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Model, Prototype, Simulation and Mock-up Development that Will Take Us to Mars and Beyond

There are many experimental steps and procedures in the development of new technology. With space exploration, continuous testing must be done with the use of models, prototypes, simulations, and mock-ups to achieve a successful mission and understand the reactions of nature far from reach of human hands over a large period of operating time.

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We have entered an era of technology where machines are being developed to generate their own energy, operate by remote control, operate with motion sensing, navigate with global positioning, collect data, store data, recall memory, follow schedules with internal clocks, navigate with global positioning systems, perform tasks in challenging environments, and use environment for function. These developments can allow us humans to work out of human reach or human life support and at speeds, strengths, endurance, and accuracies we cannot comprehend. We could not have achieved this technology we have obtained today without experimenting with prototypes, simulators, models, and mockups.

Since the beginning of human life, we have been constantly exploring new lands, cultures, ideas, sciences and procedures. Now, we have a new goal for our world and that is exploring and expanding beyond our atmosphere. People want to discover whether life exists or existed at one time on other globes. People want to know if it is possible to make life possible beyond our atmosphere. Mars is the next closest goal to the moon.

A big reason why outer space exploration is so difficult has to do with humans surviving months or even years without an ample supply of resources, so we use robotic space crafts and probes instead. This equipment has to be able to operate flawlessly hands free of humans. There are many steps and phases that have to take place before the craft reaches a destination, and it would be a shame if after many months or years, there is a malfunction without the ability of recovery. We need prototypes, simulations, models and mockups to solve possible errors before we launch a multi-million dollar mission that fails months later due to something as simple as a toothpick getting in the way of a crucial operation needed to get the craft to its destination safely.

The Advanced Space Propulsion Lab was founded by NASA's Johnson Space Center in 1993, and Dr. Franklin Chang-Diaz was the astronaut to start it with the intent to do research on propulsion that would dramatically shorten transit times between planets, while also increasing possible payload mass. The rocket they are working on now will hopefully use plasma with electrical charge that will thrust 100 tons at a temperature of 50,000 degrees rather than a chemical reaction. This will bring a craft to Mars in about 3 months.

Computer simulations were used to guide and understand the experimental goals in the developmental process. The production, contained heating and reactions of the plasma was the lab's main focus. Plasma diagnostics are critical for determining the behavior of the system. The animated computer models can also be found online.

Mars Express is the name of the air craft penciled to take flight by the year 2003 under the project manager Rudi Schmidt. Sixty-three engineers from many industrial teams had a critical design review so that the plans could be scrutinized using the knowledge from vast backgrounds. Usually, they take this step after a working model is built, but were pressed for time.

The propulsion system was installed last July and fitted with mass dummies in order to see how weight affects flight as we will have to do with the flight simulator being worked on in class for balance. They also had planned to do mechanical tests by filling the tanks with substitution fuel of water and iso-propyl alcohol for center of gravity simulations at Intespace, Toulouse. This structural model will eventually become a spare unit for parts, because it will have the exact same parts as the craft taking flight. The Beagle-2 lander, which is going to be transported by Mars Express, and the solar array units will be more than just mass dummies. They need to have movable parts so that vibration stimuli can be addressed.

During structural testing, Mars Express was hung to measure the shock created when the

explosive bands that hold Beagle-2 to the hull are fired for release. Too much shock and Mars Express will be sent out of orbit.

As of now, the craft is having the weight dummies replaced with flight models in Alenia, Torino. They believe that by May of next year, the spacecraft that will actually fly to Mars, will be ready for the flight model tests.

In Toulouse, on the bread boards, testing on electrical and verification systems are constantly becoming more complex as more components and sub-systems need to be integrated.

Even the models and prototypes have stages in development that need to be tested for accurate performance. When each of the stages have been run, changes may need to be made again due to other modifications. Everything needs to be integrated to match the changes in the design, but each stage needs a ball park idea to go off of.

Transportation to Mars is complicated enough and is only half the battle NASA faces. The Robotic Vehicles Group performs research, development, and tests of mobile robots for NASA. These will be hopefully be used to get up close with mobile reconnaissance as well as collect deposits. NASA wants to be able to drill for possibilities of water on the planet. Current operational vehicles range from micro rovers weighing under 5 kilograms that are designed for planetary exploration, to 3,000 kilogram military trucks, to rover test beds with demonstrated cross-country autonomous navigation capability. Other vehicles include teleoperated robots for investigation of hazardous material spills. As of now, they are working on prototypes of rovers to acquire Mars deposits. Personally, if you see the pictures of these things, I would love to take them for a go around at Battle-bots.

Simulations of different terrain have to be constructed to make sure these rovers can overcome the obstacles they may face. There is no turning around for a different look at the drawing board.

Beagle-2 was only briefly mentioned. It was named after the ship in which Charles Darwin sailed when he formulated his ideas about evolution. In the year 2003, Beagle-2 will leave Mars Express and hurtle towards Mars pulled by the planets gravity. Although there are experiments being done here on earth with high altitude flight and props, a heat resistant shield is hopefully going to protect Beagle-2 until parachutes are deployed.

Mars is a totally different ball park. Gravity is not the same. It is missing a magnetosphere and an o-zone, which is why NASA wants to drill. Everything on the surface would have been burnt by the sun, oxidized, and dried up. The only evidence on the surface would be topographical photos taken from descent into a basin where there is more likely the chance of water flow at one time.

If we take a look at all of the processes, stages, tools, machines, and expertise required, there are a large number of people that play a key role into making a complex mission such of this nature work properly. The people designing have to be able to communicate with people running the tests. They both have to communicate with people operating and building the final structure. Operators will have to take classes on how each function works, and why they function as they do. Development is a slow and tedious process requiring much research. In the case of this Mars Mission. Three years of non-stop trouble shooting, computer crunching, and brain storming. The rovers are examples of ideas not being stupid ideas.