Exploration Systems Mission Directorate Commercial Development Policy (ECDP) Implementation Plan

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CHANGE LOG

Date	Section	Description	Signature
11 Dec 2007	All	Original draft.	KD
14 Dec 2007	All	Increased the size of all figures.	KD
19 Dec 2007	All	Changes reflecting comments received from L. Ostrach, M. Stevens, and G. Yoder.	KD
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23 Jan 2008	4.0, 5.0, 7.0	Changes submitted by Mary Stevens of HQ Procurement added.	KD
24 Jan 2008	Title Page	Concurrence date added to bottom of page.	KD

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1.0 BACKGROUND

On September 19, 2007, the Exploration Systems Mission Directorate (ESMD) adopted a set of best practices, ideas, and concepts to encourage commercial space capabilities, entitled the ESMD Commercial Development Policy (ECDP). The ECDP is available as document number 399036 in the DPMC Windchill project.

An ultimate goal of the ECDP is to be able to meet NASA's exploration mission needs using commercial-type contracts with private providers of commercial space capabilities. Although NASA may initially represent a large fraction of the private company's source of revenue, it is expected that the fraction of revenue generated by non-NASA and non-government customers will grow over time, until private sources become the large majority of the company's income.

Commercial space capabilities are defined as the production, manufacturing, support, or operation of any good, service, facility, vehicle, or piece of equipment (from the lowest component levels to the highest system level), in space, or any of the above related to the testing of space-related technology. An attempt to list what is included in the definition of commercial space capabilities is shown below.

Space Goods

- Flight Vehicles with a Main Propulsion System
  - Atmospheric
  - Exo-atmospheric
  - Crewed and Uncrewed
- Orbital Vehicles With No Main Propulsion System
  - Orbital Services
  - Information, Communications, Power Relays
  - Crewed and Uncrewed
- Surface Systems
  - Habitable Structures
  - Surface Vehicles
- EVA Systems
- Space Resources

Space Services

- Flight Transportation
- Space Resources
  - Production
  - Sale
  - Distribution
- Experiential
- Position, Navigation, Communications
- Demand Aggregation
  - Travel Agents
- Training
- Imagery
- Design
  - Performance Analysis
- Manufacturing
- Assembly
- Supporting Infrastructure
  - Launch Operations Support
  - Space Flight Testing

This implementation plan is intended to describe:

- The value and vision of the ECDP to ESMD and its programs.
- The ECDP scope, including time-phased targets to gage its progress.
- The analyses and evaluative process for ECDP programmatic initiatives.

- How ECDP programmatic initiatives can be implemented, including the processes to be followed.
- How ESMD programs can support the ECDP.

Programmatic initiatives are defined as any activity or task that is proposed to be conducted as part of a program or project within ESMD that can help achieve NASA's mission goals, and supports the purpose and goals of the ECDP.

2.0 VALUE & VISION

The ESMD Commercial Development Policy (ECDP) Implementation Policy describes a process that all programs and projects within ESMD should follow in support of the ECDP. Senior management within ESMD at NASA Headquarters will control the Implementation Plan activities and be responsible for all final decisions regarding the evaluations as described herein. The specific informational, decisional, and status meetings required for acceptance of a proposed programmatic initiative are prescribed and defined in the ESMD Implementation Plan (details given in the References section of this document).

The ECDP objective is to encourage the development of commercial space capability industries that can accomplish NASA exploration mission goals at a lower cost and cost risk to NASA through commercial-type contracts of goods and services. As set forth in U.S. National Space Policy, all space capabilities, including a capable and highly competitive commercial space sector, is vital to the national security, strategic, and economic interests. As described below, these same industry sectors also support NASA's strategic and financial interests.

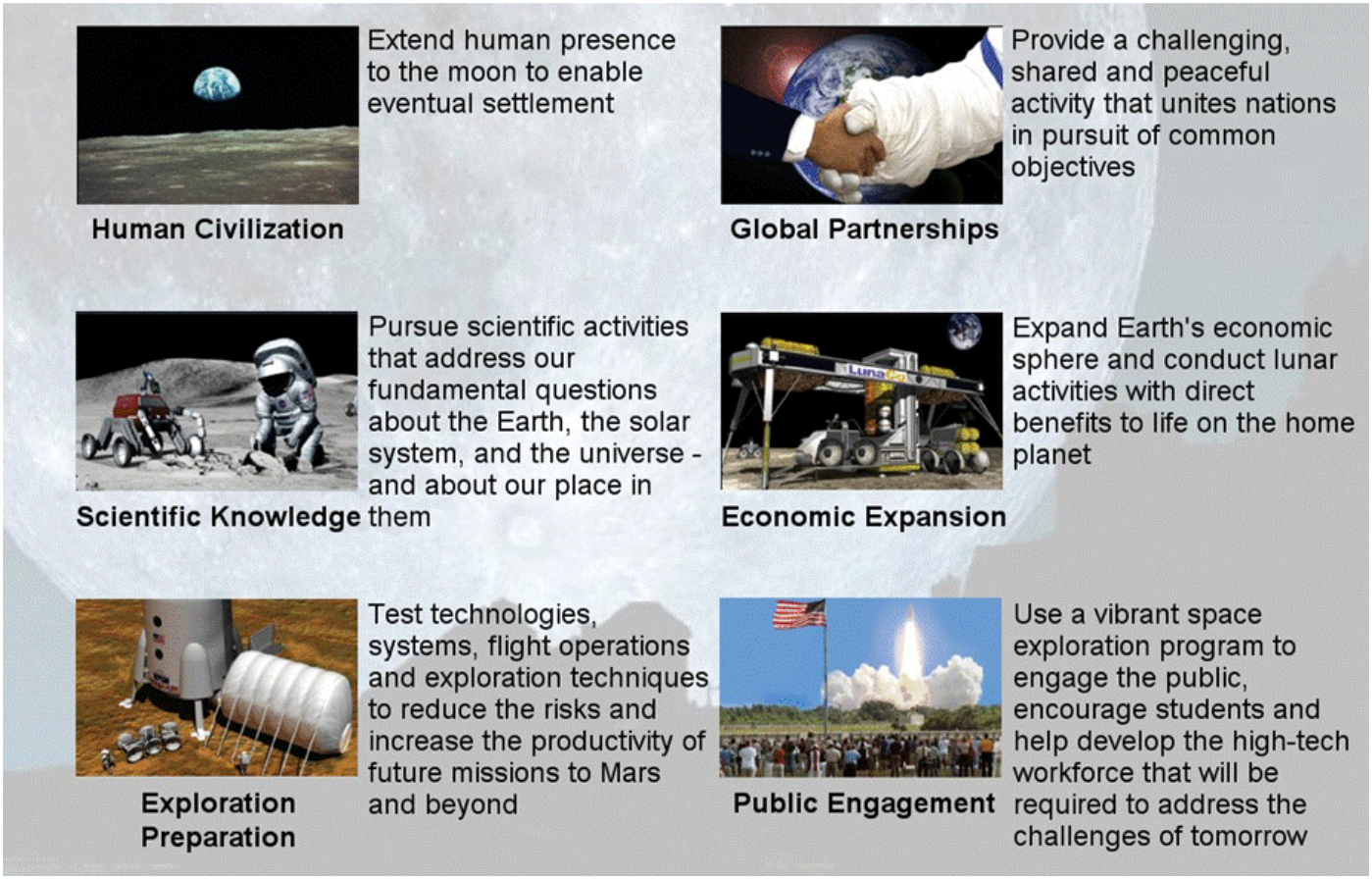
If successful, programmatic initiatives that support the ECDP will provide ESMD program and project managers with assets that decrease cost, decrease risk, increase performance, and increase the overall level of sustainability for their area of interest. When justified, funding of these initiatives can originate from within the programs and projects, but there are also sources of additional funding (from support office organizations such as the Innovative Partnership Program) that can further leverage the ESMD investment.

The sustainability of NASA's long-term exploration mission goals will rely on the successful implementation of many facets that must themselves prove to be sustainable: programmatically, politically, publicly, and economically. Economic Expansion was one of the three cross-cutting themes resulting from the Global Exploration Strategy planning activities conducted in calendar year 2006 (see Figure 1). This goal is supported by the ECDP's assumption that an important component of NASA's exploration mission is the participation of a successfully established commercial space sector.

The ECDP envisions that entire industries of commercial space capabilities will be able to support NASA's exploration mission by providing goods and services that meet NASA's most fundamental functional requirements, starting with getting cargo and people in and out of low Earth orbit (LEO). As NASA extends its exploration mission boundaries further away from Earth, it is the ECDP vision that commercial sphere of influence will also increase, both in distance from Earth as well as in the range of goods and services provided.

In defense of past launch system programs, NASA argued that, all things being equal, only through private development and operation of a new launch system can launch costs be driven down to their lowest possible level. A similar argument can be made for many other space capabilities; that open and fair

Figure 1. Exploration Strategy Goals



competition within a given commercial space sector will result in better performance, higher efficiency, and lower cost, all other things being equal, especially in comparison to governmental operations. The ECDP strives to accelerate the development of those commercial space sectors that can benefit NASA's exploration activities.

If the promise of competition in government-stimulated markets can be achieved, NASA will be able to achieve "more with less"; more of NASA's budget will be spent exploring destinations further from Earth, and less of NASA's budget will be spent on achieving the enabling functionality that is closer to home.

Another important function that the ECDP can foster is "cross-commercial communication," allowing the capabilities of one company in the private sector help other companies, not only the government. The non-NASA component of the term "dual-use" can refer to other companies as well as other types of consumers.

3.0 SCOPE

The ECDP Implementation Plan applies to programmatic initiatives that are part of the ESMD portfolio of programs and projects.

Programmatic initiatives that support the ECDP are important because they accomplish the following:

- They support current national and agency policies.
- They advance the goal of creating commercial space capabilities (goods and services) that are robust and reliable.
- They can lower the cost to NASA of the subject space capabilities

The subject of ECDP programmatic initiatives can also vary widely, ranging from:

- One or more elements, facilities or equipment (EFE) included in the NASA exploration architecture. This category can include anything from entire operational systems to individual sub-components.
- Technology, facilities, or equipment not currently included in the NASA exploration architecture, but which can complement or supplement it to meet NASA requirements.
- Other space capabilities that can support exploration or other parts of NASA.

It can be noted that primary elements of Constellation (e.g., Ares, Orion, EVA Suits, Ground Ops, etc.) are quite far along the path of development and may not be able to take full advantage of ECDP programmatic initiatives without injecting unacceptable amounts of risk into those projects. It's true that the ECDP could impact these projects at the component-level or lower, and those opportunities should be pursued if it makes sense to do so. On the other hand, the Constellation elements that are still early in the requirements definition phase (e.g., the lunar surface systems elements) are prime candidates where the ECDP can be implemented. For example, there are many benefits to be gained by identifying commercial partners that can help develop functional requirements of these surface system elements in parallel with NASA.

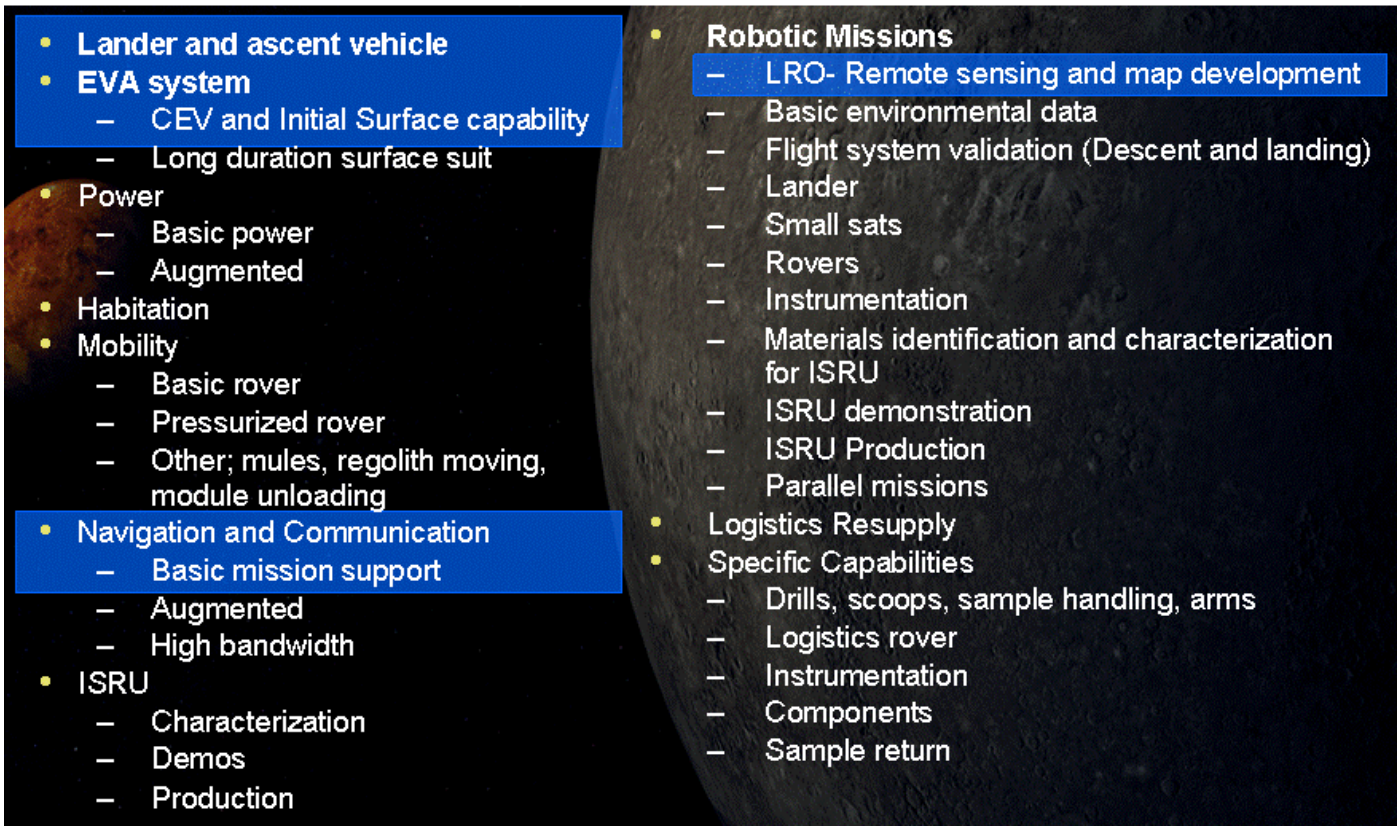
Examples of space capabilities that could directly support EFE within the currently-defined NASA architecture include an unpressurized rover, or advanced long-duration habitation modules. Programmatic initiatives that might indirectly support the current architecture include the Commercial Orbital Transportation Services Project (since it supports ISS which is not part of the exploration architecture), and the atmospheric flight test demonstrator capability available from Armadillo Aerospace's Quad vehicle (which is being used as a platform for testing exploration architecture technologies). An example of a commercial space capability that is currently not included in the exploration architecture, but could serve as a complementary component to it, is the idea of a fuel depot in low Earth orbit or elsewhere.

The extent to which exploration assets are "inherently governmental" will determine whether they will be viable subjects for ECDP programmatic initiatives.

The criteria that define when an exploration EFE is "**inherently governmental**" (as used by the Office of Management and Budget and the Congressional Budget Office) are: (1) The government bears substantial risk through an explicit guarantee of third party financing; (2) All of the risk incident to ownership of the asset does not remain with the lessor (excepting circumstances in which the government is at fault); (3) The asset is designed for a special purpose of the government rather than for a general purpose; (4) No private market for the asset exists; and (5) The asset is constructed on government-owned land (more applicable to office buildings and housing projects than to the development of new space-launch systems).

Exploration architecture assets which are "inherently governmental" will not necessarily be good candidate subjects for ECDP programmatic initiatives, because of their limited commercial viability to serve non-government purposes.

Figure 2. Exploration Architectural Elements



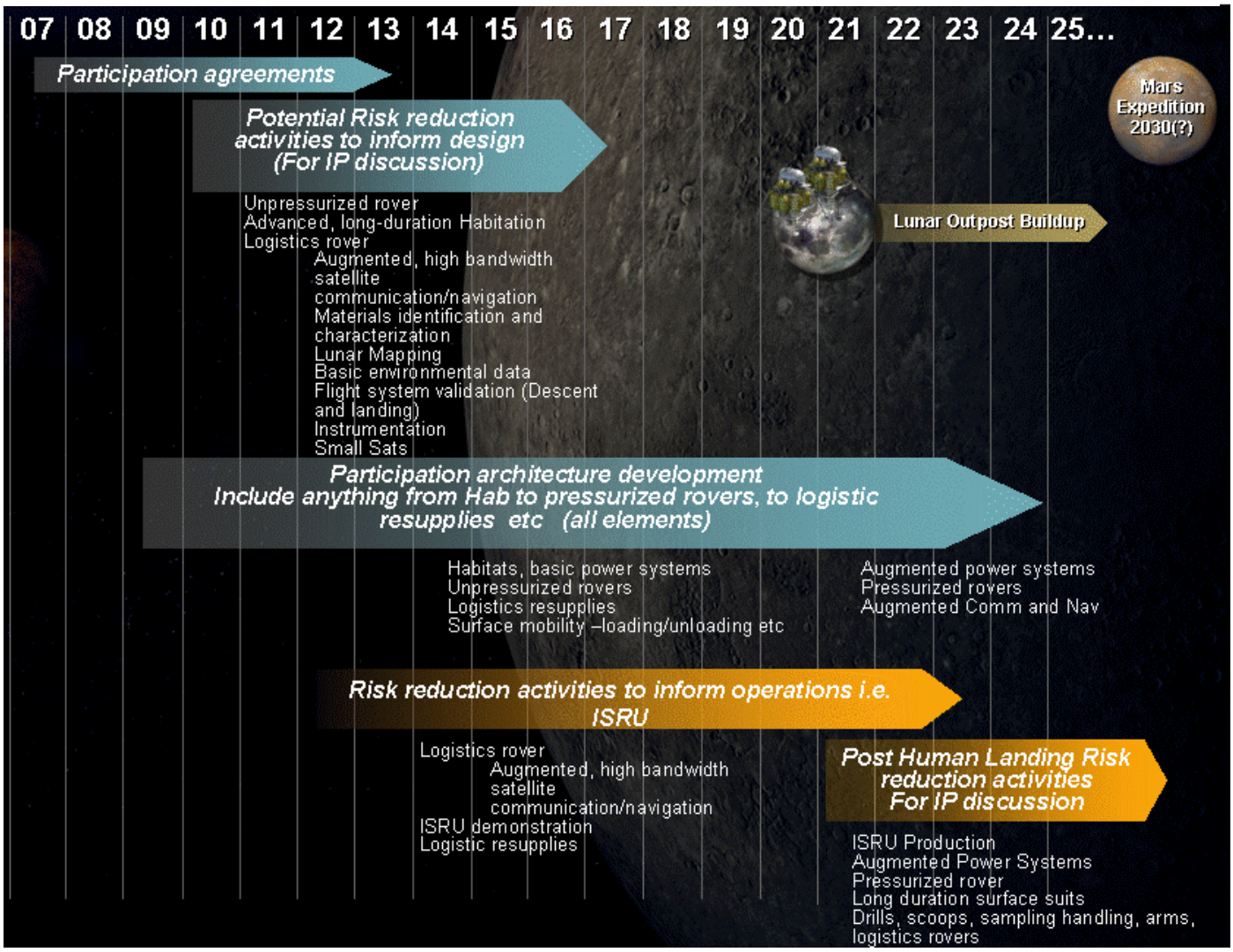
It is expected that, as experience with executing ECDP programmatic initiatives is accumulated, more and more ideas will be generated of how the commercial sector can fit into the exploration architecture in the near-term. Various capabilities from emerging commercial space industries will also develop as time progresses to meet those exploration needs. The ECDP strives to develop the viability of commercial sectors which provide specific goods and services that can reduce NASA's work-load, by assuming specific infrastructure and logistical capabilities where it makes sense to do so.

NASA has stated that certain elements of the exploration architecture will be available for collaborative opportunities, although the design and development of some assets (those highlighted in blue in Figure 2) will absolutely be led by NASA (including the Orion capsule and the Ares I and the Ares V launch vehicles). However, NASA has identified a large number of EFE for which it will not necessarily take the lead, and these elements readily present themselves for collaborative opportunities also.

A more detailed look at the time-phased implementation of the different lunar EFE identified in Figure 2 is shown in Figure 3 below. This "new view" of the lunar exploration roadmap identifies specific elements, facilities, and equipment and when they need to introduced to NASA's exploration activities. Using this information, real targets for incorporating the commercial sector into NASA's exploration activities can be identified. These are:

- ESMD will initiate, as soon as possible, at least one ECDP programmatic initiative for one of the following EFE identified in the time-phased exploration roadmap: unpressurized rover; advanced,

Figure 3. Time-Phased Exploration Architectural Elements



long-duration habitation; and/or logistics rover; augmented, high bandwidth satellite communication/navigation; materials identification and characterization; lunar mapping; basic environmental data; flight system validation (for descent and landing); instrumentation; small satellites.

- In subsequent years, and based on the experiences of the target above, ESMD will initiate additional programmatic initiatives from the same list of space capabilities given above.

Prior to initiating discussions with external entities surrounding any NASA exploration architecture element, NASA must identify high-level functional and physical requirements, and available resources that NASA can offer that will be the basis for the funded collaboration.

It should be noted that ESMD will not prescribe which commercial space capabilities will be pursued under the ECDP. NASA can only look for existing or emerging ventures that meet the exploration needs as shown in Figure 3 and pursue those that have potential.

If these programmatic initiatives prove to be successful, the viability of using commercial space capabilities for the lunar exploration program will be demonstrated. At the same time, other ECDP programmatic initiatives can be initiated for goods and services that fit within, or augment, the current exploration architecture in the rest of cis-lunar space. Figure 3 also provides a "road map" of which goods and services should be considered when, thereby providing an important tool to avoid an "interrupt driven" approach to selecting collaboration opportunities.

4.0 EVALUATION PROCESS

Since every programmatic initiative and potential partnership will be unique in both the subject and structure, the processes by which potential programmatic initiatives will be evaluated (for compliance with the ECDP) will be defined in a Terms of Reference document composed at the time the new programmatic initiative is executed.

It is imperative that, before a candidate programmatic initiative is event evaluated by the defined process, the determination of whether the subject asset (good or service) is deemed inherently governmental should be made.

Ideally, the organization or individuals responsible for the initial conception and definition of the programmatic initiative will perform all the analyses prior to the evaluation to demonstrate that all the ECDP analyses have resulted in favorable results. If necessary, assistance is available throughout ESMD from individuals capable of performing the analyses similar to those listed below.

At the evaluation stage, the results of each analysis will be examined to determine whether the initiative complies with the ECDP. If the analyses have not yet been conducted, evaluators will perform them as part of the HQ approval process.

The analyses to be conducted include the following:

- Time-Phased Industry Sector Analysis
- NASA Needs Analysis
- Cost-Benefit Analysis
- Market Analysis (i.e., an evaluation of government and private supply/demand)

These analyses (shown as a top-level flowchart in Figure 4) will help decide whether the basic criteria for programmatic initiatives are met. Those criteria are:

- Does the programmatic initiative support a space capability industry sector that will evolve in the near term or at about the same time when NASA needs it to appear (a "NASA-term" market)?
- Does the programmatic initiative meet one or more NASA mission needs when those needs come into being?
- Does the space capability market (related to the programmatic initiative) demonstrate an adequate emerging, or existing, private market supply? Furthermore, does it have an adequate existing, or potential, private market demand?
- Do adequate amounts of capital investment exist?

Senior management within ESMD at NASA Headquarters will be responsible for all final decisions regarding the evaluation of the analyses results.

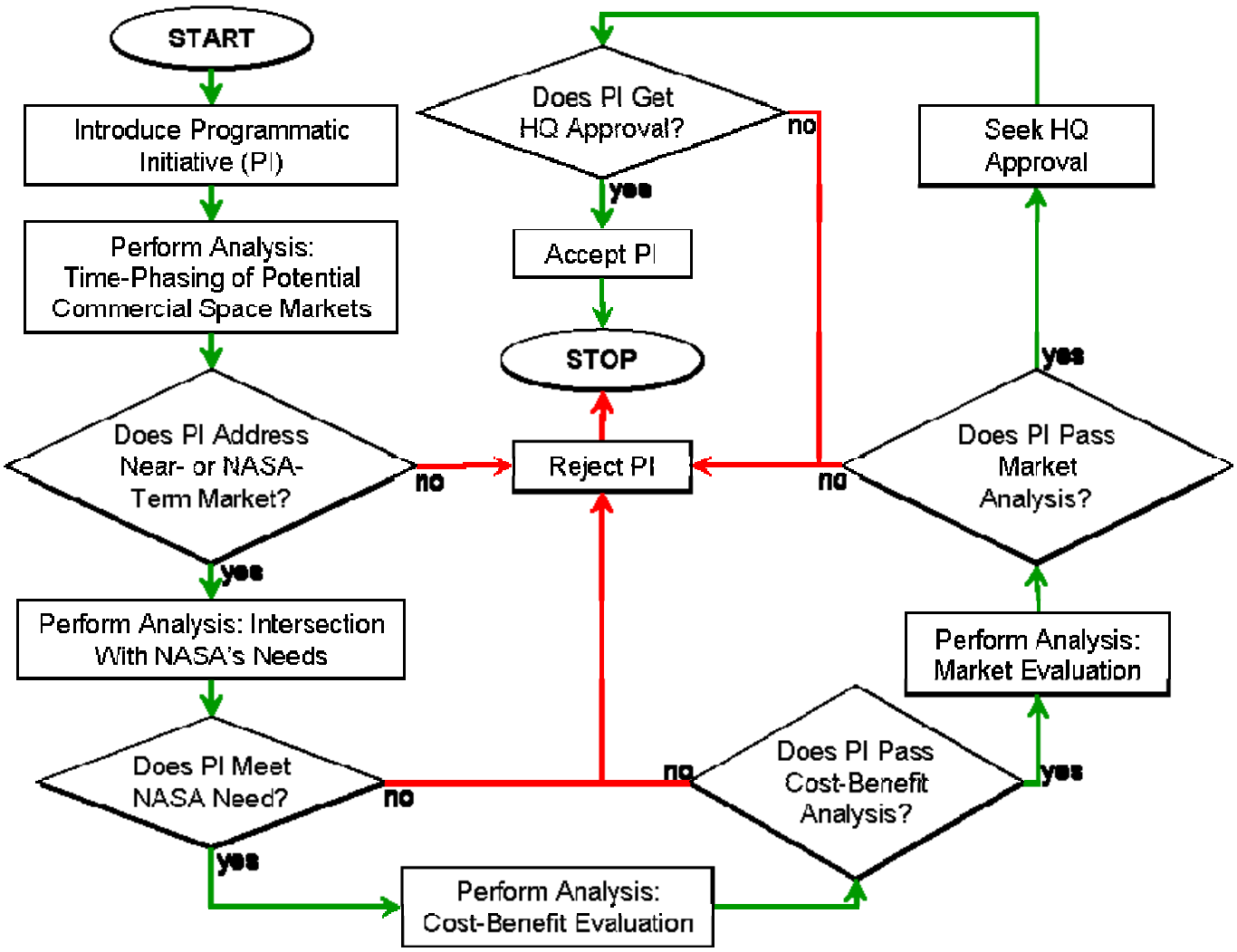
Specifically how each of these analyses will be performed will be described in a Terms of Reference document drafted for each specific programmatic initiative. Detailed sample descriptions for each of the analyses mentioned above are provided below.

4.1 Time-Phased Industry Sector Analysis

To identify and evaluate potential programmatic initiatives, a time-dependent assessment of the possible commercial space industries needs to be made. There are many ways to identify these sectors, and a sample of this type of assessment is given in Table 1.

In this example, markets are segmented functionally into Vehicles (crewed and uncrewed), Vehicle Subsystems, and Services (both Orbital and Surface) for the Earth, the Moon, and Mars.

Figure 4. Implementation Process Evaluation



Depending on the programmatic initiative being proposed, time-phased industry sector analyses can be performed similar to the example shown in Table 1. For example, other potential industry sectors include biomedical and pharmaceutical sectors.

Time periods are also depicted as near-term (defined as less than ten years), mid-term (ten to 20 years), and far-term (effectively greater than 20 years). This designation is important since it is less probable that the private sector will be interested in pursuing commercial activities for potential markets with mid- or far-term horizons. Therefore, ECDP will be less likely to support industry sectors that are evaluated as mid-term or far-term.

It is recognized that although the assignment of market segments to a particular time frame is highly subjective and speculative, it is a crucial step to identifying which programmatic initiatives will be good candidates for commercial development support. The specific type of industry sector analysis performed for any given programmatic initiative will be described in the associated Terms of Reference document written at the time the programmatic initiative is executed.

Table 1. Possible Commercial Space Industries

Time Frame time, t	Near-Term t < 10 yrs	Mid-Term 10 < t < 20 yrs	Far-Term 20 < t < 30 yrs
Uncrewed Vehicles	• Suborbital • Earth Surface ↔ LEO • LEO ↔ LLO ↔ Moon Surface	• Cis-Lunar ↔ LMO ↔ Mars Surface	•
Crewed Vehicles	• Suborbital • Earth Surface ↔ LEO	• LEO↔ LLO ↔ Moon Surface • Cis-Lunar ↔ LMO ↔ Mars Surface	•
Vehicle Subsystems	• Propulsion Systems (Engines, Tanks, etc.) • Docking Systems • Communications • EVA Suits • Pressure Suits	•	•
Earth Orbital Services	• Infocomm (Existing) • Habitat • Fuel Depots	• Power	• Maintenance • Power
Lunar Orbital, Surface Services	• Infocomm (Broadcasting, Advertising, etc.)	• Surface Habitat • Surface Power • Telerobotic Services • ISRU Excavation, Extraction • Medical Labs	• Too many to list

4.2 NASA Needs Analysis

Meeting NASA's needs is a critical component of the ECDP that traces the goals of programmatic initiatives to top-level mission requirements. Any ESMD programmatic initiative must show how its goals are directly traceable to ESMD programmatic requirements.

For cases of research and technology (R&T), the Research and Technology Prioritization Process Plan was adopted by ESMD on May 17, 2007 (details given in the References section of this document). This process ensures that all ESMD technology development projects can be traced back to a specific ESMD Constellation technology requirement. This information is used to ensure that ESMD resources are directed to necessary requirements and for advocacy purposes for specific technology projects. The output of the process is a recommended R&T portfolio and associated requirements trace for review and approval by the ESMD AA, as part of the annual Planning, Programming, Budgeting and Execution (PPBE) process.

Similarly, any ESMD architecture element or facility can be traced to specific requirements, needs, goals, or objectives to ensure that the programmatic initiative is meeting a NASA mission need, regardless of whether it is government-developed, commercially procured, or supplied by an international partner.

4.3 Cost-Benefit Analysis

The analysis requirement to evaluate ECDP includes a cost-benefit analysis to determine if programmatic initiatives are beneficial to NASA and the U.S. government. One such analysis is the Risk Adjusted Net Present Cost analysis. Other related analyses include the Risk Adjusted Net Present Value (RANPV) analysis and the Return on Investment (ROI) analysis.

The RANPV analysis is commonly used by industry and the venture community to assess different business options. It takes into account time value of money, and risk for different options under consideration.

For government employees, cost to the government is a more appropriate consideration, in-particular establishing the approach which has the lowest cost for the government. Therefore, Risk Adjusted Net Present Cost (RANPC) can become an effective quantitative tool for comparing different program options.

Both RANPC and RANPV analyses can provide valuable information used in evaluating candidate ECDP projects and activities.

A sample RANPC analysis performed for the COTS program (already in progress) yielded the following results:

- COTS SpaceX initiative will save the agency approximately $690M over the life of the Station.
- The break-even cost for delivering mass to ISS for COTS was determined to be $34.5K per kilogram.

4.4 Market Analysis

The ability of a programmatic initiative to meet a NASA need is a necessary but not sufficient requirement for selecting it for implementation as part of the ECDP. The programmatic initiatives must also be encouraging and assisting the development of an emerging commercial space industry. This is determined by making a current examination of the market “landscape” to determine whether sufficient activity is evident or foreseeable.

As with the time-phased industry sector analysis, it is recognized that the market analysis is also somewhat subjective and speculative. However, this analysis is also a crucial step to identifying which programmatic initiatives will be best suited for commercial development support.

To make this assessment, members of the programmatic office, members of the ECDP team who are familiar with the market conditions as well as the individuals and personalities involved, will concur on an assessment of the market segment under consideration.

This analysis will identify the existing and emerging supply and demand for the market segment of the subject programmatic initiatives. Both the supply and demand of the U.S. government (including NASA, the Department of Defense, NOAA, the intelligence community, etc.) as well as the private sector (including foreign governments and companies) will be assessed.

An assessment of whether or not the necessary capital investment is available for these markets to survive will be implied in assessing the viability of emerging or existing suppliers.

To avoid duplication of effort, an additional assessment of NASA programs already in progress that are assisting the subject market segment can also be identified.

A sample of this market analysis, for the near-term market segments identified in Table 1, is shown in Table 2.

Table 2. Market Analysis Results

Near-Term Commercial Possibility	USG Supply	USG Demand	Private (non-USG) Supply	Private (non-USG) Demand	ECDP Activity
Uncrewed/ Crewed Transport'n: Earth Surface ↔ Suborbital	• None	• NASA (SMD, ESMD)* • DoD*	• Scaled Composites/VG* • LLC Teams (10x, including Armadillo, Masten, U-Rocket, etc.)* • Others (RpK, SpaceDev, Canadian Arrow, XCOR)*	• Virgin Galactic (VG) • Space Tourism	• Prizes (Lunar Lander Challenge)
Uncrewed Transport'n : Earth Surface ↔ LEO	• Prime Contractors -ULA (Atlas, Delta) • NASA (Ares V)*	• NASA (SOMD, SMD) • USG IC • DoD	• Non-US (Russia, Arianespace) • Funded SAA (SpaceX, RpK)* • Unfunded SAA (SpaceDev, t/Space, SpaceHab, CSI, PlanetSpace)*	• Infocomm • Bigelow*	• COTS
Crewed Transport'n: Earth Surface ↔ LEO	• NASA (Ares I)*	• NASA (SOMD)*	• Non-US (Russia, China*) • Funded SAA (SpaceX, RpK)* • Unfunded SAA (SpaceDev, t/Space, SpaceHab, CSI, PlanetSpace)*	• Space Tourism • Bigelow*	• COTS

Near-Term Commercial Possibility	USG Supply	USG Demand	Private (non-USG) Supply	Private (non-USG) Demand	ECDP Activity
Vehicle Subsystems: Propulsion Systems	• Prime Contractors (Boeing-RPW, ATK, Aerojet, L-M)	• NASA (Ares I, Ares V, LSAM) • DoD (ORS, etc.)	• Vehicle Developers (SpaceX*, PlanetSpace*, SpaceDev*, Masten*, U-Rocket*, AirLaunch*, etc.) • Propulsion System Developers (XCOR*, Orion*, etc.)	• Vehicle Developers (SpaceX, PlanetSpace, SpaceDev, RpK, etc.)*	• None
Vehicle Subsystems: Docking Hardware	• NASA (ESMD-LIDS)*	• NASA SOMD (Ares I, Ares V, ISS)	• SpaceX* • Swales*	• Vehicle Developers (SpaceX, PlanetSpace, SpaceDev, RpK, etc.)*	• None
Vehicle Subsystems: Communications	• NASA (SOMD-TDRSS) • DoD	• NASA (SOMD-ISS) • DoD	• SpaceX* • Cisco*	• Vehicle Developers (SpaceX, PlanetSpace, SpaceDev, RpK, etc.)*	• None
Vehicle Subsystems: EVA Suits	• Prime Contractors (H-S)	• NASA (SOMD)	• None	• None	• None
Vehicle Subsystems: Pressure Suits	• Prime Contractors (D. Clark)	• NASA (SOMD)	• PSDC, de Leon* • Orbital Outfitters*	• VG • XCOR • Bigelow	• None
On-Orbit Services: Habitat	• NASA (ISS)*	• NASA (SOMD, SMD, ESMD)*	• Bigelow (Genesis modules currently)*	• Mfg (S-HAB)* • Non-US Gov't A'nauts*	• None
Lunar Orbit/Surface Services: Infocomm	• None	• NASA (ESMD)*	• None	• ILO (SpaceDev, Durst) • Lunar X PRIZE	• None

5.0 IMPLEMENTATION & PROCESSES

Programmatic initiatives serving the purposes of the ECDP can be conducted in a variety of ways. They can be collaborative in nature (using instruments such as Space Act Agreements, Cooperative Agreements, or Grants) or use traditional contracts.

An alternative to collaborative programmatic initiatives, actions in support of the ECDP goals can also be conducted by NASA personnel in a unilateral fashion. Examples of such activities can include conducting workshops, performing technical or process consultations to individuals or groups, and attending seminars or other meetings that promote the tenets of the ECDP.

The level of NASA funding or investment can be 0% (unfunded), 100% (fully funded), or anywhere in between (partially funded).

Since the ultimate goal of the ECDP is to purchase commercial space capabilities using commercial-type contracts, utilizing that family of contracts would be the most desirable outcome from the ECDP perspective. However, when necessary, Cost-Reimburesement contracts may be used. Recognizing that fully developed commercial space capabilities don't exist for many new technologies being pursued, the second-most desirable method of implementing a programmatic initiative would be unfunded collaborations and unfunded unilateral activities. Finally, third-most desirable methods to be pursued include funded unilateral activities and partially-funded collaborations.

No attempt is made to define a process to determine which programmatic initiative subjects would be best served by which type of activity (whether collaborative or unilateral) or level of funding. To do so would be counterproductive because it would limit the generation of new ideas for innovative initiatives.

Once a programmatic initiative has been identified, ESMD will work with the appropriate procurement entity to develop an acquisition strategy. The requirement and the specific capability being solicited or developed will drive the acquisition strategy and mechanism for obtaining the good or service. The ESMD Acquisition Policy will guide the strategy development as will the requirements specified in the Federal Acquisition Regulations (FAR), the NASA FAR Supplement (NFS), the NASA Program and Project Management Processes and Requirements document (NPR 7120.5D), and other applicable Federal and NASA regulations and policies as appropriate. Details for all of these documents are given in the References section.

The initial steps of any collaboration will oblige NASA to identify minimum physical and/or functional (performance) requirements for the commercial space capability that will be the basis for the subject programmatic initiative. This may require that NASA first let industry know what government resources would be available so collaboration proposals can be tailored to best fit NASA's needs.

EXAMPLE OF AN UNFUNDED COLLABORATION

The following programmatic initiative example is provided simply to demonstrate the possibilities for unfunded collaborations.

Using a piece of equipment to extract oxygen from lunar regolith as an example, NASA might specify that they have a baseline need for 10 liters of oxygen per day for two years from an oxygen extraction unit they will design and build to operate on the lunar surface.

In response to NASA's solicitation for collaboration on this oxygen extraction unit, a private company might offer to bring their own resources and assets to the partnership to help design and manufacture an oxygen extraction unit that produces 20 liters of oxygen per day.

In exchange, NASA would agree to deliver the equipment to the lunar surface, and buy any oxygen in excess of 10 liters/day at a fixed rate until the two-year period of operation was up, after which time, NASA would pay for all oxygen it used from that unit.

At no time would NASA be under any obligation to buy oxygen, but would have the opportunity to do so, if desired or needed, given the increased capability of the extraction unit. The specific terms of which

party is responsible for what costs and capabilities would be negotiated in the agreement instrument of the partnership.

This type of arrangement could provide NASA the basic capability it requires, plus the availability of a contingency capability at no cost (or a cost it voluntarily accepts, if any). The commercial entity takes the risk of investing its own resources to provide excess capability (above NASA's base requirement) in exchange for the opportunity to sell the oxygen to NASA or (potentially) other buyers.

6.0 PROGRAMMATIC SUPPORT

Each program within ESMD will assign a POC to work with Headquarters personnel on activities to participate in NASA-wide integration, coordination, and situational awareness of ECDP activities. Details of further activities would be documented in a Terms of Reference document at a later date as appropriate.

7.0 REFERENCES

- ESMD Implementation Plan, Windchill document number 408831.
- ESMD Research and Technology Prioritization Process Plan, Windchill document number 352505.
- ESMD Acquisition Policy, Windchill document number 285329.
- Federal Acquisition Regulations (FAR): acquisition.gov/far
- NASA FAR Supplement: www.hq.nasa.gov/office/procurement/regs/nfstoc.htm
- NASA Program and Project Management Processes and Requirements (NPR 7120.5D): www.hq.nasa.gov/office/codeq/doctree/71205.htm