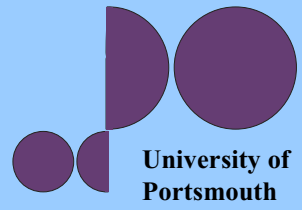
The Incompatibilities between Software Component Based Development and Present UK MoD Procurement Approaches

Michael Looney

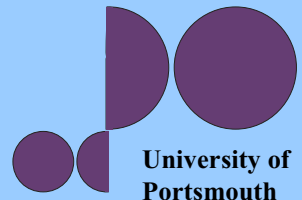
Department of Information Systems

University of Portsmouth



Presentation

- **Background**
- **Paradigm Shift**
- **Procurement & Management Issues**
- **Summary**



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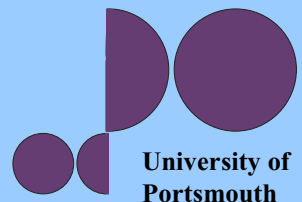
Software Problems

- **Intangible**
  - **invisible,**
  - **flexible ‘easy to change,**
- **Discontinuous Failure Modes**
  - **single error can cause system failure**
  - **100% correctness required**
- **Complex**
  - **many levels**
  - **many modules**
  - **millions of lines of code**
- **Hardware first**
  - **traditional systems started with hardware first**
  - **software was expected to take up the slack**



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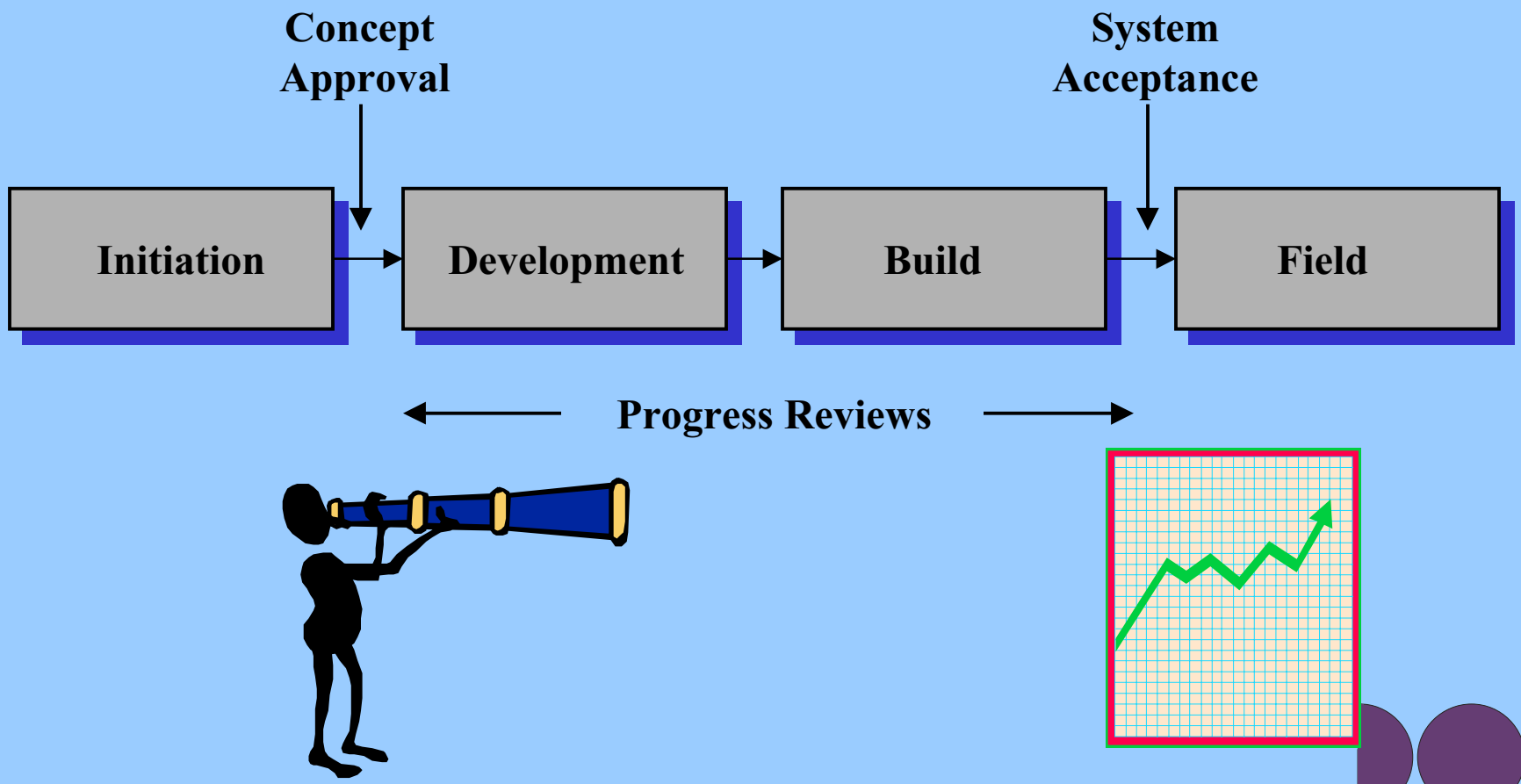
Traditional Review Process



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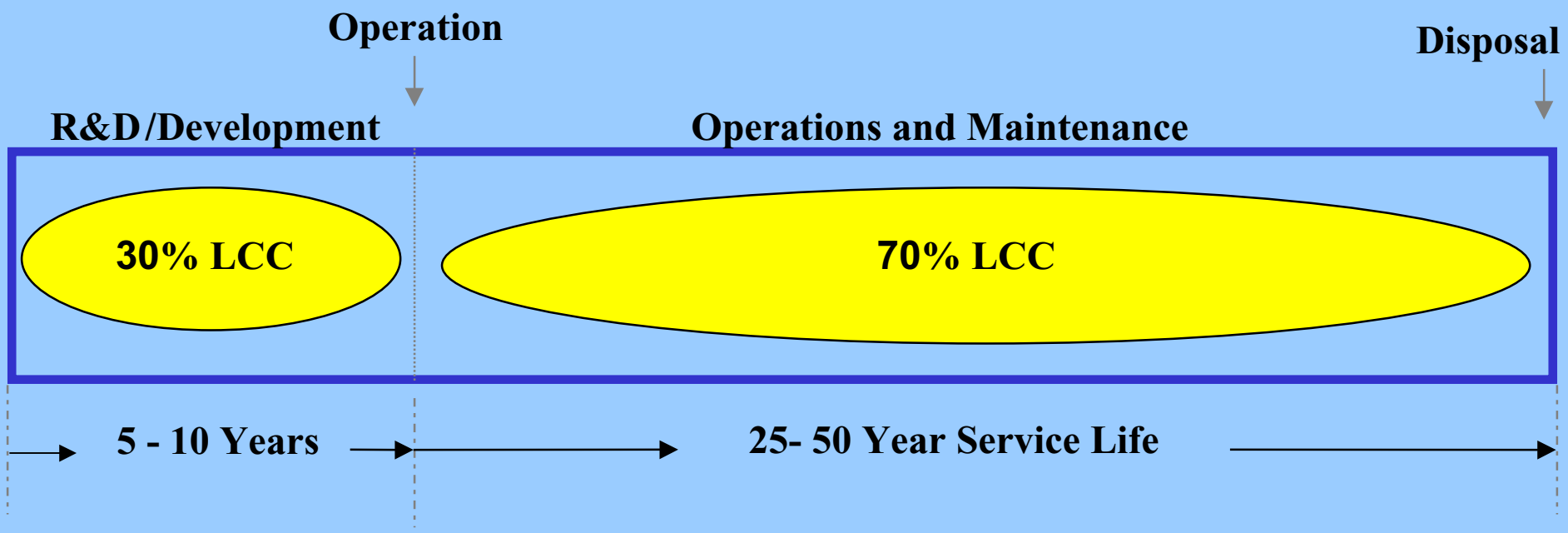
Lifecycle Timeline



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System Complexity

1950-60s
Dedicated Subsystems

Digital Fire Control
Pt-Pt Wiring
Crew dominated operations

64KB

1970-80s
Federated systems

Flight Control
Fly by Wire
Crew-assisted operations

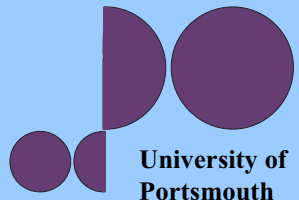
1MB

1990-00s
Integrated Systems

Aircraft wide information integration
Massive data bases
Digital sensor processing
Integrated diagnostics

100MB

Source: US Air Force Research Laboratory



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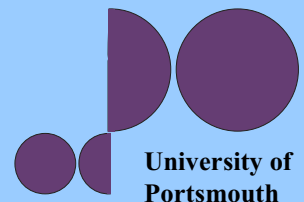
System Comparisons

System	Processors	Memory
ADA1(1961)	3	36K
ADA2	2 + 3	96K
ADAWS	2 + 2	600K
CAAIS	1	100K
CACS	2 + 7	1M
SMCS	~150	~100M
SSCS(1997)	~300	~400M



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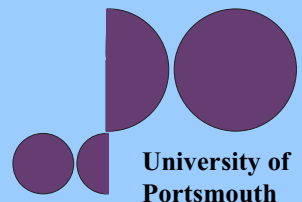
Changes

- **Process**
- **Control over the outcome**
- **System costs**

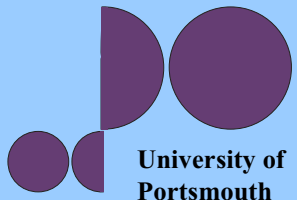


Paradigm Shift

System developers/procurers

have moved from being

producers to being consumers



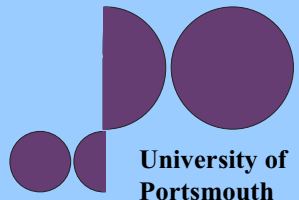
Producer v Consumer

Producer

- Identify requirements
- Build bespoke components
- Identify unique interfaces
- Integrate bespoke components
- Field and support bespoke system

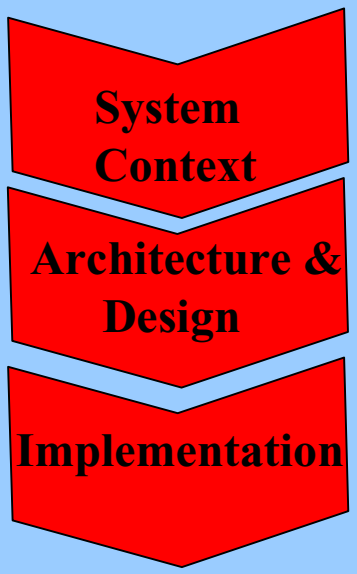
Consumer

- Identify requirements
- Framework/Integration Strategy
- Adopt standard interfaces
- Procure components based on standards
- Integrate Components into Framework
- Field and support integrated system

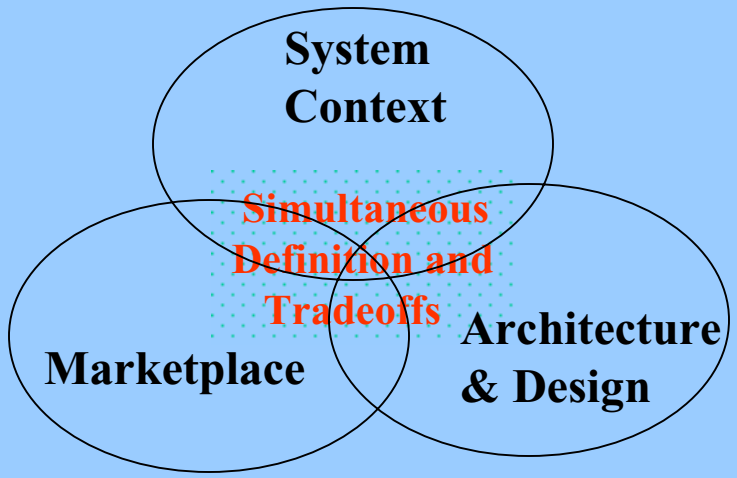


A Necessary New Way of Doing Business

Traditional Development Approach



Required Approach for COTS Based Systems



Adapted from Oberndorf & Foreman, SEI, 1999

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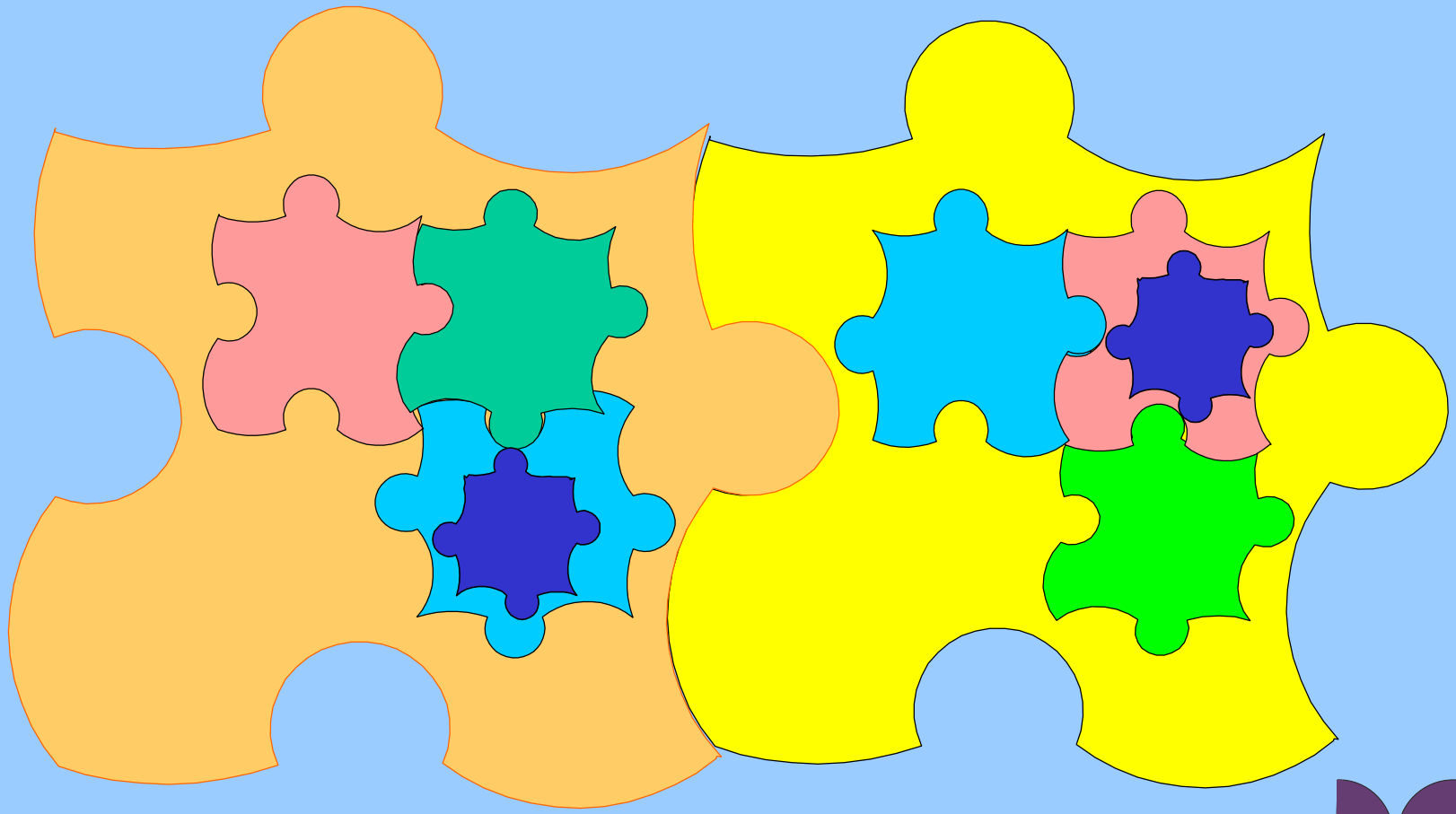
Systems Integration of Components



Real World Systems of Systems

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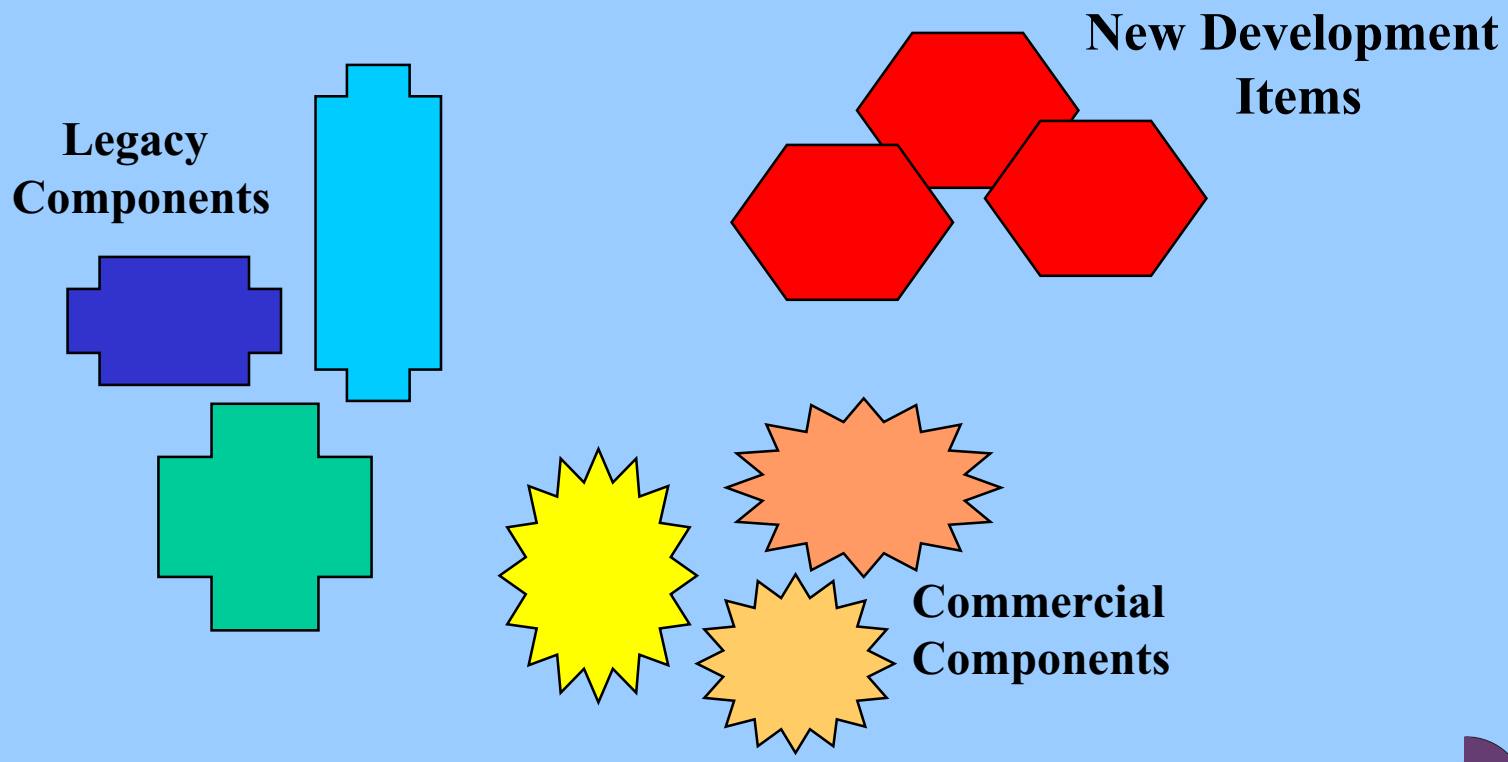
Component Based Development



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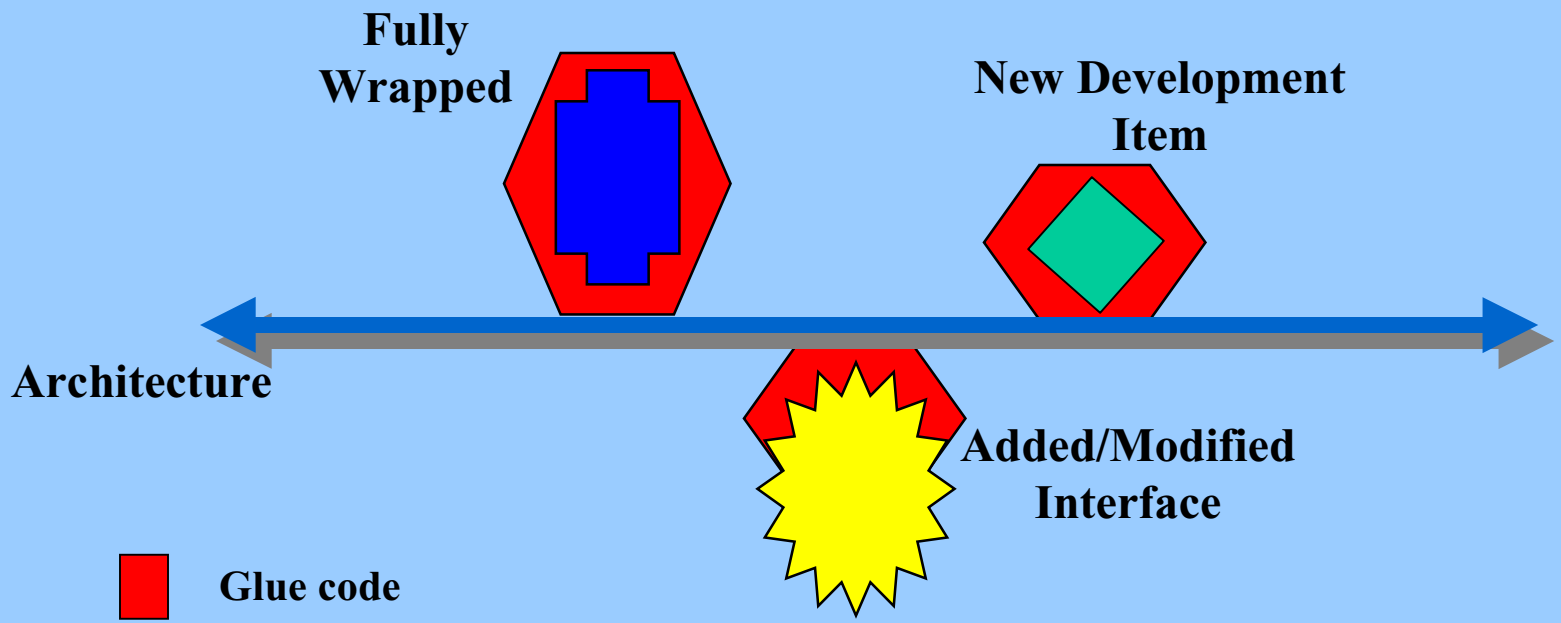
Architecture/Interface/Glue Code



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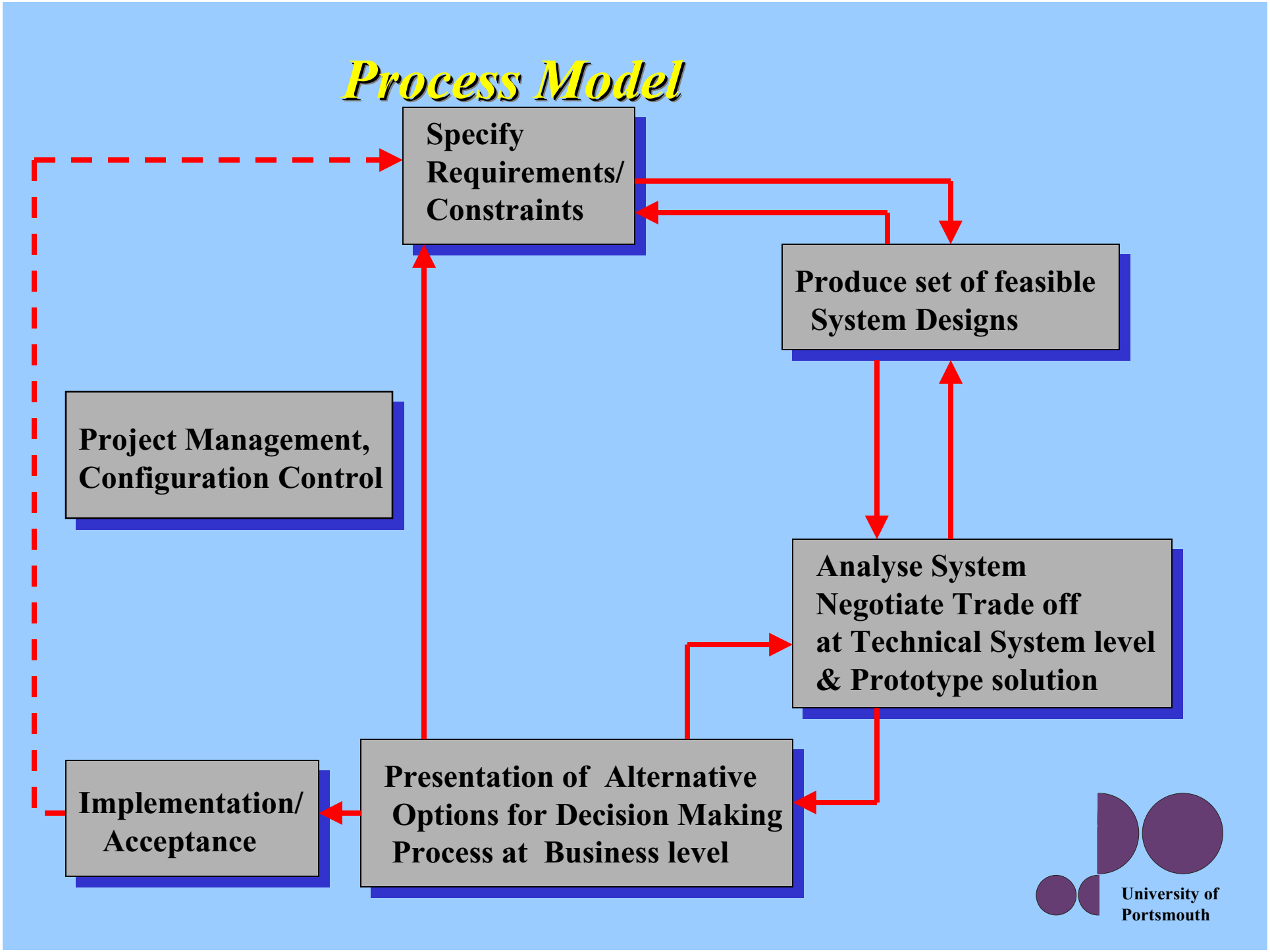
Process Model



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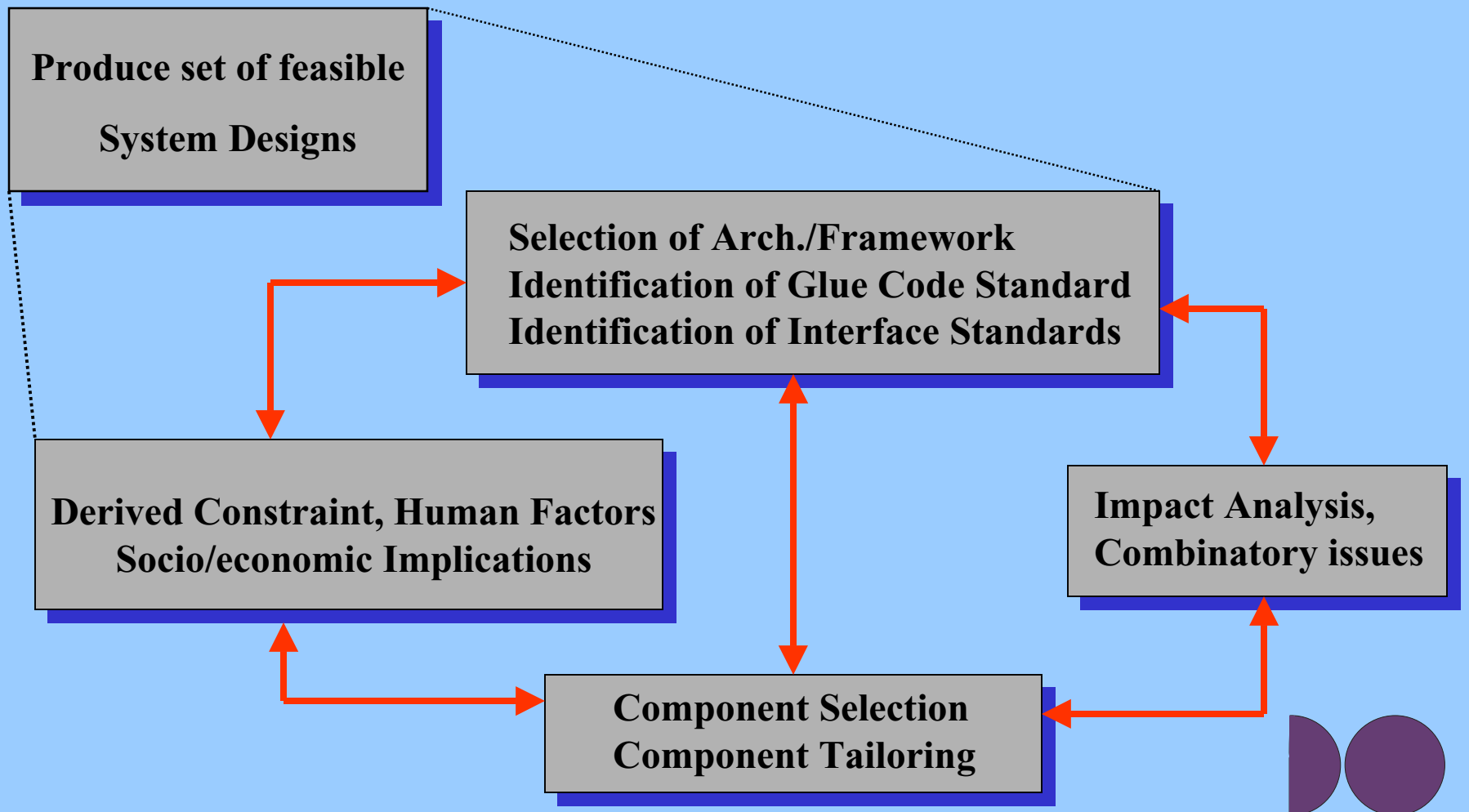
Sub Process Model



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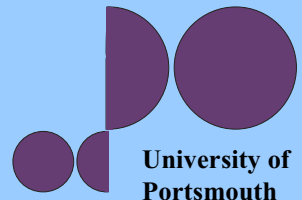

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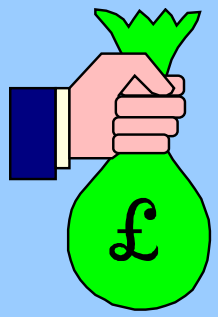
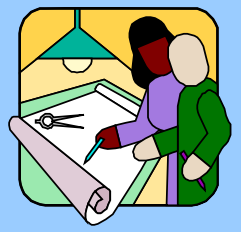
Management Process



Initiating processes



Planning processes

Executing processes

Controlling processes

Closing processes

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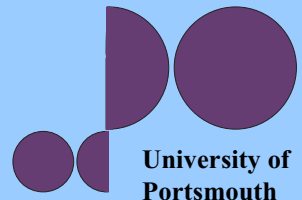
Management Changes

For

- More sources
- Better quality
- Newer technology
- Cheaper implementations
- Faster availability
- Easier Interconnections

Against

- Not finding precisely the right component
- Market driven changes
- Vendor support for the component stops



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Software Project Managers' Balancing Act

Strategies for through life support

Impact of high reliance on COTS components

Trade offs between requirements, components and cost

Components, architecture, integration

Strategies to deal with component obsolescence

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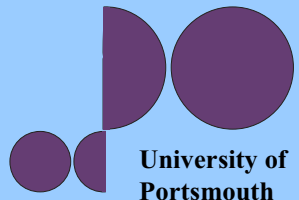
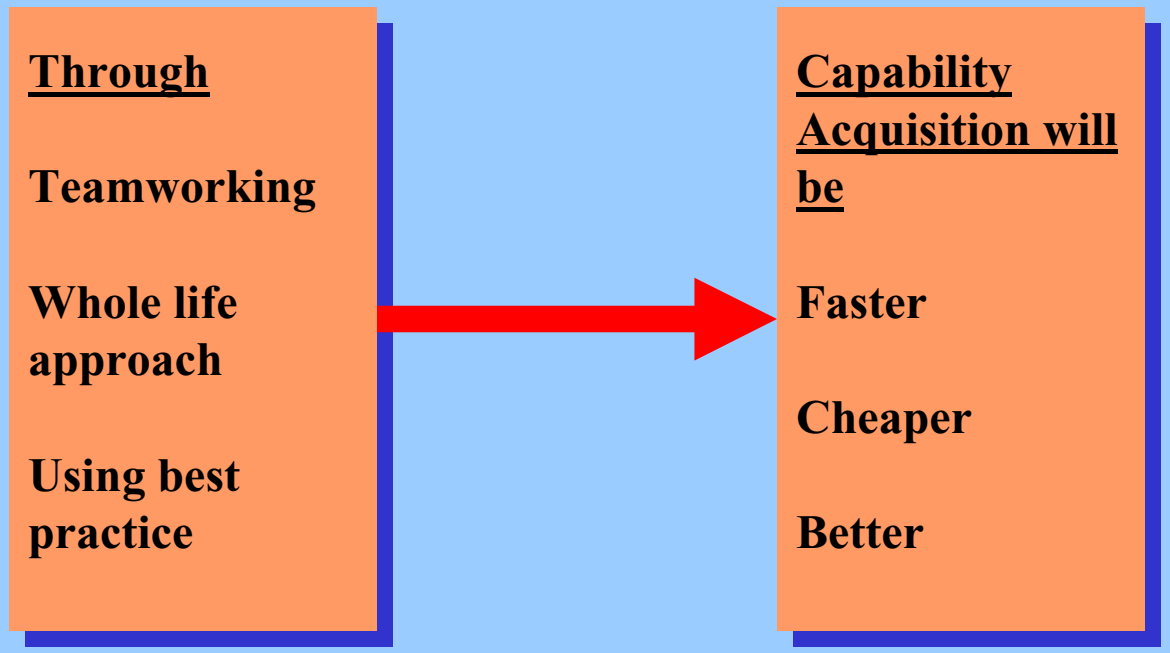
Procurement

Acquisition is a whole life process, covering requirements setting, initial procurement, in-service support and disposal



Smart Procurement



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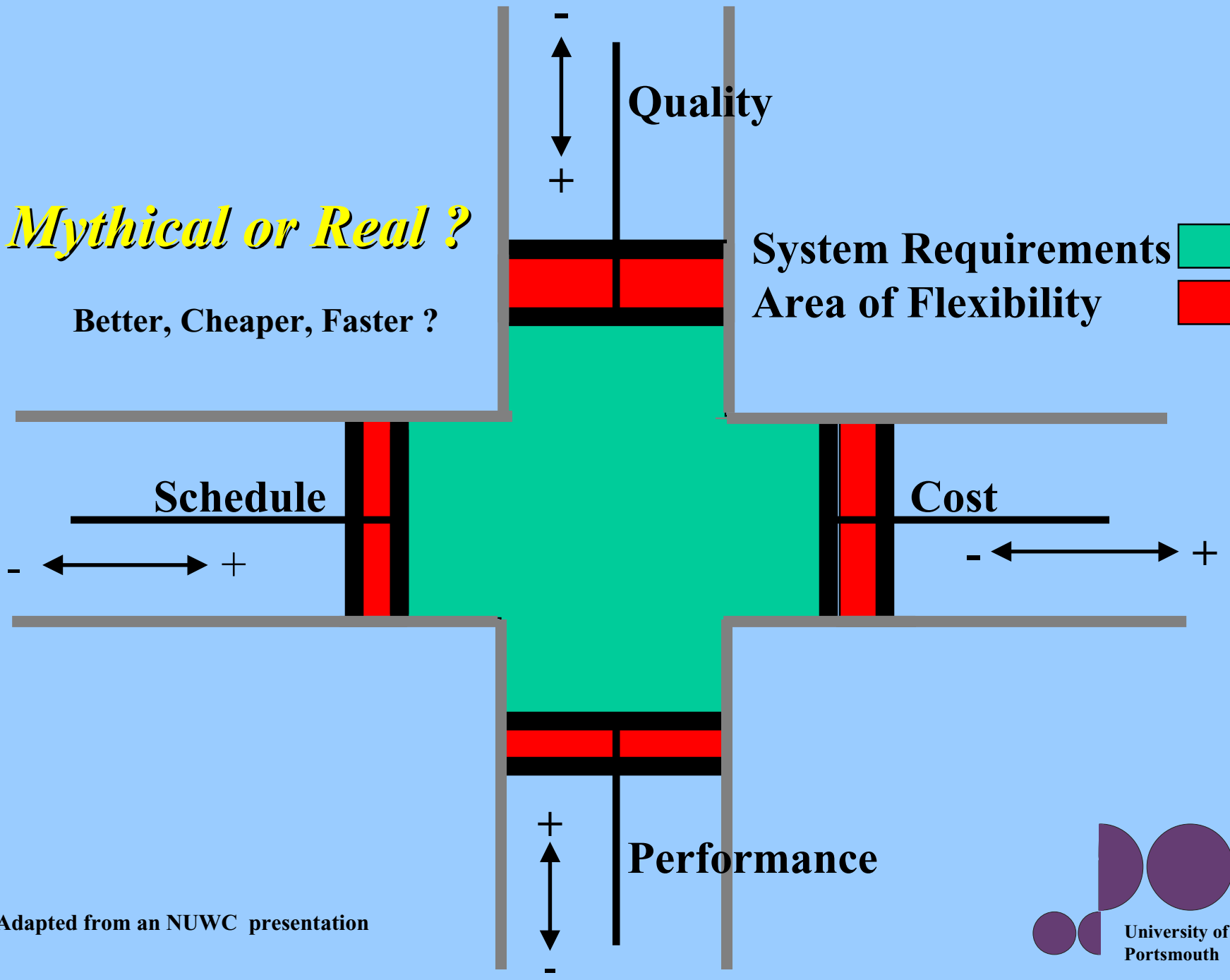
Mythical or Real ?
Better, Cheaper, Faster ?
Quality
-
+
System Requirements
Area of Flexibility
Schedule
- +
Cost
- +
+
-
Performance
Adapted from an NUWC presentation
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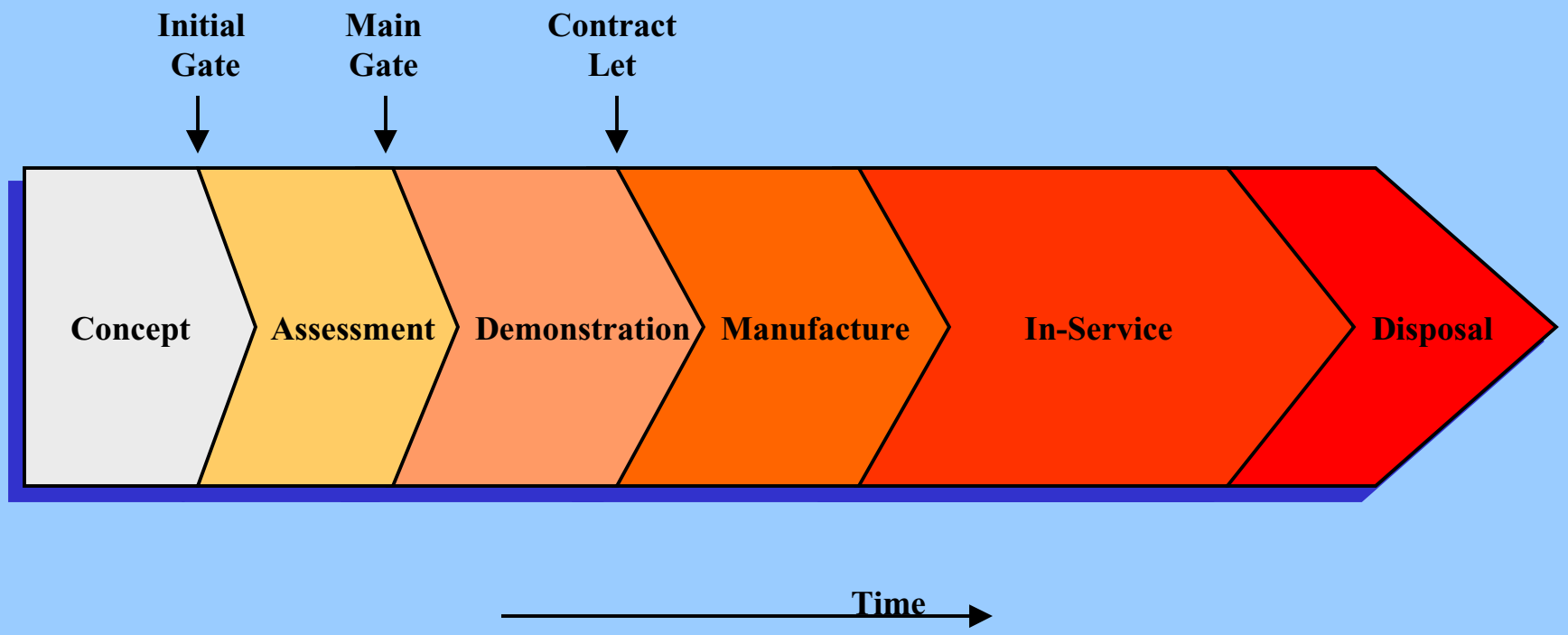
Smart Procurement Stages

- **Concept Stage** : First stage which forms the integrated team and produces the user requirements. The business case is assembled for Initial Gate approval.
- **Assessment Stage** : Begins after Initial Gate, risk is reduced to a level consistent with delivering an acceptable level of performance to a controlled time and cost. The business case is assembled for Main Gate approval.
- **Demonstration Stage** : During this stage the ability to produce an integrated capability is demonstrated. The prime is selected and a contract based on the system requirements placed.
- **Manufacture Stage** : The integrated team deliver the solution to the military requirement, completing system development and production. System acceptance is conducted.
- **In-Service Stage** : The line management provide effective front line support and carries out approved upgrades or improvements, refits and acquisition increments
- **Disposal Stage** : Efficient,effective and safe disposal of the system

Smart Procurement



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Smart Procurement

Progressive Acceptance

User and System requirements

↓

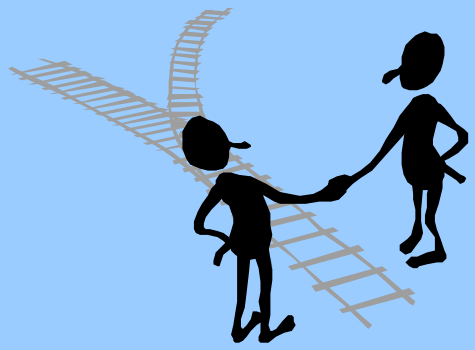
Design Certification

↓

System Acceptance

↓

In-Service Date



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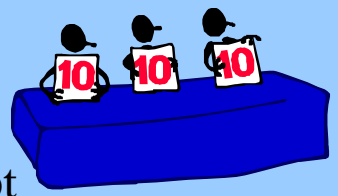
Smart Procurement Definitions



- **Initial Gate**
  - A relatively low approval hurdle, between Concept and Assessment, intended to encourage early and full exploration of a wide range of options for meeting a particular capability.

- **Main Gate**
  - An exacting approval hurdle, between Assessment and Demonstration. A business case case at Main Gate should recommend a single technology and procurement option.

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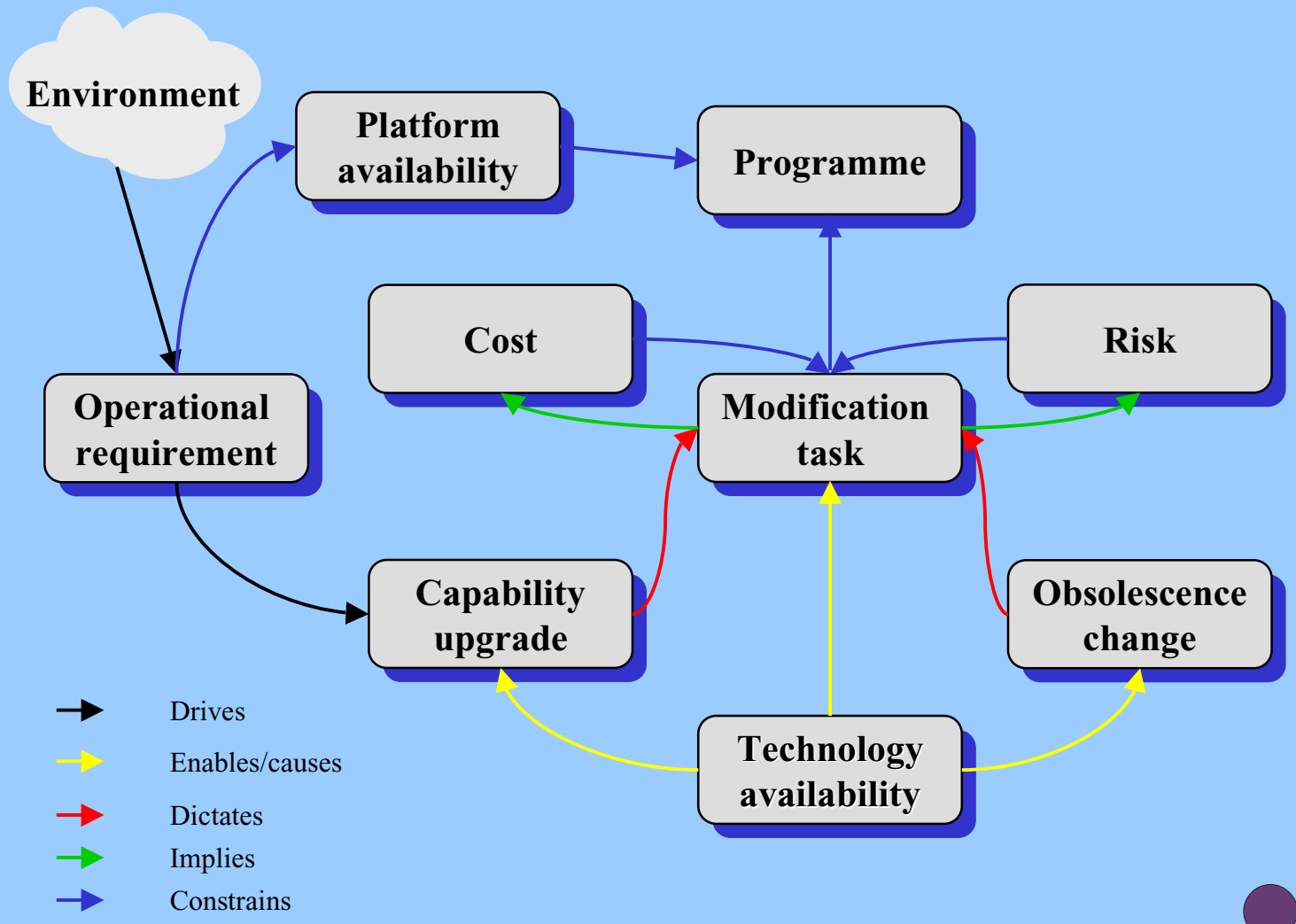
Maintenance/Upgrade Issues



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Change Drives/Rates

GSAW Survey	Release Frequency (months)
1999	6.3
2000	8.5
2001	8.75

1 Adaptive maintenance often biggest CBS life cycle cost

2 Average of 3 releases before becoming unsupported

Ron Kohl survey

Ground Systems Architecture Workshop: 2002 Aerospace Corp., LA March 2002

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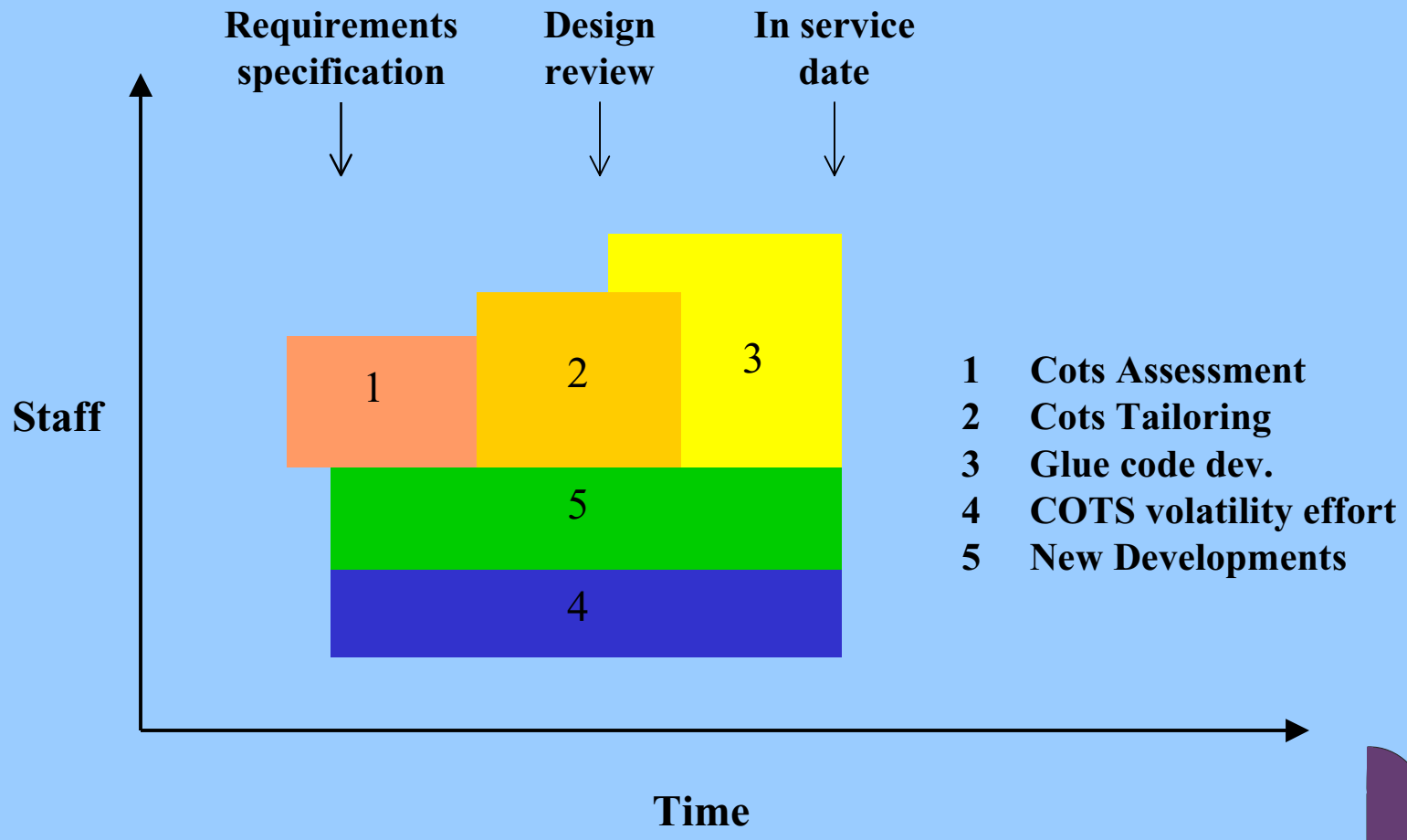
Development Cost Model



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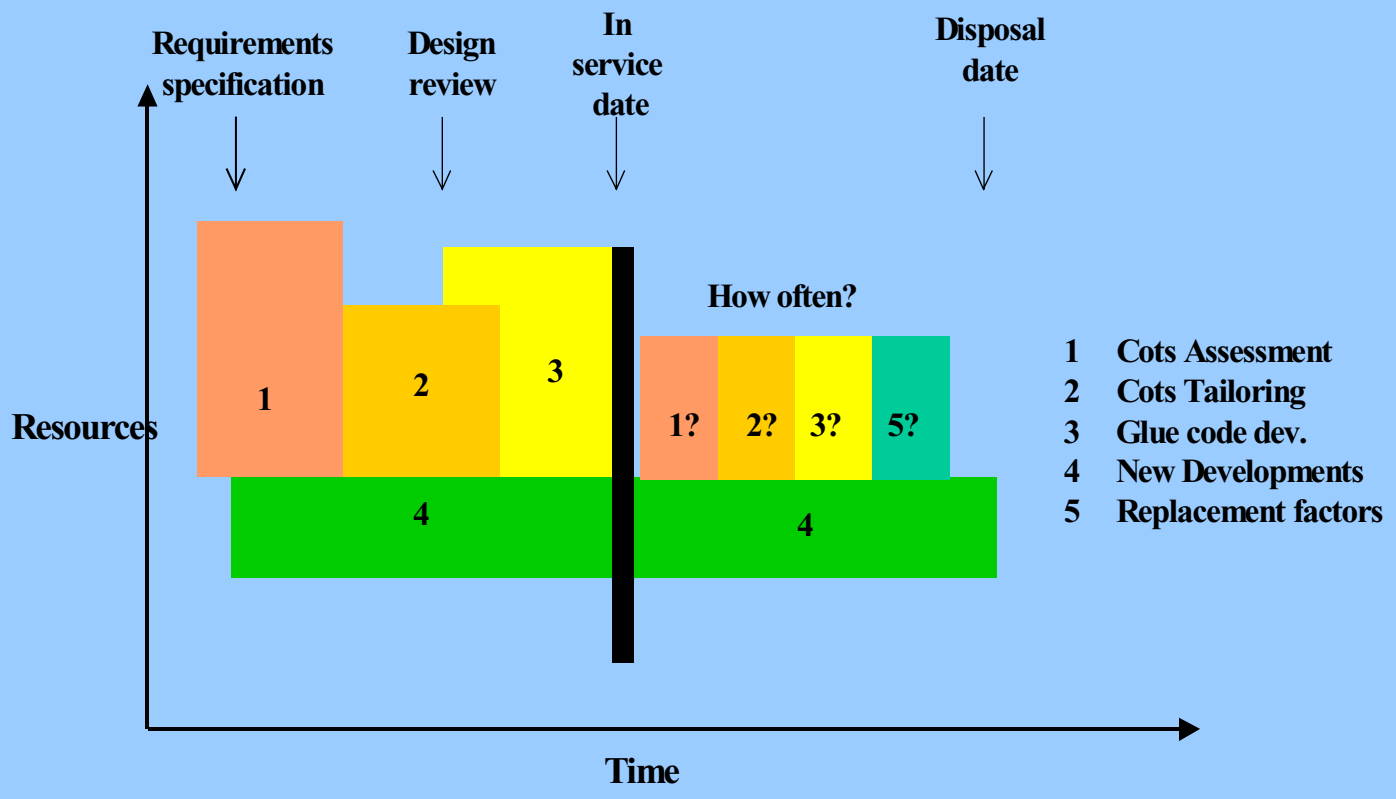
Through Life Cost Model



Adapted from USC Report

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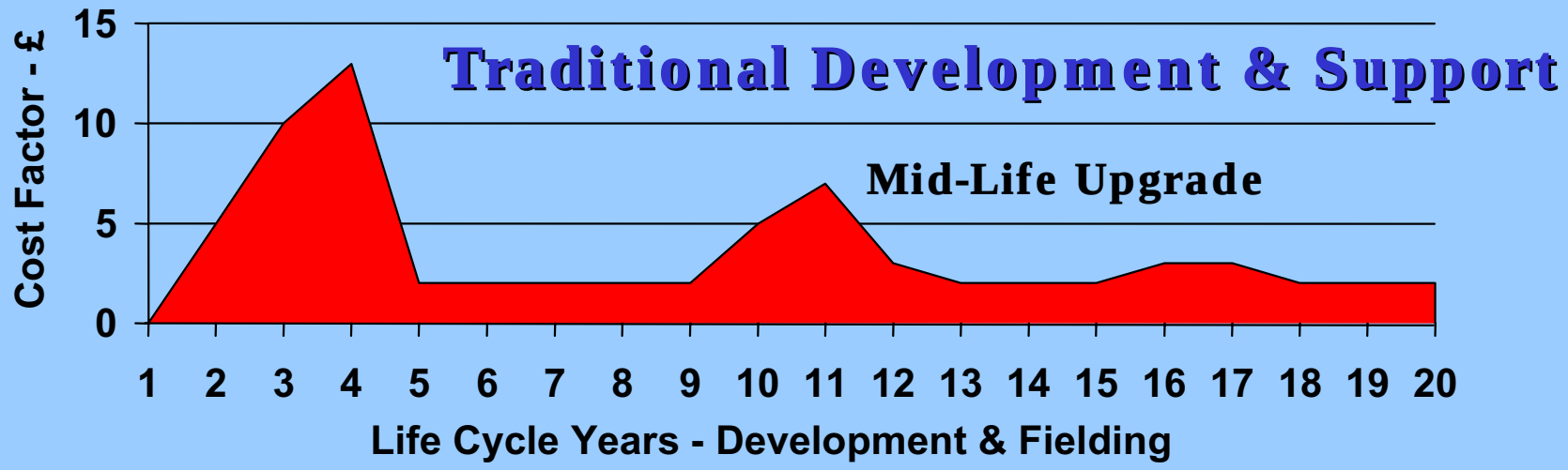
Traditional Life Cycle Cost View



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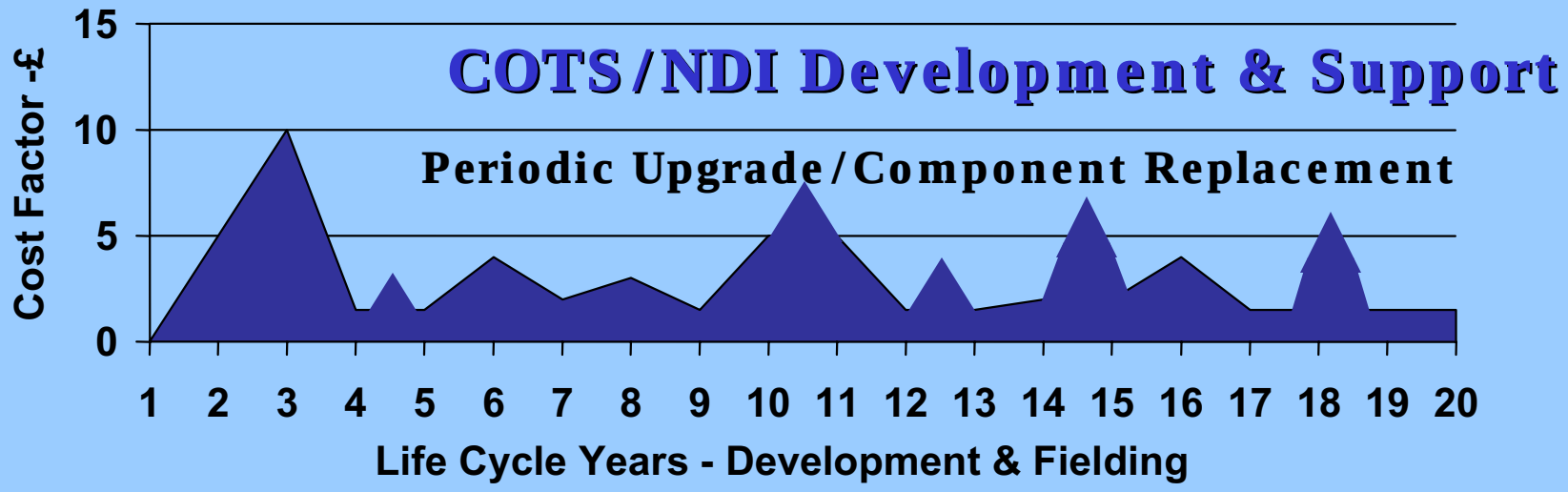
COTS/NDI Life Cycle Cost View



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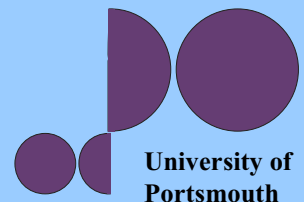

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Changes

For

- More sources
- Better quality ?
- Newer technology
- Cheaper implementations
- Faster availability
- Easier Interconnections ?

Against

- Not finding precisely the right component
- Market driven changes
- Vendor support for the component stops
- Component Volatility
- Less effective estimation and tracking
- More complexity and less adherence to any set process

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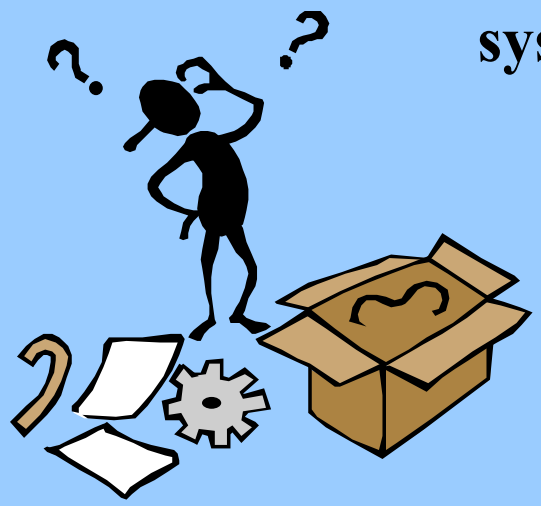
Comments

In a dynamic environment following a fixed plan can produce the system intended but not necessarily the system needed



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Comments

‘Do it right first time’

- **No uncertainty**
- **No experimentation**
- **No deviation from the plan**

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Critical Issues

- **Architecture, standards, & interfaces.**
- **Component selection.**
- **Support paradigm.**

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Conclusions

- Development and support paradigm has changed
- Project management is different
- Risks are different
- Frequency of change is significant
- Fielding and acceptance could be main cost driver
- Understanding the market is essential
- Present procurement approaches are incompatible

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For Additional Information

Michael Looney
Senior Research Fellow
Department of Information Systems
Burnaby Terrace
1-8 Burnaby Road
Portsmouth PO1 3AE

Tel. 023 9284 6407
E-mail: looney@which.net