Best Commercial (Non-defense) System of Systems Acquisition Practices

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Program & role mismatches

Users
- Many features
- Changeable requirements
- Applications compatibility
- High levels of service
- Voice in acquisition
- Flexible contract
- Early availability

Maintainers
- Ease of transition
- Ease of maintenance
- Applications compatibility
- Voice in acquisition

Acquirers
- Mission cost/effectiveness
- Limited development budget, schedule
- Government standards compliance
- Political correctness
- Development visibility and control
- Rigorous contact

Developers
- Flexible contract
- Ease of meeting budget and schedule
- Stable requirements
- Freedom of choice: process
- Freedom of choice: team
- Freedom of choice: COTS/reuse

PC: Process
PD: Product
PP: Property
S: Success
How is commercial different?

- Hope vs. reality = “The grass is always greener on the other side of the fence.”
- Trust is the greatest challenge for government acquisition, partnerships are the most difficult to obtain.
- Trust is the greatest challenge for commercial acquisition, and partnerships are possible to obtain.
- The lack of trust is justified every day in newspaper headlines!
The biggest difference

- Knowledge of capability, even if vague vs. “Can do” attitude.
  - Government: “We must have something this big!”
  - Commercial: “We don’t think we can built something that big.”
First example: CERN

- Now known as “European laboratory for particle physics" ("Laboratoire européen pour la physique des particules").
- CERN conducts pure scientific research into the laws of nature, as described in the Organization's founding convention:

"The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto. The Organization shall have no concern with work for military requirements and the results of its experimental and theoretical work shall be published or otherwise made generally available."

At present, its Member States are Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Italy, Netherlands, Norway, Poland, Portugal, Slovakia, Spain, Sweden, Switzerland and the United Kingdom. India, Israel, Japan, the Russian Federation, the United States of America, Turkey, the European Commission & Unesco have observer status.
What CERN has in common with US Defense establishment

- Many, many stakeholder communities.
- Pride is valued.
- International in scope. Many different cultures represented. Many different heritages & histories, not all positive. Melting pot, uneven skills.
- Largest programs on Earth.
  And many other -est’s!
- Serious, goal-aligned. High team cohesion.
- Very, very expensive programs. Very long programs.
- Nothing is forever = evolution is expected.
- Always a bit of a gamble, outcomes not guaranteed.
- Epitomizes – is the definition of – emerging!
One big (subtle) difference

- Immutability is understood – and respectfully poked at.
- There are some laws that you cannot break = there are some things you cannot do.
CERN accelerators
Large Hadron Collider tunnel

27 km = 16½ mi

© CERN
CERN detectors

- Beam pipe
- Tracking chamber
- Magnet coil
- Electromagnetic calorimeter
- Hadron calorimeter
- Magnetise iron
- Muon detector
Tracking chamber outputs
ALICE detector

ALICE -- A Large Ion Collider Experiment -- involves an international collaboration of more than 1000 physicists, engineers and technicians from 30 countries.
The CMS experiment is one of two large general-purpose particle physics detectors in the proton-proton Large Hadron Collider (LHC) at CERN. Approximately 2300 people from 159 scientific institutes form the collaboration building it.
LHCb - Experiment Studying CP Violation at the Large Hadron Collider

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565 scientists from 47 universities and laboratories from 15 countries

“Why we are not made up of anti-matter”
How does CERN do it?

- An institution gets to participate if it agrees to ground rules:
  - Scientific purpose
  - Standards of evaluation
  - Means (not usually all of the goals)
  - Openness, sharing of results
  - Constraints on the infrastructure
... in light of …

- Intense (scientific) competition
  - Espionage, theft, destruction.
  - Personal reputations are made, Nobel Prizes are won & lost.
  - VERY political, zero sum game.
- Many layers of interaction, not just scientific or engineering.
- No trust, not a shared definition & value for honesty. Many cultural differences.
CERN has learned over the years how to stay out of fights!
That is, fights do not add value, do not accomplish aims.
Keeps the discourse technical! Manages by influence, not hierarchy.
Complementary skills: making better agreements + making more detailed task descriptions. (see “Complementarity and evolution of contractual provisions: An empirical study of IT services and contracts,” N. Argyres, J. Bercovitz & Kyle Mayer, Organization Science 18(1) 3-19, Jan-Feb 2007.)
Second example (a bad one)

Oracle Inc., a software + services provider, bought up most of its competitors & is now trying to fuse them:
1. PeopleSoft Enterprise
2. Oracle E-Business Suite
3. Siebel Customer Relationship Manager
4. JD Edwards EnterpriseOne
5. JD Edwards World
From Oracle, part I

Traditional Process

External Providers
- Truck leaves warehouse with shipment
- Truck breaks down
- Carrier notifies shippers

Your Internal Organization
- Planner receives notification "Delayed delivery"

System A
- Planner searches for alternatives
- Find another carrier
- Planner notifies customer of delivery status

System C
- Locate other inventory close to customer

System D, E, F...
- System G

Manual Process
- System A
Next-Generation Business Process

**BUSINESS INSIGHT - Monitor, Analyze, Act**

- **External Providers**
  - Truck breaks down with shipment
  - Alert sent

- **Your Internal Organization**
  - System B reschedules and finds other carrier or inventory options
  - Alerts planner if needed

- **Customer**
  - Notifies customer of delivery status

**SYSTEM A** → **SYSTEM B**
**ACCESSES SYSTEMS A, C, D, E, F...** → **SYSTEM G**

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Architectural mismatch

- Conflicting assumptions
  - Nature of components
    - Infrastructure
    - Control model
    - Data model
  - Nature of connectors
    - Protocols
    - Data model
  - Global architectural structure
  - Construction process

Next commercial SoS disasters

- Grid computing for data intensive applications.
- US regional Bell operating companies now back as AT&T.
- Embedded automobile applications (see the Car Whisperer).

The implications are clear:
There are few examples of success, many of disaster. Acquiring Systems of Systems is a difficult problem, whether in the commercial or government sectors.