

Business Proposal: The X-Suit

It was in 1957 that mankind took its first big step in becoming the first interplanetary specie. This step, which was a momentous occasion at the time, was to send a small dog by the name of Laika into orbit in the pressurized air cabin of Sputnik 2. However, even the well financed, technologically superior, and vastly intelligent Russian army of Cold War rocket scientists and engineers could not solve the problem of how to keep little Laika alive in the harsh atmosphere in the vacuum of space.

Today, in the 21st century's space flight industry, the world is closer than ever to finally producing economically and technologically feasible ways of launching private enterprise into the arena of the stars. Companies all around the world are already planning ways to bring paying passengers to the moon and back. Various national space programs have announced that they too will look to land on the moon; the United States plans itself to return to the moon by 2020 in order to build a permanent base. But despite all of these vital advancements, perhaps the most basic necessity for human lunar travel, the overall health of the astronaut, has been overlooked. Astronauts that travel into space feel, as a result of the 0g environment, fatigued, congested, and sick. Lunar explorers report difficulties in tasks as simple as walking around on the lunar surface. Astronauts traveling to space for long periods of time experience health problems as serious as rapid bone deterioration, muscle loss, and other serious side effects. All of these problems will prove to be detrimental to the lunar excursion industry by making the experience less enjoyable for the traveler, introducing serious health risks, and providing a need for expensive rehabilitation programs, medical tools, and possible lawsuits. These are the problems that the future lunar tourism, mining, and habitation industries will have to cope with in order for lunar exploration and colonization to be a success.

Our company, Final Frontier Apparel (FFA), has found several solutions to these problems and has integrated them into the technologically superior lunar excursion suit of the future, the X-Suit. This suit, designed with an array of sensors, light-weight high-strength fabrics, computer processors, interface systems, communications equipment, Electro-rheostatic, and shape memory alloys, will tackle the challenges of muscle loss, bone loss, astronaut discomfort, and extraterrestrial biomechanics head on. Not only can our suit be fitted with all of these bells and whistles, but FFA will also offer customized versions of the patented X-Suit that will give the consumer the options of which features and add-ons they like in order to make the suit more cost effective and more individualized to the consumer's personal needs.

FFA has come up with a quadruple-tiered launch proposal for its product, the X-suit, which will first target high value long term contracts and then work its way down to the point where we will distribute the suit on a one-by-one basis. In the first tier of our product release strategy which will be implemented around 2015 (five years before NASA plans to return to the moon), we plan to target today's largest consumer sector in the space industry which consists of Government run space agencies which spend a total of \$62 Billion per year (Euroconsult, 2008) [(\$17.3 Billion in the US alone (Alexander, 2007)]. In particular our primary targets are the space agencies with budgets over \$1 Billion and space/lunar based infrastructure that would justify their long term funding and purchasing of our product. When targeting this sector, we must keep in mind that these agencies are looking at several key factors in their lunar excursion suits, 1) long lasting durability, 2) advanced technology, 3) astronaut comfort, 4) sensory technology, 5) communications equipment. For these agencies, price is not an issue since they end up subsidizing many of their suppliers companies anyway. It is vital that we show these companies that the X-Suit will be the future of lunar excursions due to the fact that it specifically addresses all of the aforementioned factors in addition to utilizing technologies that will also help both exercise and augment astronaut strength, reduce the risk of long term bone and muscle loss, increase comfort and ease of natural motion, and incorporate the latest in user interface technologies. Government space agencies will appreciate the fact that because the suit offers a built in system that can exercise the astronaut's muscles in the moons 1/3g environment just as if he were on earth, they will not have to waste space or weight capacity on exercise equipment. This also increases the astronaut's efficiency and allows them to work the entire day without having to take 2 hours each day to exercise in order to maintain their muscle mass. The suit itself is very compact and is fitted with built-in sensory devices, CPR capabilities, and other medical devices, meaning that less medical gear will be needed. Once long term agreements for the acquisition of these suits have been signed, we will have the cash, government backing, and prestige required in order to market the X-suit to smaller private companies.

The second tier phase of the release plan specifically targets the private enterprises in the space flight/lunar exploration industry and will commence around the year 2020. These companies like Virgin Galactic, Space X, and Space Adventures, among others, will look to acquire the X-suit for several reasons. First and foremost, these companies are looking for products that are cost effective because like FFA, their goal is to make a profit. With the cost of current NASA space suits at \$22,000,000 (Bolonkin, 2008) and companies like Virgin Galactic looking to spend roughly \$20,000 (Reiss, 2007), affordability is the clearly the primary issue. These companies will appreciate the fact that the X-suit is customizable and can offer whichever options they desire. Some companies may forgo certain options on the X suit like human waste disposal system if their lunar excursions are short, and they may choose to upgrade the user interface system to add to the lunar tourist's experience. Also in terms of cost, private companies will appreciate the fact that the X-suit is extremely light compared to its competition. Current space suits weigh roughly 300 lbs, and at the cost of \$10,000 (Davidson, 2008) per lb to send something in to space, weight and efficient usage of space are also big issues. Our suit is light, compact, and easily compressible at a projected weight of 20 lbs. Another reason that the X-suit is so attractive is its pure aesthetics and marketing capability. Big, square, and bulky space suits will be a thing of the past and slim, flexible, and sleek, tight-fitting suits are the way of the future because they will offer space tourists as much mobility as if they were in a track suit. Also, if FFA succeeds in winning government contracts, private companies will be assured that they are buying a reliable, top of the line product and that their customers will be wearing the same thing as the professionals. Looking ahead into the future, when industries other than space tourism start taking interest in the moon for reasons like mining and space craft construction, ease of mobility and long-duration human health will be of huge importance and the X-suit will be the first step in providing the everyday extraterrestrial clothing of the future.

Our third tier consists of the individual space traveler and will commence in roughly 2025. It is assumed that by this time FFA has secured a strong foothold in the commercial lunar tourism market, and that long term lunar bases and other lunar based industries have been established. The next market targeted consists of mainly individual consumers who are looking to buy the X-suit because they either live in a permanent settlement on the moon or their work requires that they go out and work on the lunar surface. It is assumed that at this point in the future, mass production of the X-suit has been perfected and that the costs of production of the X-suit have dramatically decreased due to more efficient building methods and cheaper and more readily available construction materials. This individual consumer will by now be familiar with the branding of FFA and the X-suit, as it has played a fundamental role in the development of lunar excursion suit technology. At this point and at this tier of consumer, the lunar spacesuit is neither simply a remarkable piece of technology nor just a tool. At this point in the future, with the standard technology of the X-suit so readily available to the consumer, FFA will start to portray the X-suit as not just a suit, but rather a piece of high-tech which is also worn on earth. It is at this point in the future that the aesthetic design of the suit itself may be just as important a factor to the consumer as the technology and materials that are integrated into the suit. Here is where fashion and function will merge to create a product that is part artistic masterpiece, part technological marvel. By offering different styles of suits in different colors, people will be able to customize their suits using thermo-chromatic, electro-chromatic, and photo-chromatic materials that will change color in response to changes in heat, light, and electric current. And it is in this way that the X-suit may be marketed to the average consumer as a trendy fashion statement which will mesh well with the aesthetic and artistic norms of the future.

The fourth tier release will be implemented from 2020 onwards. However, at this stage, we do not release a spacesuit per se, but rather a terrestrial version of the X-suit with many of the same technological features. This terrestrial X-suit, or Tex-suit for short, will be tailor made to integrate seamlessly with the terrestrial environment and will thus offer many similar technologies. The only difference in the Tex-Suit will be that the various technologies will be geared specifically toward terrestrial activities. For example, an athlete searching to increase his physical fitness and stamina may purchase the Tex-suit for resistance training. By selecting specific programs and settings in the suits internal CPU, the athlete may adjust his resistance-training level to whatever suits his specific needs. This process could turn average activities like walking the dog, doing laundry, or mowing the lawn into whole body workouts. Senior citizens may take interest in the Tex-suit due to the fact that it offers a full array of sensors and diagnostic information for the user. A senior wearing the Tex-suit could be told via the wrist touch pad information like heart rate, blood sugar, blood oxygen level, and more. If a senior citizen wearing the Tex-suit were to suddenly have a heart attack, the Tex-suit could sense erratic heart behavior and then perform CPR by using light jolts of electricity and also by thumping the chest by tensing and relaxing the electro-rheostatic material, all while simultaneously sending the patients distress signal and location to paramedics via the built-in communication system. Patients in need of physical therapy could use the Tex-Suit as a safe way to rebuild muscle and bone

strength under the guidance of the CPU program. The CPU in the suit could be programmed to gently guide and provide support to the rehabilitation patient learning to walk, almost like a tennis or baseball coach guiding an athlete's hand through the correct swinging motion. The Tex-Suit in conjunction with the corresponding helmet and Heads-up Display (HUD) could provide US army personnel with highly realistic training scenarios. The suit may even be programmed to help a professional mover augment his lifting capacity by stiffening electro-rheostatic material in the knees, back, and biceps. With highly sophisticated sensors planted in hundreds of places in the suit, the suit would be able to gather and process information in order to increase the efficiency of the suit's contracting and relaxing motions. The suit, in this sense, learns the unique movements of its user and strives to provide contracting and relaxing movements that correspond with the users unique movements. These Tex-suits would also be much less expensive than their space counterparts because this version could be customized by the consumer to have the options they need, without having the consumer pay for options they could do without. In addition the Tex-Suit does not need costly pressurization materials, heating and cooling systems, and breathing equipment. These Tex-suits will truly prove to be the ultimate in terrestrial clothing utility.

When looking at the developmental costs of such a project, FFA projects that in order to design a model, standardize production, subcontract smaller components, manufacture main components, market, and assemble the suit, the total cost of the contract would need to be roughly \$100,000,000 over 10 years at which point, in 2019, the suits will be ready for purchase by NASA, which plans to return to the moon in 2020. We estimate that over the next 5-7 years or so, new production methods and production competition coming from China and India will make state-of-the-art materials cheaper and more fine-tuned, CPU construction will become increasingly cheaper with the end result being a higher rate of performance, subcontractors from China and India will compete against each other in higher-end machining industries making subcontracting small parts cheaper, and finally, new technological advancements in the areas of nanotechnology, chemistry, and high-end machining will lead to relatively cheap production costs. We estimate that the suits themselves will have a production value of 5% the initial contract value assuming we manufacture 20 X-suits for \$250,000 a piece. The remaining 95% of the initial contract money will be used in areas like research and development and testing which will comprise of roughly 70% of the initial contract value. The remaining 20% of the contract value will be used to discern cost-effective and pragmatic ways to streamline production through automation, outsourcing, complex machining, and other similar methods. All in all, compared to Oceaneering International's bid for \$745,000,000, our contract is relatively inexpensive. Our goal is to get to a place where we have streamlined production so well and have used materials and technologies whose future values will have decreased so much that we will be able to enter the private investment area of the lunar exploration market with an X-suit that will only cost roughly \$20,000 per unit depending on the options and quantity requested.

Once we establish FFA as the premier lunar excursion suit manufacturer in the private lunar exploration sector, FFA apparel projects that it will be building 50 suits per year in 2020 and that amount will double each year after that as more and more pioneers "settle" in lunar colonies whether sponsored by private enterprise or funded by the government. That means that by 2025 FFA will be making 1600 suits per year for a total revenue of \$32,000,000. Keep in mind that all the while, production costs are getting cheaper due to falling material prices and the streamlining of production, both of which will result in a continuous increase in profit margins. Our two goals in this stage are to lower production costs and lower sale costs so as to make lunar travel and lunar industry cheaper and thus, by planetary migration, enlarge the lunar market for future X-Suit consumers. Once FFA feels like it has a sufficient population of individuals settled in lunar colonies on the moon to serve as consumers for the X-Suit, FFA will release X-suits for individual sale to the population at discount prices in order to increase profits by selling in bulk.

At this stage in the release of the X-suit to the lunar population of an estimated 5000 people, the X-suit will cost roughly \$16,000, roughly equivalent to a low-end automobile. At this point, we expect a mass interplanetary migration to take place as mining companies, steel and other metal manufacturers, and aerospace companies look for unique opportunities in the sectors of lunar mining, unique atmospheric environments for high strength alloy construction, and space craft construction. This influx of lunar industry will attract even more immigrants looking for jobs and adventure. FFA will be the low-cost lunar provider of excursion suits for the masses. By the year 2040, FFA projects a lunar population of 50,000 people and growing fast as mass transportation starts to open up lunar colonization to billions of people across the Earth. FFA projects that it will make roughly 5,000 suits a year bringing in \$80,000,000 in revenue per year in addition income from refurbishing or replacing older X-suit models.

On Earth, FFA will be producing a line of less expensive terrestrial X-suits, or Tex-suits, that will be aimed at mid-level income consumers. These suits will only cost a mere \$1000, as they will not need all of the pressurization, advanced power supply, heating and cooling, and other systems that the space version of the X-Suit does require. However these Tex-Suits will have many of the same advanced computing, user interface, rheostatic materials, and communications equipment as the space suits. The general public will now have access to what "is worn in the land of the stars." By using the mystery and allure of space and the lunar lifestyle as a marketing tool, FFA, with its X-Suit, will become the leading provider for the clothing of the 21st century space age.

Unfortunately for the industry, today's spacesuits are all extremely generic and all provide the same basic life-support services which include pressurization, audio communications, heating and cooling, waste management, and not much more. Critics have called these generic suits bulky, heavy, uncomfortable, cumbersome, and impractical and many astronauts would much rather have a suit that doesn't impede their motion with every movement they make. New suits, the most popular of which is MIT's "Biosuit," are designed to fit the astronaut in a skin-tight manner, with flexible polymers providing mechanical counter-pressure instead of having to fill a bulky suit with air pressurized at atmospheric pressure, allowing for greater mobility and comfort for the astronaut. But we here at FFA feel that the space suit is capable of so much more than life support and we believe that the space suit should not just be a tool that you wear in space out of necessity, but rather another part of the experience of traveling both on the moon and in space. We feel that a space suit should be designed in such a way as to help one perform actions which one is not normally capable, not hinder their every motion, and furthermore, we believe this applies to professional astronauts as well as amateur, private space travelers. The suit should be part of the experience, part of the excitement, and part of the individual. The X-Suit is the first suit of its kind to successfully accomplish the task of facilitating the ultimate integration of man with machine. The HUD (heads-up display) on the visor of the helmet will constantly be sending the astronaut information about his/her body's vital signs and location in space. The rheostatic materials will seamlessly contract and relax in perfect harmony with your body's natural movements, eliminating the awkward feeling most astronauts experience while walking around in a 1/3-gravity environment and making it seem like one is truly walking in Earth's gravity. The CPU will constantly be analyzing data that is being transmitted both from mission control and also from the hundreds of tiny biomechanical sensors that can pick up every movement the astronaut's body makes. The heating and cooling system will automatically adjust the suit's humidity, oxygen level, and temperature by simply checking your body temperature, shivering, heart rate, dissolved oxygen levels, and more. To summarize, the X-Suit will become a symbiote of the astronaut's body, and when one takes it off, he/she will miss the ease and convenience of having information, control, and strength at one's fingertips so much that one will immediately feel the need to put the suit back on. Perhaps the most important and unique element of the X-Suit is its capacity to serve earth-goers just as well as it serves space travelers. Many of the functions found in objects and inventions that were designed exclusively for space were completely limited to their respective space environments. The X-Suit on the other hand can use the same technologies with the same principles, ideas, and functions just as well on land as it does in space; all that is needed is a little reprogramming, a minor feat compared to the technological masterpiece that the X-Suit epitomizes. Perhaps if this idea, for some unknown reason, falls short of being a successful concept in the world of lunar exploration, there is always the possibility that it would find its niche in Earth's terrestrial markets as an all-in-one gym, a medical rehabilitation tool, a trained CPR specialist, a virtual reality tool, and even a fashion statement. The more opportunities there are for success, the higher the probability is that success will in fact be achieved.

As the creators of the X-suit concept, were it the case that our concept found its niche in the lunar excursion market, the most likely decision for our group would probably be to tap the vast expanses of financial knowledge of the parental community at our very own Milken Community High School (MCHS) and the endless lakes of technical knowledge of our dear Mitchell Academy of Science and Technology (MAST). Our first step would be to form a business whose president would be Mr. Roger Kassebaum, the director of MAST. We would be at a huge advantage with the vast financial- and knowledge-based resources of the parents at MCHS and we would welcome the formation of this business as chance to receive first hand experience for the up-and-coming researchers in our Science Research Program, as well as the aspiring entrepreneurs of our Business Forum. We would channel the academic zeal of our student body towards the goal of accomplishing something more than just a grade or a score, but rather for the improvement of spaceflight, lunar exploration, and even all of humanity. In the words of renowned theatre critic and journalist Brooks Atkinson, "This nation was built by men who took risks – pioneers who were not afraid of the wilderness, businessmen who were not afraid of failure, scientists who were not afraid of the truth, thinkers who were not afraid of progress, dreamers who were not afraid of action." Perhaps it can be said that so is the case with students who are not afraid to make their dream a reality.