IAC - 08.E6.3.3

COMMERCIAL DEVELOPMENT POLICY OF THE NASA EXPLORATION SYSTEMS MISSION DIRECTORATE

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ABSTRACT

NASA's Exploration Systems Mission Directorate (ESMD) understands the benefits to a thriving commercial space industry and has developed a policy that will help the space agency accomplish its exploration goals through the acquisition of commercial space capabilities. This paper gives the goals and rationale of the ESMD Commercial Development Policy (ECDP). The statements of authority and of policy supporting this strategy are provided and a comparison is made between the ECDP and the existing NASA Technology Commercialization Policy. A detailed derivation and description of the basic components of the ECDP are given including the targeted barriers of entry to the successful development of commercial space capability industries, and strategic elements that provide a framework to guide the programs and projects that support the ECDP.

ESMD COMMERCIAL DEVELOPMENT POLICY

The Exploration Systems Mission Directorate (ESMD) at NASA Headquarters (HQ) has approved the ESMD Commercial Development Policy (ECDP) and a comprehensive set of policy elements to encourage the development of commercial space capability markets and industries. This policy was developed and supported by individuals from other mission directorates and mission support offices at NASA HQ, as well as with significant contributions from ESMD personnel located at various NASA field centers throughout the country.

"Technology Commercialization" and "Commercial Development"

Created in response to statutory requirements, the "NASA Technology Commercialization Policy" [ref. 1] defines the term "technology commercialization" as "the development of NASA Aeronautics and Space mission technology in commercial technology partnerships, and the application of NASA technological assets in non-aerospace and aerospace markets which result in economic benefit to U.S. economy or improvements to the quality of life."

"Commercial development" is the identification and support of commercial space capability industries (goods and services) acquired for NASA's benefit. With commercial development, the role of "supplier" and "customer" reverses for both the government and the private sector.

In reversing these roles, NASA positions itself as the customer. The ECDP strives to meet NASA needs through direct acquisition of existing goods or services from one or more private industry suppliers.

Objective

The ECDP strives to achieve the following objectives:

- Encourage the development of commercial space capability industries with substantial and significant history of operational capabilities. The U.S. tax-payer will best benefit by an American industry-base that includes many companies which fill a wide variety of demand niches for space services and products.
- Meet and fulfill NASA's exploration mission goals and requirements (as defined by NASA program managers) at a lower cost and cost risk when met by the commercial market.
- Purchase space capabilities using "fixed price" acquisitions whenever practicable. For example, utilize contracts for "acquisition of commercial items" more widely than a "contracting through negotiation" acquisition. The latter is currently the predominant type of procurement contract used by NASA with its prime contractors for these types of space capabilities.

Goals

The ECDP goals are:

- To encourage the development of commercial space capabilities and markets.
- To encourage "Buy Commercial" instead of "Government Provided" decisions.
- To encourage commercial representation and opportunities in NASA's exploration architectures.

Approach

The ECDP embodies a coordinated set of policy elements that encourage the private sector to develop, demonstrate, provide, and support commercial space capabilities. Execution of all policy elements in fair, open, and non-intrusive ways would not interfere with other sales or transactions of the company. Steps will be followed to ensure that architecture development for ESMD programs are open and can utilize commercial space capabilities to the maximum possible extent.

The ECDP encourages commercial companies to bring their existing technology to the table by encouraging the funding of capability demonstrations (the application of mid-level Technology Readiness Levels, typically five or six, to a specific system, and bringing that system to operational status). This provides commercial companies the opportunity to license preexisting technology to the government in exchange for a royalty, or permit the fixed price acquisition of the eventual operational capability by NASA. The ECDP encourages NASA to rely on the emerging space business community to identify which commercial sectors are likely to remain viable and to identify viable candidates for ECDP application. Likewise, NASA should not let high-priority exploration mission goals determine which market sectors are to be encouraged, because those sectors may not be commercially viable in the absence of significant NASA involvement.

Rationale

Through the Global Exploration Strategy activities conducted since April 2006, NASA has identified specific objectives that will guide the space agency's

exploration mission to the Moon, on to Mars, and beyond. Some of these objectives are in the "critical path" of mission success and will be accomplish by NASA programs with ESMD. The ECDP anticipates fulfilling all objectives, including those on the critical path, with the commercial sector, either in partnership with NASA or through independent development.

ESMD management at NASA HQ has been working closely with its programmatic counterparts at the pertinent NASA centers, as well as with members of the nascent space exploration industry, to develop an effective strategy to encourage commercial space capabilities. If the goals of the ECDP can be achieved, the NASA exploration mission will be impacted in the following significant ways:

- More exploration goals will be accomplished sooner. Goal for goal, and accomplishment for accomplishment, the overall program will be accomplished with a lower budget.
- The development of a commercial space exploration industry, one that does not rely solely on NASA as the sole or primary customer, will be greatly accelerated, and this will represent a major step toward long-term sustainability of NASA's exploration program.
- Implementation of the ECDP will be consistent with NASA's charter, strategic goals, and other stated policies.

It should be noted that the ECDP does not constitute a NASA-wide policy. However, at the time of this writing, efforts were underway to promote this policy to an agency level.

Statements of Authority and Policy

Authorization for encouraging the development of commercial space capabilities has been stated and restated in statutes and statement of policy from different levels of the legislative and executive branches of government. The authority is as old as NASA itself, although the intent is rooted to an earlier extent in the history of the National Advisory Committee on Aeronautics. The policy of encouraging the private sector has been emphasized repeatedly by high-level policy-makers, and is emphasized in the current NASA Strategic Plan. Below are specific examples and citations that demonstrate the authority and support for the encouragement of the emerging commercial space sector:

- Section 203 of the 1958 National Aeronautics and Space Act [ref. 2] states that NASA "...in order to carry out the purpose of this Act, shall... seek and encourage, to the maximum extent possible, the fullest commercial use of space; and... encourage and provide for Federal Government use of commercially provided space services and hardware, consistent with the requirements of the Federal Government."
- More recently, the Commercial Space Act of 1998 [ref. 3] stated that "a priority goal of constructing the International Space Station is the economic development of Earth orbital space." The law further states that "competitive markets... should therefore govern the economic development of Earth orbital space."
- In the "U.S. Space Exploration Policy" [ref. 4], the administration charged NASA to "promote

international and commercial participation in exploration to further U.S. scientific, security, and economic interests."

- The NASA Authorization Act of 2005 [ref. 5] states that "In carrying out the programs of the Administration, the Administrator shall … work closely with the private sector, including by … encouraging the work of entrepreneurs who are seeking to develop new means to send satellites, crew, or cargo to outer space."
- The Director of the White House's Office of Science and Technology Policy, Dr. John Marburger, made the following remarks during the Keynote address at the 44th Robert H. Goddard Memorial Symposium on 15 March 2006 [ref. 6]: "As I see it, questions about the vision boil down to whether we want to incorporate the Solar System in our economic sphere, or not. Our national policy, declared by President Bush and endorsed by Congress last December in the NASA authorization act, affirms that, 'The fundamental goal of this vision is to advance U.S. scientific, security, and economic interests through a robust space exploration program.'"
- At a speech given during the X PRIZE Executive Summit on 19 October 2006 [ref. 7], NASA Administrator, Dr. Michael Griffin, stated "...as we go forward with the Vision for Space Exploration, it emphatically is our duty to encourage and leverage nascent commercial space capabilities."
- This policy was formalized with the release of the 2006 NASA Strategic Plan [ref. 8], in which Strategic Goal 5 clearly states that NASA is responsible to "Encourage the pursuit of appropriate partnerships with the emerging commercial space sector."

CONSTRUCTING THE ECDP

The ECDP was developed by developing a fundamental understanding of the forces affecting the emerging space capability markets, identifying the barriers of entry to those markets that the ECDP can effectively address, and then promoting strategic elements that can provide a structure in which specific programs and projects can be developed and promoted. All these steps are driven by the ECDP goals and approaches described previously in this paper.

Barriers of Entry

As mentioned previously, barriers of entry that must be overcome by the entrepreneur to make the business successful are encountered at every step of building a business.

The three key, remaining barriers that can be reduced or removed via actions (or inactions) of NASA include:

- Investor Funding (combining the venture capitalist and angel investor roadblocks into one)
- Production of Goods and Services
- Attracting Customers

A brief description and potential ways that NASA can address these barriers are discussed below.

Investor Funding

At various points in a new company's life cycle, infusions of capitol are required to help the company grow. As the company grows larger, the amounts of capitol infusion increase as well. (These are two

separate barriers from the Base Model discussed above, but they are considered together for the purposes of this report.)

Principal factors that influence the decision of potential investors (whether angels during the initial rounds of raising capital, or venture capitalists in later rounds) include:

- The level of demand for the goods or services in the proposed business plan.
- The capabilities and experiences of the entrepreneurial team requesting the support.
- The credibility of the technology in the proposed business plan.

General activities comprising the ECDP strategic elements (described below) that address this barrier include:

- Direct investment in a company as was demonstrated in COTS, in which NASA supports a specific technology and company by providing a large fraction of the company's capitol requirements at multiple points when technical achievements are successfully demonstrated. The company is required to raise the remaining fraction of operating capitol through non-NASA sources.
- Send positive signals to the investment community with the following messages: (a) NASA takes the entrepreneurial space community seriously, (b) NASA wants to encourage the development of real goods and services within the new space economy marketplace (see the discussion in the next section), and (c) NASA is one of many possible customers in the new space economy marketplace.
- Offer prizes that require a demonstration of the capability under commercial consideration. This is an effective way to reduce the perception of risk among the investment community, thereby lowering this barrier.

Production of Goods and Services

The creation of a commercial product may benefit from one of NASA's unique "technological assets" (defined in NPD 7500.2 as including "innovations, technologies, facilities and expertise). Making these assets available may be beneficial to the company at a critical stage of its life cycle.

General activities comprising the ECDP strategic elements (described below) that address this barrier include:

- Providing access to NASA assets, when appropriate, in a fair and open manner and at a cost that minimizes the burden on the asset recipient.
- The introduction of prize awards for specific capability demonstrations. This method, however, is only applicable for cases in which a company's product is identical to the capability demonstration required by the prize.

Attracting Customers

The methods by which NASA can help remove or reduce the barrier of attracting customers (and subsequently generating profits) may be limited due to legislative and ethical restrictions on NASA's endorsement of a private company. To avoid the appearance of commercial favoritism, the procurement of the product must be justified by meeting a specific NASA mission goal or need and be conducted in a fair and open competitive method.

In addition, by becoming a customer of a product or market segment, the space agency sends unavoidable signals to the market about the product's quality or market's importance. NASA's patronage may itself become a promotional advantage for the company or companies, which further lowers this particular barrier of entry.

General activities comprising the ECDP strategic elements (described below) that address this barrier include:

- Entering into funded agreements that provide positive incentives to the company to attract a customer base that is separate from NASA or another U.S. government entity.
- Providing pricing schedules (but not promises to purchase) or structures to utilize commercial capabilities for specific goods or services offered at a future date.
- Encouraging the interoperability of design standards and service procedures among multiple users can increase the base of potential users or customers.

These three barriers of entry were independently identified by attendees at a NASA workshop held in 2005, prior to the creation of the ECDP. Recommendations from that workshop were the basis for the creation of the NASA Space Portal, and Integrated Product Team located at the NASA Ames Research Center. A brief description of the Space Portal is given below.

Policy Elements

Generalized constructs that provide a variety of frameworks within which programs and projects can be developed have been identified and are referred to as ECDP strategic elements. Each strategic element may address one or more of the relevant barriers of entry to the development of space capabilities markets identified above.

The list of policy elements, given here, is not static and can be edited or augmented at any time as new or different ideas and requirements arise:

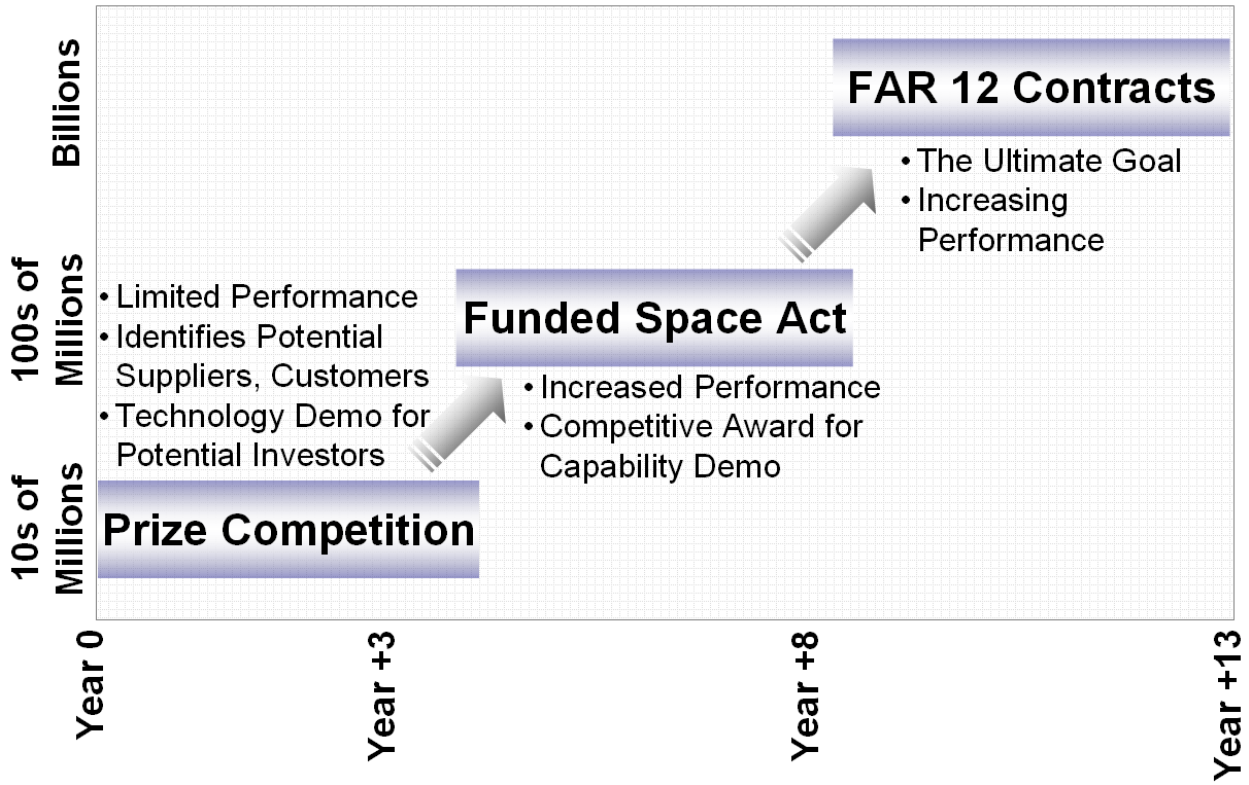
- Multi-Phased Programs
- Being a Reliable Customer
- "Encouraging Commercial Space Capabilities" Evaluation Criteria
- Parallel Government-Commercial Efforts
- Community Presence and Support
- ESMD Use of Commercial Space Capabilities

The current set of ECDP policy elements and the barriers they are designed to address are described below.

Multi-Phased Programs

Multi-phased programs can be implemented to address all three of the relevant barriers of entry listed above. An example of how this strategic element is currently being implemented is given below.

The utilization of Funded Space Act Agreements (FSAAs) as was done in COTS carries many programmatic risks in addition to the obvious technical and cost risks. To mitigate some of these risks, a prize program (Phase 1 of the multi-phased procurement tactic) could be conducted prior to the competition for FSAAs (Phase 2). After successful completion of the FSAAs, a series of FAR 12 contracts (Phase 3) could be issued for the procurement of commercial items (as developed in Phase 2). The figure below depicts this multi-phase program strategy.



The cost of Phase 1 (prize competition) of this multi-phased procurement tactic would depend on the scale and scope of the capability being demonstrated to win the competition (but could easily be in the tens of millions of dollars). It is interesting to note that the prize portion of this strategy does not have to be conducted by NASA, but could be a privately-sponsored competition. The benefit of using prizes as a precursor to a NASA FSAA is that it acts as a risk-reduction exercise, not just technically, but also in terms of identifying potential suppliers (the teams). The demonstration of the technology also reduces the perceived risk in the eyes of potential investors and customers.

The cost of the Phase 2 portion of this procurement strategy would be an order of magnitude greater than that of Phase 1 (putting it into the range of hundreds of millions of dollars, similar to the COTS FSAA budget) and would span multiple fiscal years.

Phase 3 would be yet another order of magnitude greater than Phase 2 (into the range of billions of dollars), which is not unreasonable since the government could be purchasing this capability with multiple procurements and over multiple fiscal years.

Another idea for multi-phased procurement opportunities could use prize competitions as a selection mechanism for follow-on SBIR or contract work.

Being a Reliable Customer

Being a reliable customer is a strategic element that could be implemented to address all three of the relevant barriers of entry listed above. Examples of how this strategic element could be implemented are given below.

Ideally, ESMD could become a reliable customer to providers of commercial

space capabilities simply by purchasing their products or services. To date, however, most of those wares are not yet available for sale, so until they are, ESMD can indicate their willingness to purchase in many different ways. Some of those ways could include:

- Publishing a menu of proposed prices for non-existent goods or services. This would need to be done in a way that does not commit the government to a purchase before the funding for the purchase has been appropriated by Congress (a situation referred to as "anti-deficiency").
- Entering into multi-tiered, multi-party programs that couple the encouragement of commercial space capabilities with education and outreach programs for the purpose of feeding the human capital pipeline for the benefit of NASA, the traditional aerospace sector, and the entrepreneurial companies.

"Encouraging Commercial Space Capabilities" Evaluation Criteria

Implementing evaluation criteria that assess how the goals of the ECDP are addressed can address two of the relevant barriers of entry listed above, production and demand.

In technology development, NASA provides funding to a wide variety of entities via FAR 15 contracts, and as awards in the SBIR, STTR, and Seed Fund programs. An evaluation criterion for these programs could be added that encourages the use of commercial space capabilities by the funding recipients. Specific examples of how this might be accomplished could be provided in the solicitation although the proposals should look for new and different ways to accomplish the same goals.

Parallel Government-Commercial Efforts

Conducting government and commercial efforts in parallel can be implemented to address two of the three relevant barriers of entry listed above, investment and production.

In situations where there is an on-going government hardware development effort, it may be possible to conduct a commercial effort at the same time (coincidently). The government program plan could have the appropriate decision-point milestones to evaluate the contributions or progress of the commercial activities and modify their activity plan accordingly. This type of tactic pits the performance of commercial entities in parallel with those of the government and allows for the possibility of one surpassing the plans of the other. By demonstrating a critical-path technology before their NASA-team counterparts, the commercial sector could possibly be in a position to be the providers of critical-path capabilities.

An example of this type of tactic could be to conduct a commercial hardware design and development activity at the same time, and with the same set of requirements, as the government. Design reviews of all the participating organizations could encourage and reward commercial innovations and time savings as compared to the government results.

This strategy element can promote the reduction or removal of the third barrier of entry, the creation of demand, if special efforts are made to promote interoperability in product design and service operations between multiple users.

Community Presence and Support

Maintaining a presence and showing support for the emerging space markets addresses two of the three relevant barriers of entry listed above, investment and demand.

NASA is a high-profile participant in the space community and although a sustainable industry that can provide commercial space capabilities should not rely solely or principally upon NASA as a customer, NASA will undoubtedly play an important role. It is vital, therefore, that NASA be aware of, and use its standing in the space community to contribute in a positive way to various entrepreneurial space activities. Furthermore, attendance at commercial space events maintains for NASA a high level of familiarity with the state of the industries and allows for NASA to subtly influence the course of industrial development.

Some examples of how NASA, through its involvement, can promote topics or causes of interest to the entrepreneurial space community include:

- Leading or contributing to workshops or panels discussing topics
- Attendance and participation at conferences, summits, meetings, or other professional gatherings

Actions or activities by NASA within this category could be of very high value because they can have a substantial impact on the entrepreneurial space community at very little direct cost to NASA or the U.S. taxpayer.

ESMD Use of Commercial Space Capabilities

Making use of the capabilities provided by emerging space markets addresses two of the three relevant barriers of entry listed above, investment and demand.

ESMD could make a special effort to utilize commercial space capabilities that come to market, whether stimulated through governmental efforts or not, by approaching these vendors with an open mind and willingness to utilize the capabilities that will be undoubtedly different from what they've normally used.

Currently, the stringent restrictions that evolved for the initial creation of government-sponsored space capabilities, such as parabolic aircraft flights to simulate the space environmental condition of microgravity, have become technical or operational requirements for a point design that does not allow for flexibility which could lower the barriers of entry to the commercial community.

Instead of ESMD requiring a new commercial capability meet their traditional requirements, they should be willing to try out the new product (whether a good or service) and try to see how it can be used, without modification, to achieve most of their scientific, engineering, or operational goals. Encouraging commercial space capabilities may involve getting only 90% of what could have been achieved using traditional, government-provided facilities, but over time, the commercial space capabilities will be able to adapt and evolve to the point where the NASA researchers may be getting 110% of what they could previously and at a cheaper price.

CONCLUSION

NASA's Exploration Systems Mission Directorate (ESMD) has approved the ESMD Commercial Development Policy

(ECDP) with specific goals of encouraging the development of emerging commercial space capabilities to help complement NASA's exploration mission goals using standard commercial acquisition tools available to NASA in a way that retains all intellectual property rights with the industry. Special emphasis is given to the inclusion of commercial opportunities in the development of exploration architectures developed by NASA. The ECDP is a natural evolution of the NASA Technology Commercialization Policy. Three barriers of entry to start-up space companies have been identified that can be affected by the ECDP, including (1) encouraging investor funding in commercial space companies, (2) encouraging the production of commercial space goods and services, and (3) encouraging the demand for commercial space goods and services. Specific policy elements, a variety of generalized constructs that provide a set of frameworks within which ESMD programs and projects can be developed, are given and described. They are designed to lower the barriers identified above and support the stated ECDP goals.

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ACKNOWLEDGEMENTS

I would like to acknowledge and thank the following individuals for their contributions to the content of this report: Rob Kelso and Dennis Stone of NASA JSC, Mark Nall of NASA MSFC, David Huntsman of NASA GRC, Dan Rasky of NASA ARC, Bruce Pittman of ACES, and Courtney Graham of NASA HQ.