# Applying the UK's PPP Lessons to NASA's Commercial Development Policy

David J Iron[1]
*Logica, Leatherhead, Surrey, KT22 7LP, UK*

*and*

Ken Davidian[2]
*NASA Headquarters, Washington, DC, 20546-0001*

**Under an early stage of US/UK collaboration in space exploration, the UK's experience in Public Private Partnerships (PPP) is helping guide the creation of an agency-level Commercial Development Policy (CDP) for NASA. In PPPs, private capital is secured to finance the construction of an asset which is then used for the private operation of a public service delivery. An existing CDP, that was adopted by the NASA Exploration Systems Mission Directorate, seeks to develop industrial capability and markets to achieve exploration at lower cost with fixed price contracts. Two notable European PPPs in the space sector (Skynet 5 and Galileo) provide valuable lessons for the emerging NASA CDP in several areas: enabling private debt financing, focusing on dual-use technologies, understanding value instead of cost, risk transfer, using long term planning, and impacting the national economy.**

## I. Introduction

THE Exploration Systems Mission Directorate (ESMD) at NASA Headquarters (HQ) adopted the ESMD Commercial Development Policy (ECDP) to encourage the development of commercial space capability markets and industries. Individuals from other mission directorates and mission support offices at NASA HQ helped support and develop this policy. Other significant contributions came from ESMD personnel located at NASA field centers throughout the country.

For the UK, a Public/Private Partnership (PPP) exists when a private sector company commits to the delivery of a government service and takes a commercial risk in doing so. Private financing, usually known as PFI for Private Finance Initiative, is a type of PPP in which the private sector risk includes funding of the project to build the infrastructure which enables the service. The UK's experience of PPP/PFI includes over 700 contracts now in place which altogether have raised over $130Bn of private investment, and the experience is increasingly being used abroad.

Following an agreement last year between NASA and the British National Space Centre to investigate collaboration in space exploration[i], a joint working group reported on lunar cooperation earlier this year[ii], including the prospect of using the UK's experience in PPP to help craft NASA's Commercial Development Policy.

## II. ESMD Commercial Development Policy

### A. "Technology Commercialization" and "Commercial Development"

Created in response to statutory requirements[iii], the "NASA Technology Commercialization Policy"[iv] 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."

[1] PPP Adviser, Logica, The Office Park, Springfield Drive, Leatherhead, Surrey.
[2] Lead, ESMD Commercial Development Strategy, ESMD, 300 E Street SW, and Member, AIAA

"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.

### B. 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"[v] more widely than a "contracting through negotiation"[vi] acquisition. The latter is currently the predominant type of procurement contract used by NASA with its prime contractors for these types of space capabilities.

### C. 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.

### D. 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.

### E. 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.

## III. The UK's PPP

### A. History

The PPP/PFI concept has its origins in the 1970s French road-toll concession contracts. Following its notable use for the Anglo-French Channel Tunnel in the 1980s, the UK government in the early 1990s decided to apply private finance as a default for practically all new public infrastructure, driven by the UK finance ministry's PFI programme. This was later expanded into a more comprehensive PPP approach, but the emphasis remains the acquisition of private investment to finance the infrastructure and deliver the service.

### B. Types of PPP/PFI

Generally a PPP without private financing is simply a form of outsourcing, when the private sector may rely on a government infrastructure to provide a service and charges for service availability and/or usage. Occasionally the private sector is given a government asset to exploit in the market, and shares the subsequent revenues with the public sector.

Under PFI, private financing is used to design, build and operate the infrastructure to deliver the service. The private sector usually owns the assets and its operational charging is designed to include the recovery of its investment. Examples where private financing can be efficient include:

- internal government use (e.g. defence facilities, schools, government computer services), where charging is based on availability and/or usage;
- a public service direct to citizens (e.g. roads), where charging is as above, but with the option of direct payment by users;
- a market service needing significant government involvement and permission (e.g. national lottery), with normal market pricing mechanisms;
- a mixture of the above.

Variations on private financing include:

- where public funding exists up to design & test, and private funding is used for building & operations;
- where there is joint public/private funding via an investment payment subsidy or joint ownership of the implementing organisation.

If the private sector provides funding for asset construction which is without operational risk to the private sector because of government guarantees to repay the investment even if the private sector fails during the operations phase, then this is not considered private financing. In this case, the public sector could have raised debt funding directly from the financial markets.

In practice, the balance of investment risk between public and private sectors varies from project to project. The risk could in theory range between full 100% risk on either side. UK government procurement authorities usually retain the fall-back option of a conventional procurement in which they contract for the build and then separately contract for the operation. This can be evaluated for comparison with the private financing option, in which case it is known as the Public Sector Comparator.

### C. How it works

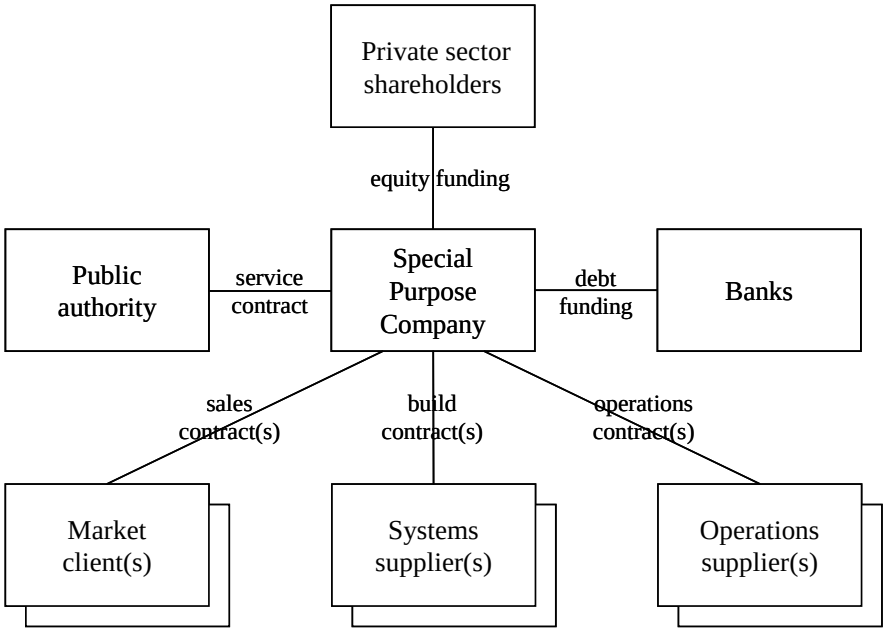


**Figure 1. A standard PFI model.**

As shown in Fig. 1, a *public authority*, sometimes via a procurement agency, negotiates a *service contract* with a *Special Purpose Company* (SPC). The service contract includes full provision for the private sector to finance, build and operate the service, from the date of the contract to its end. To ensure the private sector takes on risk, payments should at least be dependent on service delivery. The SPC is created with *equity funding* by its *shareholders* for the sole purpose of the service contract.

The SPC is the most important component of the private sector for the public sector to deal with. A joint venture (JV) if it has more than one corporate shareholder, it is a commercial entity for the most efficient contracting for financial, material and human resources, for selecting and optimising the allocation of risk, for balancing capital expenditure with operating expenditure, and for limiting to the project the risks and liabilities of those who contract with it.

In addition to having equity funding, the SPC negotiates: with *banks* for the provision of low risk *debt funding* to be repaid with low cost interest; with *systems suppliers*, perhaps with a single lead supplier, for the build and delivery of the required assets which are paid for by the SPC; with *operations suppliers*, perhaps with a single lead supplier, for operating the assets to deliver the service, and paid by the SPC according to a Service Level Agreement; and with *market clients* such as service providers and end users, for whatever deals the SPC can arrange, having a concession within the service contract to do so and often sharing its revenues with the public sector as a consequence.

Although the main contracts shown above are with the SPC, extra agreements will be needed to improve the robustness of the commercial arrangements. For example, banks expect to have recourse to the other parties in case matters go wrong. They might have a direct agreement with the shareholders or the lead supplier if the build phase goes badly, and with the public sector in case the SPC fails during operation. The private sector will insure against failure of some of its responsibilities.

### D. Advantages & disadvantages

The advantages of private financing stem from the private sector's almost unlimited access to capital (although transaction costs can limit the minimum amount of funding), its continual investment decisions based on NPV (net present value) rather than cost, its balancing of early capital expenditure with long term operational expenditure via value based deals across the supply chain, and the alignment of interests of the providers of capital with the users of capital, particularly the alignment of financial incentives with public benefits.

For public sector bodies an important advantage of private financing compared to conventional procurement is that the public sector financial commitment is defined in the service contract for the duration of that contract. Forward planning by public sector bodies is therefore greatly simplified due to the removal of cost uncertainty.

The disadvantages of private financing include the higher cost of investment money the private sector has to pay compared with government, and the fact that developing a private financing contract takes longer, is more expensive, and needs a greater skill, for both sides.

### E. Space PPP Examples

Two space sector PPP examples stand out. One is Skynet 5, providing the UK military with secure satellite communications. Skynet 5, the largest MoD (Ministry of Defence) PPP contract until only recently, is now in full operation with three geostationary satellites and has become a successful reference for other projects. The second PPP is Europe's Galileo project, an equivalent to America's Global Positioning System (GPS).

*1. Skynet 5*

A service contract between the MoD and Paradigm, a Special Purpose Company owned by EADS, is put into practice by a catalogue of communications services which can be bought at a fixed price over a secure web intranet anywhere around the world. Services include a range of radio signal types and bandwidths, from personal satellite phones to secure tactical nets and major trunk links, and extend to remote terminals and networking. They even include welfare links to service families and general internet connections.

The service contract contains service level agreements and the price varies with achieved service performance. Budgeting by the MoD can be at any level down to an operational unit. Underpinning the contract are Government guarantees for overall usage.

Paradigm can use its spare bandwidth for non UK MoD sales under a profit sharing agreement with the MoD, and already has a number of additional client contracts, e.g. with NATO, Canada, Portugal and Holland.

Its satellite and ground systems supplier is a prime arrangement led by EADS Astrium, and operational services is led by another specially created EADS subsidiary, Paradigm Services. Paradigm Services can provide bandwidth from other commercial satellite operators to enable full service satellite communications.

Around $2Bn of financing was arranged, mainly as debt from the capital markets which was secured by the quality of the UK government commitment to overall revenues and to an EADS commitment to Paradigm's project cost and delivery risks, for both the satellites and the ongoing operational services. The greater part of the financing arrangement was developed under full competitive pressure, as was the service contract itself.

*2. Galileo*

Galileo has been deliberately designed to offer a range of civilian services including integrity and liability and aims to achieve market revenues. Originally mandated by European governments to attract private investment to set up the infrastructure, Galileo presented the European Union (EU) with its largest-ever collaborative project and the first significant PPP at the European level. But after over five years of seeking a PPP solution, the decision was taken last year to rely instead on public financing.

From its early days the Galileo PPP faced several management challenges:

- The EU's executive institution the European Commission (EC) and the European Space Agency (ESA) were working together for the first time, with different financial and operating procedures and cultures.
- The project required agreement between the EU's Member States, and getting multinational cooperation to agree upon Galileo's outputs was not always simple.
- There was a parallel procurement with the EU in control of the PPP and ESA managing the technology development programme, making it difficult to set up efficient lines of customer authority.
- Many in the European public sector were facing for the first time up-front private investment rather than public asset delivery, when government traditionally would have created the initial service and then phased in private management for operations and private capital for future development.
- There was a long lasting and confusing political association between market revenues and the PPP concept, and a political expectancy that the acquisition of private capital was dependent on taking on market risk, which was always going to be unacceptable.
- The competition for the lead supplier was closed under political pressure well before priced outputs could be formally submitted.

Above all, the important PPP requirement for a single effective customer was never met. As the programme developed, it moved further and further away from the UK's view of how a PPP should be done. In the end, a Galileo PPP proved too difficult to deliver and an arrangement has recently been put in place where the EC will fund the procurement by ESA of the satellites and ground infrastructure, but under EC competitive procurement rules.

## IV. Application of PPP Principles to the ECDP

The lessons learned from the UK's PPP can be applied to ESMD's relations with the US space industry, for both established companies and emerging enterprises, including space operators, launch service providers, spacecraft contractors, component suppliers, R&D specialists, lawyers and financiers. The implications affect market development, product/service development, risk management, investment financing, contractual structures, governance and the procurement process, and extend to international collaboration for the overall space exploration programme.

The objective is to secure funding for space exploration from potentially several sources of money (governments, corporations, individuals, venture capital, and other capital markets) when they all have other competing investment opportunities. Planning involves the shaping of contracts and other agreements to align the interests across all parties, and maximising value by the allocation of investment risk.

There are six major lessons learned that can be applied, in theory, to NASA's ESMD Commercial Development Policy. These lessons are:

- Enabling Private Debt Financing
- Focusing on Dual-Use Technologies
- Understanding Value Instead of Cost
- Risk Transfer
- Using Long-Term Planning
- Impacting the National Economy

Practical implications of these applications, however, limit the benefit that PPP principles can have on NASA's interactions with the emerging commercial space exploration sector. Each of these lessons is discussed below.

### A. Enabling Private Debt Financing

PPPs share the following attributes with the ECDP: improved procurements, better spreading of risk, enabling markets in commercial companies, and payback to the public sector. Although the principle aim of a PPP is improved government procurement, many contracts stimulate wider market activity.

The ECDP could look to turn some opportunities into investments in projects, rather than the financing of companies. Investors can scope what they finance in a project, but if they are investing in a company it is harder to control where the spending goes. Governments can enable a project financing where NASA wants something and can commit to payment of a successful service over some future time period. Based on that NASA commitment, bank debt can be used to cover project investment costs not covered by NASA to allow something to be built, and the smaller the amount of shareholder equity required (typically 10-20% of total cost, in the range of the profit margin) then the less industry must spend from its own resources and the more time it can spend doing what it does best, and that is providing its goods or services. Companies have difficulty when raising major money internally for a project which goes beyond its core activities. The funding structure depends on each project. The best deal often comes from two equally powered competitors going for the opportunity and each having to work out the structural details under competitive pressure, and that competition should be managed by the public institution.

Currently, agency-specific procurement regulations limit NASA from awarding contracts with an expected duration of more than one year if the primary effect of the contract is to provide a guaranteed customer base for, or establish an anchor tenancy in, new commercial space hardware or services[vii]. Therefore, use of the SPC model by NASA will depend on a careful evaluation of NASA's requirements for the particular service offered by the SPC. Because NASA regulations would prohibit award of a contract (of more than one year) if the primary effect of the award is to subsidize an SPC that would not otherwise be viable, a close alignment between NASA requirements and the output of the SPC is crucial.

### B. Focusing on Dual-Use Technologies

Many new technology areas could eventually come under the heading of service provision. NASA should also look at dual-use, downstream, non-space applications (the creation of spin-offs) which can expand the types of deals that can be reached. Even science results can sometimes be commercialized although they are normally free initially.

This strategy is recognized by NASA as increasing the value and lowering the risk of any emerging commercial space sector venture. Since a principle tenet of the ECDP is to follow the market development instead of leading, the market forces are responsible for creatively identifying and pursuing any dual-use applications that may lead to commercial success in the near-term. However, the ECDP encourages NASA to look for terrestrial products that can help meet specific programmatic goals in space exploration (spin-in).

### C. Understanding Value Instead of Cost

The ECDP describes the use of Risk Adjusted Net Present Cost (RANPC) analysis as an example of cost-benefit calculation, but commercial companies use RANPV (V=Value) because they work to a profit where income is greater than cost (Value = Income - Cost). Because governments are not normally in the business of selling anything commercially, they do not traditionally use value but instead use cost as a metric. As people understand benefit to cost relationships better, they want to see a measurable benefit in financial terms (e.g. reduction of social costs, increasing economic efficiency, decreasing tax rates) and often it helps to show quantitative benefit. Government departments try to link costs to outcomes and values in order to bolster their arguments for getting funding. If the department can show a positive financial value to a proposed activity or industry, those future benefits can be a strong justification for the expenditure of current funds. Consequently there is a movement in governments away from cost budgeting to value management, in which there is a clearer relationship (and therefore justification) between capital expenditure and operating expenditure, and in which there is less fitting of expenditure to budgets and more fitting of budgets to RANPV decisions. This is the case with PPPs, and it can lead to more expenditure is some areas, and less in others.

The transition by NASA (and the U.S. government as a whole) to “full-cost” accounting has been taking place for a number of years. The transition is on going, and provides constant opportunities for the concepts of value versus cost to be measured and presented within NASA at all levels.

### D. Risk Transfer

There is a constant problem identifying winners in emerging markets and government needs to understand the types of risk in order to be able to transfer them to industry and commerce, specially under competitive procurement. For example, because these are high-risk activities, they are types of Venture Capital activity, and because it is difficult to get quantitative projections at an early stage of business development, commercial investors need an analysis of the early market being addressed. The US has leaders in this field, eg Michael Porter (creator of the Institute for Strategy and Competitiveness at Harvard) and Geoffrey Moore ("Crossing the Chasm").

Because NASA’s is required to exercise caution in its use of tax-payers’ money to meet its statutory objectives, there is a limited amount of risk the Agency is willing to accept. Despite the many accomplishments of groups around the world in estimating the risks of emerging markets, the truth is that only a small fraction of speculative investments ever meet expectations (let alone exceed them). Due diligence will always be a requirement before governmental investment is provided to commercial markets, in order to maximize the likely return to Agency and the tax-payer it serves.

Under a privately funded PPP, financial due diligence is undertaken in depth by the banks, allowing the government to concentrate more on the risks to its policy implementation and less on the risks of a project’s delivery and its associated market. This is risk transfer from the public to the private sector.

### E. Using Long-Term Planning

Longer-term "blue sky" market opportunities (e.g. lunar drilling, leading to exploitation of planetary resources) have value in being researched now because they can improve future investment decision-making, initial decisions which may not be that far away.

The use of longer-term planning as a way to strategically invest in nearer-term technologies or markets is a well-accepted principle. Despite the tendency of governments to act deliberately in defining programmatic requirements (i.e., agency demand), flexibility is still required during the implementation of specific programs. Therefore, commercial reliance on governmental planning that appears slow and constantly changing has limited usefulness to the commercial sector.

### F. Impacting the National Economy

It can be beneficial to ramp up the arguments beyond ESMD and NASA and go to the top level of government, if possible looking to support fiscal policy with expenditures which will result in tax revenue that will ultimately cover those expenditures. Government investment in the ECDS can lead to an increase of GDP (which is the basis of a country’s added value from which tax takes a cut), thereby increasing government revenue. Tax rates do not need to get increased, just the revenue generated by the current rate of taxation. Alternatively, the tax rate could be lowered to maintain a constant level of tax revenue. This argument would be helpful for discussions at the level of the Office of Management and Budget (OMB).

Addressing the geopolitical-level of governance when framing arguments can be useful at the proper time and place. These tactics can and should be used by NASA leadership at their discretion, when the data provides sufficiently strong rationale and support for the tenets of the overall policy.

## V. Conclusion

In this paper, NASA ESMD's Commercial Development Policy (ECDP) and the UK's Public-Private Partnership (PPP) concepts were described. They are similar in trying to meet the government's specific needs by leveraging private capital to provide commercial goods and services more efficiently. These goods and services can meet the needs of non-governmental customers as well.

However, where the ECDP concentrates on following emerging markets, the PPPs can also lead and help develop markets.

The paper described and discussed the possible application of six "lessons learned" from past PPP experiences to the ECDP. Direct application of two of the lessons (i.e., Enabling Private Debt Financing, and Understanding Value Instead of Cost) would be difficult to implement due to statutory restrictions (i.e., the U.S. Federal Acquisition Regulations), and the intrinsic difficulty of assigning a value to intangibles such as scientific or exploratory discovery unless in comparison with existing equivalents.

On the other hand, the remaining PPP lessons (i.e., Focusing on Dual-Use Technologies, Risk Transfer, Using Long-Term Planning, and Impacting the National Economy) are directly applicable to the ECDP and provide valuable guidance with the goal of maximizing the impact of the emerging commercial sector.

---

[i] Joint Statement of Intent for Cooperation in the Field of Space Exploration, NASA/BNSC, April 19, 2007

[ii] Joint Working Group Report on Lunar Cooperation, NASA/BNSC, February 15, 2008

[iii] The Stevenson-Wydler Technology Innovation Act of 1980.

[iv] NASA Policy Directive (NPD) 7500.2.

[v] Contracts under Federal Acquisition Regulations (FAR) Part 12.

[vi] FAR Part 15 contracts.

vii NASA FAR Supplement, 48 C.F.R. 1812.7000, added in 1998, that puts into NASA regulations the restrictions of TITLE 42. CHAPTER 26. § 2459d. Funding restrictions regarding new commercial space hardware or services