Assisting Muslim Ummah Nations in Obtaining Space Technology:

An Introduction to Space Sector Networking and Brokering

Abdul M. Ismail, Owner & Chief Engineer
INTERPLANETARY EXPEDITIONS, UK

GORS 15th International Symposium on "Remote Sensing and Assisting Systems"

18th to 21st September 2006 / Damascus, Syria

Assisting Muslim Ummah Nations in Obtaining Space Technology: An Introduction to Space Sector Networking and Brokering

Abdul M. Ismail, Owner & Chief Engineer

INTERPLANETARY EXPEDITIONS
100 Greenhill Road, Mossley Hill
Liverpool L18 7HN, England
UNITED KINGDOM
Tel: +44 (0)151 280 8858
Mob: +44 (0)79 76 63 19 46 (principal contact number)
Email: abdul_m.ismail@interplanetary.ae

Abstract

INTERPLANETARY EXPEDITIONS was initially established to work on advanced propulsion technologies for possible employment in future Moon and Mars missions. In recent times the company has been focussing its efforts as a space sector networker, facilitator and broker to assist developing; in particular Muslim Ummah nations obtain space technology.

As a **networker**, the company acts in the client's best interest by identifying and supplying information on the most appropriate companies that can offer space related products while ensuring that country's national requirements are met. Provided the client is impressed with initial results, the company may be appointed as a **facilitator** where the job specification will be to lead the effort to author a feasibility study to determine national requirements as well as secure project funding, if necessary and if possible. As a **broker**, the products that can be secured range from satellite turn-key services which include arranging launch, ground station establishment plus operational training and optional detailed satellite engineering know-how technology transfer, or initiating a program of astronomy and astrophysics by establishing a national astronomical observatory. The company also offers accompanying services such as introducing the client nation to a space insurance broker which will guarantee that ones satellite is covered from potential loss during launch and in-flight operation. INTERPLANETARY EXPEDITIONS has an international network of space sector educationalists and experts at its disposal and can also organise professional development programs to cater for literally any course covering the space industry, ranging from, but not limited to, subjects such as space management, space law, space business, space marketing and space systems engineering. Such subjects are specifically designed to cater for a wide variety of groups ranging from junior engineers at grass roots level to senior level civil servants who are responsible for advising the country's decision makers.

All commissioned work is conducted in a brokering capacity, under contractual agreement which is arranged at the request of the national space organisations, directly with the country's Government or with entrepreneurs. An approach is taken to ensure full participation of local administrators in order to promote transparency and know-how so future contracts can be dealt with internally thus affording a comprehensive national capability.

This paper will introduce the readers to the wide variety of professional services that INTERPLANETARY EXPEDITIONS has to offer and will highlight the way in which the company's philosophy is to emphasise national infrastructure development while at the same time reducing dependency on foreign expertise.

Introduction

In recent years, there has been a surge in interest from developing and Muslim Ummah nations wishing to participate in space related activities. Pakistan, Chile, Morocco, Algeria, Nigeria and Turkey, Indonesia and Thailand, to name a few, are all engaged in their own national satellite programs with initial focus in Earth observation where Libya and Sudan have expressed a great deal of interest in procuring their own Earth observation satellite systems.

INTERPLANETARY EXPEDITIONS has been working in an unofficial capacity, providing advice and suggestions to individuals from Libya, Algeria, Morocco, Kenya, Indonesia, to name a few. In 2005 and 2006, the company representative spent several months in total in Bangladesh presenting the benefits of satellite technology to the country's decision makers. The pertinent Ministry official has been convinced and the potential project will now be presented to higher authority for an executive decision. But where does the company fit in with respect to the 'grand scheme of things'? Why should one choose to employ the company's services? Clients are few and far between and suppliers are even fewer in number. So, effectively, when a request for proposal or invitation to tender is issued, suppliers will automatically have access to the client's requirements. The problem is two-fold. Firstly, not all countries wish to openly advertise their interest and secondly, suppliers tend to focus their attention on providing the most appropriate service that the geopolitical situation can afford which does not necessarily meet the client's requirements. Although a number of commercial companies offer excellent services and turn-key solutions, these programs are project specific and do not address the long-term interest from developing and Muslim Ummah countries to aspire to a national capability of satellite design, development, test and evaluation. In recent times, INTERPLANETARY EXPEDITIONS has been approached by a number of international clients to secure the most appropriate supplier and the philosophy employed is to engage in a phased approach so that the ultimate objective would be present the client with an opportunity to initiate their own satellite research and development program. The comprehensive programmatic solution is what places the company's proposals ahead of project-specific commercial entities.

Prior to embarking on ambitious space activities, standard practice requires that one formulates national space policy [**Section A**] and space strategy [**Section B**], which dictates the direction of a country's space program and may be addressed in the both the short term as well as the long term. If required, a Space Act is then authored and presented to the Government in order to formally inaugurate a space agency. INTERPLANETARY EXPEDITIONS has experience with assisting policy makers in defining space policy and space strategy in accordance to national needs and requirements.

INTERPLANETARY EXPEDITIONS has an extensive network and cordial relations with a large number of space sector suppliers. The company is therefore in a position to provide independent advice on a wide variety of products and services and assist nations to obtain the best technology according to their current geo-political situation [**Section C**]. These

products range from satellite turn-key services [**Section D**], insurance to cover the launch and in-flight operation of satellites [**Section E**], astronomical observatories [**Section F**] and space-sector professional development programs [**Section G**]. There is also a possibility to assist with obtaining finances [**Section H**] for multi-million Euro projects, a key aspect of the brokering service. Even if a client nation participates in an advanced turn-key service and associated know-how technology transfer program, client engineers will still require access to satellite assembly, integration and verification (AIV) facilities [**Section I**] in order pursue a national satellite development program, which can also be supplied.

One of the major benefits of the company's approach is that it ensures that local civil servants, government officials or entrepreneurs work side-by-side in order to promote transparency in which programs are defined and implemented. This is so that all future space activities, from the formulation of space policy to the procurement of satellite systems, can be dealt with internally, thus affording a comprehensive national capability for all future programs.

Section A: National Space Policy

Formulation of a national space policy is a prerequisite to embarking on any space program, irrespective of how ambitious. Since many developing nations have no national space agency, space activities tend to be run by sections of the government who are closely related to such programs and due to their close affiliation to specific Ministries, as a matter of protocol, they tend not to be in a position to dictate national space policy, much to the long term detriment of national space activities. Developing and Muslim Ummah nations also seem to focus their efforts on space related activities which afford the greatest amount of visibility or immediate gain, such as the emphasis on space applications for crop forecasting as well as disaster management, etc..

However, while focus is on near-immediate productivity or return on investment of space activities, developing and Muslim Ummah nations tend to overlook the potential of its citizens by not engaging in other fields of study such as the introduction of space technology to other sectors of society. If one were to quote an example, a number of companies now offer know-how technology transfer in the field of satellite engineering (see Section D), it is also important to note that satellite engineering is 'simply' electronic engineering tailored to survive in the hostile environment of near space. If one were to master such dual use technology, then terrestrial electronic engineering industries will also stand to benefit hence improving the standard of the nation's engineering activities. So, promoting additional benefits resulting from "spin-off" is also essential in order to educate the country's decision makers to the logic of aggressively pursuing an ambitious space program.

It is therefore necessary to encompass not just all sectors of government in a space policy, but also highlight <u>all</u> potential contributors from the academic and private sector to a national space program. INTERPLANETARY EXPEDITIONS has defined a blue print to assist with the definition of a national space policy but each country is unique inasmuch that its priorities differ and, as a result, the blueprint will have to be adjusted accordingly to cater for those requirements.

Section B: National Space Strategy

How does a national space policy and national space strategy differ? A national space policy document will usually be prepared by consultants and Government advisers and then signed and ratified by the Government. Policy dictates the way in which national space activities are to be managed and how each sector of government as well as academia and private and public industry can contribute to national space objectives. It is a document which provides an outlook to neighbouring countries and the international community at large in to how the said nation plans to conduct its space activities. National space strategy, on the other hand, will tend to address near, mid- and long term aims with detailed milestones on how one intends to attain such policy objectives.

Section C: Geo-Political Status

This is one of the most important aspects of a nation's potential space program. More often than not, the geo-political status of the said country will deter a wide choice of suppliers and not necessarily the technology that it can acquire, thus limiting the nations that one can deal with. This may result in driving up the cost of the project due to lack of competitors.

It is ironic since the UN Outer Space Affairs Act of 1967 implies that all countries have a right to employ space applications but quite often, obtaining necessary technology from those that possess it, is restricted. As mentioned above, the simple reason for this is dual use. The United States and former Soviet space programs were a function of the arms race between the two nations and ever since the beginning of the space age, military and space have enjoyed close ties. It is therefore normal that a number of countries possessing space technologies are not keen on sharing technologies which have the potential of being used for military purposes.

So, what is one to do? The most obvious solution is to promote international co-operation.

The Organisation of Islamic Conference (OIC) with its Committee on Science and Technology (COMSTECH) and Inter-Islamic Network on Space Science and Technology (ISNET) affords one possible solution. Since not all nations will enjoy the freedom to choose any supplier from around the world, OIC nations with good relations with space faring countries could define policy to strengthen ties with other OIC member states in order to share the results of the applications from space technology without jeopardising their own relationship with the governments of space related product and service providers. Even those nations with limited options can contribute to such a project. One near term suggestion would be the creation of a small, mini and micro-satellite constellation consisting of 57 satellites addressing literally every aspect of space applications from;

Earth Observation, to be positioned in Lower Earth Orbit (LEO)

1. high resolution optical mini satellites required for urban planning
2. low resolution optical micro-satellites for mapping
3. Synthetic Aperture Radar (SAR) for disaster management

Navigation, to be positioned in Middle Earth Orbit (MEO)

1. a constellation of between 22 and 24 satellites are required

Telecommunications & Meteorology, positioned in geo-stationary orbit (GEO) or geo-synchronous orbit (GSO)

1. at least 4 satellites will be required to address communications on a global scale
2. weather monitoring

If every OIC member state contributes one satellite, irrespective of size and application, then all will be in a position to contribute to the well being of fellow member states since each country's satellite will have a specific area of specialisation. Since OIC countries number 57, this hypothetically means that one could have 57 ground stations to acquire information from multiple Earth observation, navigation, telecommunication and meteorological satellites. Storage capacity in micro and mini satellites is limited so increasing the quantity of ground stations allows for an increased image acquisition capacity. With a large number of ground stations positioned at every OIC member state, there is also an added benefit of acquisition, processing and transmission of images within an extremely short lead time. For disaster management as well as search and rescue, attaining and disseminating images almost immediately is essential. Of course, political will is pertinent to the realisation of such an ambitious yet potentially beneficial project to millions of citizens from developing and Muslim Ummah nations around the world but even developing nations possess competitive tendencies and will not share each others information so easily, much to the detriment of collective development.

Section D: Satellite Turn-Key Services & Know-How Technology Transfer

Besides cost-effectiveness of micro and mini satellites, one of the principle reasons for interest from developing nations in wanting to participate in satellite programs is the thought of being able to obtain knowledge in space technology. Satellite turn-key services include the procurement of a satellite system, Figure 1, based on national requirements together with subsequent launch into orbit via a launch service provider as well as the establishment of a ground station and pertinent operational training. In addition to turn-key services, a number of companies also offer know-how training and technology transfer to different levels. Some companies afford a standard service offering 12-months (preliminary analysis) to 18-month (system definition) training for a team of 10 to 15 engineers whereas others will offer comprehensive +24-month (detailed) training for up to 40 engineers for mini-satellite design, development, test and evaluation. It is important to note that only once the client's engineers has completed all three stages of training will they possess the knowledge to design, develop, test and evaluate satellites with minimal input from foreign consultants. It is also imperative to stress that even with comprehensive training, it is unlikely that any company will offer their proprietary control algorithms (software) to international clients, free of charge. It will be up to the individual client to either

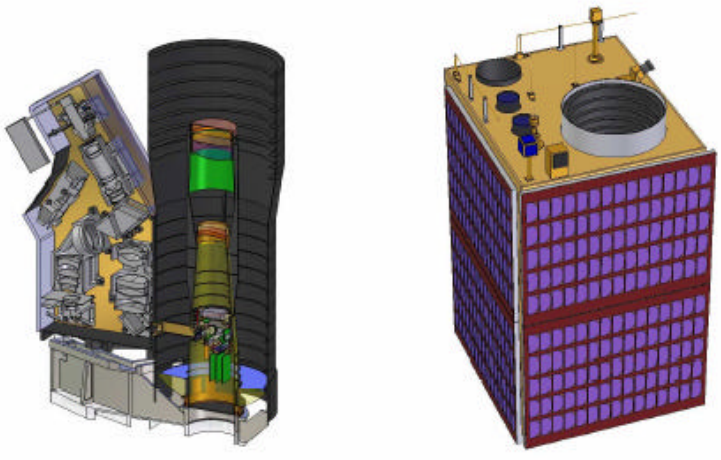

Figure 1: Depiction of a mini-Satellite

develop their own software or sign a licence agreement with the satellite supplier.

Even if one was to obtain the knowledge to manufacture satellites, this does not necessarily present the nation with the capability to do so, especially when one should only manufacture and assemble certain components in a clean-room environment. One supplier also offers the opportunity to procure an entire manufacturing facility which includes a clean-room.

Of course, there is no free lunch. Although not openly advertised, know-how transfer does not necessarily mean that the nation procuring know-how will have free reign to manufacture that specification of satellite on their own. On some occasions, some form of licence agreement is bundled into the package but this is negotiable, depending on the relationship with the supplier. Also, many developing and Muslim Ummah nations do not have the pertinent electronics industry to supply their satellite programs with the required components. INTERPLANETARY EXPEDITIONS therefore actively promotes that suppliers become technology partners, not technology providers, thus opening up a continual supply chain of necessary components to their client's satellite engineering research and development programs.

Section E: Launch Insurance & In-Space Insurance

When one procures a micro-satellite at relatively low financial value, then the logic behind obtaining insurance, which at times can be as high as 30% premium for launch, in-orbit testing phase plus first year of in-space operation, is seriously diminished. In some cases, developing nations with micro-satellite programs have taken a risk by not insuring the launch or satellite whereas others have specifically requested that insurance coverage should be a part of their program. Those that do not request insurance are sometimes deterred by the additional cost or do not see the point because of the low cost of the satellite, whereas those that actively pursue insurance find themselves in a position that they must do whatever it takes to ensure that the program succeeds. The latter category are those that wish to prove to their political superiors that the space programs that they have embarked on are completely secure from potential mishaps. After all, a rocket is essentially a controlled explosion and on more than one occasion, these vehicles have failed resulting in the destruction of the entire payload. In recent times, the most spectacular failure was the uninsurable maiden flight of the Ariane 5, Figure 2.

Figure 2: Destruction of Ariane 501

On this occasion, the payload was the Cluster mission which was offered a 'free'

ride. Of course, the series of 4 identical spacecraft never made it to orbit and the remains can be seen hanging in the European Space Operations Centre in Darmstadt, Germany to serve as a constant reminder that engineering failures are always possible. The only safeguard against such failure is to insure the risk to ensure that not only is the satellite replaced, but the launch as well as the insurance required for the next flight.

As developing and Muslim Ummah nations become more accustomed to the benefits of space applications, the size of the spacecraft will naturally become larger. As the size increases, so will its value and therefore the necessity to safeguard against loss. INTERPLANETARY EXPEDITIONS is in a unique position to facilitate an introduction to the world's largest space insurance broker who can cater for any client requirements.

As an alternative to insurance, some companies offer a replacement satellite which is developed at the same time as the flight model and in the event of a failure, the second satellite can be launched within a few months to replace the lost satellite, hence minimising service disruption. In this option, the initial satellite and its launch will not have to be insured and one will only need to consider annual in-flight insurance to protect the spacecraft against loss. If the launch is successful then in order to break even, the back-up satellite may then be sold on to potential customers at cost price minus the quoted price for the satellite launch, in-space testing and first year's insurance. The benefit of this approach is that the lead time for launching the satellite after the initial loss is reduced. However, a second satellite will cost considerably more than the cost of insuring the first satellite's launch, in-flight testing plus in-space insurance for the duration of the satellite's design life. If the launch is successful, then the customer will be left with a satellite which has been produced to its own national specifications. Even if a marketable very high resolution optical imaging satellite has been produced, the spectral resolution may not be suitable to all countries and although a number of developing nations will certainly express interest in such a system, many suppliers would be deterred to sell due to ITAR.

If delayed service from the satellite's application is not of importance, then insurance is by far the most logical option.

Figure 3: M17 Nebula taken from Hubble Space Telescope

Section F: Observatories

Astronomers and astrophysicists often supply breathtaking images of the universe which results in awe and amazement, Figure 3. The problem is, for developing nations scientific research is considered a luxury. Perhaps the incentive for engaging in such activities, especially in Muslim Ummah countries, should be addressed in a different fashion.

In the past, Islamic astronomers astounded their Western counterparts with the sheer accuracy of their calculations. The reason for this is primarily due to

the fact that in many Muslim countries, calculating the rotation of the moon around the Earth was not due to the pursuit of science and understanding, more so it was due to the need to accurately plot the position of the Lunar orbit around the Earth for religious reasons. A prime example was the Syrian mathematician/astronomer, Ibn al-Shatir (born in Damascus 1305, died 1375), who corrected Ptolemy's Lunar motion around the Earth and also presented calculations for Earth's orbit around the Sun. Copernicus was given credit for an identical model for which he presented over a century after al-Shatir, the latter whose calculations were 'rediscovered' in 1950 but by then, history had already been written.

If national leaders can be persuaded to engage in mathematics, astronomy and astrophysics with an emphasis on religion, then the millions of Madrassa students in over 50 OIC member state countries will rediscover an area for which they will be able to apply their knowledge where they would surely excel.

The United Nations Office for Outer Space Affairs (UNOOSA) has a Basic Space Sciences program which affords member states an opportunity to obtain small telescopes – on the order of 0.5 metre primary mirrors, free of charge. However, all local infrastructures, i.e. roads up mountainous paths, buildings and generators, will have to be provided with contribution of the member states. Participation in such a program would be a starting point which could lead to the procurement of a larger, more advanced observatory.

There are a number of commercial companies that offer observatories with telescopes based on that Ritchy-Chretien Cassegrain configuration. The primary mirror can range from 1 metre to 4 metres although the standard size purchased is 2 or 2.5 metres. INTERPLANETARY EXPEDITIONS has a mutual agreement with the only company that provides an in-house comprehensive solution.

Section G: Professional Development Programs

INTERPLANETARY EXPEDITIONS offers clients professional development programs in literally any type of space sector subject. Courses can be designed to benefit junior level engineers to senior government civil servants who advise the Government in defining national policy. The courses can last from two days up to two weeks. Space related topics range from, but not limited to policy, law, business, marketing, engineering, international co-operation, infrastructure development etc. The company has proven experience designing an intensive two day program for a team of ten members of staff from the world's largest space insurance broker. Although the company has expertise in numerous aspects of space related issues, it is more than likely that the participating lecturers will be outsourced so that the client will receive guidance and teachings from the world's most talented individuals.

The courses can, on some occasions, be offered free of charge, but only if the company is appointed a broker to secure space sector suppliers on behalf of the clients.

Section H: Financing Space Projects

Multi-million Euro projects will always prove to be a show-stopper for a number of developing and Muslim nations. Since brokering relies heavily on finances, INTERPLANETARY EXPEDITIONS spends a great deal of time working with potential clients to obtain Sharia'a compliment loans, and in the fortunate case, interest free loans.

A number of unique methods can be employed to contribute to funding space projects and different approaches depend on the nature of the client's requirements.

Section I: Satellite Assembly, Integration and Verification Facilities

To a certain extent, intensive know-how training is useless for nations who wish to develop their own in-house capability without a access to satellite assembly, integration and verification (AIV) facilities, Figure 4. INTERPLANETARY EXPEDITIONS has, amongst it numerous suppliers, a company that is in a position to supply complete AIV facilities including a clean room that will provide clients with a capability to initiate its own satellite research and development program.

Figure 4: Space Simulation Chamber (one component of AIV facilities)

Summary & Conclusion

In order to build up confidence with potential clients, the company spends on the order of 90% of its time with networking. This essentially consists of free advice and suggestions. If the client believes that the company can offer its service to benefit their nation, then any future work will be performed under contract.

The reason(s) for national organisations or governments wishing to employ the company's services are as follows.

One important aspect to note is that all businesses, including those that offer space technology, tend to employ their marketing abilities in order to secure a multi-million Euro contracts and there are occasions that other suppliers could provide a more beneficial product and service for the nation's requirements. INTERPLANETARY EXPEDITIONS uses its neutrality and positive relations with a large number of suppliers to ensure that the

best possible information is provided to the client. The principal focus is to place the client country's interest before the commercial benefit of the companies offering their services.

The wide variety and comprehensive subjects covered such as assisting with authoring national space policy, national space strategy and a national space act; obtaining satellite turn-key solutions plus launch and in-flight insurance; observatories/telescopes and planetariums and space related education and professional development programs.

A complete know-how approach is used to ensure that the client country's specialists will learn to employ their own initiative in order to develop the country's space infrastructure. This is so that once the company has completed its tasks, the client nation will possess the required skills to pursue all activities on its own without, or with minimal, foreign support.