December 1, 2014

Statement Of Work for Sustainable Land Imaging (SLI)

Business Model Study

1. Background:

For more than 40 years, Landsat satellites and associated U.S. Government ground processing, distribution, and archiving systems have acquired and made available global, moderate-resolution (15-120m), multispectral measurements of land and coastal regions, providing humankind's longest record of our planet from space. NASA and the U.S. Geological Survey (USGS) of the Department of the Interior (DOI) fully recognize that this information is a national asset, providing an important and unique capability that benefits a broad community, including Federal, state, and local governments; global change science, academia, and the private sector. Landsat data provide a consistent and reliable foundation for research on land use change, forest health, and carbon inventories, and changes to our environment, climate, and natural resources. Additionally Landsat data is free and openly available to users both inside and outside of the Government. More information on Landsat can be found at http://landsat.gsfc.nasa.gov/ and http://landsat.usgs.gov/.

Current Spaceborne Missions

The USGS currently operates two Government-owned satellites, Landsats-7 and -8, both developed by NASA for USGS. Each satellite is in a Sun synchronous, 705 km orbit, with an equatorial crossing time of 10:00 a.m. + or – 15 minutes, and (nadir) revisit of 16 days. Landsat-7 was launched in April 1999. It has been flying with degraded Enhanced Thermal Mapper Plus performance since May 2003 and is expected to be decommissioned in 2018. Landsat-8, formerly known as the Landsat Data Continuity Mission (LDCM), was launched in February 2013 and has a mission design life of five years for both the spacecraft bus and the primary instrument, the Operational Land Imager (OLI). The Thermal Infrared Sensor (TIRS) has a design life of three years. The Landsat-8 Observatory is carrying sufficient fuel for a mission duration of more than 10 years.

Beyond Landsat-8

Recognizing the importance, demonstrated utility, and future potential value of multi-decadal, continuous, global measurements of our planet's land cover properties, the U.S. intends to design and implement a robust land imaging system to ensure that necessary data are collected, processed into useful and efficient information products, archived, and broadly distributed for use by the wide range of interested communities. This spaceborne system may include alternative sources for Landsat-quality data, either procured through commercial approaches or through partnership agreements, as they become available.

In Fiscal Year 2014, NASA has been leading, and the USGS has been supporting, the design of a system architecture for a sustainable, realistic, and affordable program

that will provide future land imaging data compatible with the existing Landsat data record and specifically as consistent with the characteristics of the data stream currently produced by Landsat-8, as practical. The agencies will cooperate in the establishment of a Sustainable Land Imaging (SLI) program, including development, launch, and operation of spaceborne assets and their associated ground systems. The agencies will also cooperate in the planning and other preparations for continuing the acquisition and distribution of moderate resolution spectral data, as required, in the post Landsat-8 era.

To further inform the agencies as to potential future implementations within the SLI program, a study contract with multiple potential awards will be issued to investigate potential business models for system acquisition.

The NASA Sustainable Land Imaging (SLI) office is investigating the potential use of innovative business models to reduce the costs of future land imaging missions. The 2014 architecture study by the SLI Architecture Study Team (AST) provided some aggregated evidence that satellites developed for commercial enterprises and satellites developed under NASA contracts tended to have comparable overall reliability. The study also provided some evidence that comparable commercial satellites tended to be lower in cost than government sponsored satellites. This study is motivated by these preliminary findings to explore their veracity and consider the implications for SLI space system development.

This study is targeted to explore:

- The management, contractual, and technical differences in how industry develops commercial satellites verses NASA satellites;
- The historical cost and schedule differences of developing commercial and government-sponsored satellites as well as the resulting satellite reliability performance;
- Business models for application by the SLI program that might reduce costs while still satisfying performance and quality requirements.

This study focuses primarily on the development/acquisition of spacecraft buses and related services; some aspects of the study also involve consideration of observatory integration and test, launch, ground systems, and mission operations. For this study, it is presumed that the government will acquire science payload instruments independently from acquisition of the spacecraft bus, either via direct contract to industry or by in-house development at a NASA Center, and then provide them to the spacecraft bus developer for integration onto the observatory; instrument development/acquisition is not a focus of this study.

2. Summary Of Work:

CLINs A, B, and C are independently awarded study tasks.

CLIN A: Experienced Spacecraft Bus Developers

The contractor shall perform analyses of their company's experience in space system development and assess various business model considerations to address the following tasks.

1) Assess and compare how your company's business and satellite development practices under a NASA contract are different than those under a commercial contract. In particular, identify and discuss specific differences that lead to cost, schedule, and/or quality differences, and quantify the impacts of these differences by analyzing your company's historical government and commercial spacecraft bus development data. For this assessment and comparison, assume a NASA contract implemented as a Risk Class B procurement with a 5-year on-orbit lifetime requirement.

1a) Describe the structures and features of your commercial and government spacecraft bus contracts. Describe the most significant advantages and disadvantages of a commercial spacecraft bus acquisition approach versus a traditional government spacecraft bus acquisition approach. Describe the contract type differences and pros and cons.

1b) Quantify the potential savings in cost and schedule, if any, that could result from acquiring a spacecraft bus using commercial approaches and the rationale for those savings as compared to a typical NASA Class B contract. Assess your organization's historical relative cost or labor hours associated with building comparable government and commercial systems; identify any differences and explain.

1c) Describe how reliability, performance, cost, and schedule are financially incentivized on commercial contracts vs. government contracts. Describe how payment philosophies, incentives, and distribution of pre-launch vs. on-orbit payments are best used in commercial contracts to encourage quality, performance, schedule, and long-life. Provide examples of how such payment structures were used on past contracts. Describe and provide examples of how your organization makes use of insurance to offset financial risk in commercial spacecraft bus developments, and the role of insurance in either encouraging or discouraging the effectiveness of financial incentives or penalties imposed by your customer.

1d) Describe how the risk management process and the resulting degree of risk differ between government and commercial spacecraft bus acquisitions. Describe how risks are assessed and ranked in terms of company financial or

business risk, and how the contract payment and financial incentive structure impacts risk assessments in commercial contracts.

1e)Describe your approach under commercial spacecraft bus developments to reviews, customer involvement, and on-site monitoring so as to maximize insight while minimizing acquisition cost.

1f) Analyze the demonstrated on-orbit reliability of your spacecraft buses built for commercial satellites versus those built for government satellites via government-imposed specifications. Correlate the realized lifetime to the statistical design lifetime so that comparisons can be made to NASA risk class.

1g) Compare your organization's safety and mission assurance practices in detail relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document – see http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx. Identify differences and explain the associated risks linked with each item of difference. Provide some indication of the depth of analysis, testing, audits, and verification required to meet your organization's mission assurance requirements. Highlight specific aspects of 320-MAR-1001E that are unnecessarily burdensome; propose more efficient or effective alternatives for risk reduction; describe your experience with and provide evidence of implementing these alternatives.

1h) Provide your company's expectations for government's S&MA interaction with your development team given a fixed price vs a cost plus contract, including attributes such as insight vs oversight, failure and anomaly notification, and voting membership on failure and anomaly review boards.

1i) Compare your organization's environmental testing practices in detail relative to the General Environmental Verification Standard (GEVS) For GSFC Flight Programs and Projects (GSFC-STD-7000A) – see http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-7000A.pdf. Identify differences and explain the associated risks linked with each item of difference.

1j) Compare in detail the LDCM Spacecraft Statement of Work (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-01_SC_SOW_01-10-13_Rev_H no cr.pdf) and Contract Data Requirements List (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-02_SC_CDRL_10-19-12_Rev_D_Final_Doc1 no cr.pdf) to similar commercial spacecraft bus procurement documents. Identify differences in methodology and specific required deliverables between government and commercial approaches and explain the impacts on cost, schedule, risk, and customer insight.

1k) Assess in detail the degree to which imposition of the GSFC Rules for the Design, Development, Verification, and Operation of Flight Systems (GSFC-STD-1000F – see http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-1000F%20Admin%20Changes.pdf) reduces mission risk in comparison to reliance on your organization's development practices. Quantify the programmatic impacts (e.g., cost, schedule, etc.) of imposing GSFC-STD-1000F.

2) Assess your company's experience implementing block buys of spacecraft buses. Assess your organization's historical data to determine cost profile differences as a function of number of identical spacecraft buses developed. Assess the degree to which parallel versus serial development affects cost savings on subsequent units. Suggest methods the SLI Program might use to implement block buys while avoiding cost peaks that would exceed the SLI budget profile.

3) Provide specific feedback on the notional business model described below for acquisition of a spacecraft bus, launch, and mission operations services, called here Prime Payload Flight Services (PPFS). The PPFS model may offer some distinct advantages to the SLI Program that deserve consideration. Required specific feedback includes the following:

- Assess the model's feasibility and its advantages and disadvantages.
- Assess risks and potential mitigations. Assess if and how commercial-type profit motives and contract features can be used to incentivize performance and reduce risk under this model in place of more traditional prescriptive NASA quality requirements and approval processes.
- Assess specific methods to provide a sufficient level of government insight into spacecraft bus, launch, and operations development under this model while maintaining development efficiency
- Assess how safety and mission assurance practices for the spacecraft bus, observatory I&T, launch, and operations would change under such a model relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document (http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx):
    - Provide proposed revisions to the 320-MAR-1001E document to establish a starting point for discussions with NASA on appropriate S&MA requirements that might be applied to a spacecraft bus, launch, and operations service contract issued under the PPFS business model
- Assess whether such a model might enable cost efficiencies not typically available under a typical NASA contract, and specifically how cost efficiencies would be expected to emerge

- Assess whether such a model might result in cost increases not typically experienced under a typical NASA contract, and specifically how cost increases would be expected to emerge
- Discuss and suggest how such a model might be contractually implemented, including assessment of contracting issues that might be encountered (e.g., asset ownership and authority, liability, accountability for performance, limitation of funds, etc.)
- Assess the degree to which other commercial revenue streams (e.g., hosting of secondary commercial payloads on the SLI satellite) enabled by this business model might offset government costs
- Discuss how best to structure payments given the service nature of this approach, including how payments can be most effectively distributed pre- and post-launch to incentivize performance and quality. Discuss how innovative financing may help reduce peak funding requirements, and identify potential contracting issues that might be encountered if contractor financing is implemented
- Discuss how the purchasing of insurance would likely be utilized under this model and assess its impact on government cost. Describe how the government can best incentivize contractor performance and product quality given that the contractor's losses for poor performance will be, to some degree, reimbursed by insurance.
- Discuss your experiences working under a contractual relationship that might be in some ways similar to PPFS. In particular, describe your experience implementing spacecraft bus developments that included your also providing launch services and/or mission operations.
- Discuss how the contractor would handle mission operations and coordinate with the government to implement special imaging operations requests, to respond to and recover from anomalies, and to reach end-of-life decisions. Specifically address ideas for how best to structure requirements and decision authority to prepare for those situations.
- Discuss how a contract requirement for a replacement spacecraft bus and launch (in the event of a launch or early-orbit spacecraft bus failure) would change the character and cost of the contract. For example, in what ways would a replacement clause alter S&MA or other approaches to spacecraft bus development to reduce the risk of failure? Estimate a percentage cost impact to the contract of applying a replacement clause to the contract.
- Propose modifications (if desired) to this business model

4) If desired, propose and discuss your own business model ideas to improve the efficiency of government space system acquisition that you would like the Sustainable Land Imaging program to consider.

CLIN B: Spacecraft Bus Developers With Less Experience

The contractor shall perform analyses of their company's experience in space system development and assess various business model considerations to address the following tasks.

1) Assess and compare how your company's commercial business and satellite development practices are similar or different to practices typically required under a NASA contract as exemplified in the reference specifications below. In particular, identify and discuss specific differences that might lead to cost, schedule, and/or quality differences, and quantify the impacts of these differences to the degree possible by analyzing your company's commercial spacecraft bus development data. For this assessment and comparison, assume a NASA contract implemented as a Risk Class B procurement with a 5-year on-orbit lifetime requirement.

1a) Describe the structures and features of your commercial and government spacecraft bus contracts. Describe the most significant advantages and disadvantages of a commercial spacecraft bus acquisition approach versus a traditional government spacecraft bus acquisition approach as exemplified by the reference specifications below. Describe the contract type differences and pros and cons.

1b) Quantify the potential savings in cost and schedule, if any, that could result from acquiring a spacecraft bus using commercial approaches and the rationale for those savings as compared to a typical NASA Class B contract. Assess your organization's historical relative cost or labor hours associated with building comparable government and commercial systems; identify any differences and explain.

1c) Describe how reliability, performance, cost, and schedule are financially incentivized on your contracts. Describe how payment philosophies, incentives, and distribution of pre-launch vs. on-orbit payments are best used in contracts to encourage quality, performance, schedule, and long-life. Provide examples of how such payment structures were used on past contracts. Describe and provide examples of how your organization makes use of insurance to offset financial risk in commercial spacecraft bus developments, and the role of insurance in either encouraging or discouraging the effectiveness of financial incentives or penalties imposed by your customer.

1d) Describe how the risk management process and the resulting degree of risk differ between government and commercial spacecraft bus acquisitions. Describe how risks are assessed and ranked in terms of company financial or business risk, and how the contract payment and financial incentive structure impacts risk assessments in commercial contracts.

1e) Describe your approach under commercial spacecraft bus developments to reviews, customer involvement, and on-site monitoring so as to maximize insight while minimizing acquisition cost.

1f) Analyze the demonstrated on-orbit reliability of your spacecraft buses. Correlate the realized lifetime to the statistical design lifetime so that comparisons can be made to NASA risk class.

1g) Compare your organization's safety and mission assurance practices in detail relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document – see http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx. Identify differences and explain the associated risks linked with each item of difference. Provide some indication of the depth of analysis, testing, audits, and verification required to meet your organization's mission assurance requirements. Highlight specific aspects of 320-MAR-1001E that are unnecessarily burdensome; propose more efficient or effective alternatives for risk reduction; describe your experience with and provide evidence of implementing these alternatives.

1h) Provide your company's expectations for government's S&MA interaction with your development team given a fixed price vs a cost plus contract, including attributes such as insight vs oversight, failure and anomaly notification, and voting membership on failure and anomaly review boards.

1i) Compare your organization's environmental testing practices in detail relative to the General Environmental Verification Standard (GEVS) For GSFC Flight Programs and Projects (GSFC-STD-7000A – see http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-7000A.pdf). Identify differences and explain the associated risks linked with each item of difference.

1j) Compare in detail the LDCM Spacecraft Statement of Work (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-01_SC_SOW_01-10-13_Rev_H no cr.pdf) and Contract Data Requirements List (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-02_SC_CDRL_10-19-12_Rev_D_Final_Doc1 no cr.pdf) to similar commercial spacecraft bus procurement documents. Identify differences in methodology and specific required deliverables between government and commercial approaches and explain the impacts on cost, schedule, risk, and customer insight.

1k) Assess in detail the degree to which imposition of the GSFC Rules for the Design, Development, Verification, and Operation of Flight Systems (GSFC-STD-1000F - see

http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-1000F%20Admin%20Changes.pdf) reduces mission risk in comparison to reliance on your organization's development practices. Quantify the programmatic impacts (e.g., cost, schedule, etc.) of imposing GSFC-STD-1000F.

2) N/A

3) Provide specific feedback on the notional business model described below for acquisition of a spacecraft bus, launch, and mission operations services, called here Prime Payload Flight Services (PPFS). The PPFS model may offer some distinct advantages to the SLI Program that deserve consideration. Required specific feedback includes the following:

- Assess the model's feasibility and its advantages and disadvantages.
- Assess risks and potential mitigations. Assess if and how commercial-type profit motives and contract features can be used to incentivize performance and reduce risk under this model in place of more traditional prescriptive NASA quality requirements and approval processes.
- Assess specific methods to provide a sufficient level of government insight into spacecraft bus, launch, and operations development under this model while maintaining development efficiency
- Assess how safety and mission assurance practices for the spacecraft bus, observatory I&T, launch, and operations would change under such a model relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document (http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx):
    - Provide proposed revisions to the 320-MAR-1001E document to establish a starting point for discussions with NASA on appropriate S&MA requirements that might be applied to a spacecraft bus, launch, and operations service contract issued under the PPFS business model
- Assess whether such a model might enable cost efficiencies not typically available under a typical NASA contract, and specifically how cost efficiencies would be expected to emerge
- Assess whether such a model might result in cost increases not typically experienced under a typical NASA contract, and specifically how cost increases would be expected to emerge
- Discuss and suggest how such a model might be contractually implemented, including assessment of contracting issues that might be encountered (e.g., asset ownership and authority, liability, accountability for performance, limitation of funds, etc.)
- Assess the degree to which other commercial revenue streams (e.g., hosting of secondary commercial payloads on the SLI satellite) enabled by this business model might offset government costs

- Discuss how best to structure payments given the service nature of this approach, including how payments can be most effectively distributed pre- and post-launch to incentivize performance and quality. Discuss how innovative financing may help reduce peak funding requirements, and identify potential contracting issues that might be encountered if contractor financing is implemented
- Discuss how the purchasing of insurance would likely be utilized under this model and assess its impact on government cost. Describe how the government can best incentivize contractor performance and product quality given that the contractor's losses for poor performance will be, to some degree, reimbursed by insurance.
- Discuss your experiences working under a contractual relationship that might be in some ways similar to PPFS. In particular, describe your experience implementing spacecraft bus developments that included your also providing launch services and/or mission operations.
- Discuss how the contractor would handle mission operations and coordinate with the government to implement special imaging operations requests, to respond to and recover from anomalies, and to reach end-of-life decisions. Specifically address ideas for how best to structure requirements and decision authority to prepare for those situations.
- Discuss how a contract requirement for a replacement spacecraft bus and launch (in the event of a launch or early-orbit spacecraft bus failure) would change the character and cost of the contract. For example, in what ways would a replacement clause alter S&MA or other approaches to spacecraft bus development to reduce the risk of failure? Estimate a percentage cost impact to the contract of applying a replacement clause to the contract.
- Propose modifications (if desired) to this business model

4) If desired, propose and discuss your own business model ideas to improve the efficiency of government space system acquisition that you would like the Sustainable Land Imaging program to consider.

CLIN C: Commercial Satellite Customers

The contractor shall perform analyses of their company's experience in space satellite acquisition and assess various business model considerations to address the following tasks.

1) Assess and compare how your company's commercial business and satellite acquisition practices are similar or different to practices typically required under a NASA contract as exemplified in the reference specifications below. In particular, identify and discuss specific differences that might lead to cost, schedule, and/or quality differences, and quantify the impacts of these differences by analyzing your company's historical commercial satellite acquisition data. For this assessment and comparison, assume a NASA contract implemented as a Risk Class B procurement with a 5-year on-orbit lifetime requirement.

1a) Describe the structures and features of your satellite acquisition contracts. Describe the most significant advantages and disadvantages of a commercial satellite acquisition approach versus a traditional government satellite acquisition approach as exemplified in the reference specifications below. Describe the contract type differences and pros and cons.

1b) N/A

1c) Describe how reliability, performance, cost, and schedule are financially incentivized on your satellite contracts. Describe how payment philosophies, incentives, and distribution of pre-launch vs. on-orbit payments are best used in commercial contracts to encourage quality, performance, schedule, and long-life. Provide examples of how such payment structures were used on past contracts. Describe and provide examples of how your organization and the satellite developer organization both make use of insurance to offset financial risk, and the role of insurance in either encouraging or discouraging the effectiveness of financial incentives or penalties you impose on your satellite developer.

1d) Describe how the risk management process and the resulting degree of risk differ between government and commercial satellite acquisitions. Describe how risks are assessed and ranked in terms of company financial or business risk, and how the contract payment and financial incentive structure impacts risk assessments in commercial contracts.

1e) Describe your approach under commercial satellite acquisitions to reviews of satellite development, your involvement in satellite development, and on-site monitoring so as to maximize insight while minimizing acquisition cost.

1f) Analyze the demonstrated on-orbit reliability of satellites built for commercial applications versus those built for government applications via government-imposed specifications. Correlate the realized lifetime to the statistical design lifetime so that comparisons can be made to NASA risk class.

1g) Compare in detail the safety and mission assurance requirements that your organization places on your satellite developers relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document – see http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx. Identify differences and explain the associated risks linked with each item of difference. Provide some indication of the depth of analysis, testing, audits, and verification required to meet your organization's mission assurance requirements. Highlight specific aspects of 320-MAR-

1001E that are unnecessarily burdensome; propose more efficient or effective alternatives for risk reduction; describe your experience with and provide evidence of implementing these alternatives.

1h) Provide your company's expectations for government's S&MA interaction with your development team given a fixed price vs a cost plus contract, including attributes such as insight vs oversight, failure and anomaly notification, and voting membership on failure and anomaly review boards.

1i) Compare in detail the environmental testing requirements that your organization places on your satellite developers relative to the General Environmental Verification Standard (GEVS) For GSFC Flight Programs and Projects (GSFC-STD-7000A – see http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-7000A.pdf). Identify differences and explain the associated risks linked with each item of difference.

1j) Compare in detail the LDCM Spacecraft Statement of Work (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-01_SC_SOW_01-10-13_Rev_H_no cr.pdf) and Contract Data Requirements List (http://sustainablelandimaging.gsfc.nasa.gov/documents/427-06-02_SC_CDRL_10-19-12_Rev_D_Final_Doc1 no cr.pdf) to similar commercial satellite procurement documents. Identify differences in methodology and specific required deliverables between government and commercial approaches and explain the impacts on cost, schedule, risk, and customer insight.

1k) Assess in detail the degree to which imposition of the GSFC Rules for the Design, Development, Verification, and Operation of Flight Systems (GSFC-STD-1000F – see http://sustainablelandimaging.gsfc.nasa.gov/documents/GSFC-STD-1000F%20Admin%20Changes.pdf) reduces mission risk in comparison to reliance on your organization's acquisition practices. Quantify the programmatic impacts (e.g., cost, schedule, etc.) of imposing GSFC-STD-1000F.

2) Assess your company's experience implementing block buys of spacecraft buses or complete satellites. Assess your organization's historical data to determine cost profile differences as a function of number of identical systems developed. Assess the degree to which parallel versus serial development affects cost savings on subsequent units. Suggest methods the SLI Program might use to implement block buys while avoiding cost peaks that would exceed the SLI budget profile.

3) Provide specific feedback on the notional business model described below for acquisition of a spacecraft bus, launch, and mission operations services, called here Prime Payload Flight Services (PPFS). The PPFS model may offer some distinct

advantages to the SLI Program that deserve consideration. Required specific feedback includes the following:

- Assess the model's feasibility and its advantages and disadvantages.
- Assess risks and potential mitigations. Assess if and how commercial-type profit motives and contract features can be used to incentivize performance and reduce risk under this model in place of more traditional prescriptive NASA quality requirements and approval processes.
- Assess specific methods to provide a sufficient level of government insight into spacecraft bus, launch, and operations development under this model while maintaining development efficiency
- Assess how safety and mission assurance practices for the spacecraft bus, observatory I&T, launch, and operations would change under such a model relative to the GSFC Standard Mission Assurance Requirements (320-MAR-1001E) document (http://sustainablelandimaging.gsfc.nasa.gov/documents/320-MAR-1001.RevisionE.docx):
    - Provide proposed revisions to the 320-MAR-1001E document to establish a starting point for discussions with NASA on appropriate S&MA requirements that might be applied to a spacecraft bus, launch, and operations service contract issued under the PPFS business model
- Assess whether such a model might enable cost efficiencies not typically available under a typical NASA contract, and specifically how cost efficiencies would be expected to emerge
- Assess whether such a model might result in cost increases not typically experienced under a typical NASA contract, and specifically how cost increases would be expected to emerge
- Discuss and suggest how such a model might be contractually implemented, including assessment of contracting issues that might be encountered (e.g., asset ownership and authority, liability, accountability for performance, limitation of funds, etc.)
- Assess the degree to which other commercial revenue streams (e.g., hosting of secondary commercial payloads on the SLI satellite) enabled by this business model might offset government costs
- Discuss how best to structure payments given the service nature of this approach, including how payments can be most effectively distributed pre- and post-launch to incentivize performance and quality. Discuss how innovative financing may help reduce peak funding requirements, and identify potential contracting issues that might be encountered if contractor financing is implemented
- Discuss how the purchasing of insurance would likely be utilized under this model and assess its impact on government cost. Describe how the government can best incentivize contractor performance and product quality given that the contractor's losses for poor performance will be, to some degree, reimbursed by insurance.

- Discuss your experiences working under a contractual relationship that might be in some ways similar to PPFS. In particular, describe your experience implementing spacecraft bus developments that included your also providing launch services and/or mission operations.
- Discuss how the contractor would handle mission operations and coordinate with the government to implement special imaging operations requests, to respond to and recover from anomalies, and to reach end-of-life decisions. Specifically address ideas for how best to structure requirements and decision authority to prepare for those situations.
- Discuss how a contract requirement for a replacement spacecraft bus and launch (in the event of a launch or early-orbit spacecraft bus failure) would change the character and cost of the contract. For example, in what ways would a replacement clause alter S&MA or other approaches to spacecraft bus development to reduce the risk of failure? Estimate a percentage cost impact to the contract of applying a replacement clause to the contract.
- Propose modifications (if desired) to this business model

4) If desired, propose and discuss your own business model ideas to improve the efficiency of government space system acquisition that you would like the Sustainable Land Imaging program to consider.

Description of Prime Payload Flight Services (PPFS) Business Model

NASA frequently acquires spacecraft buses using the NASA/GSFC Rapid Spacecraft Development Office (RSDO) catalog of spacecraft buses. The RSDO approach offers an expedited acquisition methodology that treats spacecraft buses to some degree as a rather mature commodity, in contrast to science instrument payloads that are generally treated as very unique developmental items. The Prime Payload Flight Services (PPFS) model proposed here for consideration goes one step further in regard to spacecraft buses by acquiring them as a bundled service rather than as a government-owned commodity in the interest of achieving additional cost and schedule efficiency.

In addition, NASA implements a mission risk classification methodology (NPR 8705.4 Risk Classification for NASA Payloads) that provides the basis for program and project managers to develop and implement appropriate mission assurance and risk management strategies and requirements. This classification methodology establishes a set of standard mission assurance and risk management practices for missions as a function of mission priority, national significance, lifetime, and other factors. The 2014 architecture study by the SLI Architecture Study Team (AST) provided some aggregated evidence that satellites developed for commercial enterprises and satellites developed under NASA contracts tended to have comparable overall reliability. The study also provided some evidence that comparable commercial satellites tended to be lower in cost than government sponsored satellites. These findings raise the possibility that more efficient yet similarly effective methodologies are being employed in commercial satellite

developments compared to those implemented under the NASA risk classification approach. The PPFS model proposed here attempts to enable greater use of commercial practices and contract features to ensure reliability and performance; a unique and perhaps enabling feature in this regard of the PPFS model is that the spacecraft bus would be commercially owned and not government owned.

Under this model, the government would procure or develop the science instrument(s) via a typical direct contract to industry or in-house at a NASA Center, and then provide them to the flight services contractor as government furnished equipment (GFE) for integration and flight. Having direct government control of instrument development is considered to be a key factor in reducing mission development risk.

Under this notional model, acquisition of the spacecraft bus, observatory integration and test, launch, and mission operations are bundled together into a single contract that also strives to achieve cost reductions by leveraging commercial practice and perhaps also leveraging other commercial markets. The idea behind this model is to purchase these items together as a service much like NASA already purchases launch as a service. Like the launch services model, the government would not own the spacecraft bus. The government would purchase the service of: 1) hosting government-owned instrument(s) on the spacecraft bus as the mission's primary payload(s); 2) launching the observatory to the orbit the government desires; 3) operating the observatory in a contractor-provided mission operations center; and 4) sending the required data from the government instrument(s) and other required ancillary data back to the government via contractor-provided ground stations and networks. Bundling the spacecraft bus, observatory integration and test, launch, and operations services together significantly reduces the number of interfaces that have to be controlled by the government, presumably resulting in more efficient implementation. In addition, with a commercially owned and operated spacecraft bus, the potential exists to make better use of profit motives (i.e., contract features and incentives) to encourage performance and quality while reducing some typical NASA mission oversight requirements. This might enable greater use of commercial practices to reduce cost.

Additionally, this model that makes use of a privately owned spacecraft bus opens up the possibility of the spacecraft bus hosting secondary commercial payloads, perhaps enabling secondary revenue streams to further offset government costs. These secondary commercial payloads could be of any type as long as they do not interfere with the primary government payloads.

The service contract nature of this model also may enable the contractor to manage its financing to flatten out the development cost peaks to the government, thus facilitating the ability of the SLI program to avoid exceeding its annual budget while minimizing schedule delays in mission development.

To ensure adequate government insight into spacecraft bus development and observatory I&T, it is envisioned that the prime contractor for this approach would

be the spacecraft developer, with the other functions of launch and operations presumably being implemented via subcontracts to the prime.

This model likely carries some increase in risk that will have to be appropriately managed. As part of this study, the SLI program seeks the input of study contractors to identify appropriate quality requirements, contract features, and methods for government insight to ensure mission success while enabling greater implementation efficiencies.

3. Period of Performance

This effort is estimated to begin on January 5, 2015 with a four-month period of performance nominally ending on May 5, 2015.

4. Deliverable Items and Schedules

- The contractor shall host a kickoff teleconference and web-enabled presentation within three weeks ARO of approximately 1-2 hours in duration.
    - The contractor's chart package shall be delivered electronically to the Government at the time of the meeting. The main purpose of this event is for the contractor to demonstrate that requirements are clearly understood, and demonstrate how the study is to be accomplished.
- The contractor shall support a preliminary results (midterm) teleconference and web-enabled presentation approximately 2 months ARO of approximately 2-4 hours in duration.
    - The review chart package shall be delivered electronically to the Government at least 1 business day prior to the review.
    - The main purpose of this review is for the contractor to present progress and preliminary findings on all task items. The Government will provide feedback on these initial results for consideration by the contractor to guide the activities for the remaining period of performance.
- The contractor shall host a final results teleconference and web-enabled presentation approximately 4 months ARO of approximately 2-4 hours in duration.
    - The review chart package shall be delivered electronically to the Government at least 1 business day prior to the review.
    - The main purpose of this review is for the contractor to present the final results of all task items.
- The contractor shall deliver a final report addressing all required content within one week following the final review teleconference.
    - The report shall be delivered electronically.
    - The form of the final report shall be in a mutually agreed to format (likely some combination of text documents, spreadsheets, and/or presentation charts) and shall thoroughly address all required

content. The SLI office will work with the study contractors to develop reporting methods that will facilitate government analysis and understanding of the data developed by the study contractors.

5. Travel

The contractor is not required to travel for work.

6. Work Location

The activity shall be performed at the contractor's location with communication via email and teleconferences.

7. Reporting Requirements

In addition to reporting requirements provided in Section 4, the contractor is welcome to propose weekly or ad hoc teleconferences with the government to discuss study progress if it feels such interaction would be in the best interest of the study.

8. Reference Documents

Reference documents for this study are available at:
http://sustainablelandimaging.gsfc.nasa.gov/referencedocuments.html