Smart Procurement

Optimizing the Total System

Professor Derek K Hitchins

UK Defence Procurement Scene

Defence Procurement Paradigms

- Essentially, there are only two ways buy gentlemen's suits and defence equipment :—
  - Go into the market place and buy what you want,

    OR…
  - Contract a tailor/manufacturer to create a bespoke solution to your specific needs
- Less developed nations have had little choice but to buy in the market place—they lack the industrial muscle
- Traditionally, developed nations have opted largely for bespoke solutions, developed by indigenous industries for national purposes
- As defence technology becomes more complex, sophisticated and expensive, even the developed nations are questioning this perceived wisdom

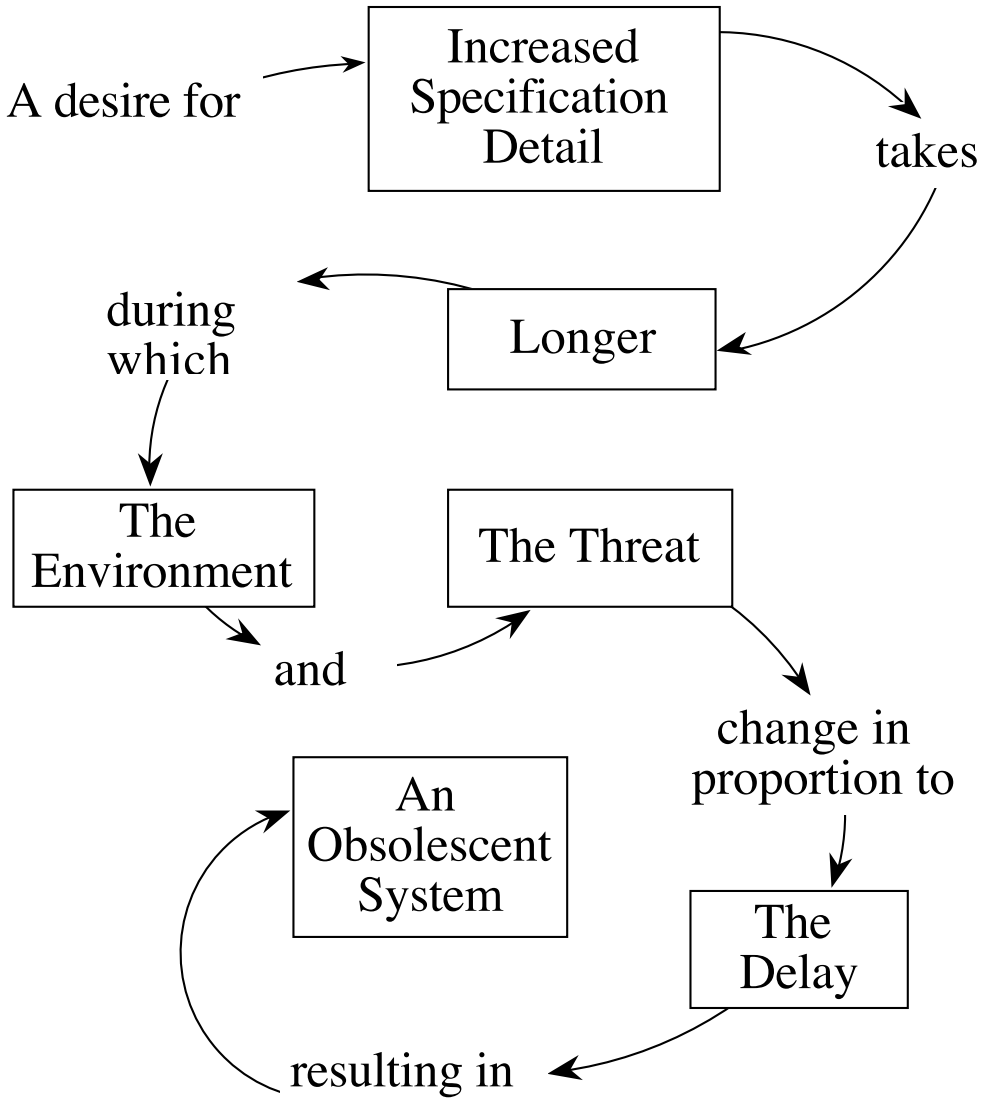
Bespoke Limitations

- Classic Cold War Procurement strategy was based on Intelligence.
- Given sufficient information about the Enemy it was possible, in principle, to:—
  - identify potential shortcomings in own capability
  - specify a solution which would plug the gap and restore own supremacy
- This Operational Requirement was translated into an equipment requirement for industry to build
- It did *not* work well.

Bespoke Limitations in the UK

- Defence intelligence was invariably incomplete.
  - As the collapse of the Soviet Union showed, it was considerably wide of the mark, too
- The process of developing operational requirements and imposing them on industry was/is severely challenging
  - Expertise was provided by operators who:—
    - were themselves operating 15—20 year-old equipment designs;
    - increasingly, had no recent fighting experience,
    - had little contemporary technology understanding
    - were poorly-placed to conceive new tactics, using new technology in future conflict
  - Complex operational and equipment characteristics are not amenable to straightforward, consistent, concise complete text description by industrially-naïve authors
  - Requirements grew in length and deepened in specificity,
    - taking longer and longer to prepare in ever more detail…
    - …during which time the need evolved…
    - …resulting in "carefully-specified obsolescence" I.e. out of date before delivery
  - Process became antagonistic as procurer attempted to control contractor ever more tightly in a vain effort to get what he could not adequately specify

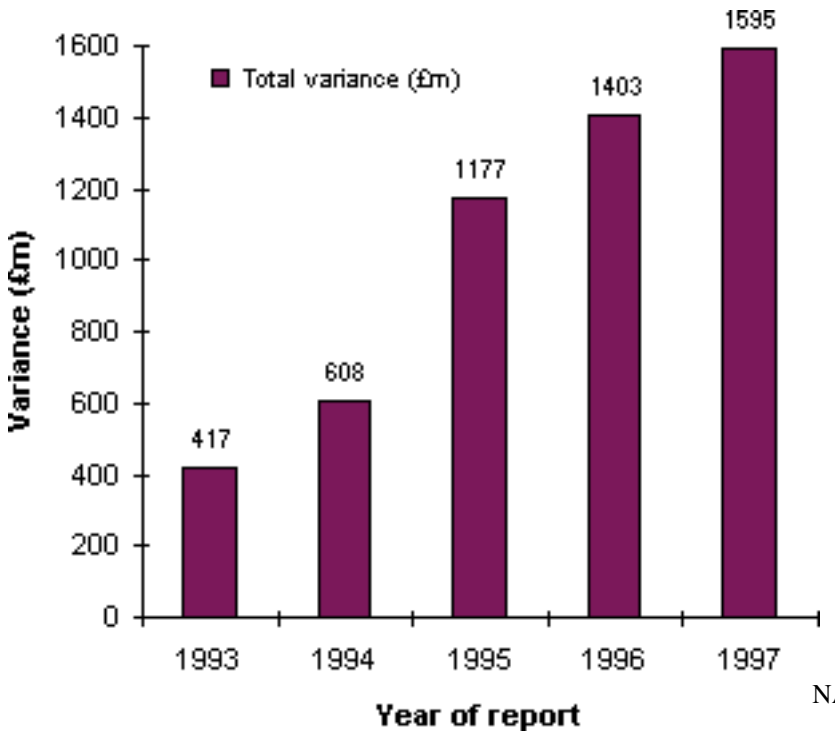
Carefully Specified Obsolescence

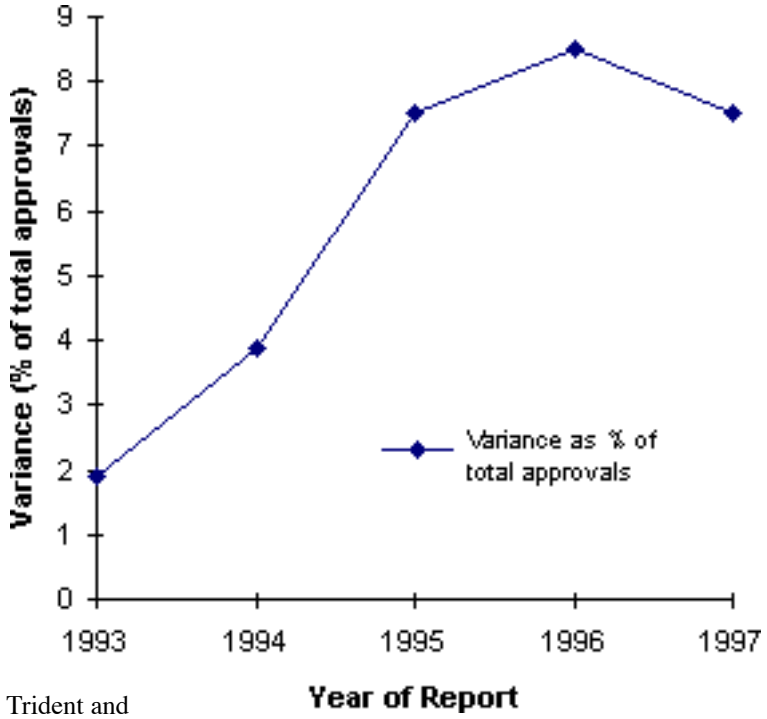


The Control Paradigm

- Defence Procurement since WWII characterized by applications of successive layers of government control over the defence industry.
- Reasonable to suppose that tighter control of requirement specifications, budgets, contracts, schedules, milestones, payments against progress, etc., would result in predictable project outcomes
- Counter-intuitive results—tighter control leads invariably to escalating cost and time scales
  - Suggests complex procurement system is "non-linear dynamic"
- Nonetheless, the emerging pattern of Smart Procurement is "more of the same"

Cost of the Current Control Paradigm





NAO—excludes Trident and Eurofighter

- Successive tightening of Procurement Controls has coincided with successive increases in overspend
- **Control *has not worked*. Control *does* not work**

Yet Smart Procurement is emerging as
controlled, bespoke procurement to order

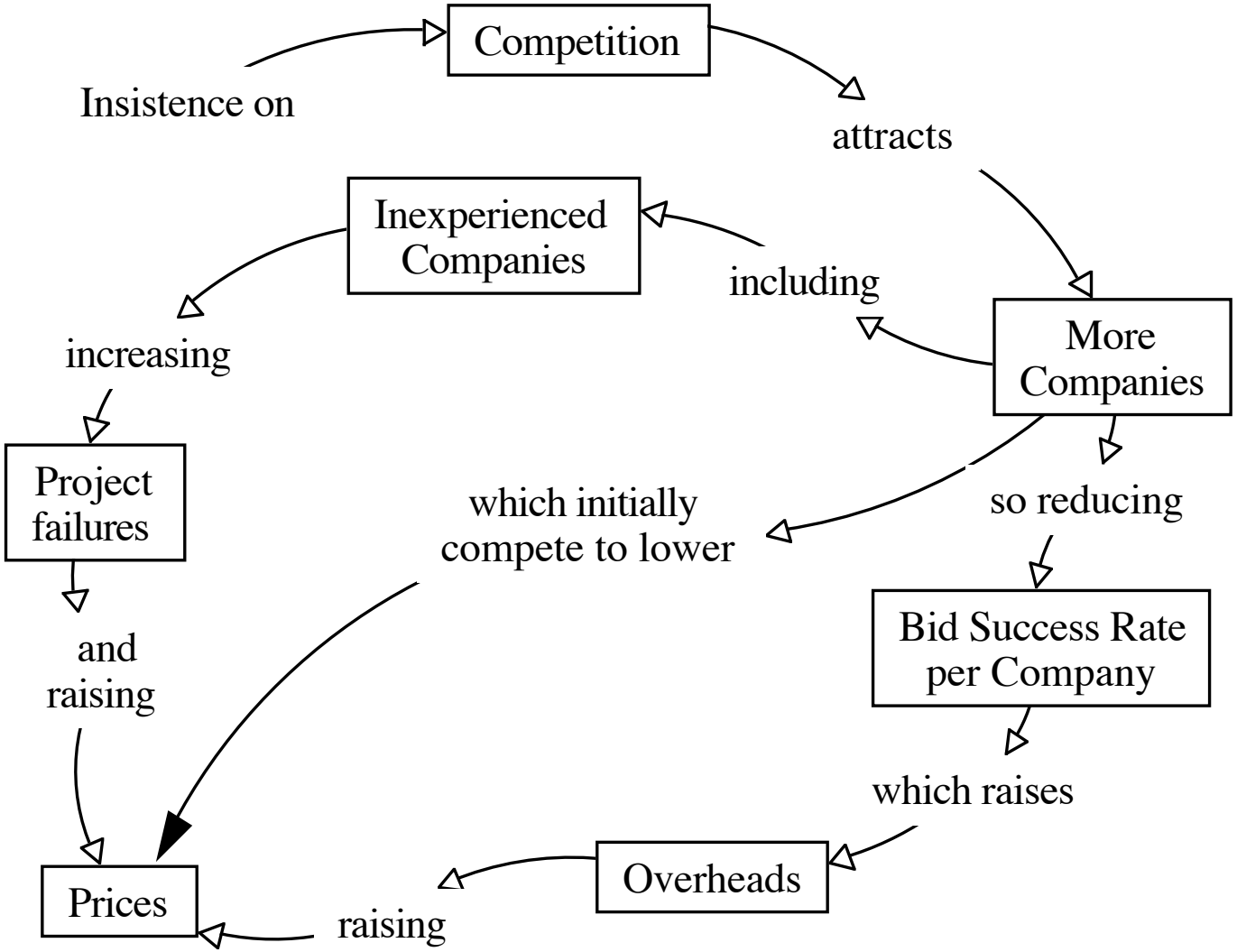
Bespoke Limitations

- Bespoke solutions were invariably nation- and theatre-specific and unsuitable for out-of-area operations and export sales to other nations
- They were/are, naturally, more expensive, too:—
  - Cutting edge materials, sensors and weapons technology
  - Specific, therefore relatively small quantities in manufacture
  - Hedged round with detailed specifications, procedures
  - Elaborate control hierarchy through successive committees
  - Security precautions
- To control expense, government hit upon competition
- Competition, it was argued, would oblige contractors to reduce their costs. More competition would mean more savings. Therefore, there should be open competition at every stage

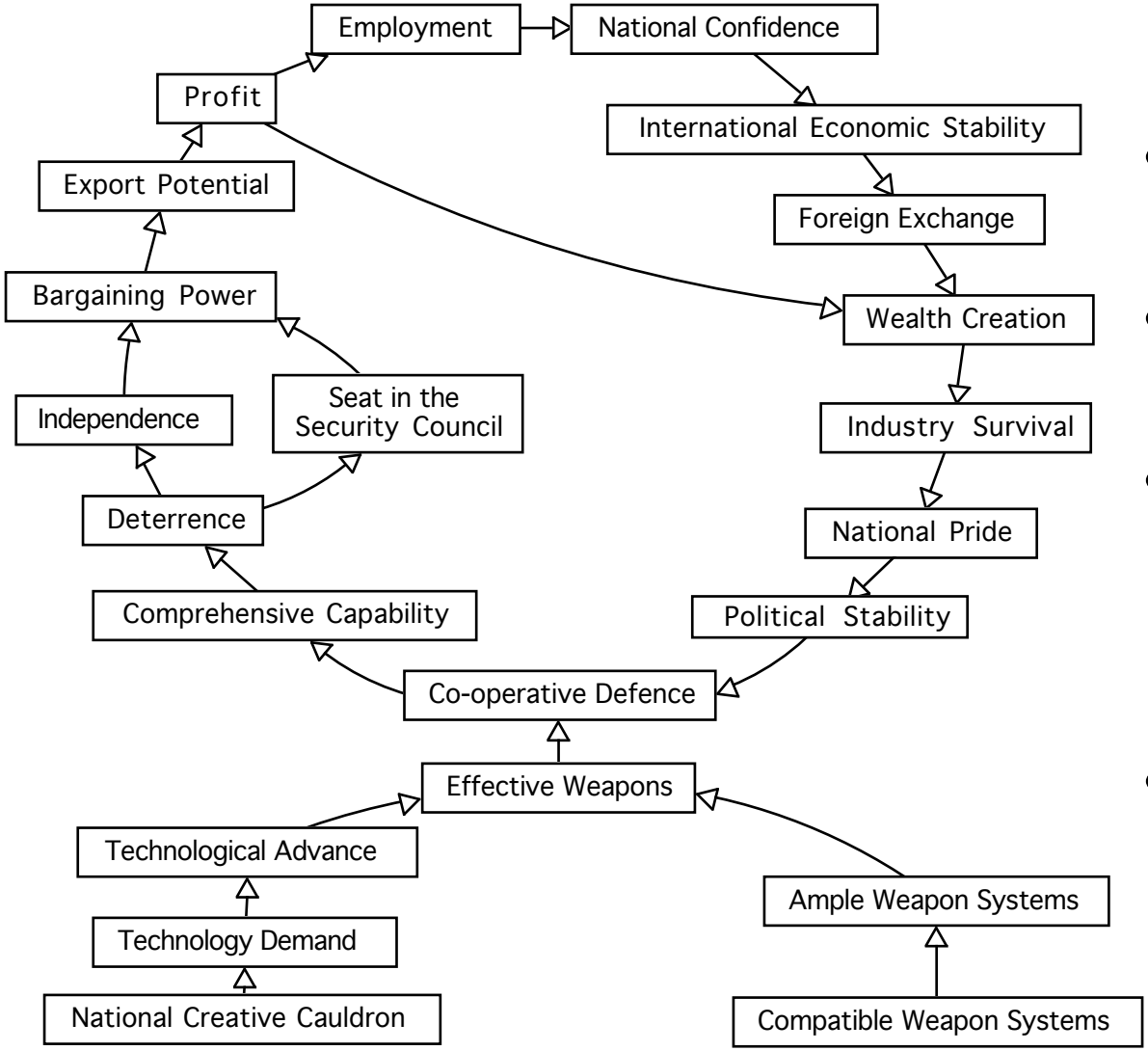
Open Competition

- To further the ideas of competition projects were phased, using the so-called Downey approach
  - Pre-feasibility, feasibility, project definition (Parts 1 & 2), pre-production and production
  - Each phase was subject to competition and was conducted by a different contractor
- Principal results were:
  - Excessive delays caused by the inter-phase competition
  - Increased costs as industry teams went on hold
  - Increased costs from allocating phases to lowest bidder, who bid low through inexperience and subsequently failed to deliver
  - Inability to build up knowledge and understanding through the course of a project—hence limited end-product effectiveness
  - Nugatory antagonism between industry competitors and MOD procurement and contract functions

Counter-Intuitive Competition



Importance of Defence Exports



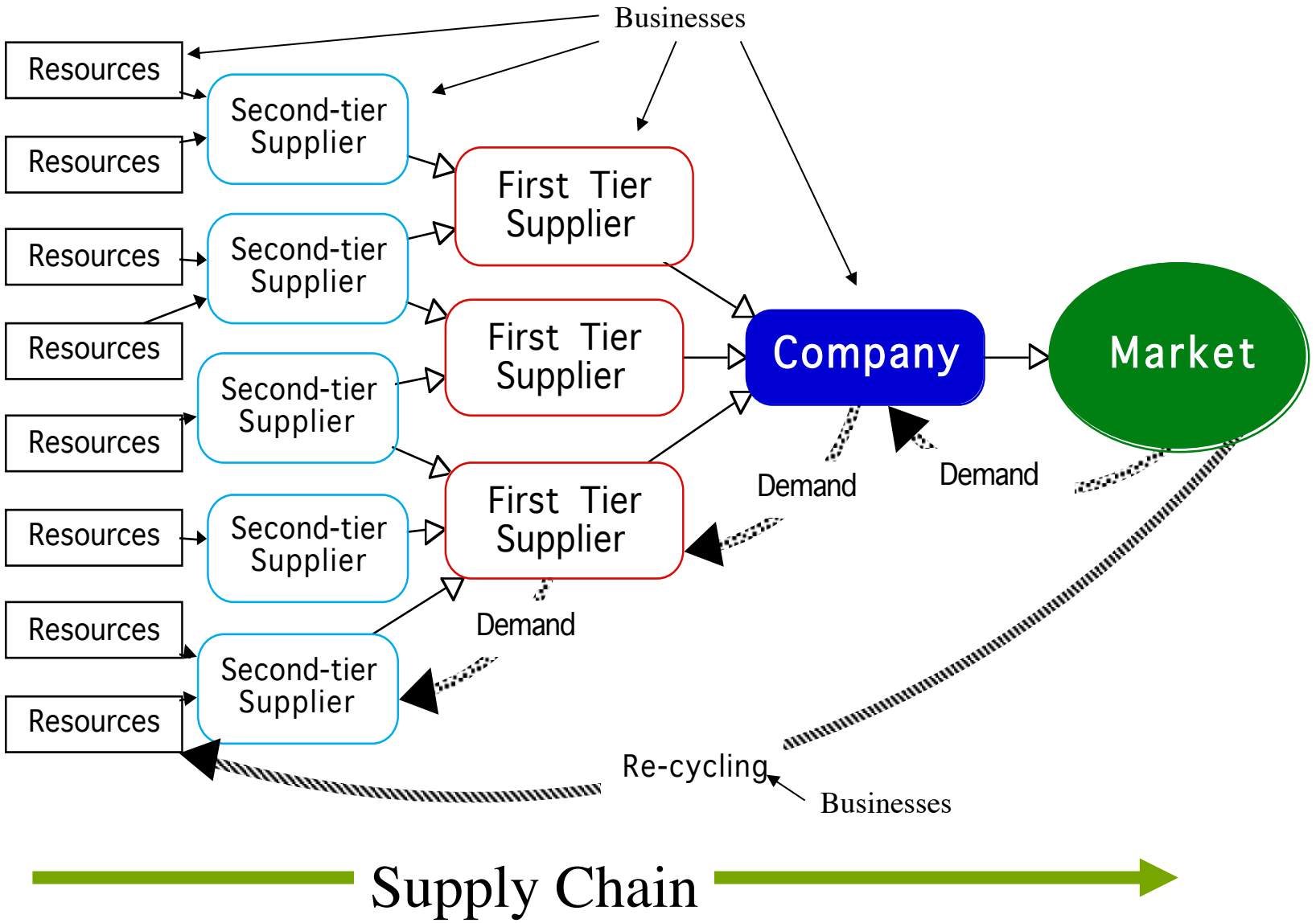
- UK Defence has vital political rôle
- Enables co-operative defence within NATO
- Maintains UK as an international player
  - Assures UK seat in the Security Council
- Major UK wealth creator.

Changing Industrial Patterns

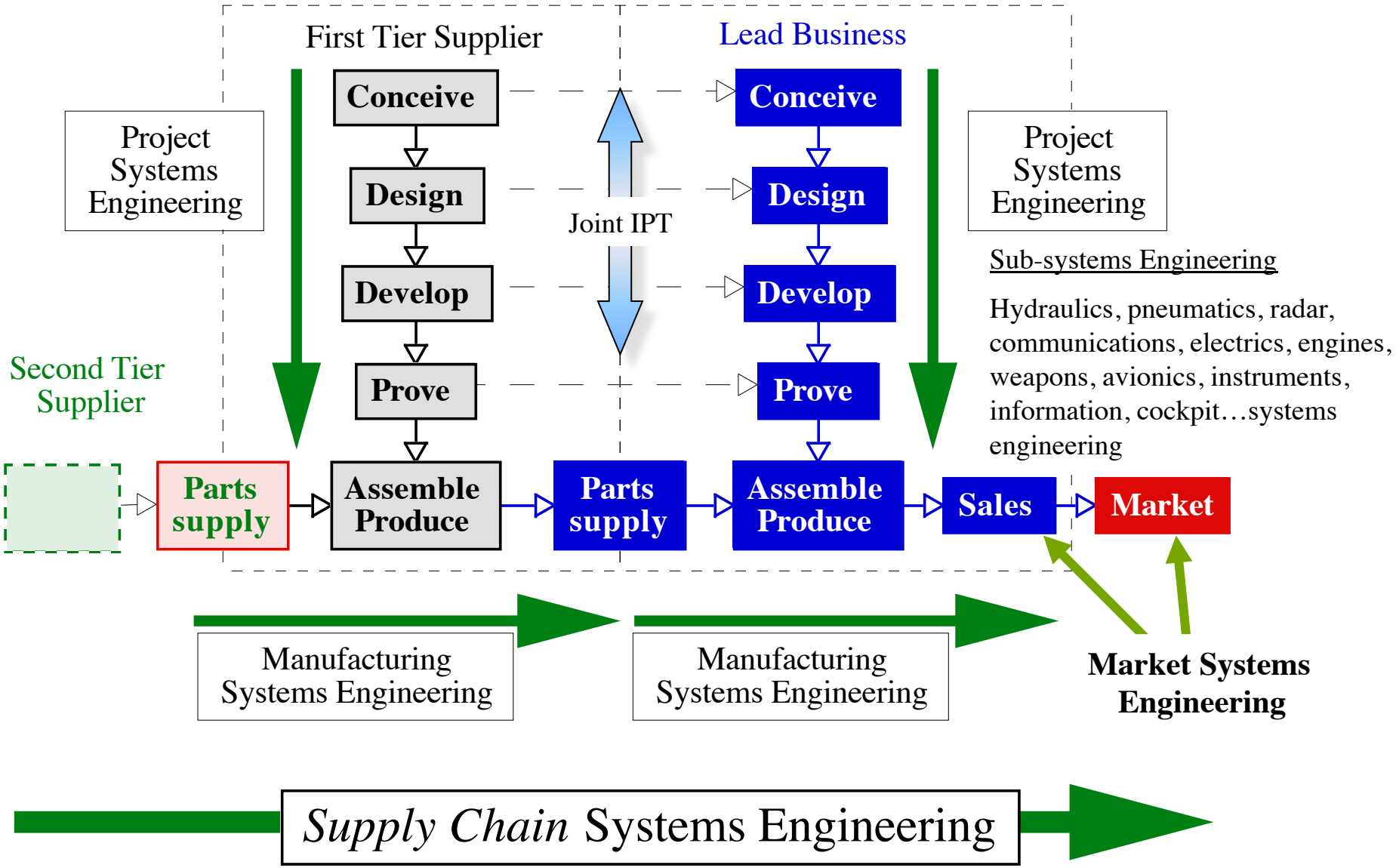
Issues

- Global changes threaten the status quo
- Societies are fragmenting along old fracture lines
- Commercial industries are being revolutionized by Japanese-inspired Lean, Volume Supply
  - High quality, reduced cost, international production systems
  - E.g. automobile and electronics industry
  - Industry now major supplier and consumer of high performance, high reliability electronic/processor goods
- Demise of the Cold War has given way to high levels of uncertainty in Defence.
  - International policing appears to be a significant future rôle, usually as part of some international force with former enemies as new allies
  - Nuclear proliferation continues with India and Pakistan squaring up, and China in the background

Market-Pulled Industrial Systems Engineering



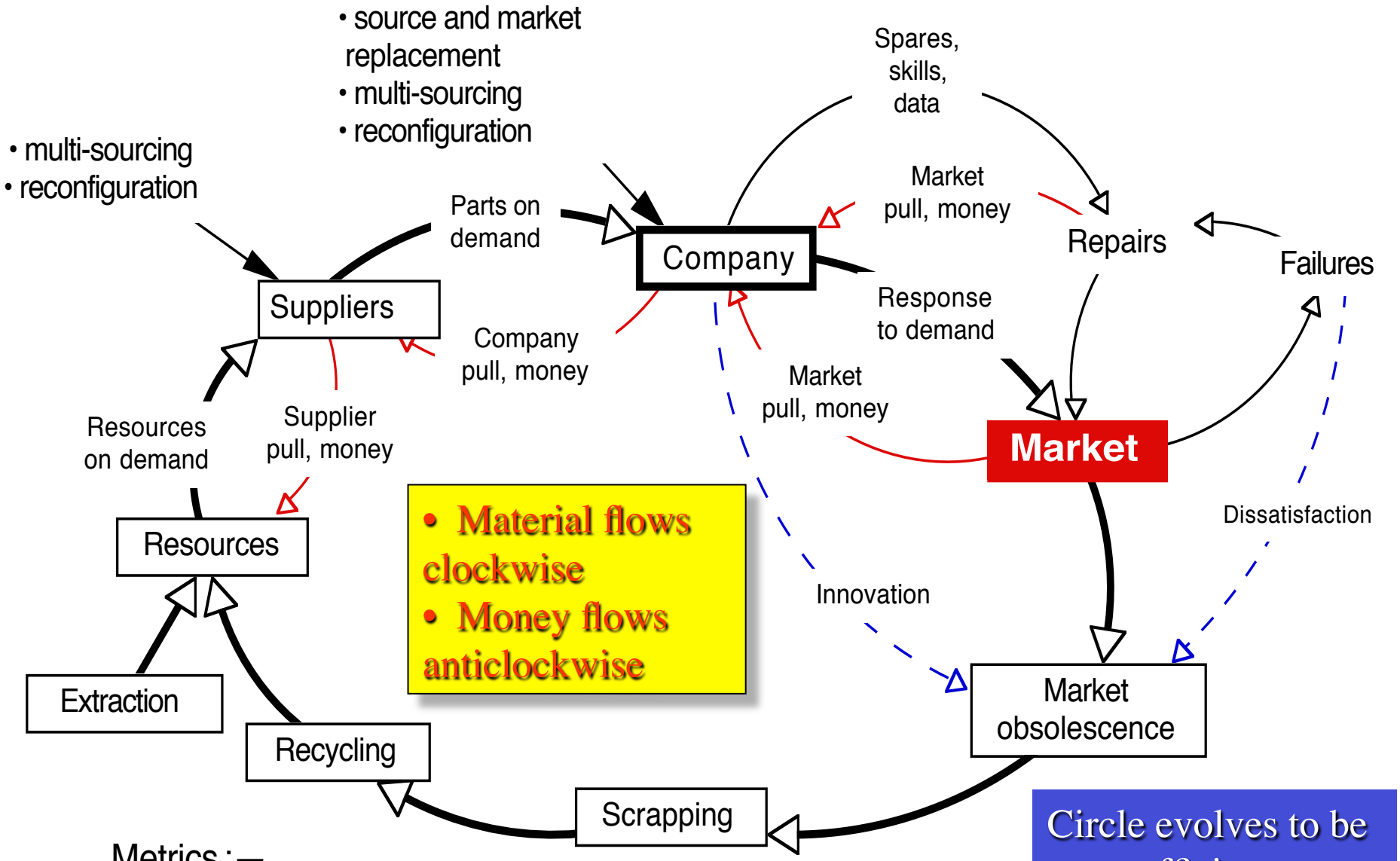
Inside Business Systems Engineering



Integrated Product Teams

- Lean industries *empower* workers
  - I.e. delegate authority to make product design/development/ engineering decisions
- Decisions made on-the-spot, therefore *fast (= efficient & effective)*
- Most decisions are multi-dimensional
  - Technological, financial, commercial, sales, etc.
  - Ethic is to improve product on behalf of customer
- Small Integrated Product teams formed to make such composite decisions:—
  - Team composition relative to decision
  - May include supplier(s) representative(s)
  - Team size typically 5. Small teams…
    - speed decisions
    - keep costs in check.

Agile Lean Volume Supply System

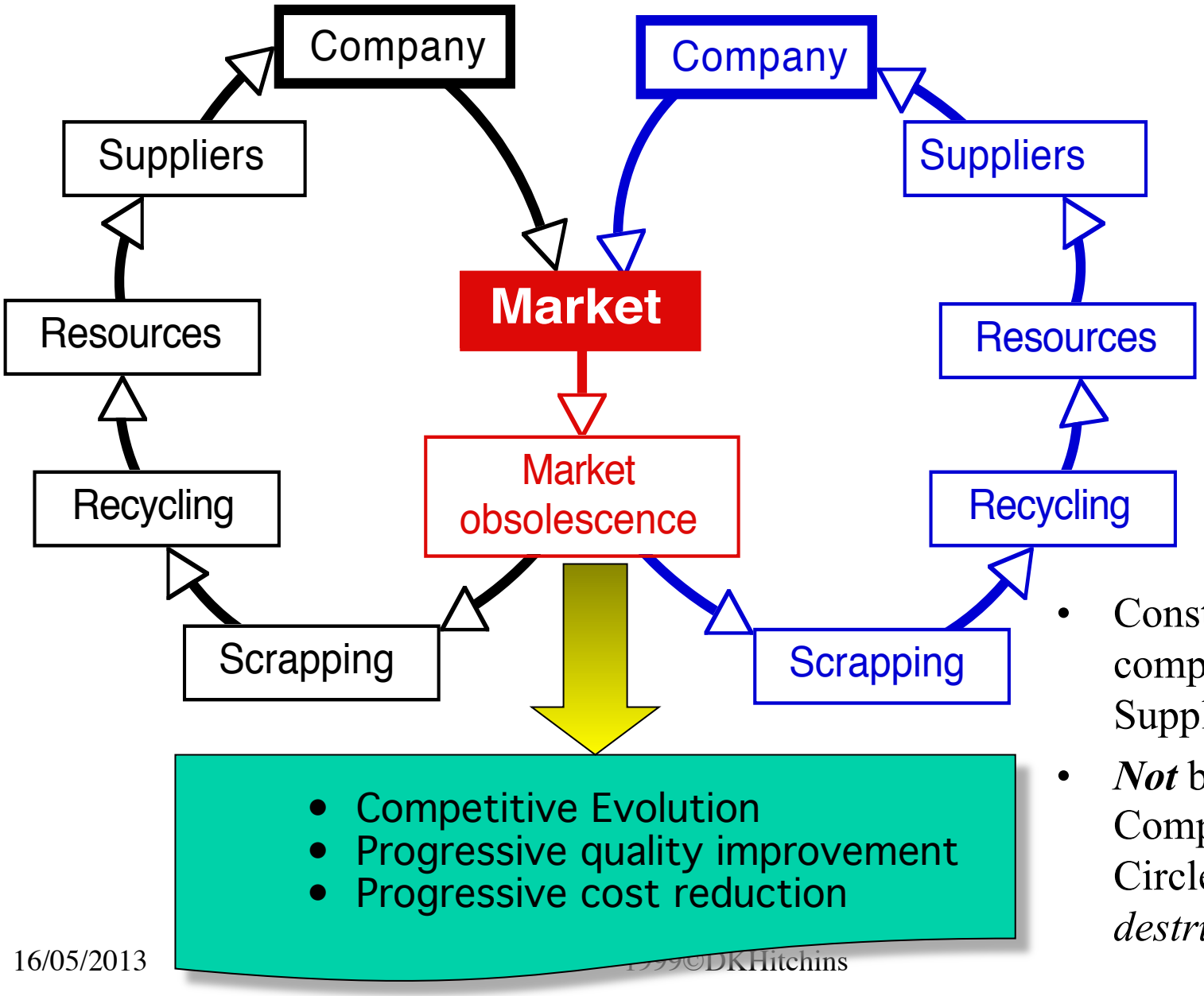


Metrics :—

1. Flow rate around the system
2. Proportion of circulation time/resources spent in Market

Circle evolves to be more efficient over time using *Kaizen*

Supply Chain Competition



- Constructive competition is *between* Supply Circles,
- ***Not*** between Companies in a Supply Circle—that's *self-destructive!*

US Defense Acquisition Reform Program

- US Defence Industry obliged by US Administration to introduce commercial lean practices to reduce costs
- US Defense Acquisition Reform Objectives:
  - ***Emulate Phenomenal success of Commercial Volume Supply***
  - Reduce US defence tax burden—sound politics and economics
- US Defense Acquisition Reform Tactics:
  - Create super-aerospace companies, able to afford their own defence R&D
  - Dispense with Mil Standards, Specifications, introduce Single Process Initiative…

Smart Procurement, Foresight and "Systems Engineering"

- US Defense Acquisition Reform threatens UK/European defence industry
  - Unable to amalgamate effectively—piecemeal nationalistic politics
  - UK/European Defence Industry threatened/swallowed(?) by US amalgamations
- UK response is Smart Procurement, heralded in 1996 by George Robertson, then Defence Minister.
  - It was to be faster, cheaper, better, using commercial practices and off-the-shelf products to reduce procurement times
- Government's Foresight Initiative reported that Systems Engineering was a necessary cornerstone of future Aerospace industrial success.
- Systems Engineering became instantly, and erroneously, identified with Smart Procurement
- Those jumping on the accelerating Smart Procurement/"Systems Engineering" bandwagon:—
  - Overlooked the substantial body of knowledge on systems, systems thinking and systems engineering—past practices, previous pitfalls, current theory and research
  - Introduced their own, untested ideas—largely reductionist, rather than systems, in nature, OR declared their current practices to be closet systems engineering OR proclaimed that software engineering was really systems engineering
  - Concentrated on Requirements, the traditional means of controlling the Defence Industry

What Should Smart Procurement Look Like?

- George Robertson rightly stated only the goals, not the route to Smart Procurement
- To procure commercial-off-the-shelf (COTS) products, however, requires that procurement cycles be less than 2/4 years—else COTS products will be superseded before delivery
- On this basis Smart Procurement should aim, then, to reduce platform procurement times from c.21 years to 2/4 years
- Is such a reduction feasible?
- Evidence from BAe's Experimental Aircraft Project (EAP) suggests it is—under specific circumstances

BAe's Experimental Aircraft Project (EAP)

- From a standing start, EAP took 4 years to conceive, design, build and fly.
- Commercial organization
  - BAe worked with established, preferred systems suppliers—no competition *per se*—"costs lay where they Fell"
  - Operated as the "front end" of a commercial lean supply chain
  - Limited integration, sufficient for purpose
- Result? A splendid achievement in a short time for relatively little cost
- Could such fast procurement be the norm?
  - Only if there were fundamental changes in procurement methods

Changes to Reduce Procurement Cycle

- Tempting to simply streamline the current procurement—and that has been the route to Smart Procurement so far:—
  - Reduce number of phases
  - Minimize inter-phase delays
- Unfortunately, this approach does not offer enough scope to reduce cycle, reportedly, by much more than one third, from 21 years to 14 years
    - Half-life of commercial, computer-based technologies c. 18 months, so…
    - COTS effectively precluded by simple streamlining process
- Significantly, mention of COTS has become progressively less frequent in the Smart Procurement literature
- Even were COTS unimportant, a 14 year procurement cycle is still *far too long* in a dynamically changing technological, social and political world

Radical Change

- Radical changes appear to be necessary if Smart Procurement's original—and laudable—aims are to be even approached
- Two notions come to mind:—

A. Eliminate phases altogether—simply provide industry with an objective and leave them to produce the result
    - Requires government trust and "hands-off" during design, development and proving

B. Switch to the alternate way to buy a gentleman's suit—off the peg
    - Completely different approach, but familiar in most other fields of endeavour

- These potential alternatives will be examined below

A. Eliminate Phases Altogether

- Why not eliminate phases altogether?
  - After all, phasing is anti-systems, i.e.reductionist—it breaks the creation process into independent "chunks"
  - If removing some phases saves time, removing all phases should save more time—*reductio ad absurdum*
- Eliminating phases in bespoke procurement equates to customers providing a requirement at the start and trusting the contractor to produce the goods to order some years later
- Procurers are mandated to safeguard public money, however.
  - Flow of money seen as controllable if released in tranches against tangible progress—although tranches cost more in the long run (sic)
  - Notion of trusting contractors is incompatible with mandate
- Without taking other measures, eliminating phases is unlikely to reduce the procurement cycle by more than a further 3/4 years. It would still be too long at 10-11 years

B. Buy "off the peg"

- We do not place a requirement specification on a car manufacturer, then wait several years to receive the product
- Instead we form an idea of what we need, go into the market place and see what's on offer from a variety of manufacturers
- Often we see products which offer benefits we had not thought of—shopping around becomes a learning experience
- When we choose, we expect the new car to be delivered in weeks, including any optional extras we may have chosen.
- We can do the same thing with most defence systems, even with complete tanks, planes and ships, provided:—
  - There is a robust market, with competitive products to choose between, some of which meet our perceived and evolving needs
- What's the catch?

B. Off the Peg Pitfalls

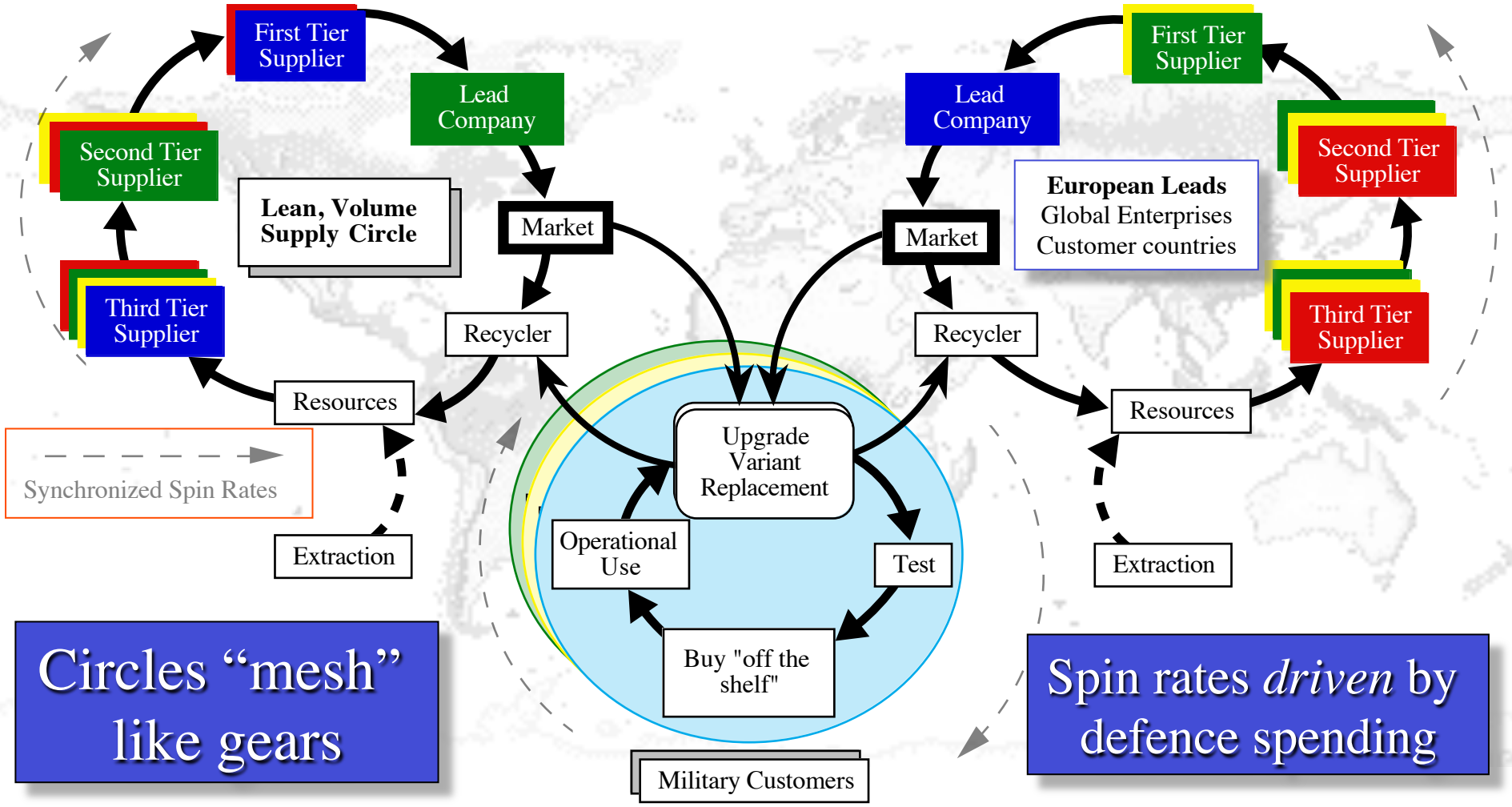
- A robust market implies international sources. If we do not buy from our indigenous defence industry, how are they to survive?
  - Once freed to compete in an open defence market, our defence industry will become much leaner and meaner through competition
  - Once freed, they can form Agile, lean volume supply associations
- How could we integrate and maintain different systems purchased from an open international market?
  - Our systems would have to be designed to accommodate differently sourced products, just as computers accommodate Plug and Play, variously sourced motherboards, etc.
  - The key is “loose-coupling”
- What if some of these products were COTS?
  - They would be subject to continual, commercial upgrade to both soft-and hard-ware
  - Places special responsibility on the operational user organization to act as a “consumer” of “consumable products”.

Revealing the Flaws

- Last bullet reveals major issue. Defence procurement should be balanced with Defence consumption
  - No successful tailor would make suits either faster or slower than the rate at which customers discarded them.
- Smart Procurement, despite commandeering the term "Systems Engineering", has failed to identify the "whole system"—a basic tenet of any systems approach
  - The operational user organisation is part of the whole system
- If future Smart Procurement is to take advantage of Agile Lean Volume Supply potential to supply faster, better and cheaper, then
  - Operational Users of Defence Equipment will be seen as consumers of defence products
  - Operational User consumption rates and patterns will be matched to Lean Volume Supply patterns of provision

UK Defence Acquisition and Total Systems Acquisition

Total Systems Acquisition—Overview



Circles "mesh" like gears

Spin rates *driven* by defence spending

- Wealth Creation in Europe • reduced public spending • reduced taxation
- Socio-economic stability – within Europe – between customer countries
- Counter to US industrial dominance • International Political Stability

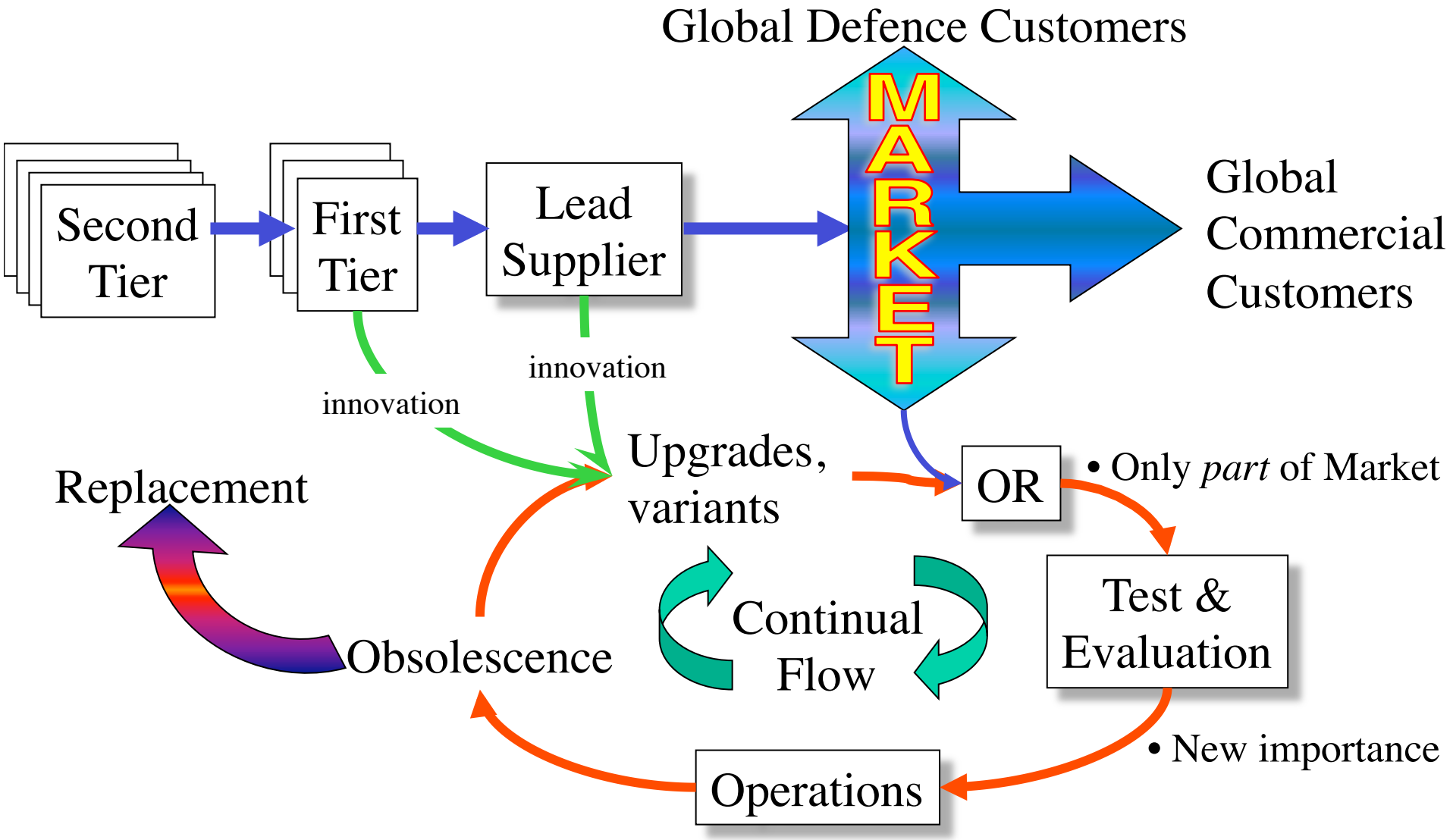
Total Systems Acquisition

- **Key concept**:
  - Procurement is ***not*** the system-of-interest (SOI). It is only part of that system
  - The SOI is the ***complete supply circle***, including supply, market, customer, (military) user and recycling into new supply
- **Optimizing this *complete* system can**:
  - Build UK National wealth/reduce national tax burden
  - Enhance our position in both world politics and economics
  - Supply our Armed Forces with the latest technology
  - Enable us to afford more of that latest technology
- **Barriers to Optimization**:
  - Piecemeal "improvements". Tried and failed since Downey.
  - Political fragmentation, esp. within Europe
  - Failure to understand/apply the principles of systems engineering *at high enough systems level*
  - **Failure to match Armed Forces Procurement to Supply System!**

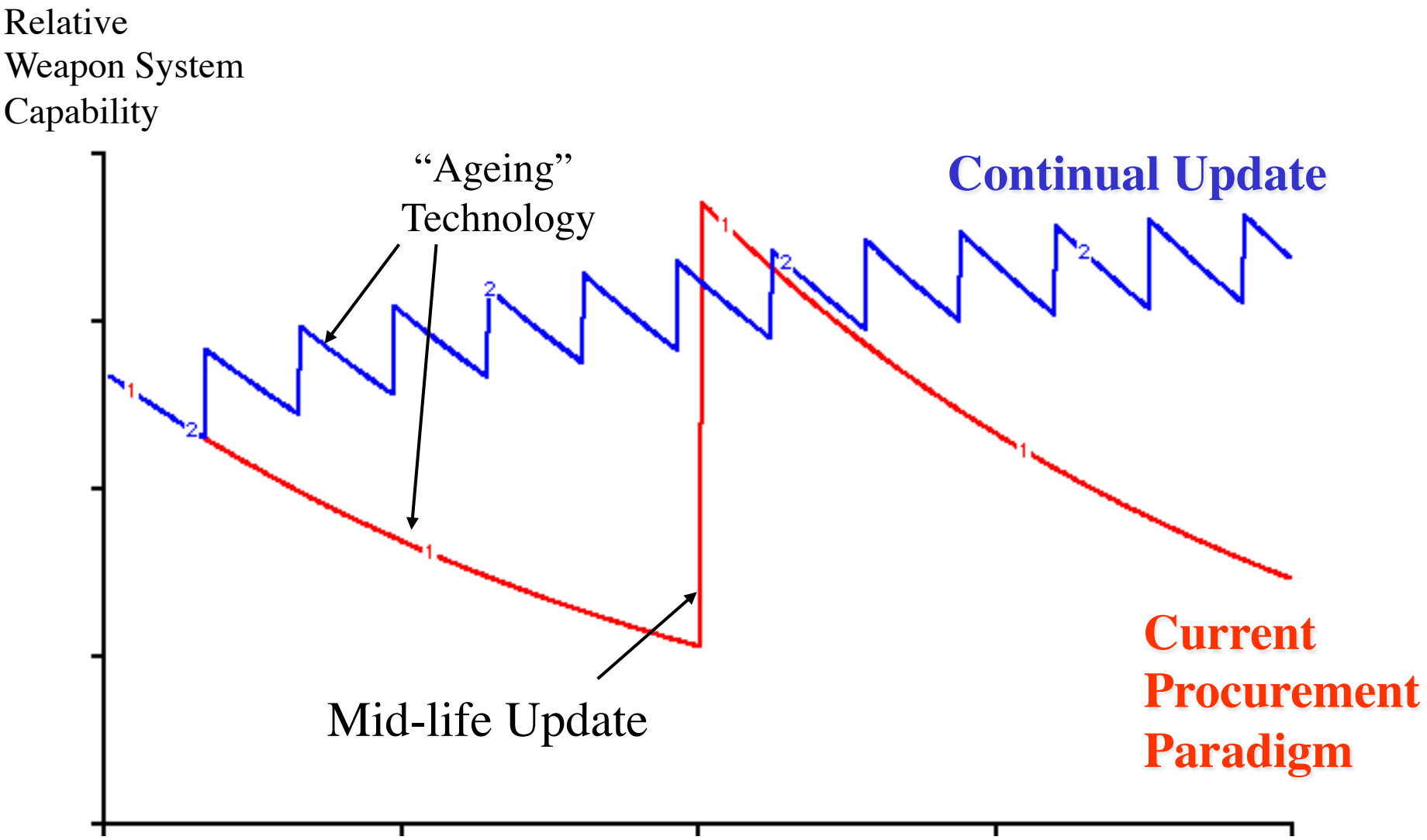
UK right on top of Cross Roads!

Armed Services —Implications

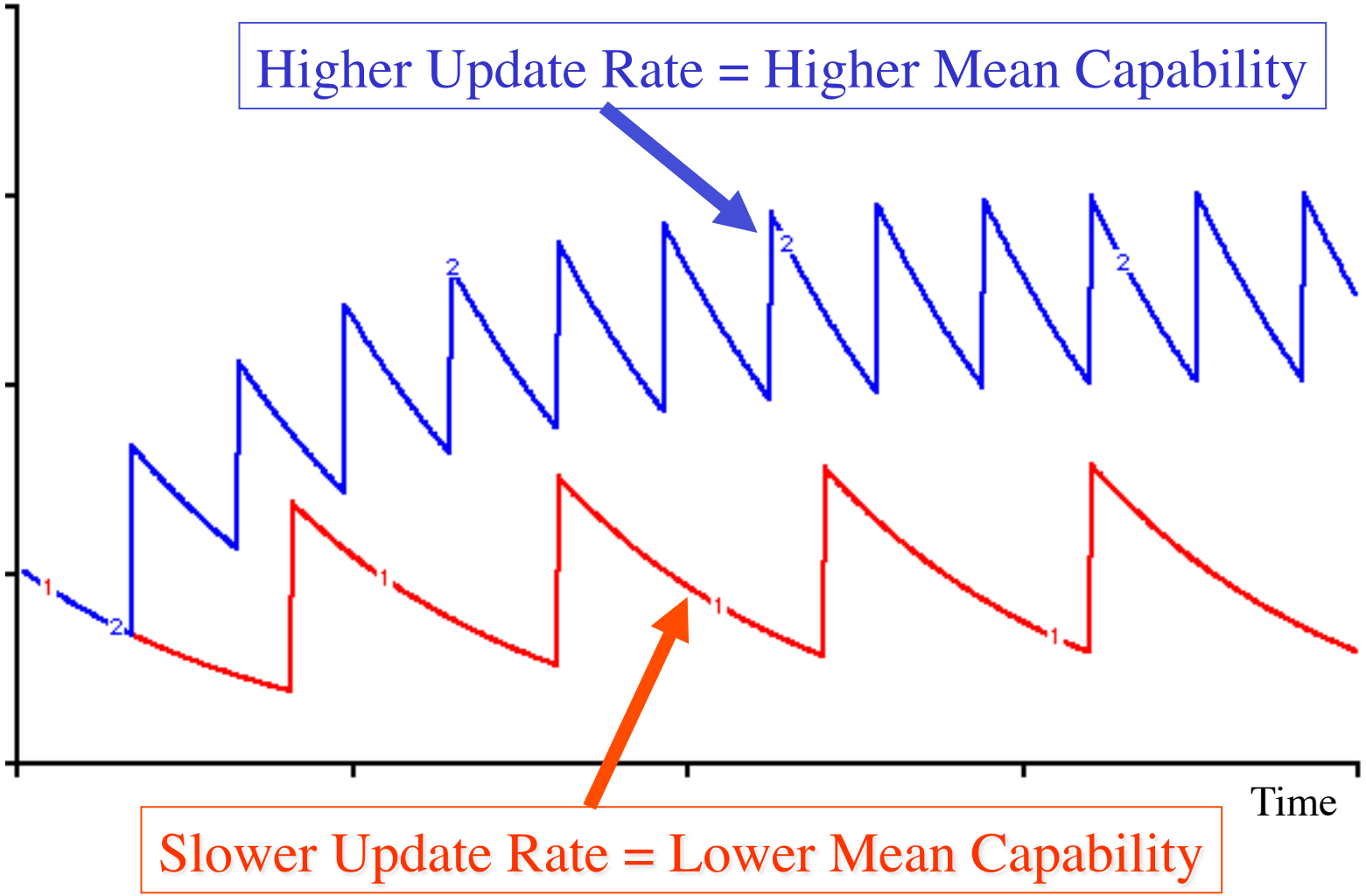
Supply Chain—In-Service Impacts



Relative Capability and Update Rate—1



Relative Capability and Update Rate—2



In-Service Systems Engineering Challenge

Balance Update Turbulence against Higher Capability

Challenge to Armed Forces

- Nature of volume supply systems requires that they supply continuously:
  - maintains flow of products and revenue,
  - maintains currency and expertise of lean development teams
  - variants, upgrades, operating systems, hardware, interface standards…
  - new technology
- Armed forces accustomed to:—
  - long periods operating increasingly-dated equipments
  - major upheaval as "unprecedented" system arrives
- Armed forces challenges & changes:—
  - *take advantage* of continual flood of change and new technology
  - *revolutionize* acquisition, operation, support, training

No Forces revolution?

No benefit from supply revolution

Opportunities

- Design systems to be continuously upgradeable:—
  - Classic systems engineering
    - ***Loosely-coupled sub-systems***
    - ***"Plug-and-Play" add-on/substitution/upgrade/variant***

- Forces *could* transition from *Systems* Supply to *Facilities* Supply:—
  - Industry "leases" systems to Force
  - Industry responsible for maintenance, continual upgrade and recycling
    - Except "forward"
  - V. similar to *de facto* Desert Storm operations

Government policy?

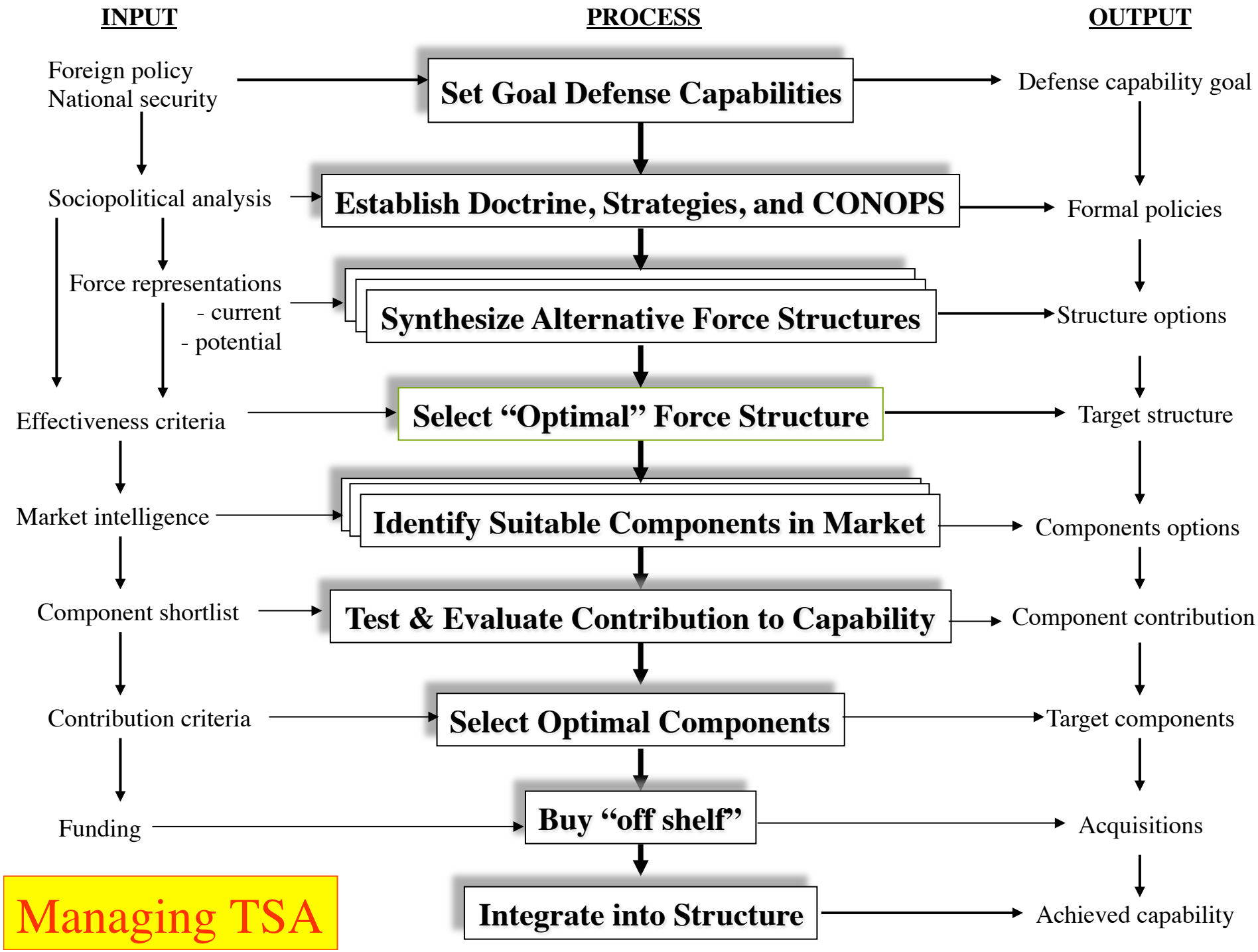
—Public-Private Partnerships

Transitioning to Total Systems Acquisition

A new Rôle for Government?

- Encourage UK defence industry to create world dominant commercial supply chains
  - Defence specific? Restricts volume supply market
  - Dual technology? Regulation presents obstacle
- Government rôle—create, perhaps even impose, climate for commercial supply chain building
  - Japanese evidence; rôle of government's MITI (c.f. DTI?) crucial in creating industrial supply circles
- US model of amalgamations not the only route…
- Alternative is for Lead Company to "seduce" First Tier, Second Tier, etc., suppliers
  - Invest in suppliers' infrastructure,
  - Introduce supply chain information systems
  - Lead Company becomes the market for its suppliers

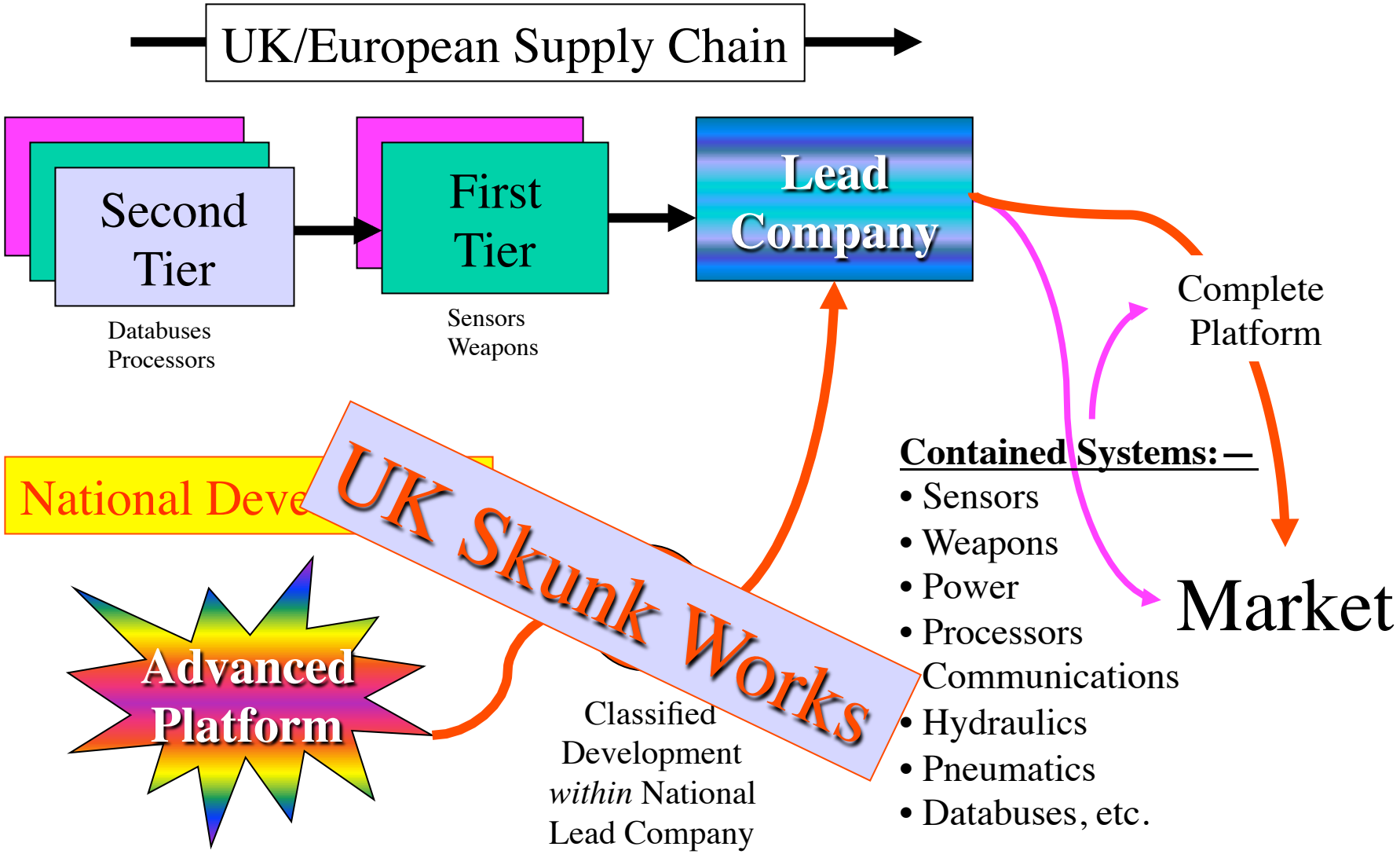
Necessitates Government De-Regulation


INPUT
PROCESS
OUTPUT
Foreign policy
National security
Set Goal Defense Capabilities
Defense capability goal
Sociopolitical analysis
Establish Doctrine, Strategies, and CONOPS
Formal policies
Force representations
- current
- potential
Synthesize Alternative Force Structures
Structure options
Effectiveness criteria
Select "Optimal" Force Structure
Target structure
Market intelligence
Identify Suitable Components in Market
Components options
Component shortlist
Test & Evaluate Contribution to Capability
Component contribution
Contribution criteria
Select Optimal Components
Target components
Funding
Buy "off shelf"
Acquisitions
Integrate into Structure
Achieved capability
Managing TSA

Transitioning to TSA—National Sensitivities

- US Super-companies—US-only companies:
  - Contain US sensitive material & data
- UK/Europe Supply Circles, European + customer countries
  - More open—national security an issue?
  - UK/Europe: lead company's country sets rules?

Keeping National Technology "Edge" Secure

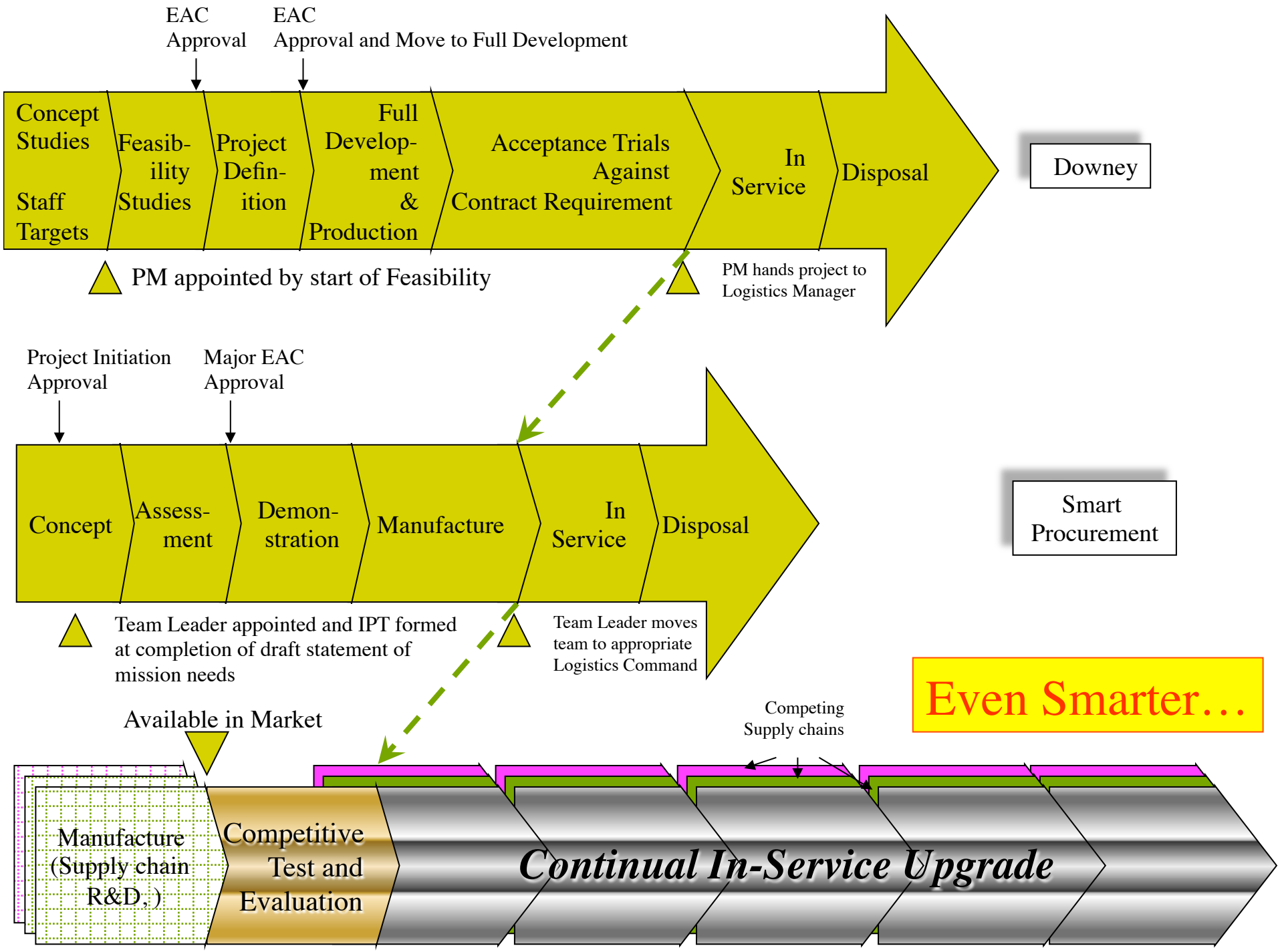


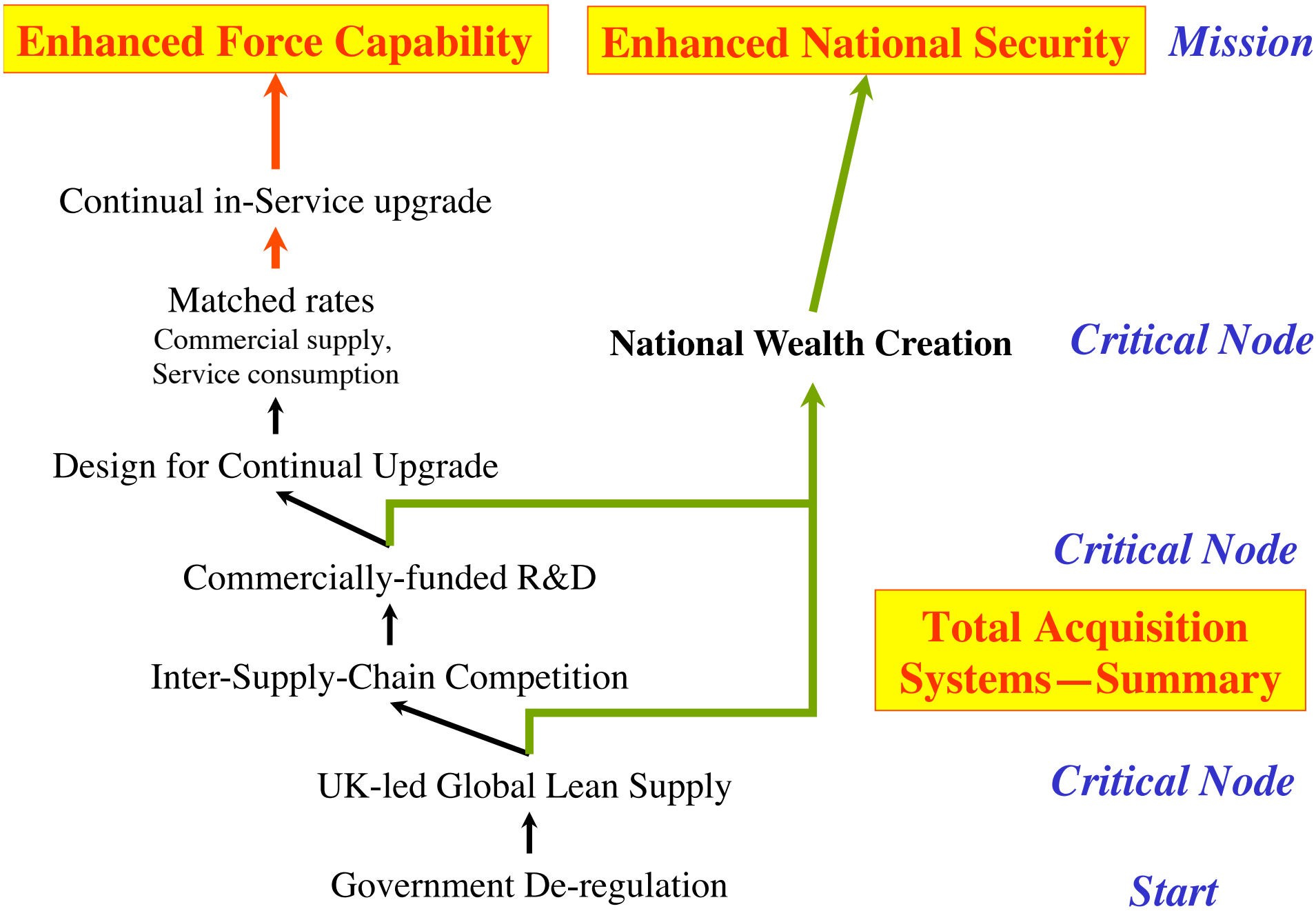
Total Systems Acquisition & UK Economy

*How much could we save in **taxation** by moving to Total Systems Acquisition?*

- How much do we spend as a nation on Defence R&D?
- What's the annual cost of the requirements and procurement elements of MOD and MOD(PE)?
- How many military personnel, trained for military operations, spend their time on procurement, requirements, etc., for which they are *not* trained?
  - *Double* waste of money!
- And how much would it cost to go to war inadequately equipped?

That's how much Public Money we could save…and that's *£billions p.a.!!*


EAC
Approval
EAC
Approval and Move to Full Development
Concept Studies
Staff Targets
Feasib-ility Studies
Project Defin-ition
Full Develop-ment & Production
Acceptance Trials Against Contract Requirement
In Service
Disposal
Downey
PM appointed by start of Feasibility
PM hands project to Logistics Manager
Project Initiation Approval
Major EAC Approval
Concept
Assess-ment
Demon-stration
Manufacture
In Service
Disposal
Smart Procurement
Team Leader appointed and IPT formed at completion of draft statement of mission needs
Team Leader moves team to appropriate Logistics Command
Even Smarter…
Available in Market
Competing Supply chains
Manufacture (Supply chain R&D,)
Competitive Test and Evaluation
Continual In-Service Upgrade


Enhanced Force Capability
Enhanced National Security
Mission
Continual in-Service upgrade
Matched rates
Commercial supply,
Service consumption
National Wealth Creation
Critical Node
Design for Continual Upgrade
Critical Node
Commercially-funded R&D
Total Acquisition Systems—Summary
Inter-Supply-Chain Competition
UK-led Global Lean Supply
Critical Node
Government De-regulation
Start

Smart Procurement Vs. TSA

Smart Procurement	Factor	Total Systems Acquisition
Regulated Defence Industry	*Paradigm*	Free defence market
Customer pays	*Development Cost*	Industry pays
Customer	*Development Risk*	Industry
Trust paper promise	*Customer mode*	Try before buy
Customer	*Financial Exposure*	Industry
Prevents supply circles	*Competition*	Between supply circles
Phased, controlled, slow	*Development Cycle*	Commercial, fast, expert
Excluded due to long cycle?	*COTS Products*	Included
Customer controlled	*Innovation*	Industry inspired
High (low throughput)	*Production Cost*	Low, getting lower *(Kaizen)*
Outmoded at delivery	*Design currency*	Contemporary
Periodic, take out of service?	*Upgrades*	Continual, by industry in-service
Tight, software intensive	*Systems coupling*	Loosely for continual upgrade
Periodically improved in service	*Performance*	Continually improved in service
Integrated Project Team	*IPT*	Integrated Product Team
30/50	*IPT Size*	5/6
Control design & manufacture	*IPT Purpose*	Serve customer, better, faster, cheaper

Conclusions—1

- US switching to lean *commercial* SE
- UK/European Defence Industry at imminent risk
- Smart Procurement promised to counter—*but* hijacked
  - Obsession with ***imposing*** requirements ***and*** in-project competition
  - regulation, contracts, DEFSTAN ***straightjacket*** on Industry
  - Lost opportunity—but is it too late?
- Recognize Total System-to-be-Optimized:—
  - supply system, market *and* military user in international competitive framework
  - hence ***Total System*** Acquisition
- TSA:—
  - **Affords:** national wealth creation; reduced national R&D; cutting-edge technology in-Service; international stability
  - **Obstacles:** procurement regulation; control paradigm
  - **Meets:** Capability goal; public-private partnership; VFM
  - **Needs:** swift, positive government deregulation

TSA—Implications

- Government *could* still "control" by setting Defence Capability Targets
- Competition *would* still occur between supply circles
- Europe *could* establish 2/3 agile, lean, volume supply chains
  - different national leads?
  - cross border/international suppliers (inc. S. America, E. Europe)?
  - = economic and political stability?
- Agile lean volume supply circles die without continual market
  - Wider European forces to become "home market"?
  - Forces to gear up for continual change/new technology?
- Continual flow impracticable at platform level?
  - Secure UK "Skunk Works" to maintain national research edge?

Smart Procurement has made a start—
but we have *much* more to do to survive…