Preface

"It's interesting as a thought experiment. I mean, Lansdorp doesn't have $6 bn, but NASA does and in terms of going only one way – hey, we're all on a one-way trip to somewhere! But I think it's utterly fantastical that you'll fund a Mars mission with a reality TV show."

Robert Zubrin.

Full disclosure here. I applied to Mars One in the spirit of 'nothing ventured, nothing gained'. I figured I would give the enterprise the benefit of the doubt and if it all fell apart then at least I would have material for a book, which is why you're reading this! So I have some insight into the Mars One mission and I also happen to have a number of space industry colleagues who went through the selection process, some of whom provided insight into the reasons why Mars One will never get off the ground. Also, as Editor-in-Chief of the *Handbook of Life Support Systems for Spacecraft and Extraterrestrial Habitats*, I had access to many world class experts who weighed in on some of the many, *many* reasons why the Mars One life support system cannot work – not for long at any rate.

> "None of the vehicles exist. And you can't just go to SpaceMart and buy those things. People don't know what astronauts do. We don't just go to astronaut school, take a few classes and then ride a station somewhere. That's not how it works. It's simply not the process; it's almost sweetly naive to see it like that. We astronauts are in fact intrinsically involved in mission design. And in making the process safe. And it's really hard to get to Space Station and back. We've killed people, just trying to get up to space and back. Even very recently. It is extremely difficult to do that [get there and back].
>
> "And the astronauts are as pivotal in making the process safe as anyone else. It's not simply a case of going to classes and learning which knobs to flick. That's not our part in the process at all. To be a shuttle commander, you already have to be one of the top test pilots in the world. Just to get selected – to get a start in the process. And we don't choose those people just because we want qualifications. We need those skills to safely do it. And even still, we lost two shuttles."
>
> *Chris Hadfield, Canadian Space Agency astronaut.*
> *Perhaps the world's best known astronaut and someone who happens to know*

Figure P.1 Credit: Mars One

more than most about spending time in space.

Mars One is a bold and very popular initiative; plugging it into Google generates 136 million hits! It is also an initiative mired in controversy. Their astronaut selection process required only a self-secured medical with the candidate's doctor. No mental health exam. No psychological or psychometric testing. Not even a criminal background check! In fact, the selection process to date more closely resembles the casting process for a terrestrial reality TV show than a serious astronaut selection. And on the subject of reality TV, Mars One's deal with Endemol Productions has fallen through. Its 6 billion dollar price-tag is fantasy because it doesn't consider resupply, while Mars One's assertions that it can attract media revenue at the same level as the Olympic Games are optimistic at best. Then there's Mars One's available finances. These are listed at just $700,000 (!), which is why the organization has suspended its robotic mission. And then there's the MIT life support study that predicts the first colonist will die after 68 days. Ask *any* professional astronaut and they will say the same thing: the technology required to get a human being to Mars and keep them alive on the surface does not exist – certainly not on a budget of $6 billion at any rate. But according to Mars One, these astronauts and highly credentialed people at MIT are wrong! So what is the real story? Rip-off? Hoax? Scam? Does Mars One have any chance of succeeding? You will find some of the answers in this book.

I've written more than 20 books and I have never had cause to include a warning before, but the content of this book may be disturbing to some, especially the 'Mars in a decade' crowd. The subject matter of this book may significantly disrupt your perception and belief as to whether a manned Mars mission is possible and will almost certainly shake your worldview of the viability of Mars One. This is not intentional: it is just that sometimes the truth hurts. So, if you want to continue to live in a fantasy world in which manned Mars missions are achievable within a decade on a budget of $6 billion and in which humans arrive on Mars unscathed by deep space radiation please stop reading right now. And, if you are a Mars One disciple who truly swallows the make-believe Harry Potter world where this can happen, perhaps you can save a couple of hours of your time by giving this book to someone else. But, if you are capable of dealing with the facts, however uncomfortable these may be, and if you feel there is something not quite right with the Mars One delusion, then this book is for you.

To begin with, let's give credit where credit is due and say right here and now that Bas Lansdorp did not invent the concept of a Mars One mission. Before Bas, there was Dirk

Schulze-Makuch of Washington State University. Together with his colleague, Paul Davies, Dr. Schulze-Makuch dreamt up a one-way Mars trip as a way of making an interplanetary journey more affordable: by as much as 80% in fact.

> "Really, this isn't a joy ride. You have to understand that the motivation for doing this is to not only open up a human presence on another planet, but to provide the opportunity to do some fantastic, groundbreaking science."
>
> *Dr. Paul Davies, Washington State University*

Now that we're clear on that, let's move on to a snapshot of the Mars One endeavor, such as it is. It all began with a website, complete with substandard CGI video. The organization bandied about a few letters from aerospace companies and the odd resume of people with little or no understanding of long duration spaceflight. They called a press conference to announce they were taking applications from anyone who wanted to go to Mars and never return. Nothing about the mode of transport. Nothing about the mode of landing, or the life support system, or radiation protection, or… anything really. But it was a reality television show so the media – predictable as ever – lapped it up. In fact they jumped all over it. A few clicks on Google and the hacks had their story. Never mind that most of the stories were full of holes. A one-way trip to Mars? What crackpots would sign up for something like this? And is it even viable anyway? Well, it obviously must be, because Mars One rolled out a Nobel Prize winner to say he liked the idea, even though this particular Nobel Prize winner's area of expertise had nothing to do with getting to Mars. But Nobel Prize winners are smart, so if this guy says it's doable it must be doable. The application process? Simple. Anyone can apply. After all, on a one-way trip to Mars what possible need would there be for a doctor or an engineer or a pilot? A baker you say? Sign up! Thousands did. To be fair, not all the applicants were astronaut no-hopers; there were some serious applications in the mix. But as the months dragged on, the reality, feasibility and fairy tale of Mars One began to unravel; hence this book. Still reading? Great. Depending on your perception, Mars One lies somewhere between an illusion perpetrated by one of the great con artists of all time, a suicide mission or just a crackpot idea. Which brings us to the wake.

In October 2015, I was lucky enough to be invited to give a talk at the Shackleton Museum Autumn School in Athy, Ireland. My talk was on the parallels between exploration in the 'Heroic Age of Antarctic Exploration' and future Mars exploration. At some point in the lecture, I described the Mars One mission architecture. I explained that while such a plan may seem extreme to many, this mindset was much more accepted back in the days of Shackleton and Amundsen, because 100 years ago the crews knew full well there was a good chance they were never coming back. After the lecture, a lady came up to me to say how much she enjoyed my talk and went on to suggest that perhaps the Mars One crew's families should hold a wake in advance of the mission, given that the outcome will be a foregone conclusion.

For those of you who have had the good fortune to visit Ireland, you will be familiar with the 'craic'. 'How's the craic?' is a greeting used by just about everyone in Ireland, and is a custom as common as St Patrick's Day or enjoying a pint of Guinness. More than most, the Irish have a rich history when it comes to customs and traditional rites. Especially when it comes to funerals, or 'wakes', as the Irish refer to their way of celebrating the death of a loved one. And 'celebrate' is the right word, because a wake is no place for tears. It is more a way

to celebrate the life of a loved one in a way unique to the Irish custom: with plenty of food and drinks! Why the talk of wakes in a book dedicated to spaceflight? Well, if – and it's a mighty, *mighty* big 'if' – this Mars One boondoggle is ever realized, then the mission planners could do worse than plan a wake in celebration of the very-soon-to-be-deceased crew.

The pre-launch wake will serve an important function, because it will not only mark the departure of the crew from their home for the very last time, but also provide some measure of comfort to their family members, relatives and friends, who will have an opportunity to say their final goodbyes to their nearest and dearest. Mars One take note. Now back to Mars.

With the Curiosity Rover (Figure P2) going about its business and the success of the '*The Martian*', it's not surprising that hardly a day goes by without some mention of manned missions to Mars, whether it be in the form of press releases, YouTube videos, NASA's marketing campaign – or those Mars One folks. Now, the blogosphere is overflowing with the naysayers and promoters of this self-styled suicide mission, but why does it attract so much press? Well, for the 'Mars in a decade' crowd it represents a fast track to Mars, because this sort of a mission can be done on a budget. Ask any engineer and they will tell you that it will cost ten times as much to bring astronauts back from Mars as it will just to get them there in the first place. Now you may be thinking that these sorts of missions should be left up to government agencies, but anyone who thinks that should take a step back and consider what plans NASA has to get humans to Mars.

You may have read about the Space Launch System (SLS), the Orion crew capsule and wonderful cutting edge space technologies, and how these will eventually enable astronauts to travel to Mars. You may also have read about the critical work being done

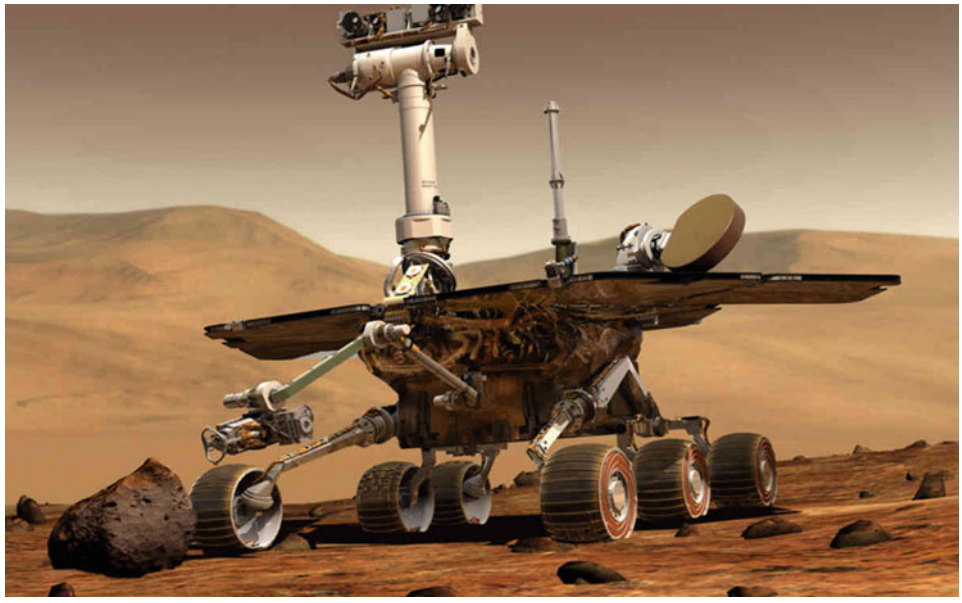

Figure P.2 Credit: NASA

to ensure that humans will land on Mars sooner rather than later and, after reading all of this, you may be persuaded that the venerable agency has a plan to get us to the Red Planet. After all, those pretty graphics showing mission architectures must have come about after an awful lot of planning by some very clever people, right? Well, yes, but how NASA is organized and how it operates isn't as streamlined as some people may think. For example, you may think that NASA Headquarters tells the rest of the NASA Centers what to do and those centers do exactly that, but this not how the agency works. In short, form does not follow function. And all those directorates: the Science Mission Directorate (SMD); the Human Exploration and Operations Directorate (HEOMD); the Space Technology Mission Directorate (STMD). Take your pick. And all those boards and councils and working groups? Well, you would think by looking at all those teams that NASA has this 'Mission to Mars' business figured out, especially when you see all the neat graphics. The problem is that while all these groups are supposed to coordinate a plan to get astronauts to Mars, it can't be done, because there just isn't enough money and no strategic master plan. Don't blame NASA for this, because it isn't NASA's fault. The agency does an absolutely incredible job with a budget that continues to be slashed in real terms, but there is only so much NASA can do with the pittance it is given.

A case in point: in October 2015, the agency released *Journey to Mars*, an upbeat 36-page report that described how NASA will send its astronauts to Mars. In the document were plans for asteroid capture, a deep-space laboratory and all sorts of new technologies that would be developed to help astronauts live and work on the Red Planet. The problem with this opus was that there were two key elements missing: dollars and deadlines. And without those, nobody is going anywhere. The problem? Political viscosity and successive Administrations – the Obama one in this case – that cut hundreds of millions of dollars from NASA's Mars programs. In fact, one of the reasons the Mars program and others have been kept alive is because Congress has passed budgets that have exceeded the President's budget request. But keeping a program on life support and actually making progress are two different animals, and if the United States wants to avoid more delays then the funding issue has to be solved. For quite some time, NASA has never known how much funding it will be receiving in any one year, and that makes it nigh on impossible to make any long-term plans, never mind developing all the new technologies needed for such a venture. To have any chance of putting government-trained astronauts on the Red Planet, NASA will need a big increase in funding *and* a coordinated strategy. Without those two factors, boots on the ground anytime soon is pure fantasy. Let's take an example. Back in the days when the International Space Station (ISS) was being planned, there was a proposal to fly a centrifuge called the Centrifuge Accommodation Module (CAM). You can see an image of this in Figure P.3. Needless to say, the CAM never flew. Instead, it is now gathering rust in a parking lot somewhere in Tsukuba, Japan. Which is a shame, because if the CAM had flown we would know a hell of a lot more about artificial gravity than we do now. But, because of fiscal viscosity, bad planning and the lack of a coordinated long-term strategy, we are almost as much in the dark about this Mars-enabling technology as we were 20 years ago.

And data on artificial gravity is just one of many, *many* data sets we badly need to acquire before a serious mission to Mars can be mounted. What about multi-year missions on the ISS? I keep a keen eye on the goings on in the world of manned spaceflight but I don't seem to remember a single NASA tweet about two-year missions. Or even one lasting 18 months for that matter. Yet a trip to Mars will be a multi-year mission, so how on Earth does NASA plan on gaining those invaluable long duration data-points? Especially now that the ISS is slated for decommissioning in 2024. Hmmm. The lack of a coordinated plan pretty much answers *that* question as well. Another check item on the manned Mars mission list is the sample return mission. NASA pulled the plug on this years ago and there is no definitive plan to realize this mission anytime soon. This, and so many, many other enabling missions and technologies are firmly slotted in the 'TBD' and/or 'fingers crossed' pile, thanks to the slow, uncoordinated climate that is pervasive nowadays. Another example? The Low-Density Supersonic Decelerator (LDSD). As all of you Mars fans know, one of the biggest challenges to any Mars mission, whether you plan on returning or not, is actually landing, and this is where the LDSD might come in handy.

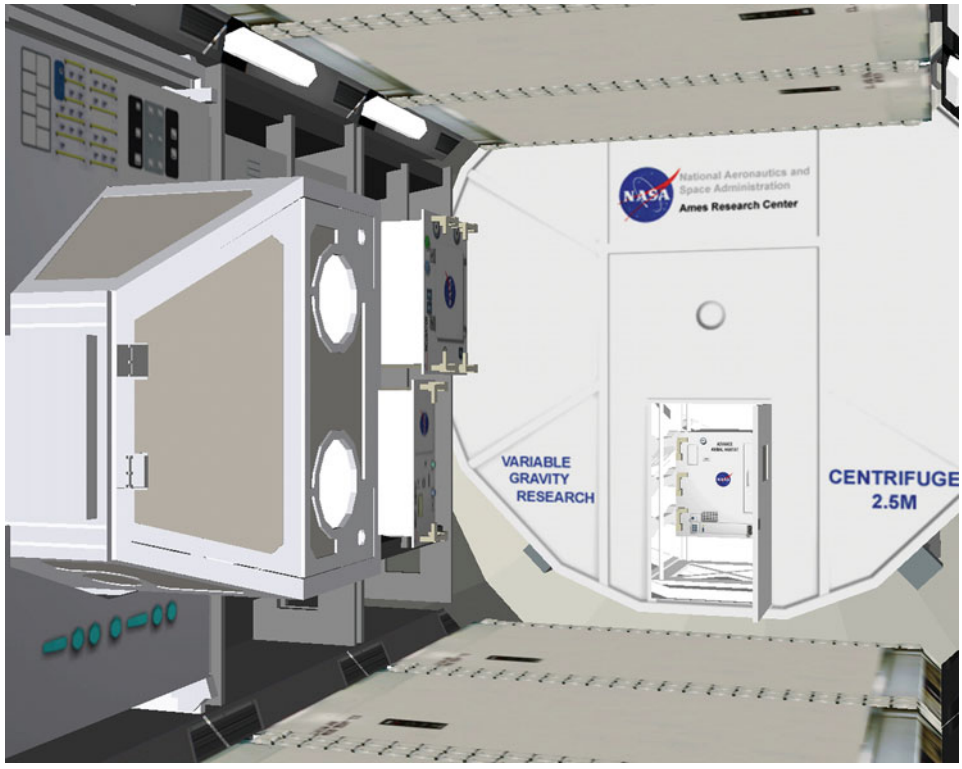

Figure P.3 Credit: NASA

NASA has tested the LDSD, and accumulated a fair amount of data until the parachute failed. The agency may do more testing or it may not. It depends, yet again, on funding and a coordinated plan. So, no artificial gravity, no LDSD and no multi-year missions. Let's face it, this 'manned mission to Mars' business is going nowhere fast. Sure, there are lots of graphics with arrows and flow charts with dates, but these do not constitute a viable plan to land humans on Mars in the 2030s. The 2130s perhaps. Pessimism? No, just a dose of reality. NASA has had a manned Mars mission on the drawing board for more than 40 years and all we have to show for those plans are some fancy graphics and charts. To many diehard Mars supporters, the 'Mars by the 2030s' mantra repeated by the NASA hierarchy is nothing more than a sales campaign and hot air, hence the support for other options – however misguided and far-fetched – such as Mars One. And even if there was a concerted effort starting today, we all know what can happen to best laid plans. Remember President Bush's Vision for Exploration (VSE)? It was announced in 2004 and it called for a return to the Moon by 2020 (Figure P.4). Well, since VSE was announced, the clock has been ticking steadily and NASA is nowhere near returning to the Moon. There is an outside chance a crew may fly a mission around the Moon sometime around 2023 but that speculative possibility hardly keeps the manned mission to Mars plan alive. The point is that NASA has been 20 years away from planning to send humans to Mars for the best part of half a century. Small wonder then, that a reality TV show called Mars One gets so much coverage: Mars supporters are just so fed up with listening to broken promises that they just want humans – any humans as it turns out – to get to Mars. Unorthodox? Certainly. Daring? Most definitely. Far-fetched and wildly ambitious? You betcha. Doomed to failure? More than likely. But for all the controversy surrounding this extravagant suicide mission, Mars One has captivated imaginations around the world by stating it will have humans on Mars by 2023. Or 2025. Or maybe 2027.

Mock them all you like, but you have to admire the bold idea of having everyday people pay money to sign up for the chance of being selected as an astronaut for a Mars mission. Harebrained? Absolutely. Feasible? No chance. We'll get into the details later in the book, but here are a few snapshots of why Mars One is doomed to fail. Let's begin with technology. In short there is a dearth of the technology needed to keep humans alive for months on end. In the world of manned spaceflight, this is known as life support. Now, if you listen to the Mars One debates and watch the interviews with the Mars One contestants, they will say all this life support technology exists. And to support this claim, the Mars One crowd uses the ISS as evidence, saying that these life support systems work just fine up there. Well, yes they do, but these systems won't work on Mars and here's why. On the ISS, the systems are replaced on a routine basis. That's the bonus of orbiting just 250 miles above the Earth: if something needs to be repaired, one of the supply vehicles can bring up the spare parts on the next resupply flight. Not so on a spacecraft en route to Mars. And on ISS, if something goes terribly wrong, the astronauts can simply pack up and head home in one of the lifeboat Soyuz craft. But if things go south on a spacecraft heading for the Red Planet? Well, let's just say it will be an unfavorable outcome for all concerned. Let's extend this logistical resupply issue a little. One thing NASA has learned over the years is that stuff breaks down. A lot. Which means resupply runs. Lots of them. In fact, the ISS gets resupplied every three months or so. But a Mars mission? We're talking about a long stretch of 26 months between resupply runs. No return vehicles for the Mars One

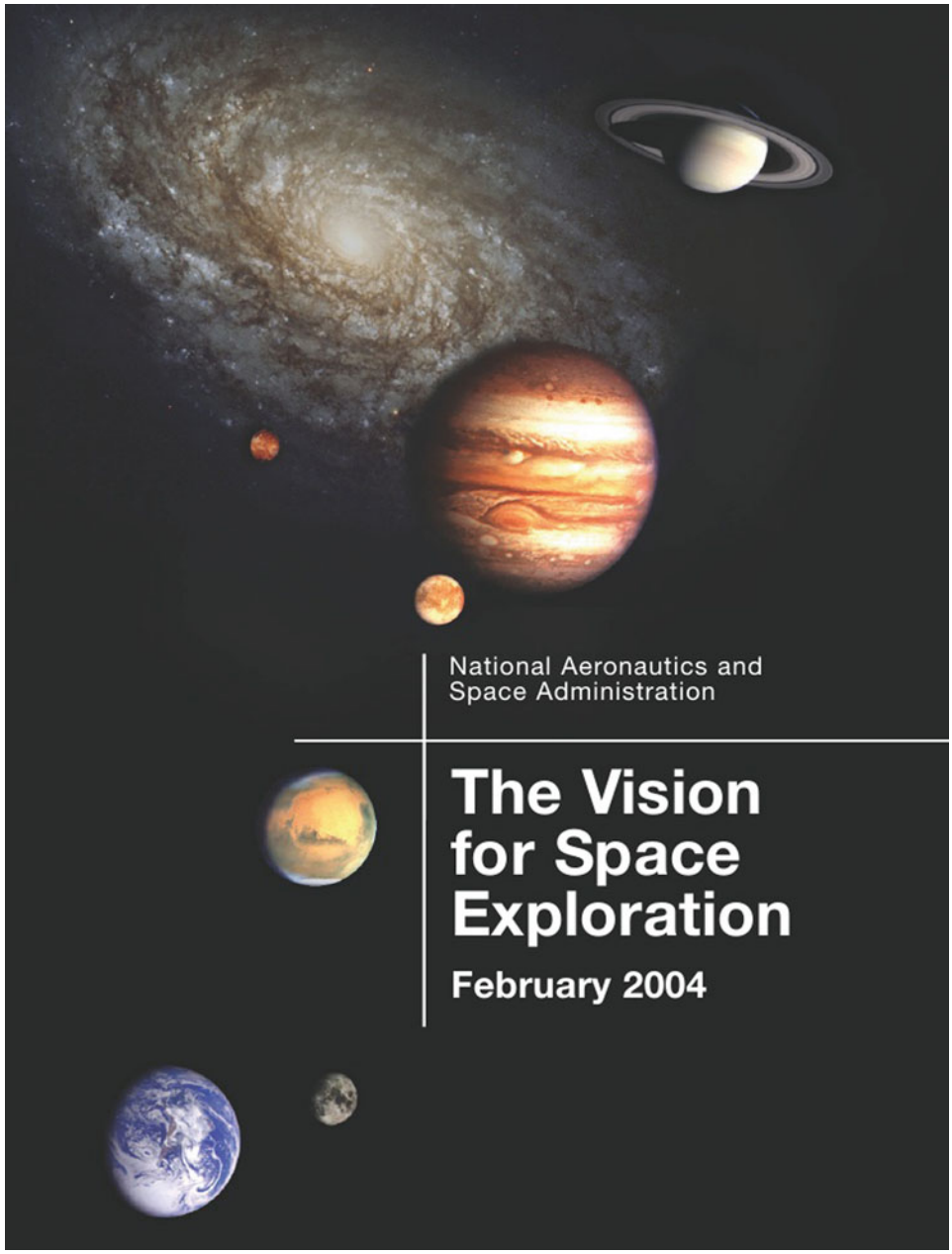

Figure P.4 Credit: NASA

astronauts, remember. Now, researchers have crunched the numbers and have reckoned that the Mars One crew will have to take along an awful lot of spare parts: based on the experience of astronauts living on the ISS over the years, three SpaceX Dragon vehicles will need to be stuffed with spare parts for every two crewmembers. And that's just to ensure a 50 percent chance of survival. That's bad enough, but the spare parts issue doesn't stop there, because the second crew will need to truck along its own spares and extra spares for the first crew. And so on and so on. Oh dear. Obviously such a mission plan is unsustainable. In-Situ Resource Utilization (ISRU) you say? Sure, but there is a *long* way to go before we have an ISRU system (Figure P.5) that is going to work reliably on Mars, as we'll find out later in this book.

But hasn't the Mars One team insisted that no new technology needs to be developed for this enterprise, such as it is? Yes, they have, which makes all these claims all the more surreal, because it would suggest that the Mars One team know something that space scientists and engineers don't: namely how to extract resources on the surface of Mars. Maybe they meant conceptually? Well, if they did then those in the Mars One team have a flimsy grasp of how conceptual understanding relates to actually doing stuff. After all, we have a pretty good idea of how fusion works, but nobody has actually gone ahead and built a fusion reactor because fusion is a tough nut to crack. As is ISRU as it turns out. And life support. And… well, you get the idea. Mars One defends itself against the naysayers on the subject of technology by insisting that the tech will be developed once they have investors. Catch-22 anyone? Let's face it: who in their right mind is going to sink money into a mission architecture when in reality there is no mission architecture? And there is no mission architecture because Mars One is still developing it. They don't know which vehicles will be ferrying their reality TV lemmings to the Red Planet and they haven't got a clue what sort of life support system they will be using. In short, the whole enterprise has no plan.

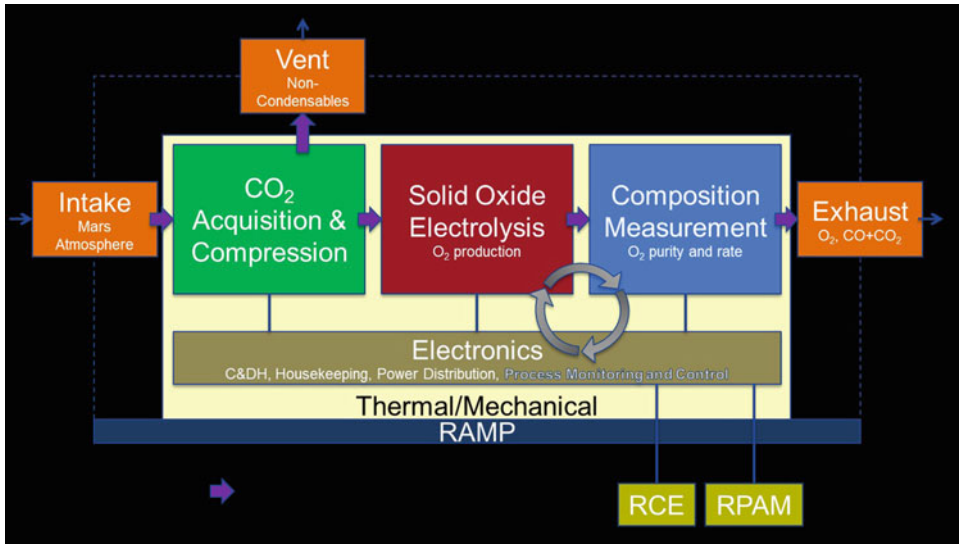

Figure P.5 Credit: NASA

OK, so enough about technology for the moment. What about some of the physiological mission-killers? Radiation, for instance. As long as there have been astronauts, we've known that space is a risky place to be. And one of the reasons it is so dangerous is radiation. For decades, we have been fed images and computer-generated videos of astronauts rambling around (Figure P.6) on the surface of Mars, when in reality they will be holed up in bunkers deep, *deep* underground. How little did we know. You see, radiation is the number one mission-killer in deep space and the take-home lesson from the results of all those radiation readings accumulated by probes sent to Mars[1] is this: take shielding – and plenty of it!

Now those of you who watched *The Martian* and believe (don't!) what they see in Hollywood movies may be wondering how Mark Watney survived. After all, NASA's most famous stranded astronaut spends most of the film wandering outside with little or no radiation protection to speak of, except for a space suit. In reality, Watney would have died of cancer, an outcome acknowledged by Andy Weir, the gifted author who wrote the book. Weir has acknowledged the lack of radiation protection in interviews, arguing that he had to apply some artistic license for the sake of moving the story forward. In the real world, the radiation measurements sent back by Curiosity indicate that after the outbound trip to Mars and 500 days on the surface, astronauts would receive a dose of one Sievert, which is about a five percent increased risk of cancer (NASA limits prescribe no higher than a three percent increased risk).

Now you may argue that this manned mission to Mars business is so risky that you just have to accept these hazards. Well, yes you do, but what happens to the crew when they start dying and losing their minds? You may be wondering why astronauts will lose their

Figure P.6 Credit: NASA

[1] The Mars Curiosity Rover calculated the average dose of a 180-day mission to Mars as 300 mSv, or about fifteen times the annual radiation limit for someone working in a nuclear power plant.

minds (some may argue that simply volunteering for Mars One would qualify, but that's another story), but the latest research shows that being exposed to cosmic rays for many months can result in brain damage and eventually dementia-like symptoms, such as memory deficits, confusion and loss of awareness. How do you care for an astronaut bumbling about a habitat unable to recognize his or her fellow crewmates and unable to perform the simplest of functions? It's a bad scenario at best. Mars One's answer? They don't have one and neither do any of the space agencies.

"We are very confident that our budgets, timelines and requirements are feasible."

Bas Lansdorp

You may be Bas, but the rest of us involved in the spaceflight industry are less than convinced. Your budget is a work of fantasy, your timeline is delusional at best and your requirements? Well, turn the pages and find out what the experts think about your requirements.

http://www.springer.com/978-3-319-44496-3

Mars One
The Ultimate Reality TV Show?
Seedhouse, E.
2017, XXIII, 174 p. 93 illus., 84 illus. in color., Softcover
ISBN: 978-3-319-44496-3