the overall oxygen usage rates are 4.0 kg per 4-hour EVA sortie, or 1.0 kg/h.

BVAD Table 5.2.4 - Summary of Mars EVA Operations

Value	**Units**	**Low**	**Nominal**	**High**
	MJ/CM-h		1.06	
Human Metabolic Rate During EVA	W/CM		295	
EVA Crewmember Hours per Week	CM-h/wk		80	80
EVA Sorties per Week	Sorties/wk		5 (for 8-hr EVAs) or 10 (for 4-hr EVAs)	5 (for 8-hr EVAs) or 10 (for 4-hr EVAs)
Cooling Water Losses	kg/CM-h	0	0.19	0.57
Oxygen Losses	kg/CM-h	0.005-0.076	0.15	1
AIrlock Volume	m^3	1.02	4.25	
Airlock Free-Gas Volume	m^3	0.89	3.7	
Airlock Cycles per Week	Cycles/wk	0	5 (for 8-hr EVAs) or 10 (for 4-hr EVAs)	5 (for 8-hr EVAs) or 10 (for 4-hr EVAs)
Airlock Gas Losses per Cycle as a Percentage of Airlock Gas Volume	Percentage	5	10	10

BVAD Table 5.2.5 - EVA Metabolic Loads

Parameter	**Units**	**Rate**
Oxygen Consumption	kg/CM-h	0.075
Potable Water Consumption	kg/CM-h	0.24
Food Energy Consumption	MJ/CM-h	1.062
Carbon Dioxide Production	kg/CM-h	0.093

EMU Options		
Mark III		Designed for rear-entry and use with suitports
Z-2 Space suit	http://jscfeatures.jsc.nasa.gov/z2/	
Z-1 (first within Z-Series)	http://techland.time.com/2012/11/01/best-inventions-of-the-year-2012/slide/nasas-z-1-space-suit/	

Potential Paper Discussion Points	Details		
Description of current baseline Mars One Mission Plan	Habitation architecture, astrodynamics, logicstics plan, ECLSS and ISRU philosophy - maybe summarized best in a diagram?	Take data from mars-one.com	
Description of current ISS ECLSS and logistics	Discuss logistics scheme, population/crwe size variation, contingencies, cost		
Discussion on mass estimation approaches	Three general approaches: 1. Bottoms-up 2. By analogy 3. Mass Estimating Relationships (using existing data)	For ECLSS, we assume existing hardware initially, then size accordingly if this does not appear feasible (mainly tank capacities and flow rates as a first estimate)	For ISRU, since there is very little data available, and all hardware is currently in development and not sized for flight, we use a combination of optons 2 and 3 for mass estimates
Effect of Number of EVAs on resource demands			
What to do with Methane? Pyrolizer currently not in flight ready state. Currently vented on ISS			
Solid waste? No clear solid waste management strategy Current state of the art - trash to gas; heat melt compactor			
Ability to support crew during contingency scenarios (ECLSS running in open loop mode) - what would it take to always have this contingency, and ability to recover from it?			
Cost?			
Food growth	Cable culture is a lighter weight option as compared to a shelf based system (UA lunar green house)		
Crop Growth			
Compression requirement for recharging high pressure tanks (eg O2 for EVA)			
Need an O2 adsorption specific technology to manage atmospheric partial pressures within the plant environment			
Previously observed failure modes in your simulation case studies	What happens if you don't size things correctly?		
Plants producing too much O2	3 options: 1. Selective O2 removal (requires new technology development) - O2 can be used for EVA and makeup purposes 2. Increase habitat volume (reduces O2 molar fraction by effectively increasing the size of the atmospheric buffer) 3. Dedicated plant growth habitat where conditions can be optimized for plant growth 4. Bring along stored food		
Show daily carbon gain comparison - proves that O2 production is correct (since it's just multiplied by OPF)			

Paper Structure	Section		Details						
1	Mission Intro and Background	Sydney	Mars One baseline and history	Summary of their mission architecture	Summary of paper objectives	Show model N2 diagram and structure sections according to its flow			**Cases:**
2	Habitation	Sydney	- Current state of the art - Current functional feasibility of state of the art (gap between state of the art and analysis assumptions - Technology Selection (if applicable) - Analysis assumptions - Model set up						*All food grown via plants*
3	ISRU	Sam							*All food stored*
4	Logistics	Koki							
5	Sparing	Andrew							
6	Integrated Mission Feasibility Analysis		Results and graphs (time-based for ECLSS, sizing for ISRU and ECLSS, sizing breakdown for Sparing)						
7	Summary and Conclusions								
*Writing in Word									
*Sec 2-5 due by Saturday noon									
*Meeting on Saturday									
TODAY									
Predeployment Numbers									
Bring yo own lunch									

Simulation Case	MATLAB m-file	Results file (.mat)	Results Summary	ISRU H2O Requirement (Liters)	ISRU O2 Requirement (moles)	ISRU N2 Requirement (moles)	Comments	Carried Food
Mars One Habitat Pre deployment phase				Potable water tank: 1500	1x Inflatable: 3783.11415389325 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 0.356321608106484 moles/hour O2 tank: 3750.234389649353 (equates to 120kg)	1x Inflatable: 10478.51241116094 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 0.986943623962865 moles/hour N2 tank: 10401.59349581990 moles	Meet these numbers between deployment and the time the crew arrives	
Fire risked hypoxic case		FirstRunWithBiomassPS.mat						
Decoupled code to test plant growth strategies	MarsOnePlantGrowthTest.m		Grow plants in batch mode (don't stagger) to maximize yield (this is a trade off against a large food store size)					
Hab with stored food and no EVA	MarsOneDefaultConfig???	4xN2store.mat	Crew survives 19000 ticks but requires 4x the ISS level of N2					
Hab with plant growth but no EVA incorporated	MarsOneDefaultConfigV2	MarsOneCropBatch.mat Result described to the right is saved in O2fireRiskPPO2tooLow.mat (obtained by running m-file to the left)	Crops produce too much O2 which drives the venting of N2 and results in the O2 molar fraction passing the flammability limit, and the total pressure reducing due to leakage, causing the ppO2 to decrease below the safe threshold and causing the crew to suffocate					
Hab with stored food and with 5 EVAs per week with METOX and UCTA	MarsOneNoPlantConfigWithEVA	4xN2storeWithEVAv2 4xN2storeWithEVA23000ticks (With ISRU): MarsOneNoPlantWithEVAandISRU	O2 store runs out, causing EVAs to be skipped after about 2300 ticks. Potable water store runs out but crew finds an equilibrium where they experience dehydration, then recover from it (then repeat this cycle). N2 store depletes causing leakage to dominate, reducing ppO2, and causing the crew to suffocate	H2O production rate: 0.2Liters/hour	O2 production rate: 1.5moles/hour	N2 production rate: 1.5 moles/hour		
Hab with plant growth and 5 EVA per week with METOX and UCTA	MarsOneDefaultConfigWithEVAandPlants	MarsOneORArun1	This involves plants sharing a module with the crew					
Plant Chamber on its own	MarsOneDefaultPlantsNoCrew	PlantChamber19000ticksComplete.mat StaggeredPlotGrowthFlightCrops.mat (this one took 15482secs!)	This file was used to determine that a separate plant chamber should be incorporated due to humidity concerns. This includes a CO2 injector to maintain CO2 molar fraction and its own ORA and nutrient storage tank. This file was run with a large initial water tank to determine nutrient storage requirements					
Crew, EVA, and separate plant chamber	MarsOneDefaultConfigWithEVAandPlantChamber							
Full Hab pre-deployment stage - no plants, only stored food				Total potable water tanks: 1500x2 = 3000	2x Inflatable: 2x 3783.11415389325 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 2x0.356321608106484 moles/hour = 0.712643216212968 moles/hr O2 tank: 3750.234389649353 (equates to 120kg)	2x Inflatable: 2x 10478.51241116094 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 2x0.986943623962865 moles/hour = 1.973887247925730 moles/hour N2 tank: 10401.59349581990 moles	Meet these numbers between deployment and the time the crew arrives	
Full Hab with EVA but stored food	MarsOneNoPlantConfigWithEVAFullHab	FullHabNoPlants (no ISRU case) FullHabNoPlantsWithISRU (uses RCA PLSS)		H2O production rate (for RCA case): 0.13L/hour H2O production rate (for METOX case): 0.21L/hour	O2 production rate: 1.6moles/hour (good for both RCA and METOX cases)	N2 production rate (RCA case): 1.5 moles/hour N2 production rate (METOX case): 1.7 moles/hour	Validated by simulation. Data file: FullHabNoPlantsWithISRU	2351kg (based on simulation run recorded in FullHabNoPlantsWithISRU.mat)
Predeploy for 100% crop case				With ISRU, we can reduce the cropwater store requirement to 11000L. Therefore, before the crew arrives, we need a total of 11000+3000 = 14000L of water produced over a 500 day period This equates to a water ISRU production rate of: 1.17L/hour	2x Inflatable: 2x 3783.11415389325 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 2x0.356321608106484 moles/hour = 0.712643216212968 moles/hr O2 tank: 3750.234389649353 (equates to 120kg) Over 500 days this equals 0.313moles/hour Total O2 ISRU requirement: 0.713 + 0.313 moles/hr = 1.03 moles/hour (same as no plant/all carried food case)	2x Inflatable: 2x 10478.51241116094 Over a 500 day (12000hours) predeployment period, this equates to a production rate of: 2x0.986943623962865 moles/hour = 1.973887247925730 moles/hour N2 tank: 10401.59349581990 moles Over 500 days, this equals 0.867 moles/hour Total N2 ISRU requirement: 1.974+0.867 moles/hr = 2.85moles/hr (same as no plant/all carried food case)		
Full Hab with EVA and 100% crops	MarsOneFullHabWithEVAandPlantChamber	IntegratedHabWithPlantsAttempt1 IntegratedHabWithPlantsAttempt2 IntegratedHabWithPlants19000ticks	Attempt 1 - Crew starvation started at tick 4091. Death occured on tick 9448 Attempt 2 - Fixed CrewPersonImpl2.takeFoodCalories - crew starvation started at tick 9302. Death occured at tick 15299 Attempt 3 (19000 ticks) - Fixed foodconsumerdefinition for EVAenvironment to also include LocallyGrownFoodStore ... SUCCESS! ... we may have a sustainable supply of food	1.13L/hour (verified by simulation)	0 (No ISRU required)	1.7moles/hour (verified by simulation)		406kg (based on simulation run recorded in IntegratedHabWithPlantsAttempt2.mat