Profligate *Systems Engineering*

We live in a society exquisitely dependent on science and technology, in which hardly anyone knows anything about science and technology.
- Carl Sagan

Profligate:
extravagant or wasteful (dictionary.com)

Systems Engineering:
an interdisciplinary approach and means to enable the realization of successful systems (INCOSE);

an interdisciplinary field of engineering focusing on how complex engineering projects should be designed and managed over their life cycles (wikipedia.com);

an interdisciplinary process that ensures that the customer's needs are satisfied throughout a system's entire life cycle (Univ of Ariz)

Challenge Problem:

Provide ubiquitous, full-spectrum, global coverage

Interdisciplinary:

What disciplines should be represented and what level of expertise? How are we doing?

Life Cycle:

What are the life cycle phases considered? How are we doing?

Mission Success/Customer Needs Satisfied:

How do we assess mission success? How are we doing?

Interdisciplinary:

Aerospace, Physics, Metallurgy, Chemistry, Computer Science, Statistics, Operations Research, Economics, History, …

Life Cycle:

Ideation/Need, Development, Design, Validation, Operations, Disposal,…

Mission Success/Customer Needs Satisfied:

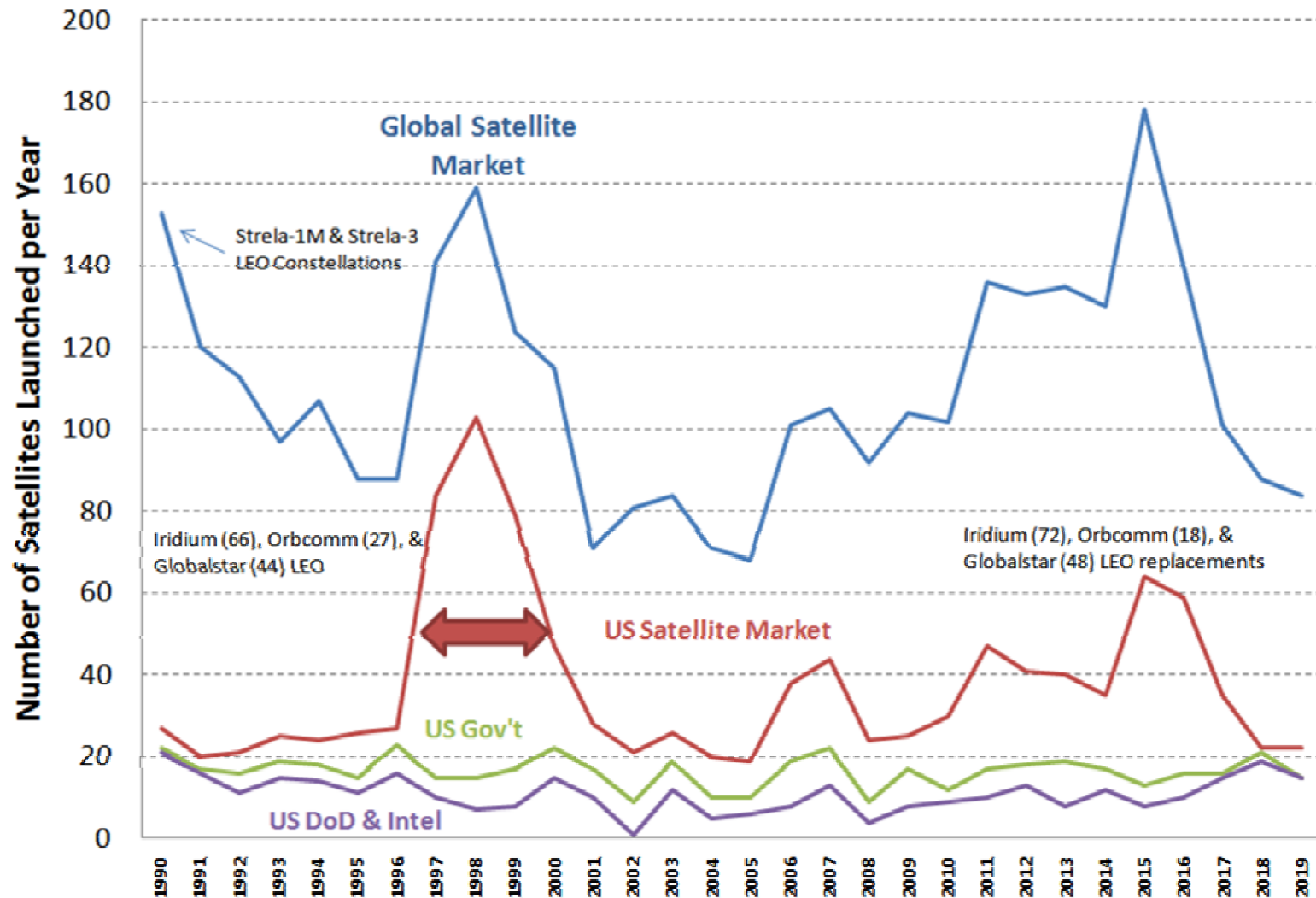Operations, Performance, Test, Manufacturing, Cost & Schedule, Training & Support, Disposal,…

Technical Performance Optimization:

Multiple Collectors
Persistence
Spectrum
Resilience
Surprise
Specificity

Historical Global Satellite Market

Source: Aerospace Space Systems Engineering Database and Euroconsult 2010

For all the companies in the Standard & Poor's 500-stock index, earnings are on track to post a 6.6% year-on-year rise in the fourth quarter. Once Apple's earnings are factored out, the expected fourth-quarter gain shrivels to just 2.8%, according to UBS.
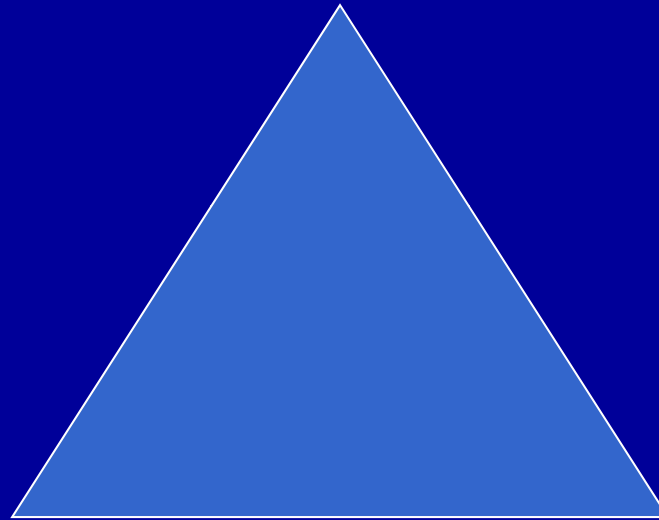
WSJ, 15 Feb 2012

If Apple is a model, what can we learn/reuse/adopt?

People
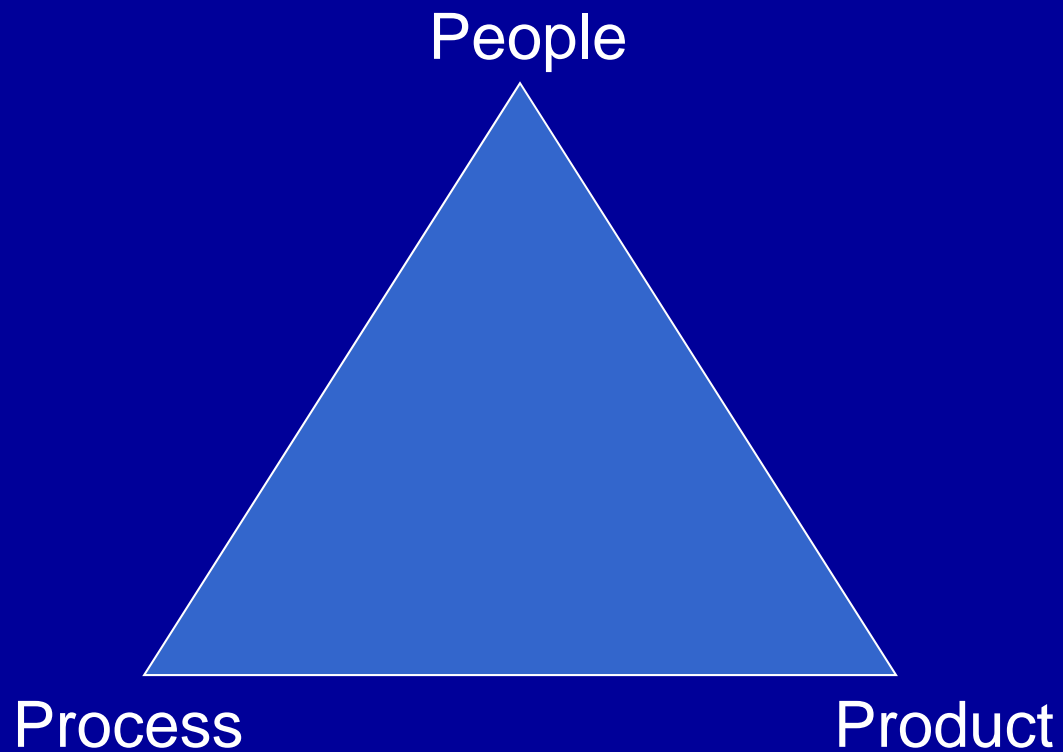
Process

Product

People:

Customer <or> Stakeholder
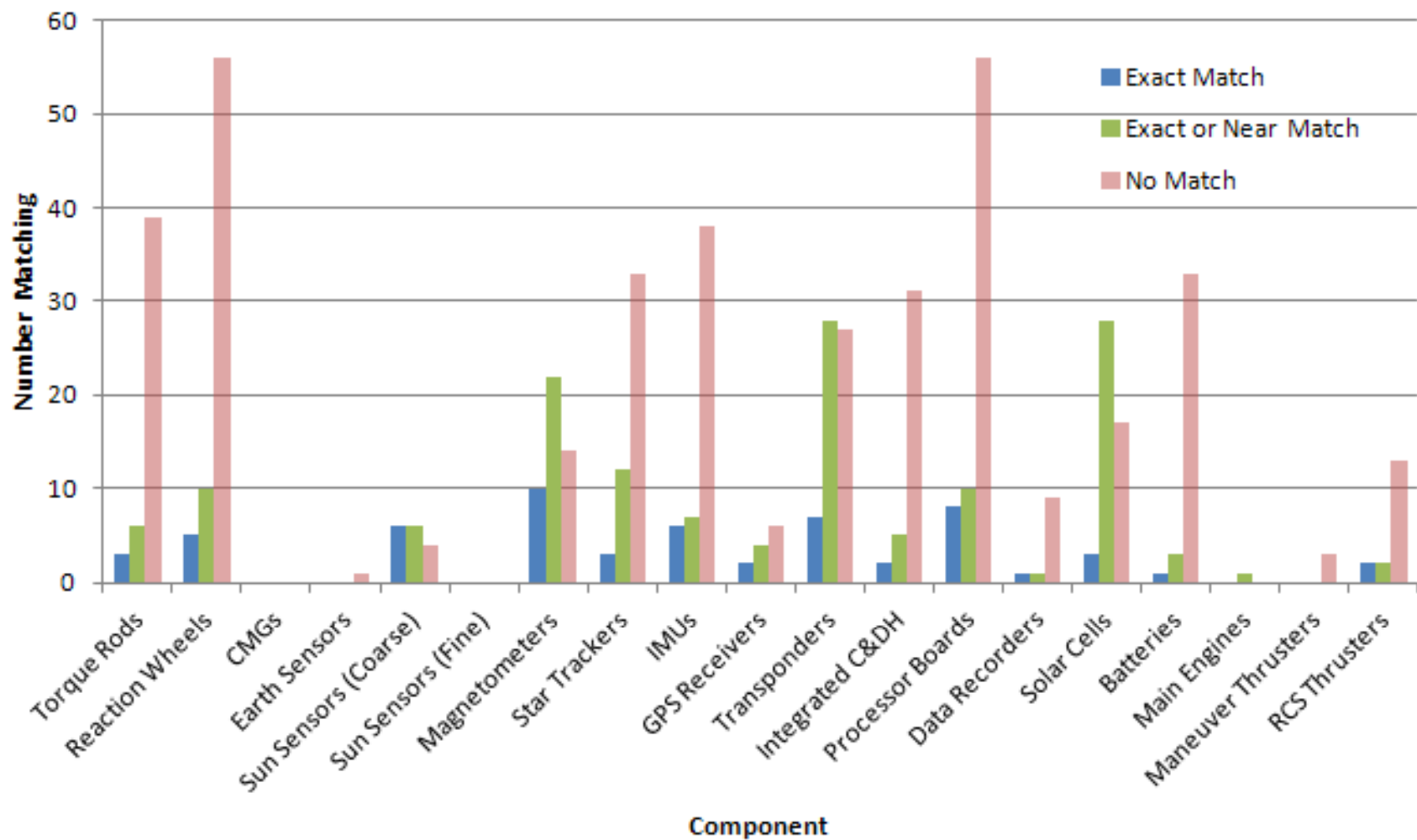Commercial <or> Government
Skills
Communications

Process:

Make <or> Buy
Manufacturing Practices
Contract Practices
Review Practices
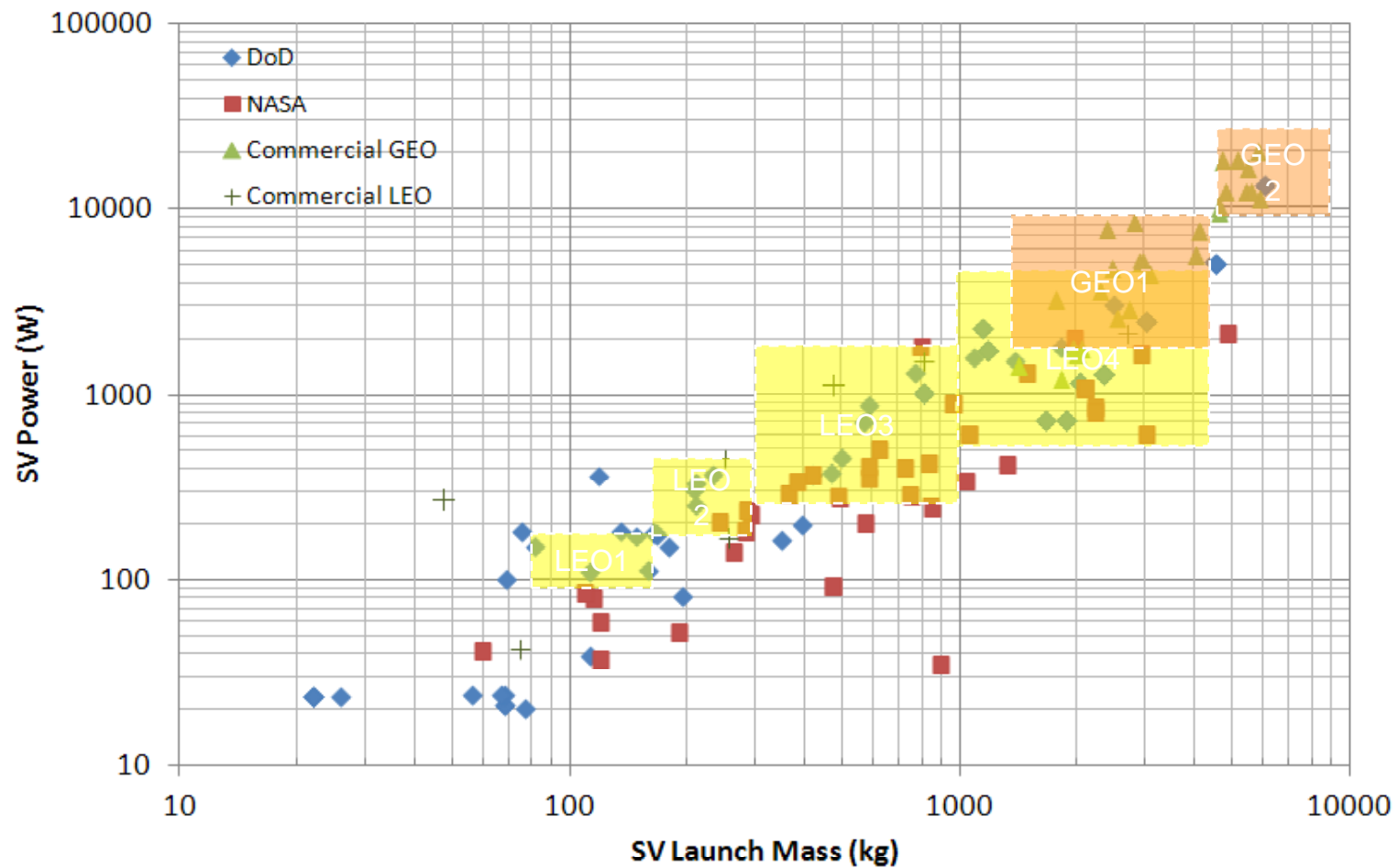Mission Assurance/Risk Management
Delivery Practices

Product:

Product <or> Service
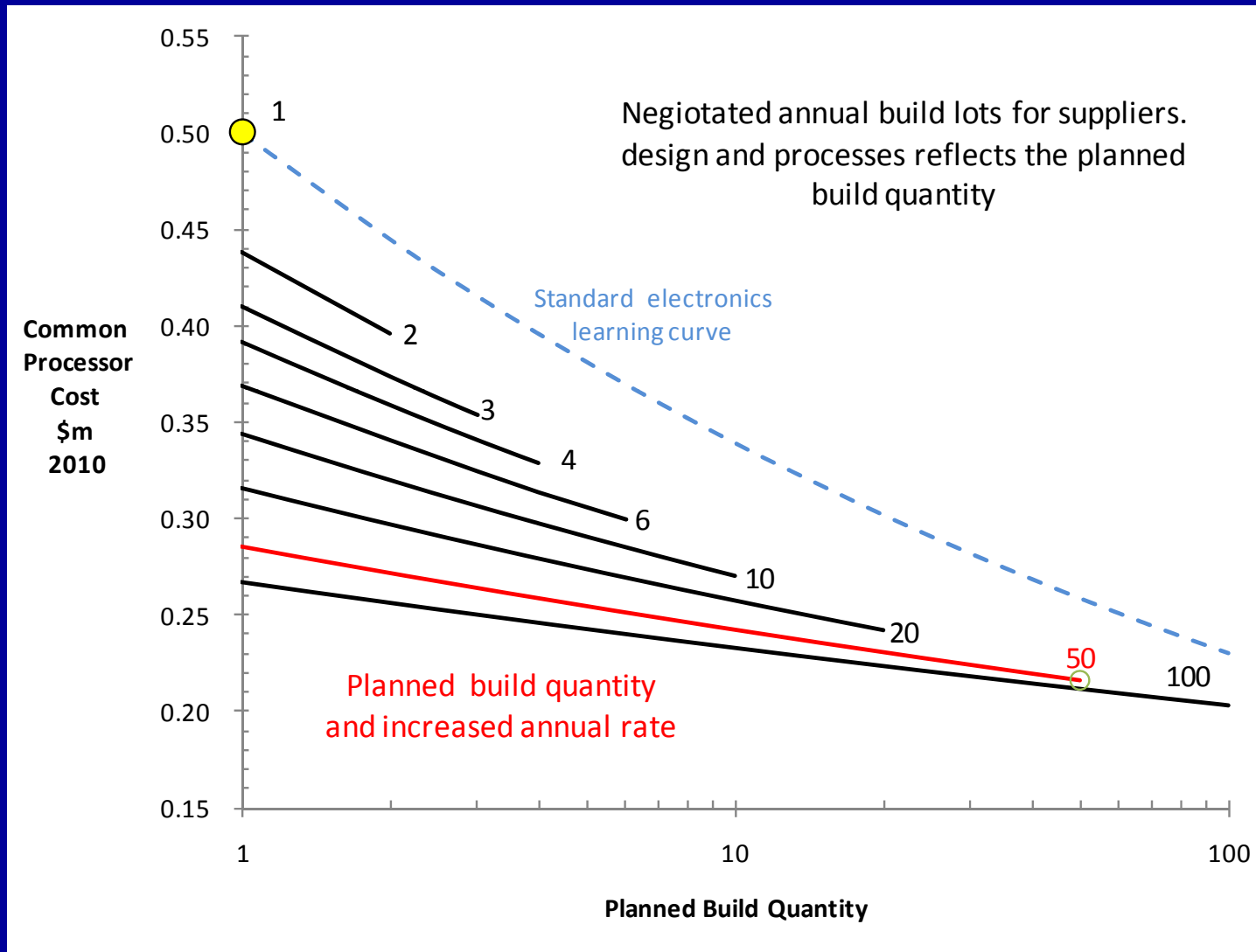***Architectural Precepts***
MultiINT <or> Single INT

SC Component Matching - 12 SC Set (10% near match)

| Component | Style | SV Class (Component Qty per SV) | | | | | | 1 Year | 20 Years |
		LEO1	LEO2	LEO3	LEO4	GEO1	GEO2	Total	Total
Torque Rods	Style A	3						17	330
	Style B		3					4	72
	Style C			3				34	684
	Style D				3			7	138
Reaction Wheel/CMGs	Style A	3						17	330
	Style B		3	4				49	984
	Style C				4			9	184
	Style D					4		59	1184
	Style E						4	27	544
Sun Sensors	Style A	6						33	660
	Style B		6	6	6	6	6	219	4380
Magnetometers	Style A	1						6	110
	Style B		1	2	2			29	572
Star Trackers	Style A	1						6	120
	Style B		1	2	2	2	2	72	1436
IMUs	Style A	1						6	110
	Style B		1	2	2	2	2	72	1436
GPS Receivers	Style A	1						6	110
	Style B		1	2	2			29	572
Transponders	Style A	1	1	2	2	2	2	77	1546
Integrated CDH	Style A	4	5	6	8	8	8	288	5752
Processor Boards	Style A	4	5	6	8	8	8	288	5752
Solar Cells	Style A	752	2372	2959	11090	9274	19895	338763	6775264
Battery Cell	Style A	1	2	2	13	24	28	606	12124
Main Engine	Style A					1	1	22	432
Maneuver Thrusters	Style A					6	6	130	2592
RCS Thrusters	Style A	4	4	4	8	12	12	350	7000
Avgerage Satellite Quantity Per Year		5.5	1.2	11.4	2.3	14.8	6.8		

SV Power versus SV Launch Mass

Negiotated annual build lots for suppliers. design and processes reflects the planned build quantity

Standard electronics learning curve

Common Processor Cost $m 2010

Planned build quantity and increased annual rate

Planned Build Quantity

Could we….

- Build consensus to stabilize our space manufacturers"?

- Identify and commit to regular purchase of "commonized" components?

- Adapt/Adopt a Space Plug-n-Play Architecture (SPA)?

Should we?

What are the principle inhibitors to mission effectiveness?

What are the principle inhibitors to mission efficiency?

Can these be addressed through people, process or product means?

*BREAK*

Responsible *Systems Engineering*

Management:
the organization and coordination of the activities of an enterprise in accordance with certain policies and in achievement of defined objectives (businessdictionary.com)

Leadership:
the activity of leading a group of people or an organization, or the ability to do this... leadership in an organizational role involves (1) establishing a clear vision, (2) sharing that vision with others so that they will follow willingly, (3) providing the information, knowledge, and methods to realize that vision, and (4) coordinating and balancing the conflicting interests of all members or stakeholders (businessdictionary.com)
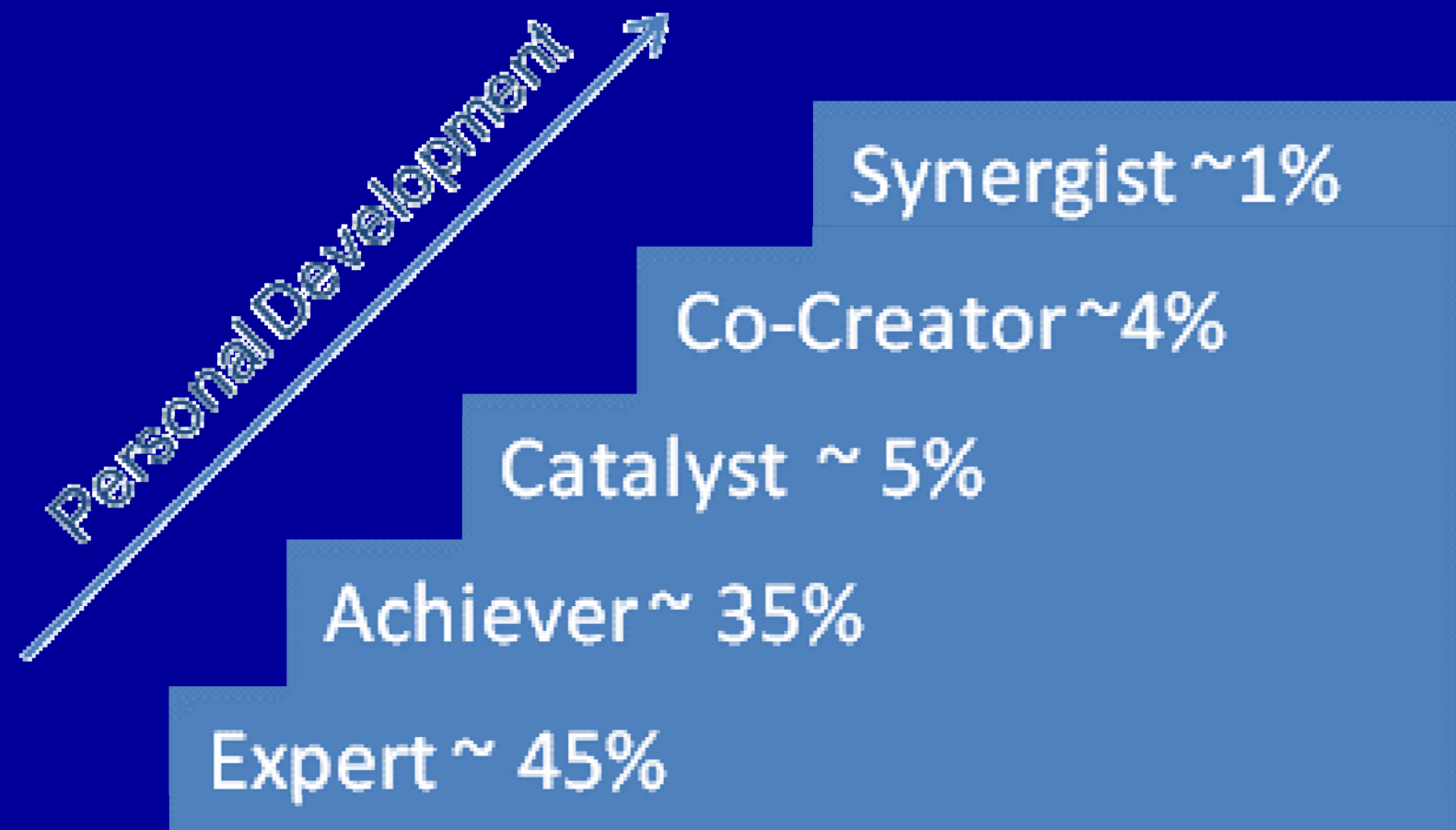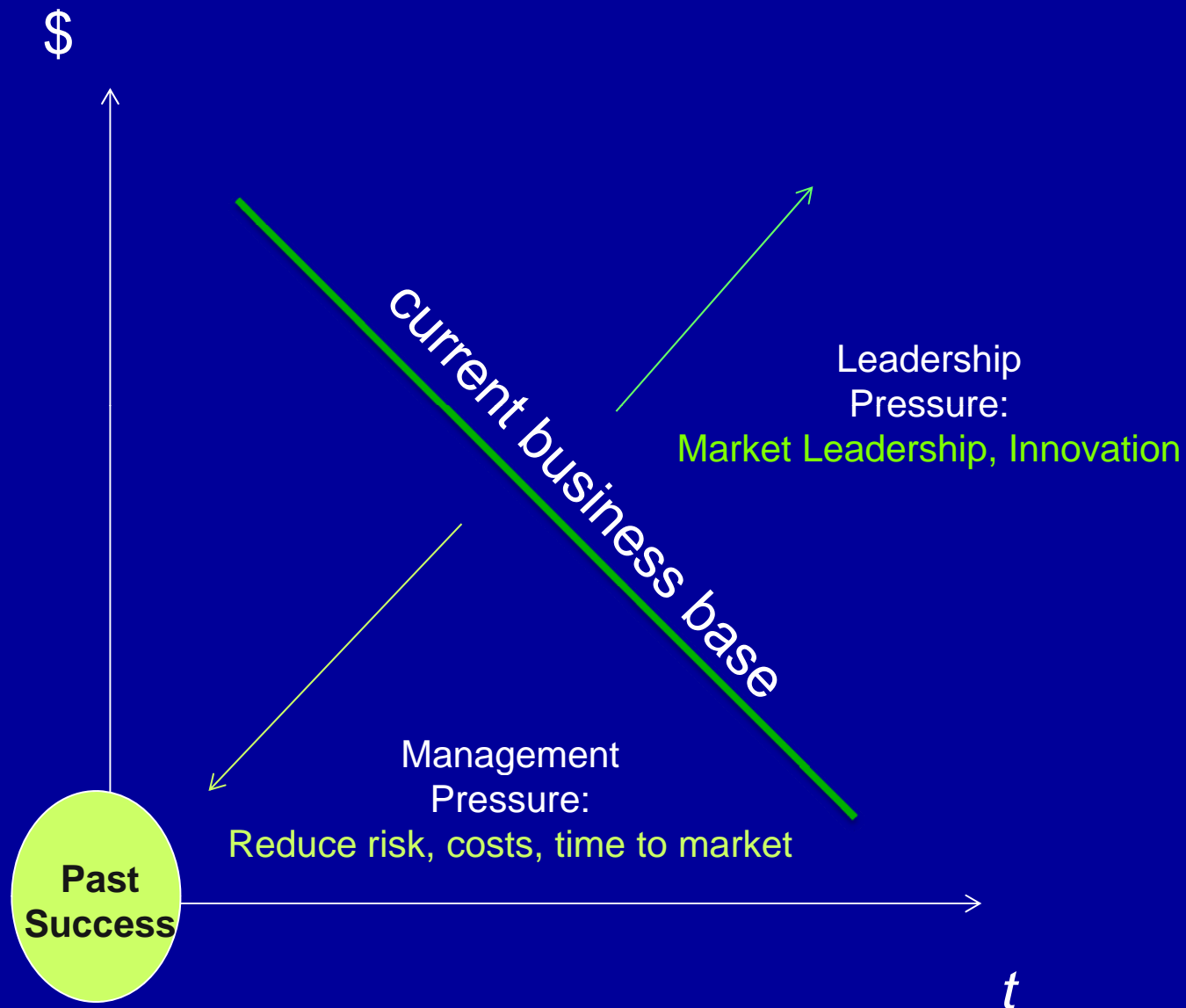
Agility:
the **power** of moving quickly and easily; nimbleness; (dictionary.com)

Leadership Agility:
the ability to lead effectively under conditions of rapid change and mounting complexity (changewise.biz)

"Leadership Agility: Five Levels of Mastery for Anticipating and Initiating Change", Joiner & Josephs

Level of Agility	View of Leadership	Pivotal Conversations	Leading Teams	Organizational Change
Expert (~45%)	Tactical, problem solving; leaders are respected and followed due to authority and expertise	Either strongly assertive or accommodating; tends to avoid giving/requesting feedback	More of a "supervisor" than "manager"; creates groups of individuals rather than teams; focused on details of own work rather than leading strategically	Incremental improvements inside a unit with little attention to stakeholders or external environment
Achiever (~35%)	Strategic outcome; leaders motivate other by making it challenging and satisfying to contribute to larger objectives	Primarily assertive or accommodating with some ability to switch between; will accept or initiate feedback if helpful to achieving outcome	Operates as full-fledge manager; initiates meetings to discuss important strategic issues often to gain buy-in to own views	Organizational initiatives include external environment; strategies to get stakeholder input range from one-way communications to soliciting input

Level of Agility	View of Leadership	Pivotal Conversations	Leading Teams	Organizational Change
Catalyst (~5%)	Visionary, facilitative orientation; leaders articulate a vision and brings people together to make it a reality; leaders empower others and facilitate development	Adept at assertive and accommodative styles as needed; articulates and questions underlying assumptions; genuinely interested in diverse viewpoints; proactive in seeking and using feedback	Creates highly participative teams; team leader and facilitator; models and seeks open exchange of views; empowers direct reports; uses team development for leadership development	Organizational initiatives promotes teamwork, participation and empowerment; proactive engagement with diverse stakeholders to increase quality of decision/product
Co-Creator (~4%)	Shared purpose and collaboration; leadership is a service to others; deeply purposeful vision and collaboration with other leaders	Integrates both styles and is agile in use; able to process and seriously consider negative feedback even when highly charged emotionally	Develops a collaborative leadership team, members feel full responsibility for the whole organization; preference for consensus decision-making	Develops key stakeholder relationships with deep levels of mutual influence and dedication to the common good

Understand the game board

Self-aware
&
Self-reflective

Pigs
Or
Chickens?

Love fresh challenges & perspectives

Wheel labels:
Scoping Initiatives
Setting Direction
Developing new skills
Understanding Stakeholders
Context Setting Agility
Self-leadership Agility
Stake-holder Agility
Seeking Feedback
Resolving Differences
Creative Agility
Creating Solutions
Analyzing Problems

Who is the worst manager you've ever worked for?

Who is the best manager you've ever worked for?

Who is the best leader you've ever worked with?

What are the outstanding characteristics of each of these?

How do your lists of characteristics compare to the models?

Hint:
Look for white space....your mental model may indicate personal or team growth opportunities

What role(s) do you play today?

What role(s) do you want to play?

What are you doing today?

What should you be doing today?
Tomorrow? In the next six months?

Of all the awkward people in your house or job, there is only one whom you can improve very much.
- C.S. Lewis

Thank you