PRIVATISING NASA – IMPLICATIONS FOR SPACE TOURISM

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ABSTRACT

The underlying issue of Space Tourism is that it posits a new model for spacefaring that challenges the existence of NASA, a lingering legacy of the Cold War. NASA actively frustrates the development of civilian space travel, but does it do this for the betterment of America and its aerospace industry? This analysis suggests not. NASA unfairly competes with corporations for America's best and dwindling creative talent—its engineers, scientists and designers—without producing the leveraged return on investment that private enterprise demands.

This paper proposes that NASA be broken up, with most of its assets allocated to aerospace, airline, computing and engineering corporations. The challenge for America is to develop cooperative methods to dismantle this monstrously inefficient Cold War construct. Simultaneously, NASA needs to be refashioned as a smaller, nimble organization that enables private enterprise to create new spacefaring industries, cultures and democracies. NASA must provide aid to national security agencies, and re-focus on scientific exploration through the pure and applied sciences, but it must leave the enabling technology to the private sector; allowing business entities to do what they know best. Create wealth effectively.

Why is this important, and why should we care?

As a NAFTA partner, Canada's fortunes are tied to America's. Our interlinked economy means that NASA's economic intransigence threatens our bloc's ability to compete with global markets. This could leave our security dependent on other trading alliances.

THE NEXT GREAT ADVENTURE

In Quarter 2, I wrote *Measuring S/Core Values*, a case study analyzing corporate sustainability positionings (excerpt, Appendix 1). For that effort, I divided industrial organizations into three types based on their positioning in three phases of the Industrial Age: 1st and 2nd Phase organizations consume and waste at will, but are often unable to adapt to emerging 3rd Phase models [systems that emphasize Closed (Value) Loops by minimizing waste inputs, while emphasizing value recovery]. In his seminal paper *Industrial Ecology: An Environmental Agenda for Industry* (1993),[i] Hardin Tibbs detailed the likelihood that an inability to move from 1st and 2nd Phase[ii] to 3rd Phase outlooks will produce systemic organizational die-offs in the emerging world order: "entire industries will also go thixotropic, swallowing entire companies, even industries. Learning to spot the market conditions and factors that can trigger this process will be a key to future business survival, let alone success."[iii] This is likely also true for government bureaucracies.

INTRODUCTION

Tibbs observes that "the emerging agenda requires a shift to "long-time;…thinking across decades."[iv] Tibb's model neatly describes what is about to happen to the so-called "US Space Program," because commercializing requires precisely the systems applications that are developing terrestrially from Tibbs' work. Spacefaring requires entrepreneurial flexibility (what we can call "capitalist sustainability") to transform into a civilian activity.

When I started this paper, I thought there was a riddle to be solved, however whilst writing I have decided the following is a truism: Space Tourism is developing because entrepreneurs, the essence of a thriving wealth-creating social system, have observed that NASA—the product of the world's most unabashedly capitalist society— has lost its nerve. The irony is astounding because capitalist sustainability—a minimalist cost-efficient resource use approach--is a necessity if America's space industry is to survive without government handouts. Moreover, market-driven change is necessary if America and its democratic allies are to avoid the loss of technical ability to maintain reliable access to space. The challenge is to garrot, gut and remake the Agency. I propose four framework axes to frame the argument (Appendix 2):

1. NASA is a Cold War barrier to trade
2. Technological barriers are not the key constraint
3. The key constraint is bureaucratic
4. The civilian space travel market already exists

Framework Axis One – NASA is a Cold War barrier to trade

Capitalist sustainability did not always drive the civilian space sector. Cold War rivals President Kennedy and General Secretary Khrushchev waved their hands and said "let there be a space program," and their will became metal. Kennedy even declared: ""...the nation which controls space can control the Earth."[v] NASA and its Soviet counterpart built rockets and conquered local space, but the fall of the USSR left NASA mouldering behind—a bureaucratic machine created to plant the US flag first, but not do much else. It is a common event in business that first-to-market does not mean controller of the market. NASA has lost control, and will not get it back.

Where the Industry Stands

The commercial space industry is a relatively new construct that develops and manages launch vehicles, satellites and spacecraft on contract to or independent of government. Most players are corporate symbionts who obtain competitive advantage through preferred supplier and R&D user status with national space agencies. The Space Tourism segment is coming about because a web of technical, financial, market-driven and institutional factors are merging into a potent force for change at the fringes of the industry.

Framework Axis Two – Technological barriers are not the key constraint

Design Constraints

A knowledgeable source indicates that while fuel cost is not a significant concern, the industry faces technical constraints[1] centred around vehicle design, mass and safety constraints. But all technical issues relate to one simple fact: vehicles must achieve Mach 26 velocity; also, they must be very light as most of the mass is fuel.[vi] "Launch costs have remained essentially stagnant since the beginning of space flight in the late 1950s"[vii] but at present there are limited options for known technology. The optimal shape is a spherical fuel tank within a missile fuselage. A second approach is to use wings to obtain "aerodynamic lift" but these are not as efficient as spherical tanks "and it is therefore much easier to produce a two-stage horizontal take-off, horizontal landing (HTOHL) vehicle, in which only a small part of the total vehicle reaches orbit."[viii] The X-Prize winning Scaled Composites/Virgin Galactic ***SpaceShipOne*** ***(link below)***[2] is a HTOHL variant because it uses two mated, winged vehicles—the first achieves lift, then the second rockets to Low Earth Orbit (LEO) before gliding to earth. Single-stage-to-orbit winged vehicles are also in development, but "require major advances in materials technology."[ix]

The Cost to Launch (CTL) Constraint

Leading research firm Futron Corporation notes that the "the cost of transporting payloads into space has been nothing less than an obsession."[x] For example, Shuttles are not commercialized, yet NASA produces estimated CTL aggregations ranging from US$350 to $500 million per flight[xi] and occasionally to US$1.0 billion plus; in 2002, this was based on eight flights a year."[xii] But these aggregations are tied to budget allocations, ***not*** operating fluctuations, asset writeoffs, market forecasting, passenger seat usage, freight volume, Net Present Value or Return on Investment, all standard free enterprise calculations to determine payback on investment.[xiii]

NASA has been unable to achieve lower CTL for decades because it continues to focus on highly complex and "wholly or partly expendable" vehicles where the entire craft "or major parts of it, are discarded after every launch. This is the basis of the shuttle program,[xiv] despite the fact that the Shuttle is uncompetitive, even with ex-Soviet (!) companies.

Consider NPO-Energia; this Russian state corporation produces reliable, low CTL spacecraft, including Soyuz crew vehicles (US$12 million at retail), Progress cargo craft ($6 million) and Soyuz launch vehicles ($16 million). The Soyuz vehicle design has "made nearly 2,000 flights, including hundreds of successful manned flights."[xv] "There have been no manned (Soyuz) failures since 1971;

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[1] Personal Communication from Steve Jones, a UBC physics student working with the Canadian Space Agency.
[2] http://www.virtuoso.com/us/Why/VirginGalactic/ [click on right upper sidebar: "*Experience the flight to space*"]

a result of the Russian tendency to build simple systems using reliable "off-the-shelf" components, which, together with low labour costs, contribute to producing one of the cheapest launchers[xvi] on the market."[3] Unlike Soyuz, the Shuttle was developed after the traditional missile launcher the Saturn V put America on the Moon. The Shuttle was designed as a Reusable Launch Vehicle (RLV) that NASA believed "would drastically reduce the cost of space travel." The Shuttle launches as a traditional rocket, offloading fuel tanks in transit. When returning to Earth, it lands on a runway; but ironically, it "is the most expensive launch vehicle in the world." Designed to be commercially reusable, it is ***only*** useful for specific military and scientific payloads and in fact is unreliable because of lengthy turnaround time:[xvii] "Because of its intrinsic technological problems and lack of demand, the Space Shuttle has become an example of "an unusable reusable vehicle." [xviii]

Operational and Infrastructural Cost Constraints

A key commercial management task is to minimize variable costs (labour, associated costs, inventory, etc.). But any examination indicates that NASA's per flight costs are wildly overcapitalized because of huge support costs associated with each flight:[xix] NASA must maintain a huge workforce because the Shuttle "is only reusable after the vehicle has essentially been taken apart and reassembled. The thermal protection system alone takes 30,000 people-hours (3,750 working days) to inspect, refurbish and reinstall between flights. This labour intensive process is one reason why the US space shuttle fleet has never flown more than nine times in any one year.[xx]

Over-design Constraints

Systemically simplified systems are always less expensive to build and operate—and more likely to work reliably, but NASA designs its systems to be so robust as to be particularly prone to failure. "If wide-bodied jet airliners were scrapped after a single flight, passenger flights would cost $1 million each, and air travel would not be a commercial business."[xxi] But this is what NASA does. It risks the vehicle and crew every time by designing systems that are so overdesigned with multiple backups and redundancies that failure is more likely. In *The Next Goal for Rockets* (2007), Nagata effectively demonstrates "that we must create a system with a scheme to permit malfunctions and yet achieve a safe landing" just as we do with modern aircraft. But, he says "Launcher men" are always overdoing it."

[3] Sawaya (2004) claims "the price of an unmanned Soyuz is approximately US$35 million, while a manned vehicle costs much more as a result of the complex life support and atmospheric re-entry systems." This unmanned price is still about 90% cheaper than the most conservative in-house NASA estimate of its own costs. But unlike NASA, Energia competes in the global market.

Framework Axis Three- The key constraint is bureaucratic

NASA is unable to commit seppuku because of institutional myopia and a bureaucracy's natural tendency to preserve itself. The key issue is that the agency is unable to adapt to a space industry that is not dominated by government, as "can be seen from the orders of magnitude difference in cost between G7 space agencies' procedures, and what can be taken as a proxy for commercial "best practice" today: Energia, a Soviet era Russian state Corporation that has transformed itself into a market leader.[xxii]

If NASA's present "technical capabilities are of little economic value,"[xxiii] the "cost of development and fabrication of reusable vehicles has little significance. (It follows then that) we can obtain an economic return by making a sufficiently large number of repeat flights." (Appendix 3) [xxiv] If the key constraints are not technical, as Nagata says, but institutional and market/investor-driven, what has NASA done to address this?[xxv] During its first 40 years, NASA made no attempt to determine market opportunities. Instead, NASA turned its back on capitalism, while the USSR's former rocket agencies entered the market with entrepreneurial panache. The Russian space program leads the global market for reliable launches, and even supplies NASA. Meanwhile, NASA fights a rear-guard action out of self-interest, not the greater good:

> **NASA perpetuates the myth** that its very existence is necessary to ensure reliable US access to space: "From this it is commonly concluded that, since the Shuttle costs about $100 million/ passenger/flight, space tourism is therefore a fantasy, or at least conceivable only in the far future after several more decades of government-funded space technology."[xxvi]
>
> **NASA acts unlawfully.** "Even after having paid for market research" that clearly supported the cause for civilian spaceflight, NASA suppressed the report for three years.[xxvii]

NASA continues to waste billions of dollars when it could be sponsoring the development of reliable, off-the-shelf technology and concurrent development of civilian industry, but many factors are intersecting to overpower NASA's ability to stay the traditional course:[xxviii],

- NASA's obvious technical failures and investment failures demonstrate that "the only relevant data are those relating specifically to dedicated passenger vehicle design studies."[xxix]
- The presence of wealthy, passionate Internet entrepreneurs entering the industry[xxx]
- The growing number of wealthy…extreme adventure tourists ("thrillionaires")"[xxxi]
- Powerful realignment of political-economic forces, driven by globalization, high speed cross-cultural computing and internet connectivity
- The development of robust, adaptable, flexible and quick prototyping methods[xxxii]
- SpaceShipOne's success convinced sceptics that investment is the key issue
- The US Federal Aviation Administration recent announced that it had achieved authority to manage the market-driven consumer spacefaring industry.xxxiii On December 15, 2006, the FAA issued flight rules for civilian space flight by clearly stating that "Anyone involved in the fledgling activities of private human space flight does so with full awareness that there is risk *and we accept it*." xxxiv

Framework Axis Four – The civilian space travel market exists

The opportunities are there, but the market requires specific answers to determine whether there is an attractive investment:

- How much investment is needed?
- What is the investment timeline?
- What efficiencies can be achieved by industry versus government?[xxxv]
- Is there (or will there be) sufficient market demand?

In Simberg's opinion (2000) "The most difficult problem…(is) in raising needed investment funds."[xxxvi] But to obtain those funds, markets must exist. NASA exists to serve an artificial market—itself! If NASA faced open markets, what segments could it serve without having an unfair competitive advantage? Market data suggests that as of 2007, that rational approach would be to focus on anything other than spaceflight,

The communications and resource mapping satellite design and launch-to-orbit market "has peaked and no growth is expected for the next 15 years," principally because technical reliability made the industry its own worst enemy. So, what other quantitatively justifiable segments exist? Nagata (2007) could only identify two segments with sufficient potential to drive industry growth: solar-power satellites (SPS) and general consumer space travel. SPS systems are uneconomic relative to other energy technologies, so civilian sparefaring is the logical growth market for the coming decades. And unlike NASA's artificial market, investment in this segment is driven by numerous statistical surveys of estimated market demand (passengers per year) "compared with regular airlines." Even conservative surveys estimate a potential future market of one million passengers per year.[xxxvii], [xxxviii]

Challenges and Opportunities

The situation facing the segment is similar to that faced by the budding aviation industry. There were no aerodromes, radar controls or radio. Yet pioneering inventors developed aircraft. As the market for flight services grew, the infrastructure grew alongside it.

Systems, Goods and Services

Studies independent of NASA and its captive contractor base have identified economies of scale as the key driver to grow a viable industry. Somewhat akin to a snowball gathering mass whilst rolling down a wet snow-covered hill, if achieved, high reusability (much higher than the Shuttle)—plus lowered maintenance costs, high turnaround time and correspondingly high launch rates—automatically produce ever-increasingly reliable systems, driven by continuous improvement and increasing experience with those systems.[xxxix] Collins (2003) "estimates that (if) initial regularly

scheduled passenger services (were) active by 2025-2030," there would be a spin-off economic value of "some $1 trillion greater than continuing government space activities as they are today…in contrast to the minimal effect of traditional space agency activities."[xl] The terrestrial tourism, hotel and cruise ship segments all exist because of the civil aviation industry.[xli] It is virtually certain than these industries would expand, too. Orbiting hotels are already in development.

The Opportunity for Industry

The segment needs a massive influx of capital and talent, but significant assets are tied up in NASA-related relationships. But if NASA was broken up and its space transport R&D assets reallocated to industry, there would be an opportunity for corporations to do what they do best—innovate and recapture market value. Privatising NASA's spaceflight segments would accomplish the following tasks:

1. Improved launch turnaround time
2. Reduced systems complexity coupled with improve performance and reliability
3. Reduced labour costs
4. Increased availability of mission-flexible systems and capabilities
5. Obtain economies of scale through mass production
6. Experienced pilots would be immediately available from the astronaut corps, as pilots and as flight school instructors for follow-on generations
7. Standardization of piloting training to reduce attrition

Conclusion – The Impacts on Canada and International Business

The Global Exploration Strategy announced this week proposes to coordinate space exploration through an international framework. The announcement this week by NASA and 13 other national agencies suggests that all 14 agencies are aware of the threat to their collective futures—and are looking for ways to control the spaceflight agenda rather than letting private enterprise do the job. [xlii] But private enterprise always does it faster, cheaper and more efficiently. A privatized and broken up NASA would produce significant impact on the international business climate generally and the NAFTA economy in particular. There would be more opportunities for manufacturing and investment —and greater opportunity to retain the "leading edge" skills that drive Western economies.

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[iii] A. Henriques, *The Triple Bottom Line,* 2004. p.3.

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[xxix] P. Collins, "*Space Tourism Market Demand*,” 2003.

[xxx] Ibid.

[xxxi] Ibid.

[xxxii] Ibid.

[xxxiii] Ibid.

[xxxiv] "It has long been feared that private human space flight would be held to the same standards as the mature private and commercial aircraft industry. These include safety, crew and pilot training--perhaps even experience and certification as test pilots of supersonic aircraft—and rigorous physical examinations for passengers equivalent to those astronauts must pass. The other concern has been that the required documentation will create so much paperwork that no small or even medium-size operator will be able to afford it. Much to its credit, the FAA did not issue such restrictive and potentially costly rules. In fact, it specifically stated that it will not require such standards. For example, The FAA recognized that simulator training may not even be available for new types and configurations of vehicles, therefore simulator training was only recommended where possible." G.B. Leatherwood, "*The Federal Aviation Administration Reports on Space*," 04 January 2007, www.spacefuture.com/journal/journal.cgi (Accessed 20 May 2007).

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