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All you ever needed to know about

Product Development

and were too shy to ask

Professor Baback Yazdani

4th November, 2008

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Thought for the day:

Product Development is the key to the success, prosperity and long-term sustainability of all companies, organisations, and material condition of our lives

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A small mistake in Product Development can cost the reputation of a company

The A-Class Moose Test (1997)

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Mercedes Benz introduced the A-Class in 1997 after a $1.5 Bn Development.

The Swedish magazine, Teknikens Vaerld“ (World of Technique) tested one A-class at 60Km/h, simulating a moose-test, and the car flipped over!

2500 newly-sold cars were recalled

…and sales almost stopped!

Mercedes added stability control (ESP) and redesigned the car's suspension

Cost of Change = $ 250,000,000

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A serious mistake in Product Development can cost the company

Story of Ford Edsel

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- Biggest market research and marketing exercise in automotive history
- Development cost = $400 M (equivalent of $6.7 Bn in 2007)
- Planned to sell 200,000/year
- Sold
  - 58,000 in 1958
  - 16,000 in 1959

Ford Edsel nearly bankrupt
Ford in the late 50s

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Repeated mistakes in Product Development will cost the company

Firestone disaster (2001)

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More than 250 deaths and 700 injuries in the US were as a result of Ford Explorers rolling over after the tread separated on Firestone tyres.

22 May:

Ford to replace **13 M** Firestone tyres and take a **$3 Bn** charge

18 July:

Ford reports **$551M** quarterly loss

1 Aug:

Ford's market share falls by **22%**

17 Aug:

Ford cuts **10%** of its white-collar workers

17 Oct:

First consecutive loss in a decade

30 Oct:

Ford CEO Jacques Nasser resigned

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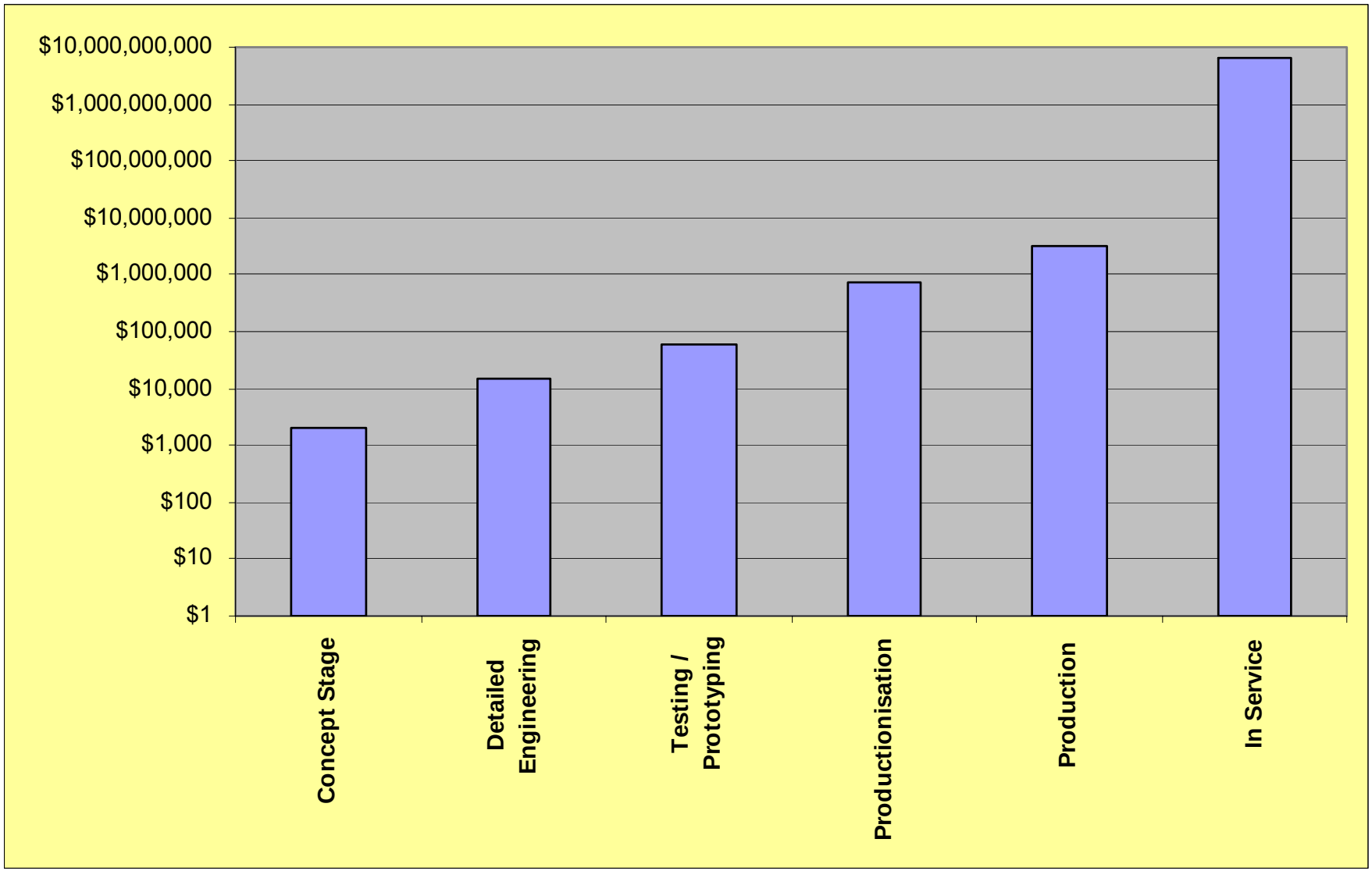
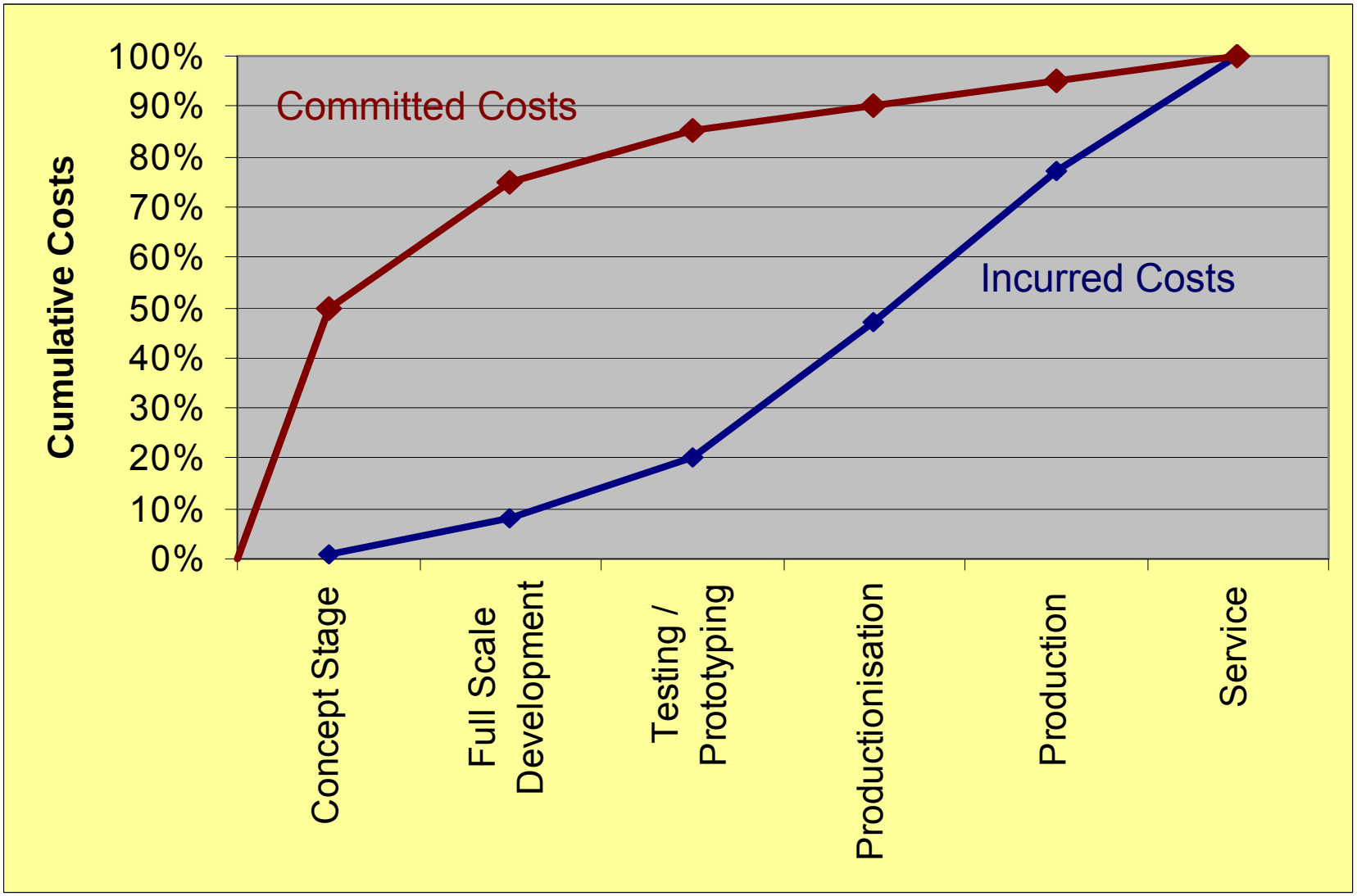
Logarithmic scale plot of cost of change to fix the Firestone problem



Product Development determines the outcome



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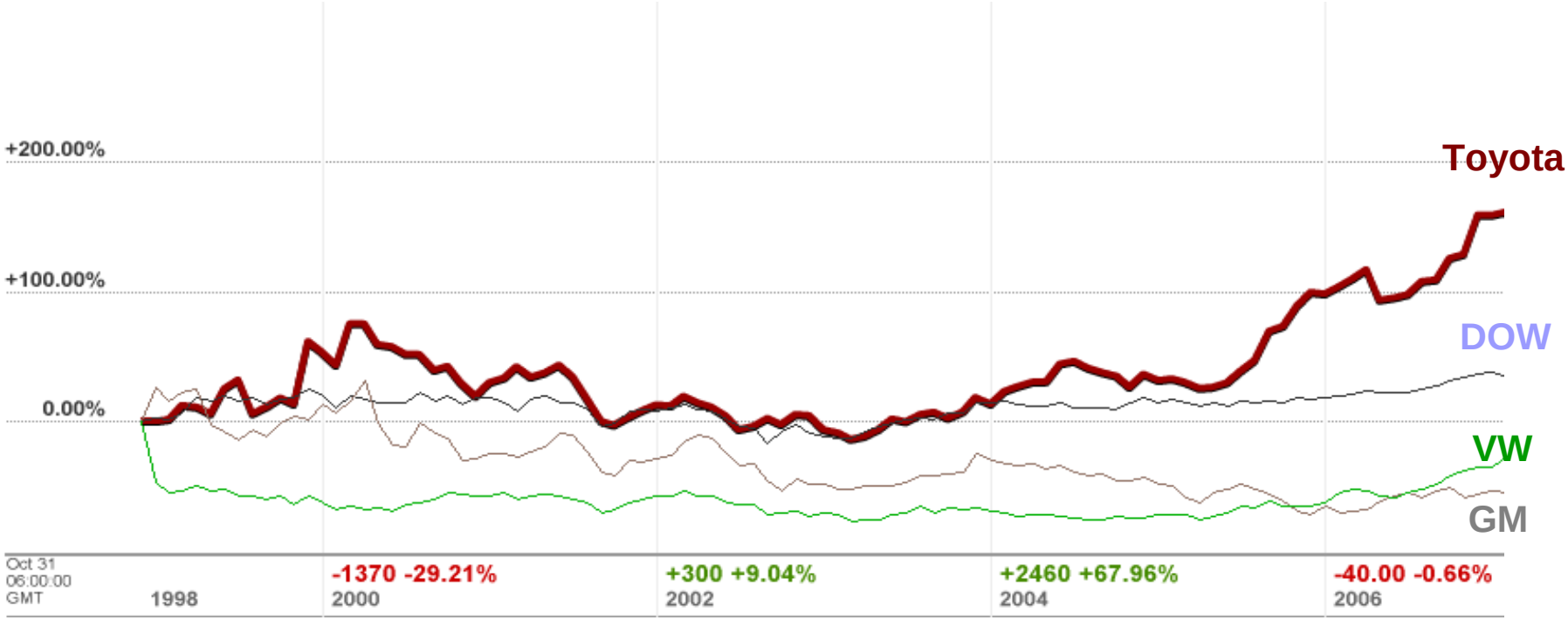
Superior capability in Product Development will renew the company and increase its profits over time

Toyota's PD capability gives it long-term advantage



- Toyota's Programme costs have been consistently 50-75% of European and US car makers
- Toyota's PD lead times are nearly half those of European and US car makers
- Toyota's Product Quality has consistently been at the top of JD Powers Quality Metrics

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Sector classification

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Risk \ Complexity	High	Low
High	Aerospace Major Construction Automotive	Fashion Textiles Cosmetics Food / Drink
Low	Electronic Products White Goods	Commodities - Paper - Glass - Building Materials

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Terminology

- **Product**

  Something used by a customer or something sold by an enterprise –

  not necessarily physical and discrete

  Aircraft, kettle, components, insurance, bank account, educational programme, training course, ….

- **Product Development**

  Flow of activities from identification of market need to production and use of product

- **Design**

  Execution of ideas, manifest in plans to deliver it

One of four fundamental processes in business

1. Product Development
2. Product Delivery
3. Planning, Execution, and Control: Management
4. Learning

5. Support and Supply

Triangle of compromise

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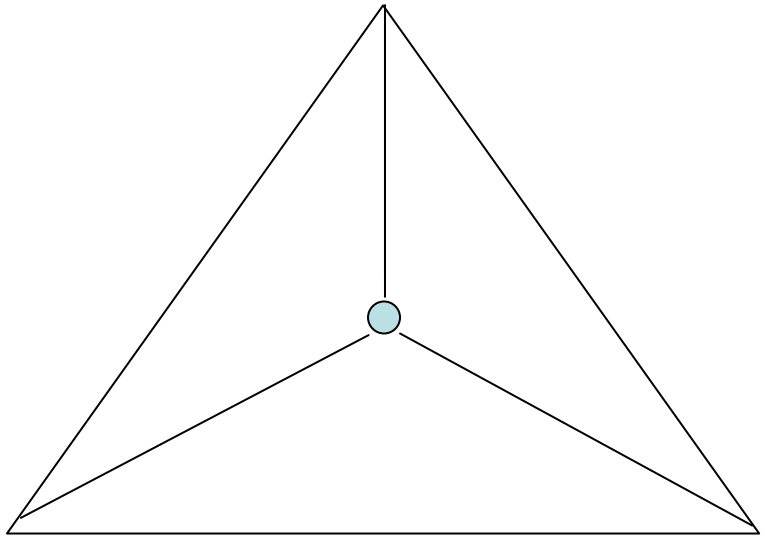
Time



Cost

Quality

I/O of Product Development

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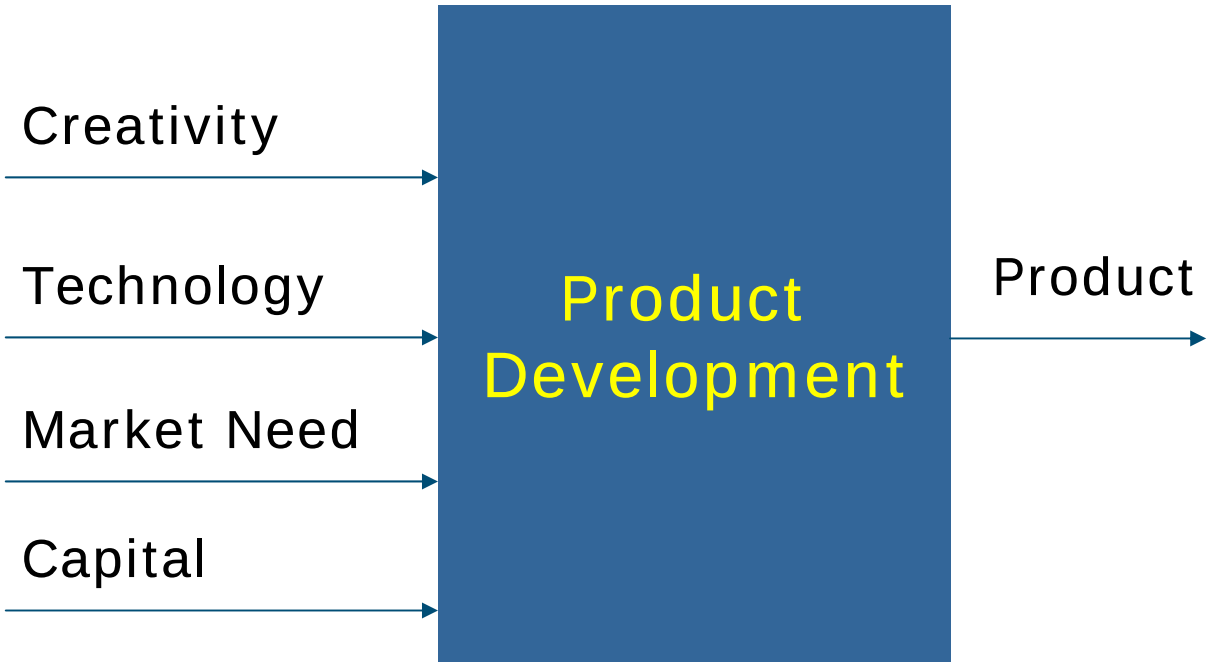

Further decomposition

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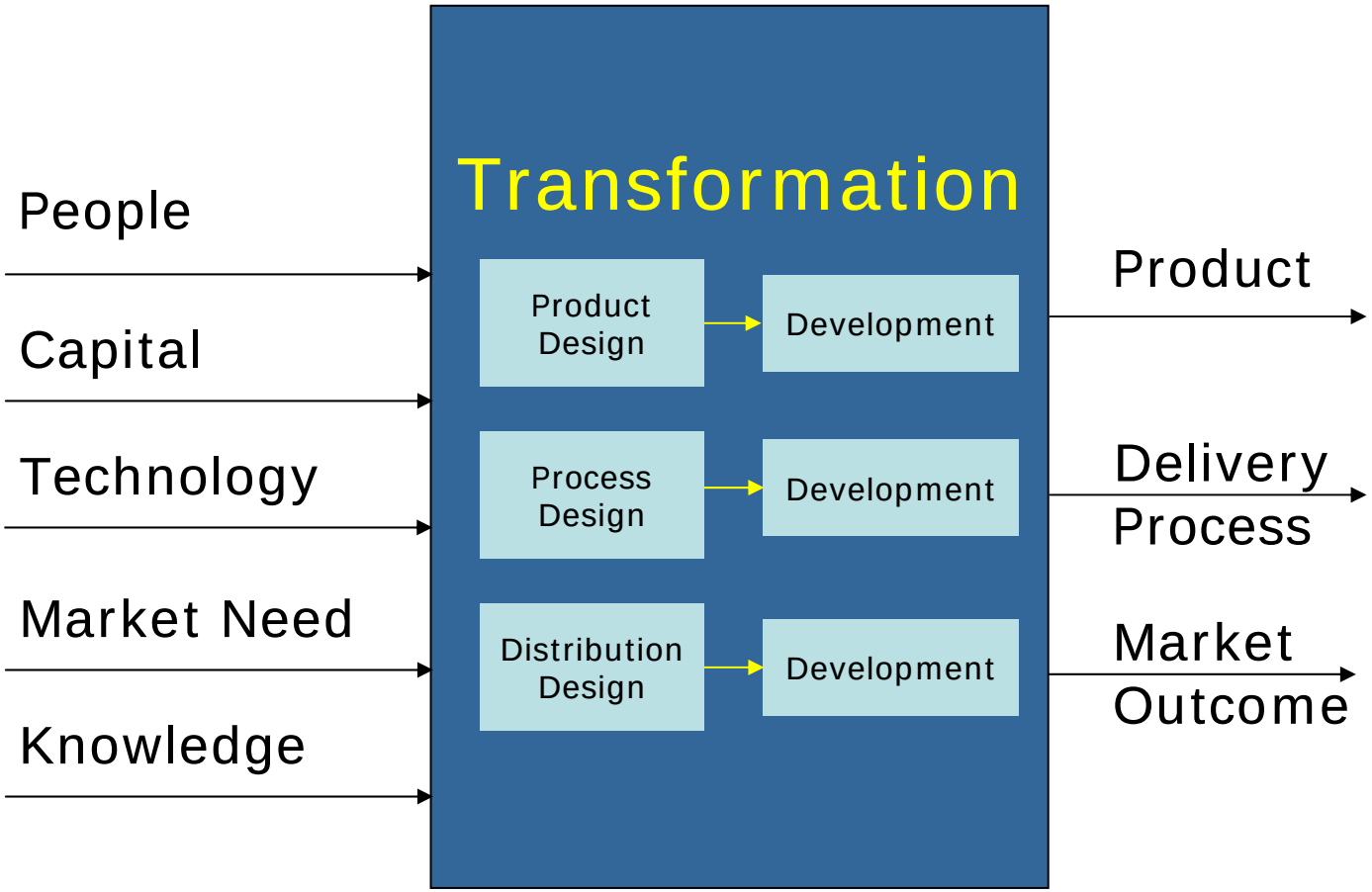

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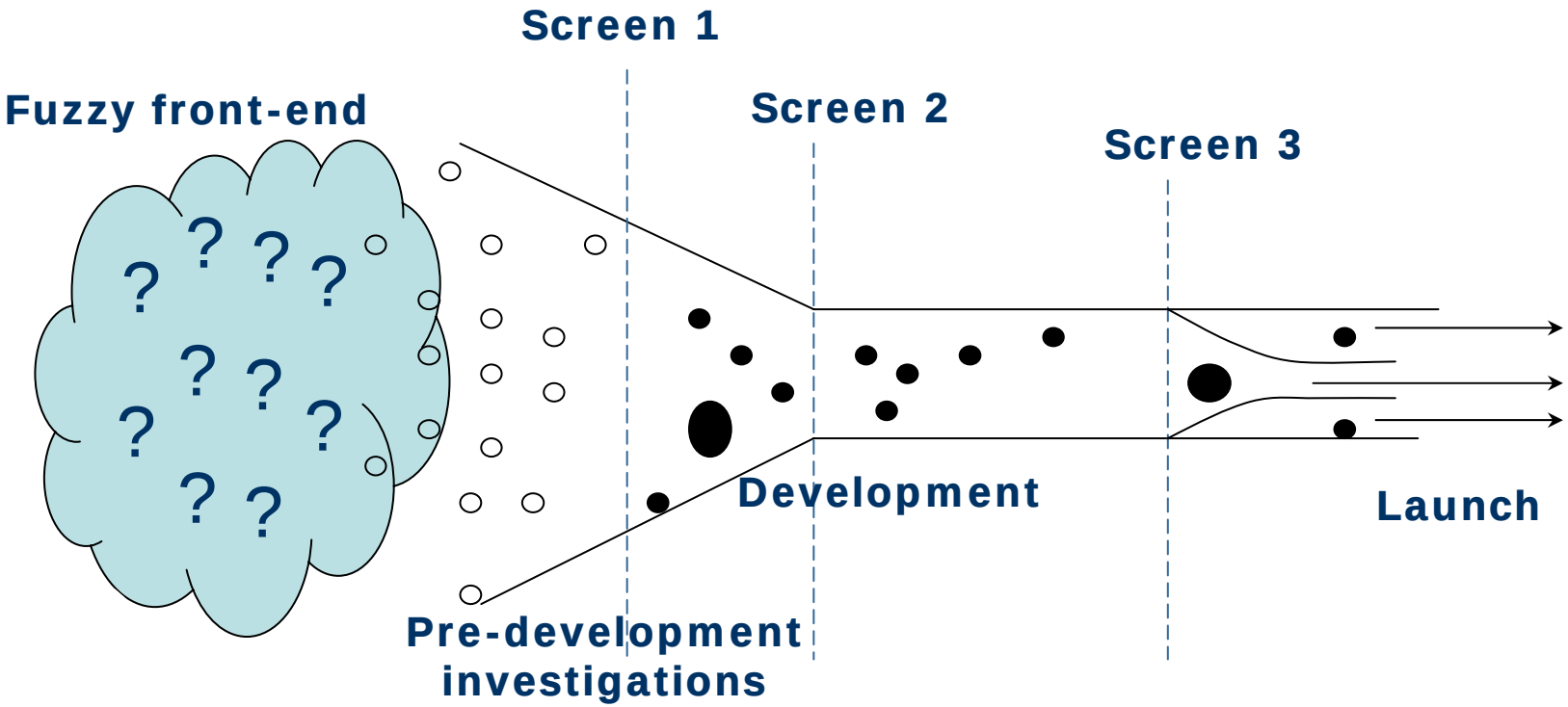
Fuzzy front-end and development funnels



Generic Product Development process

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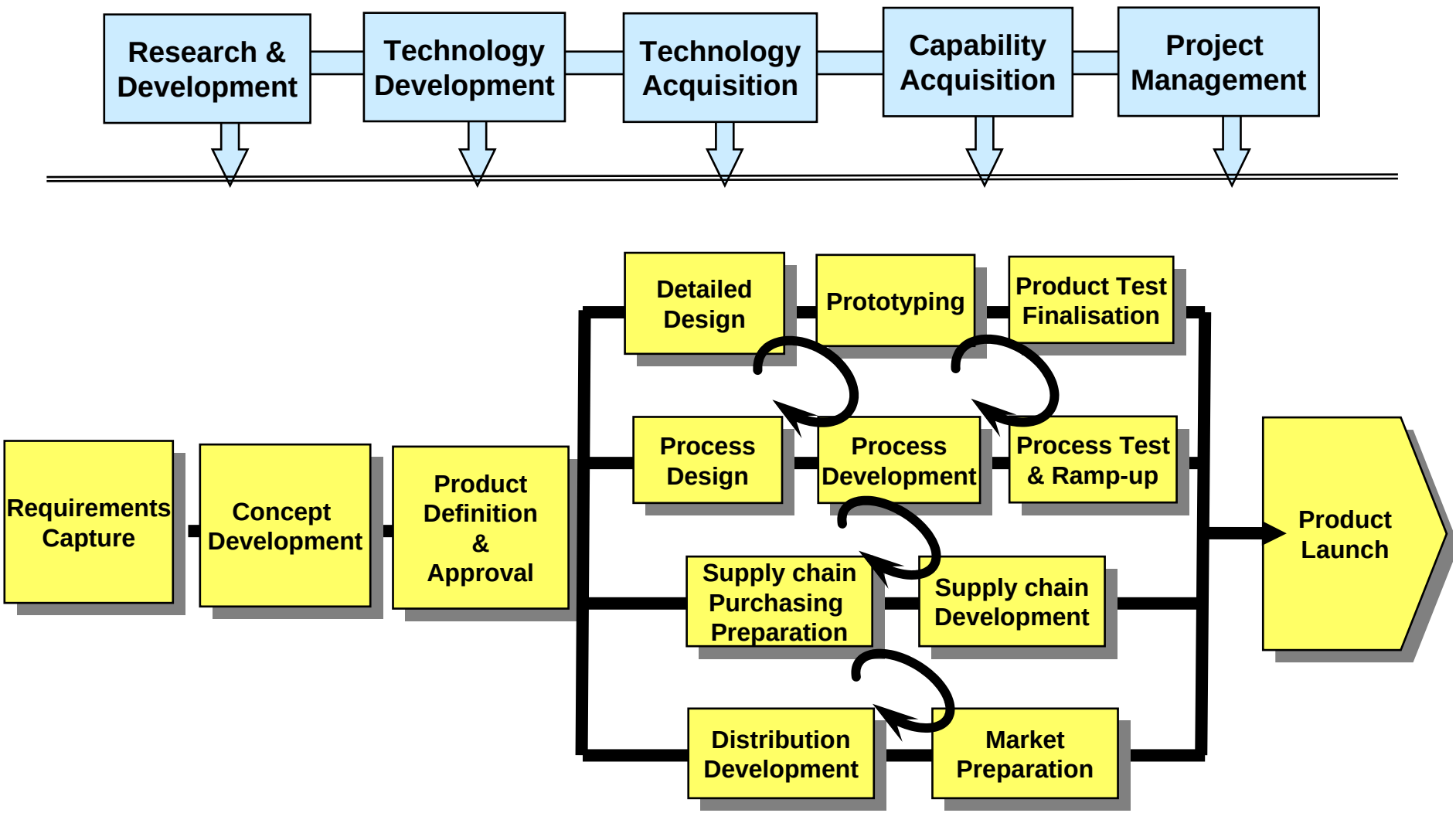

Product Development cash flow

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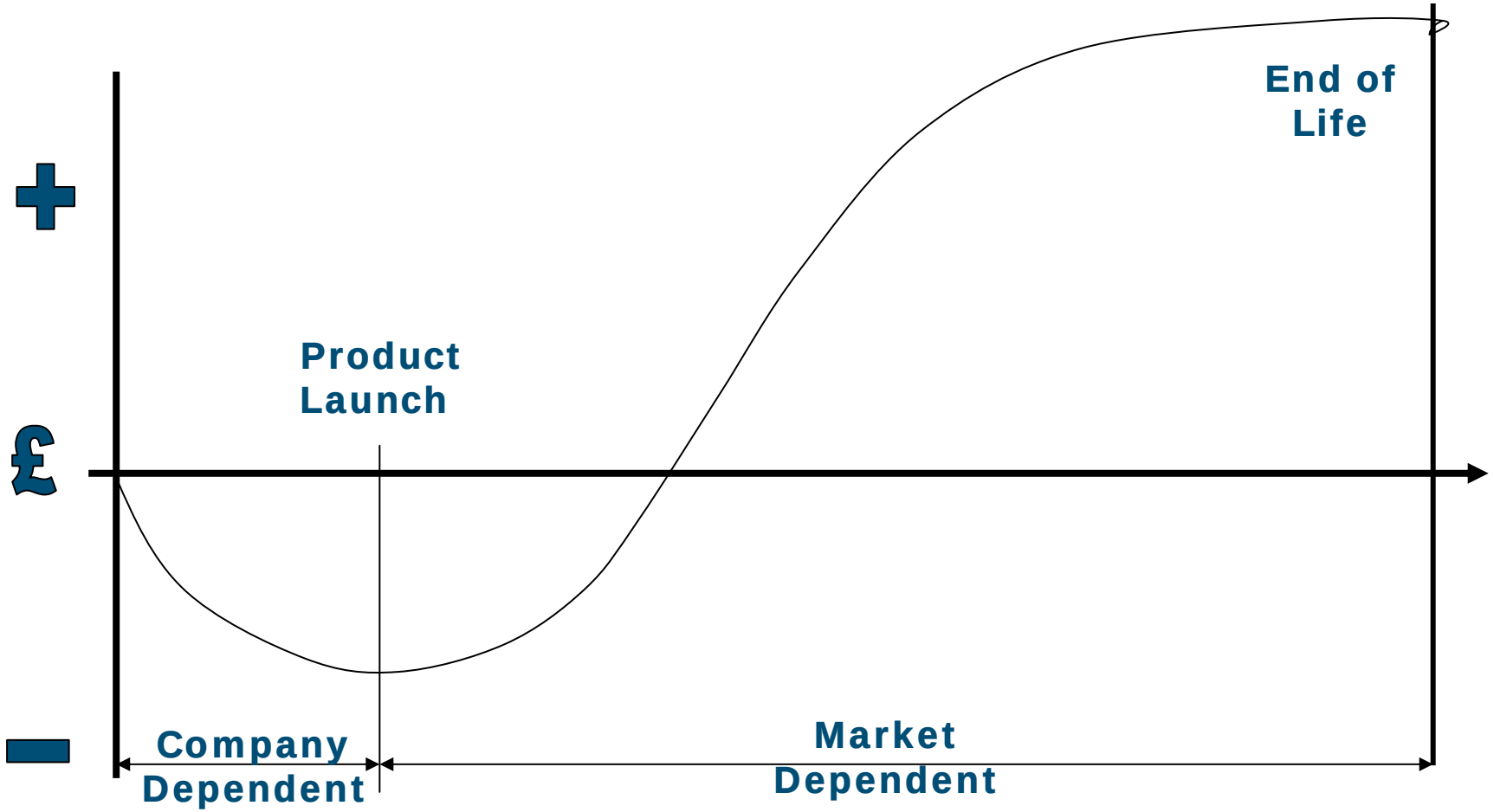

Product life-cycle

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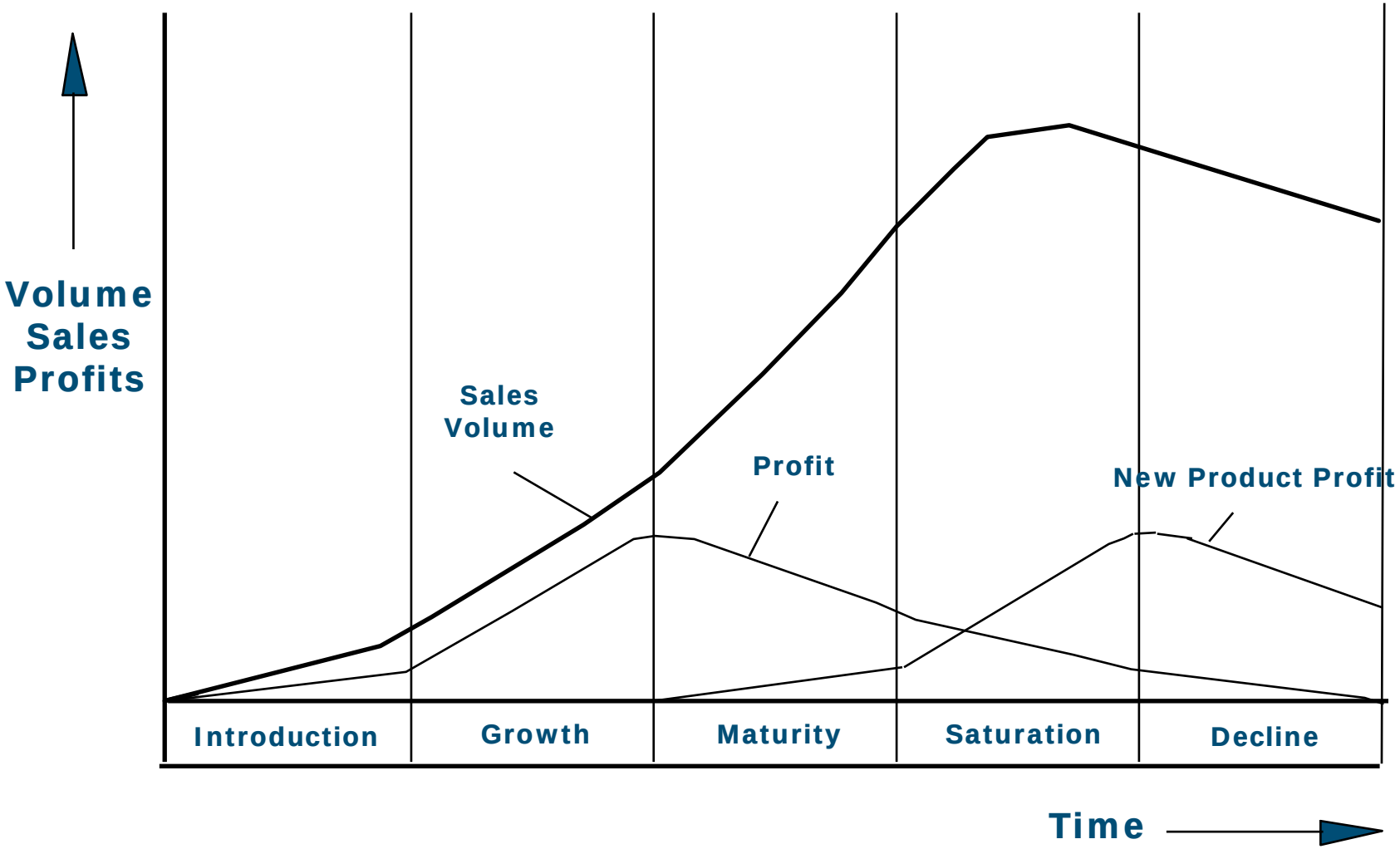

Smith and Reinertsen's work

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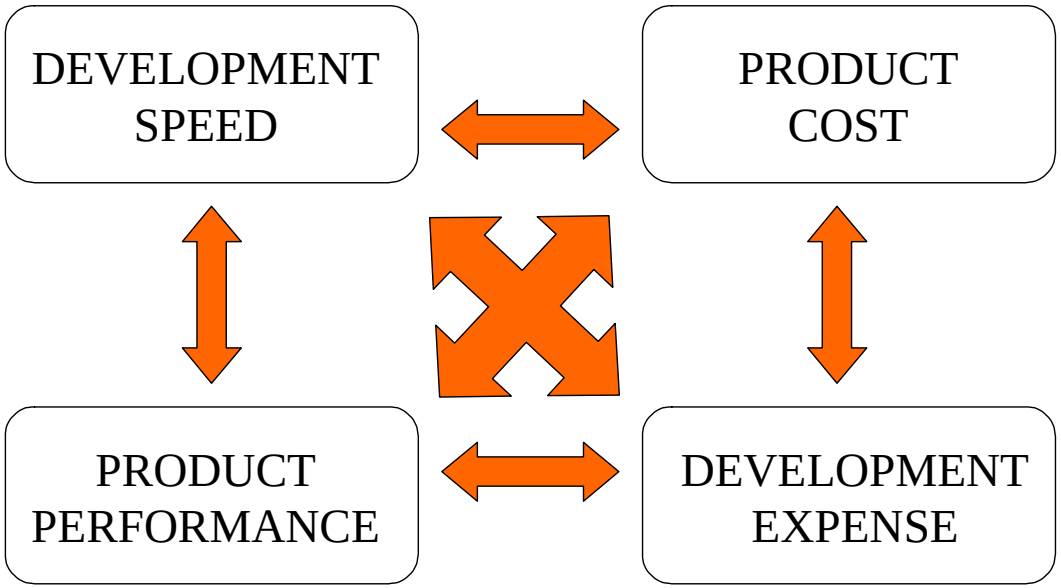
The Four Economic Objectives



Smith and Reinertsen's work

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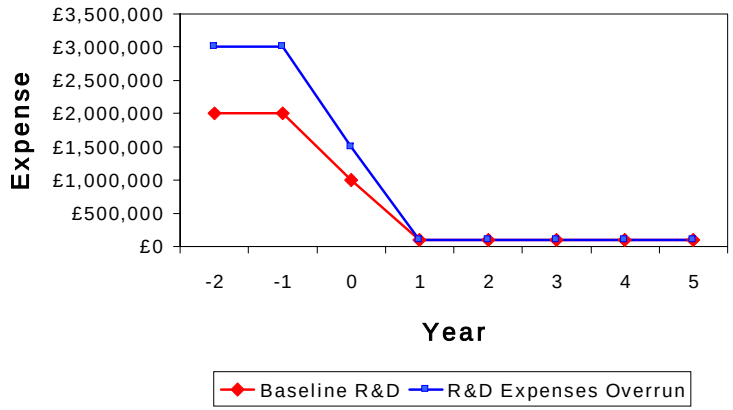
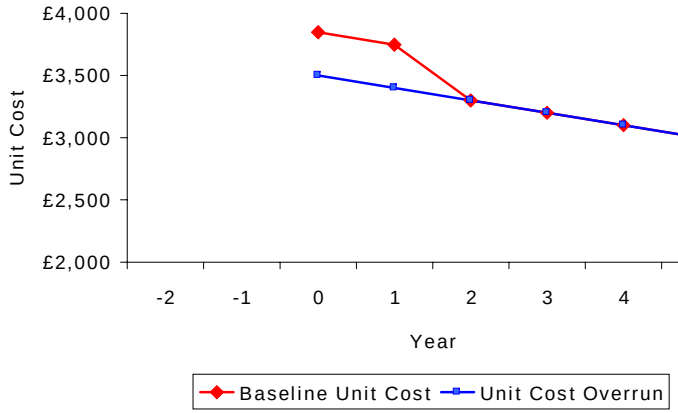
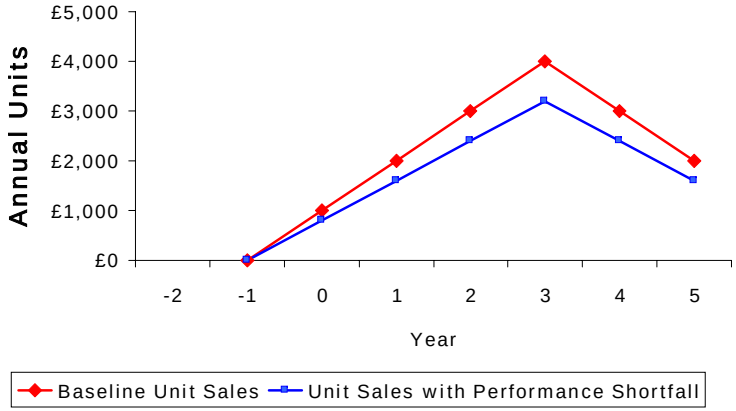
Expense Overrun



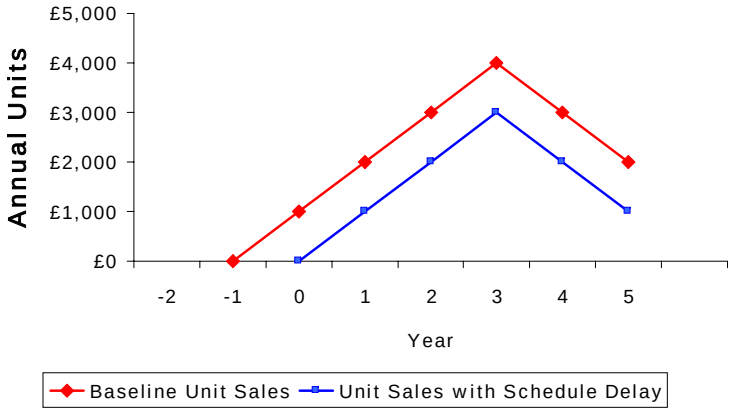
Cost Overrun



Performance Shortfall



Schedule Delay



Product life-cycle pressures

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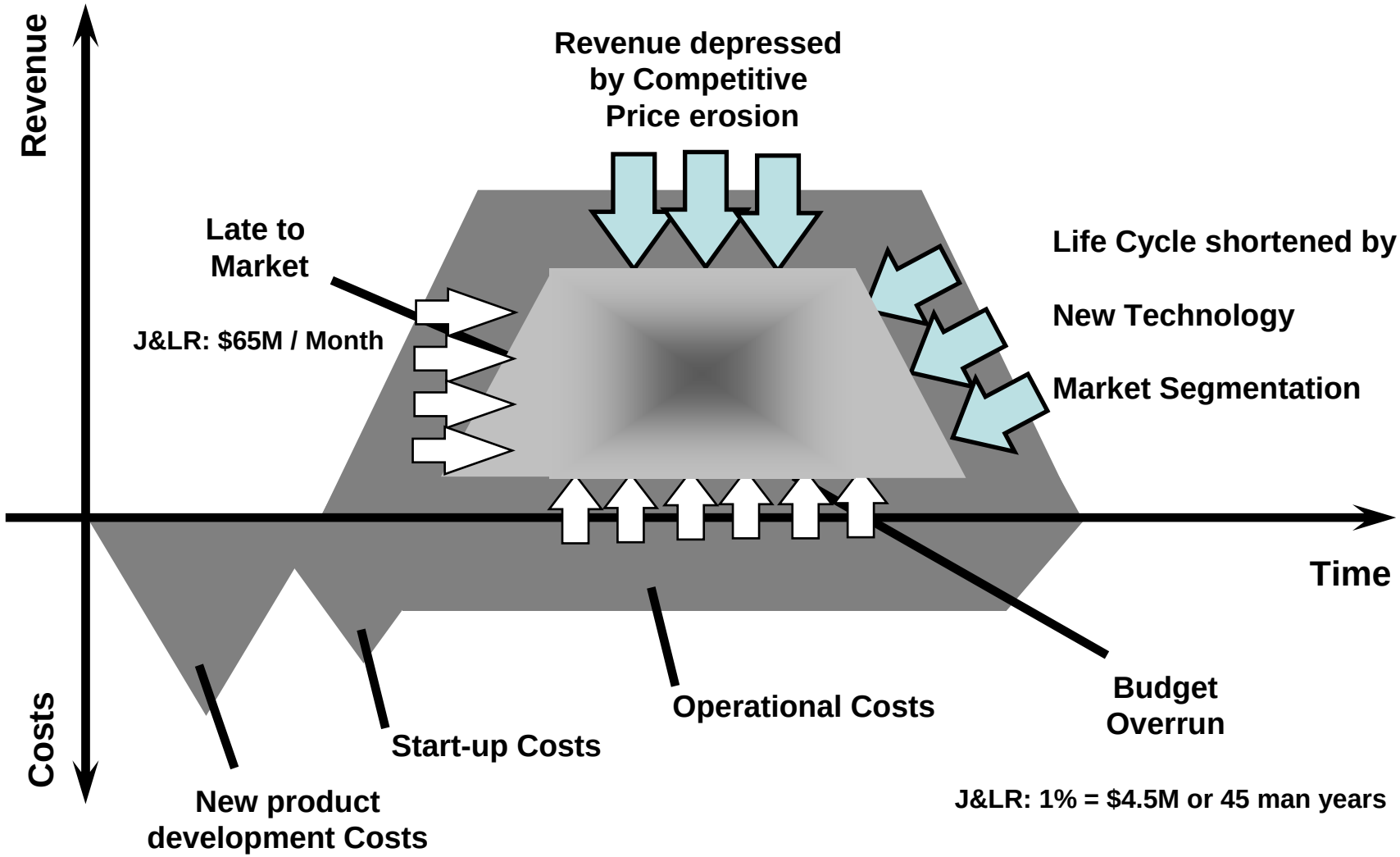
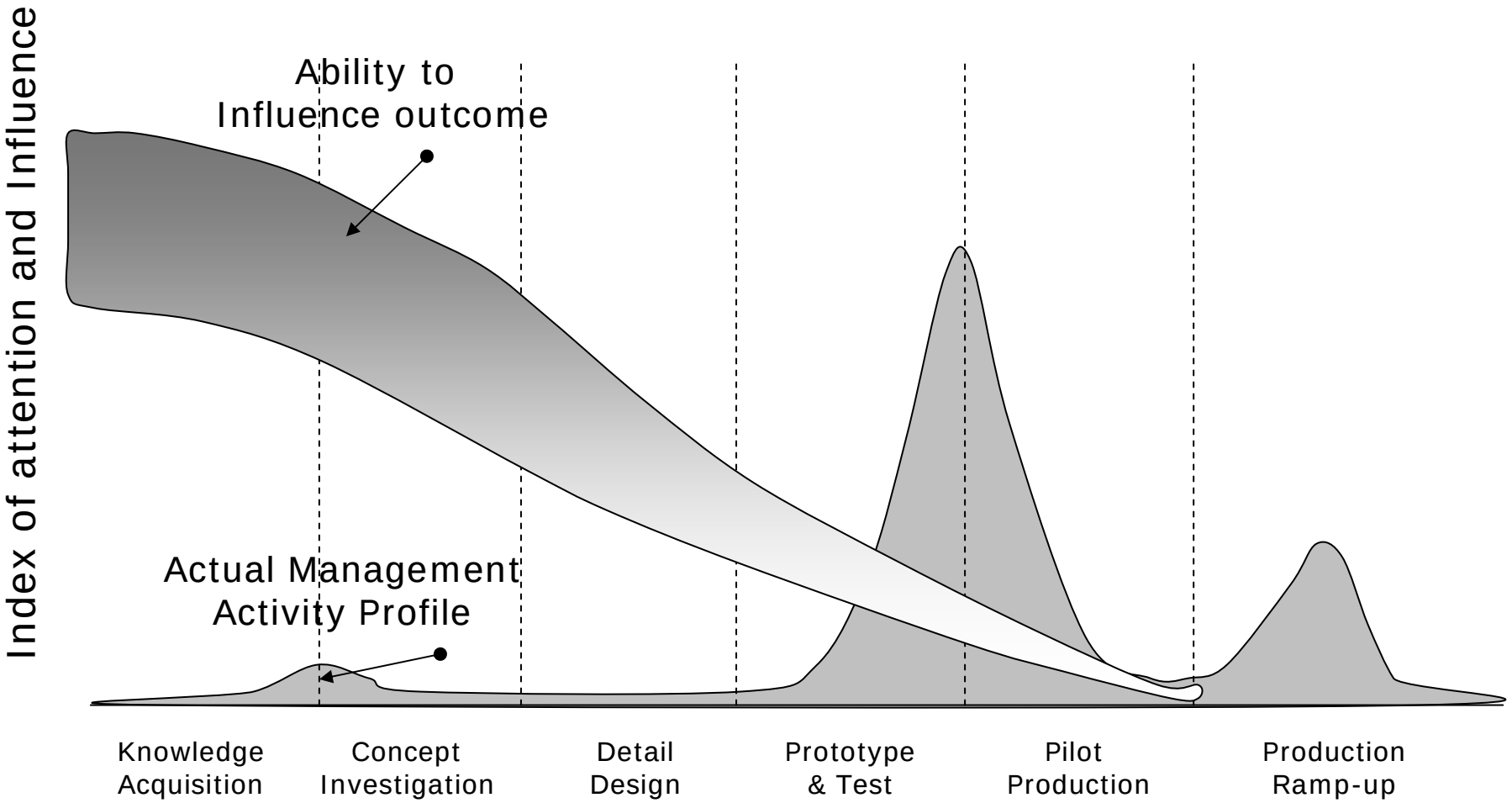


Timing and impact of management attention and influence



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Major developments in industrial management

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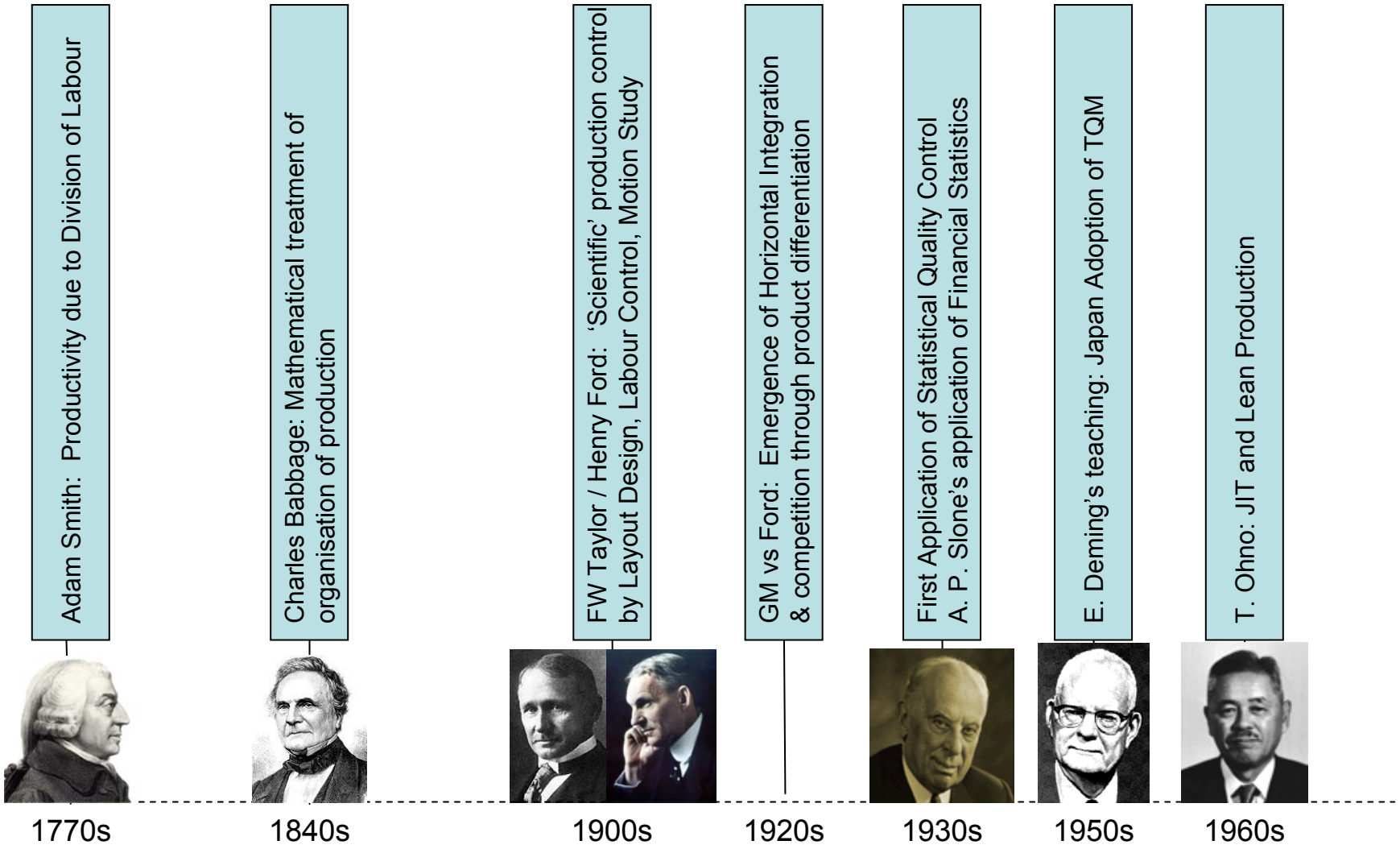
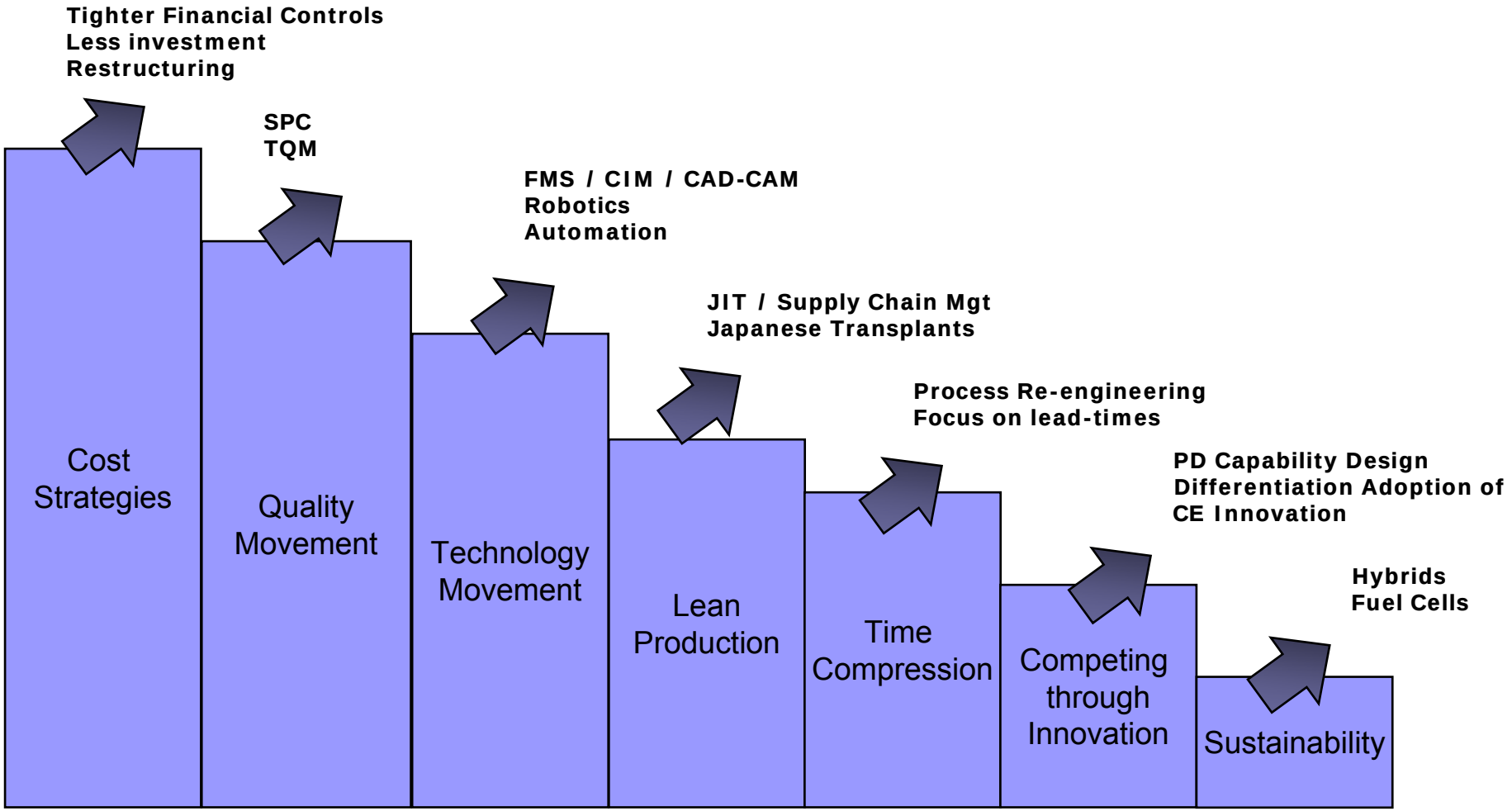


Development of business strategies in AI



Automotive industry

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- An industry over 100 years old
- One of world's largest industries
- Turn over of $1.4+ Trillion a year
- Employing more than 20 Million people

- One of the most organised and complex
- Innovator of industrial management practices

- Over capacity of 20 million units / year
- Intense international competition
- most systemised in Product Development

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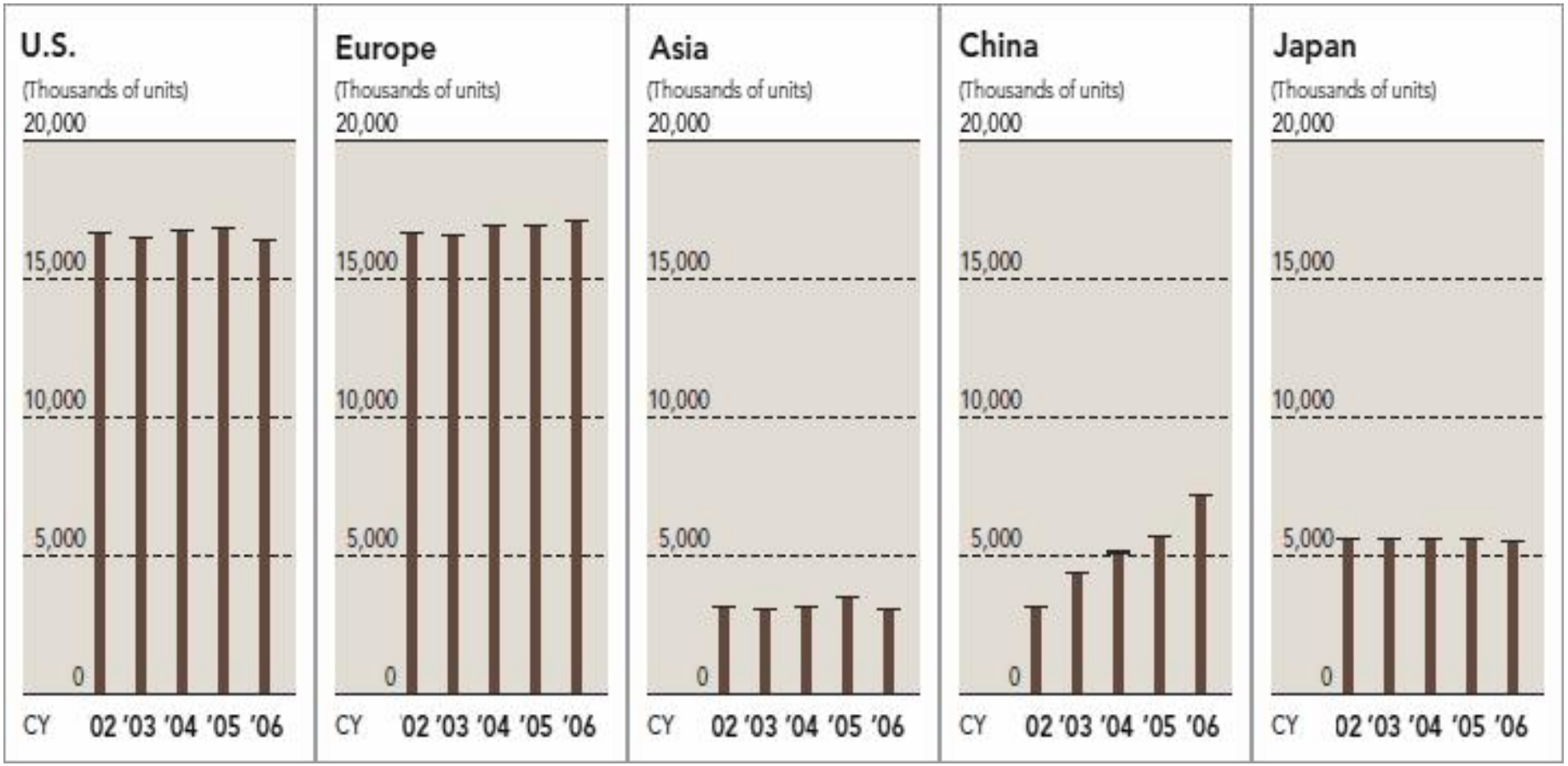
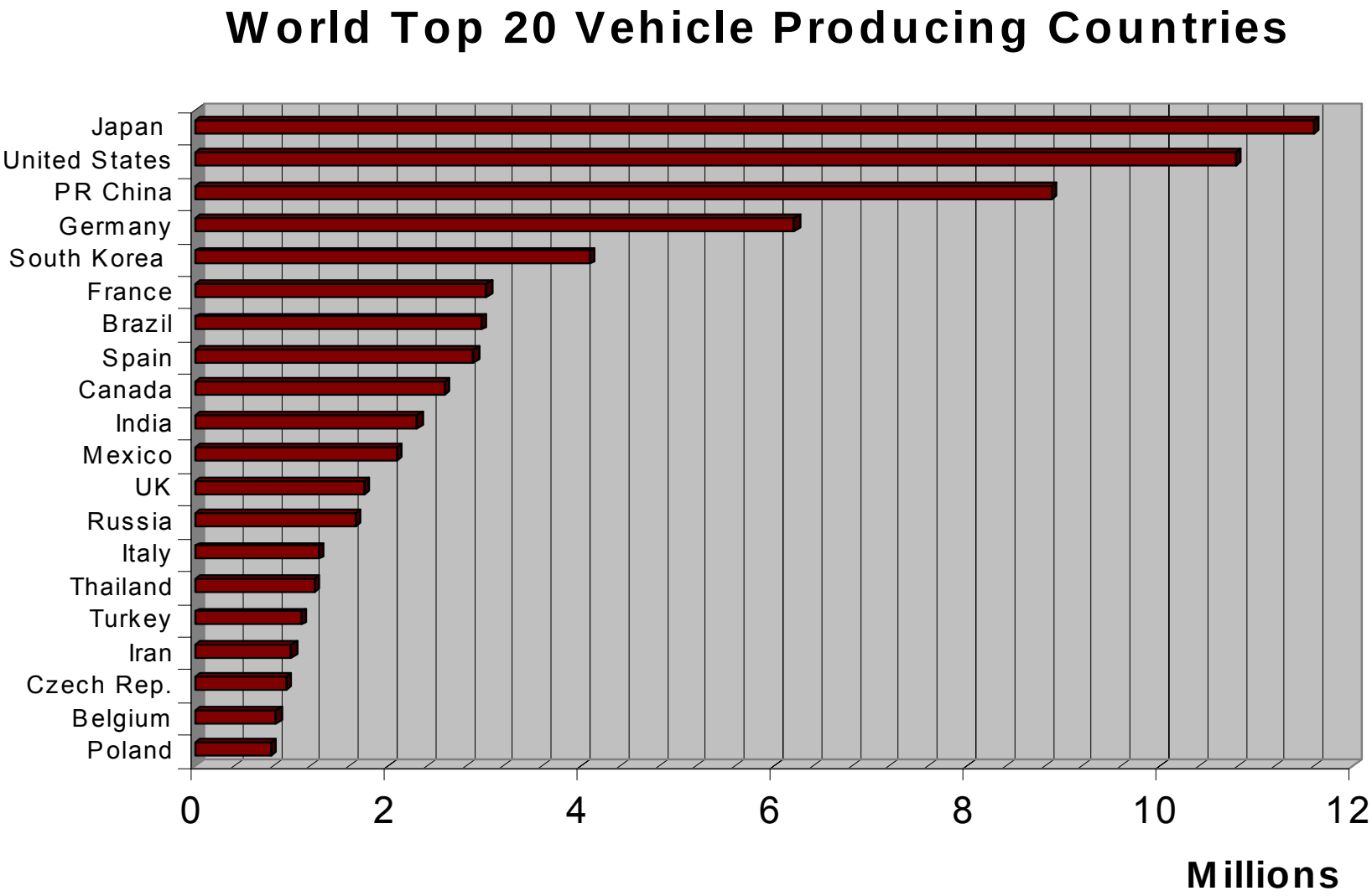
World's major automotive markets (2002-06)



One of world's largest industries (2007)



Top 20 vehicle producers (2007)

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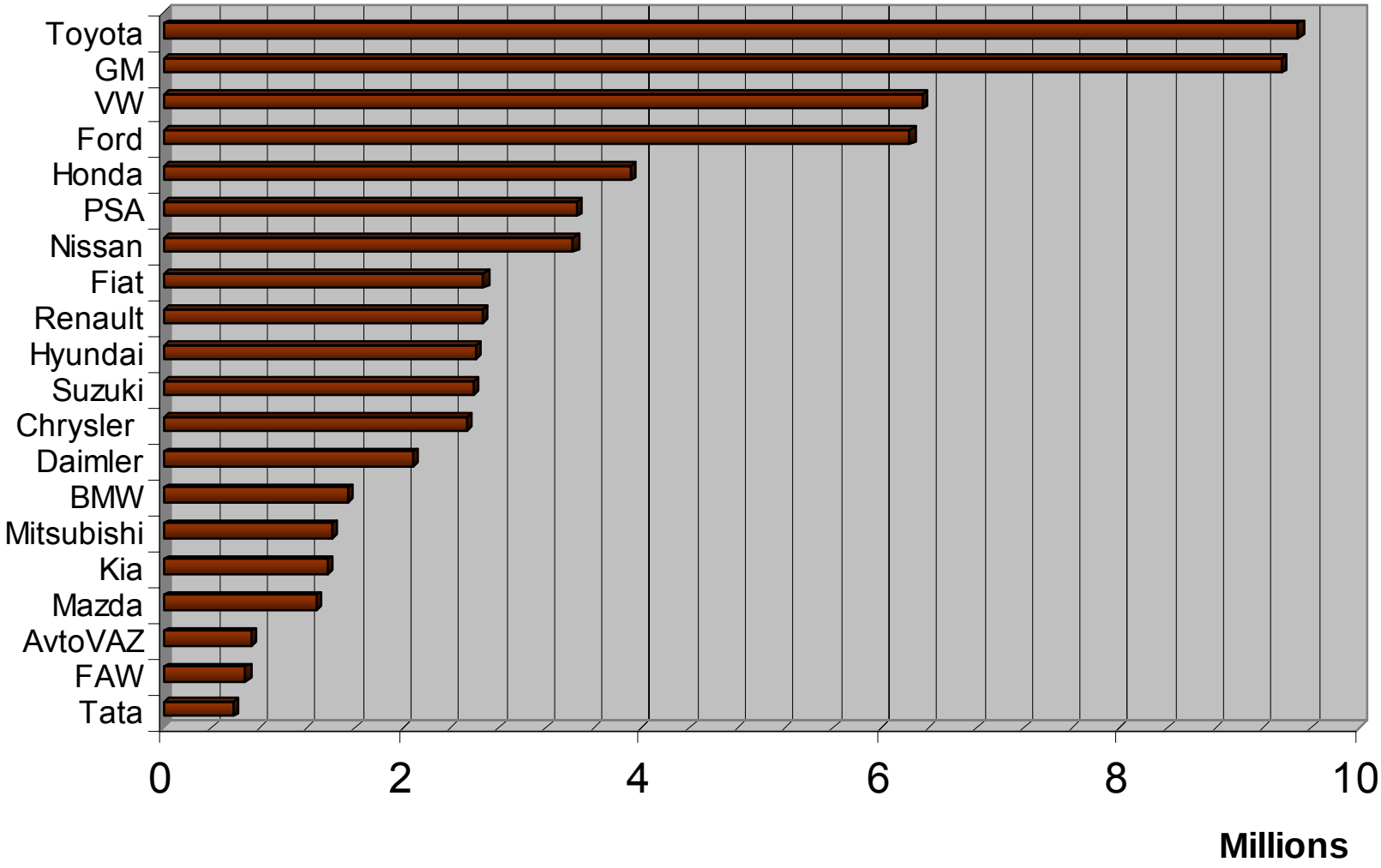

Top 10 automakers' market capitalisation (2007)

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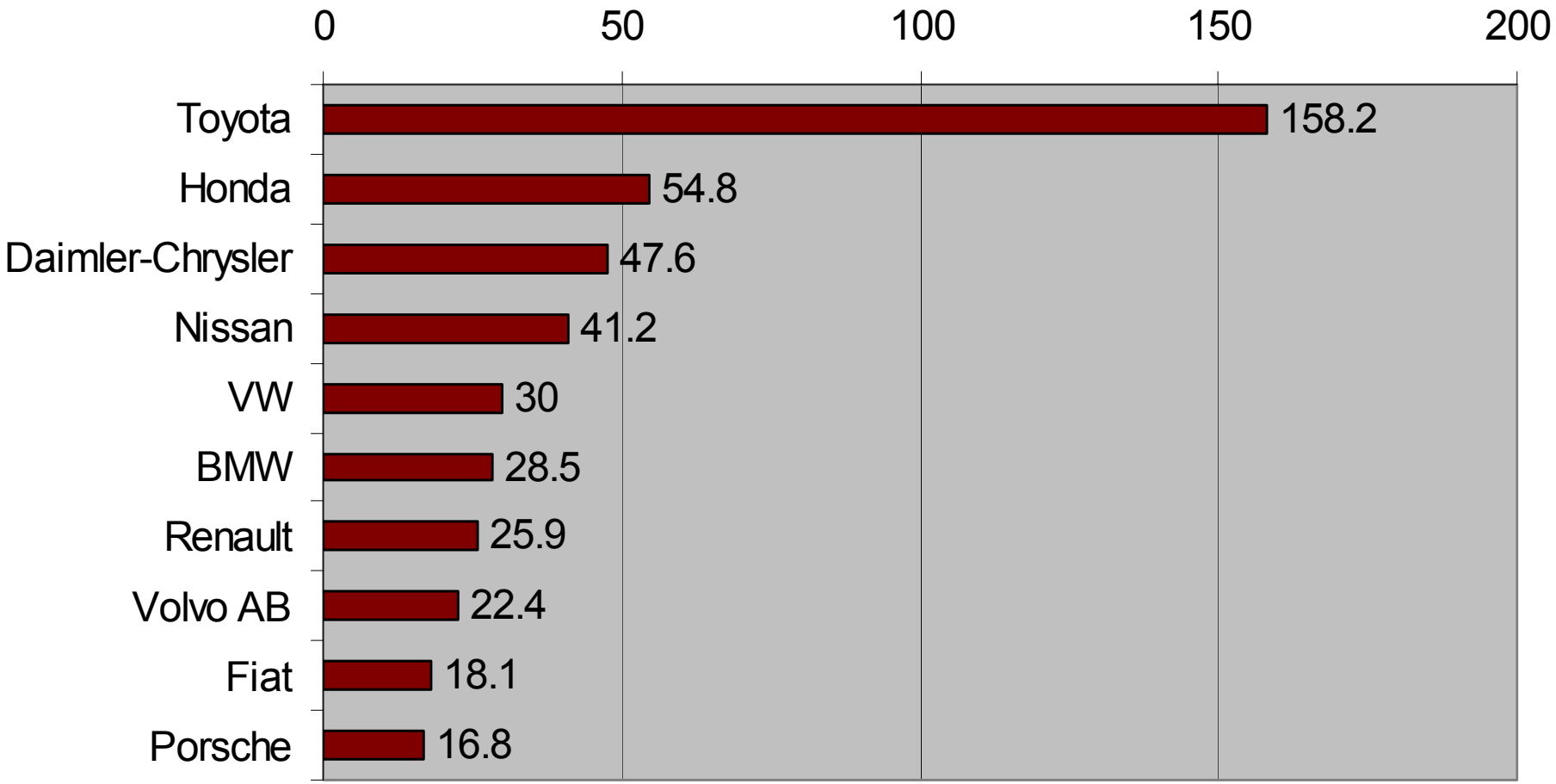
(€ Bns)



Over capacity in global auto industry

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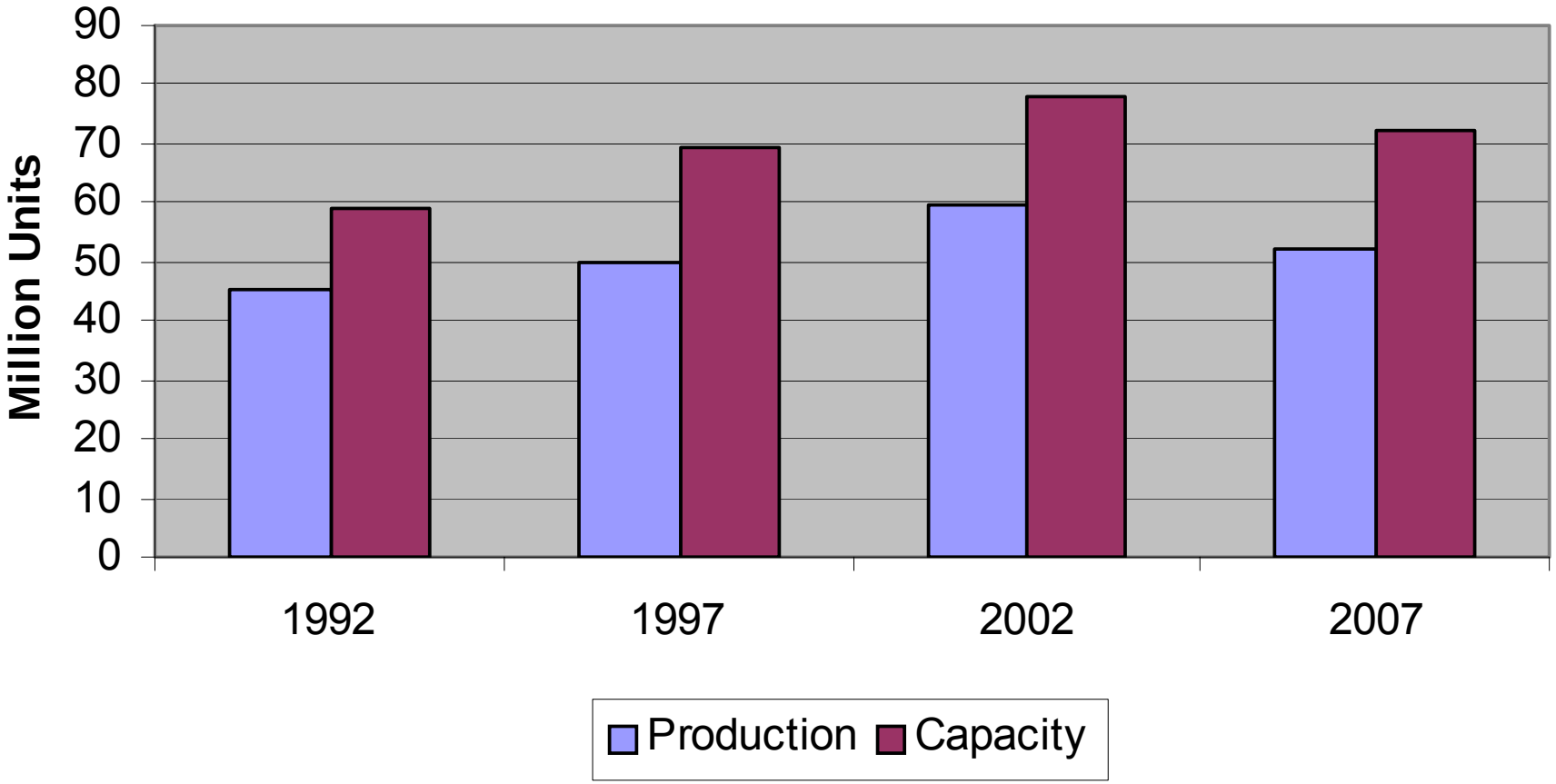
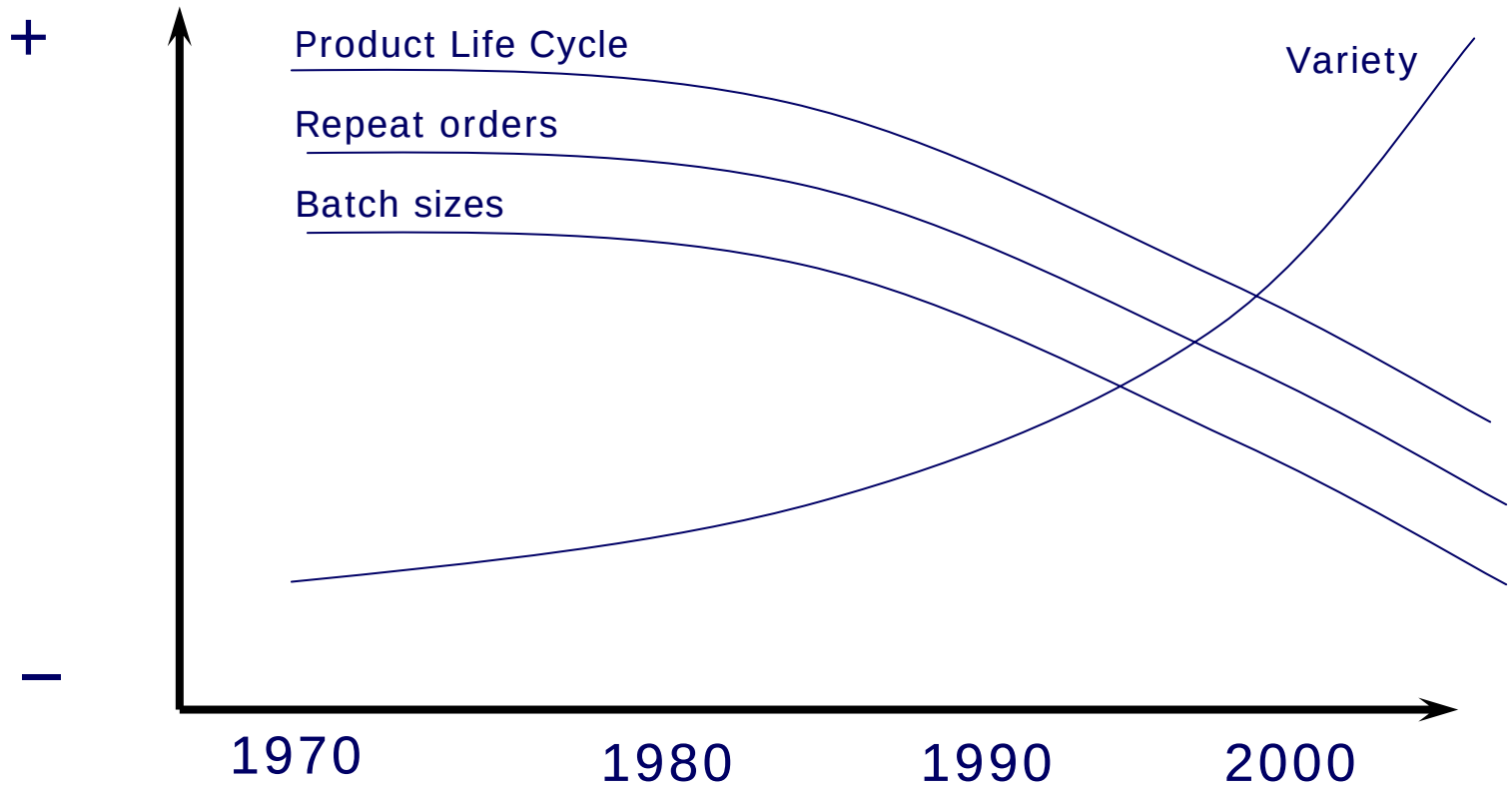


Trends


+
−
Product Life Cycle
Repeat orders
Batch sizes
Variety
1970
1980
1990
2000

Drivers of new product development in AI

1. Environment, fuel prices, sustainability
2. Legislation
3. Intense international competition
4. Extremely sophisticated customers
5. Fragmentation of the markets
6. Inclusion of new technologies

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Vehicle attribute decomposition

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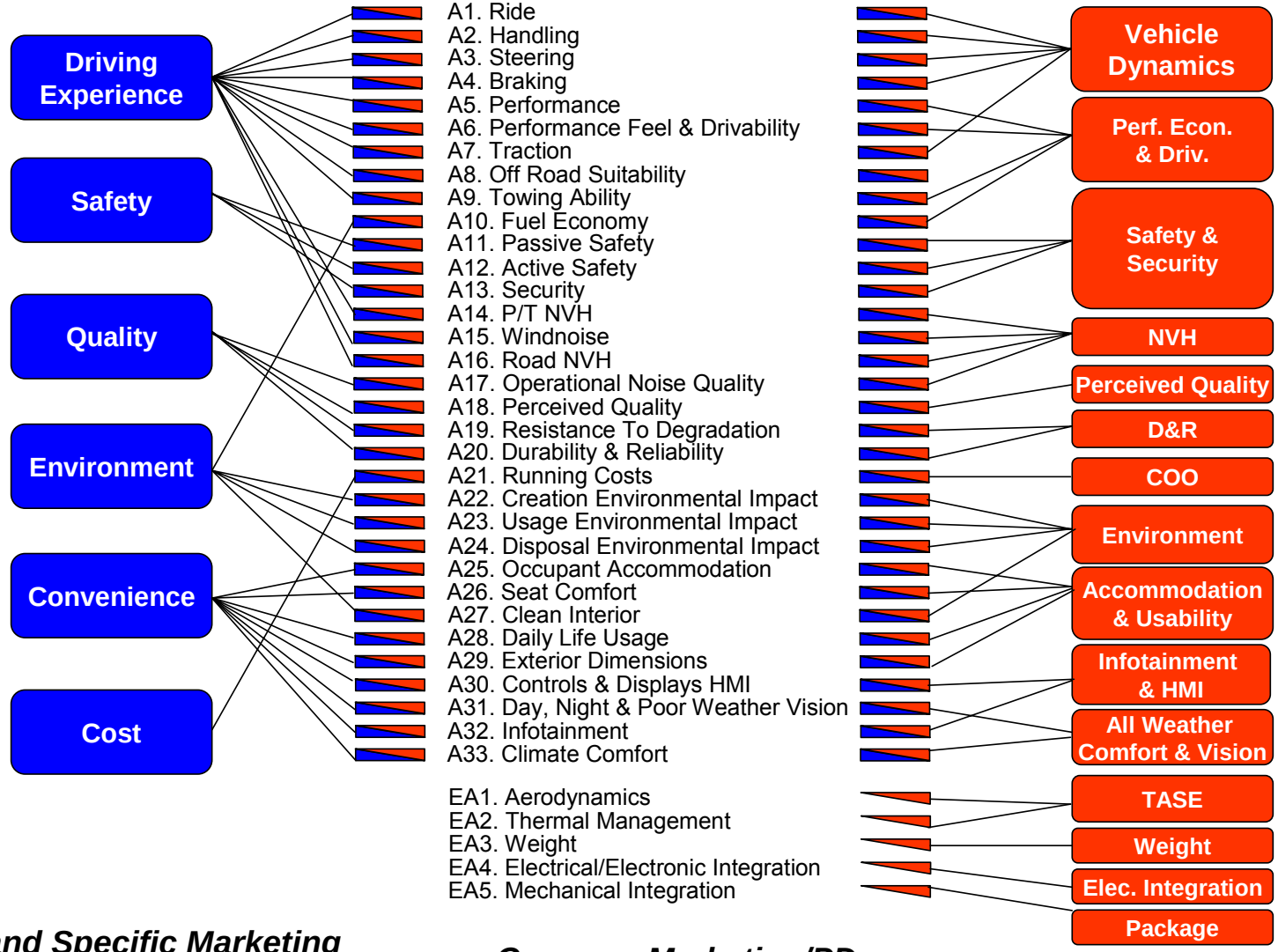
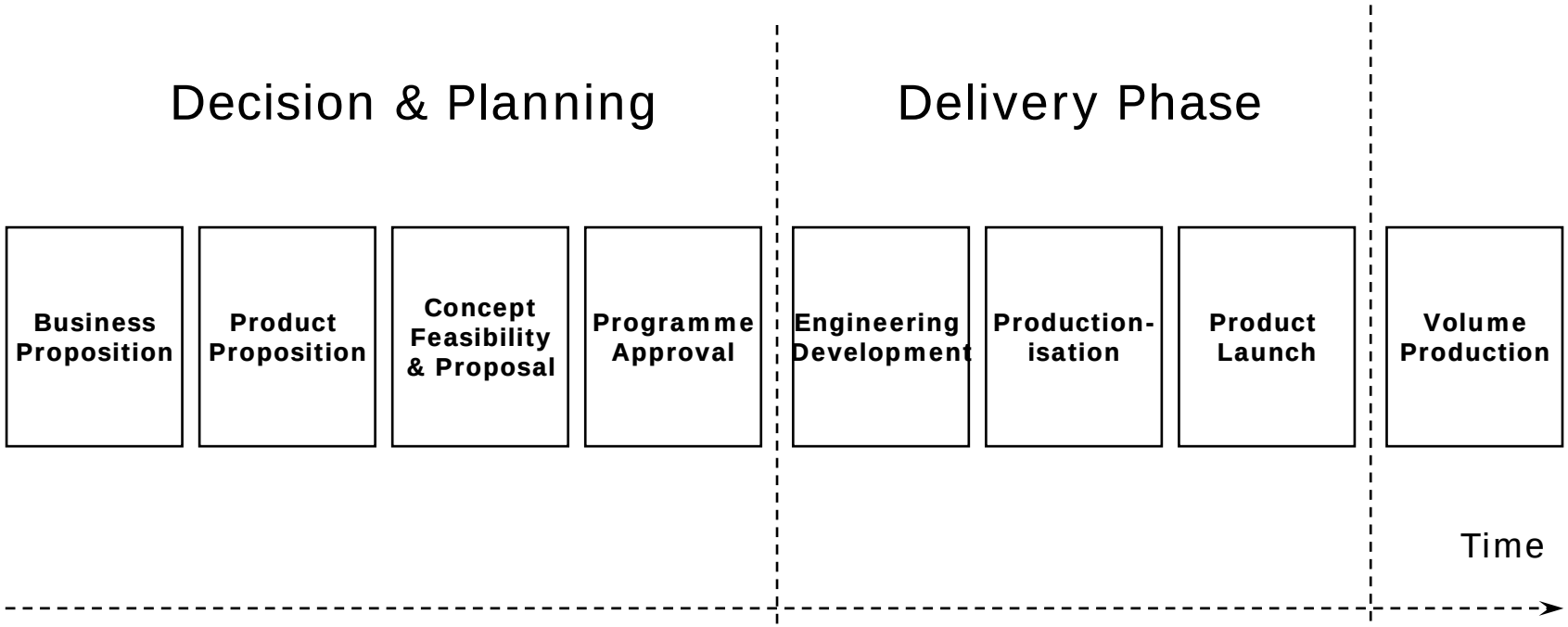


Brand Specific Marketing Level1 Attributes. (Volvo Example)

Common Marketing/PD Level 2 Attributes

Engineering Execution

New model development generic high-level process



Time to market for complete new vehicle

	Time to Market	Design Freeze <ST>
Toyota	38	15
Honda	32	18
Mazda (655)	38	18
Nissan	28	19
Ford/J & LR	51	25
Renault	49	26
DaimlerChrysler	39	28
General Motors	36 (SI)	30

Clarifying the fuzzy front-end of PD

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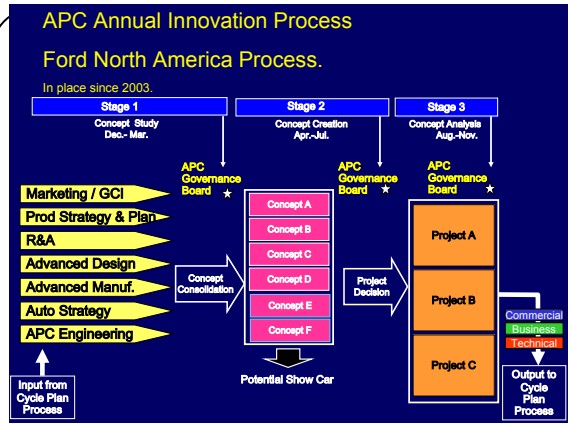
Annual Strategic



- Co-Located Creative X-Functional Team
- Focused On New product Innovation

Year 1 | Year 2 | Year 3

Commercial | Commercial | Commercial

Business | Business | Business

Technical | Technical | Technical

Annual Process Total Cycle Plan

Platform/Programme

Serial Development Of Particular Platform Or Vehicle Programme "Can Use"

PS- 6

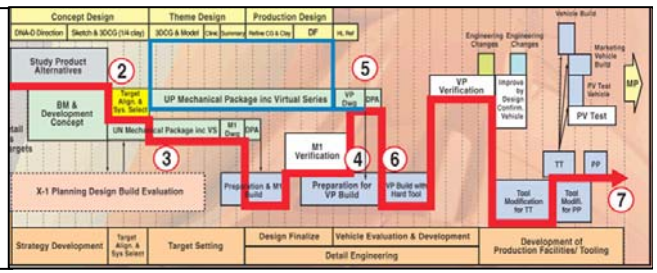
PS

Pre-PS Activity

Commercial

Business

Technical



Maximising knowledge and certainty

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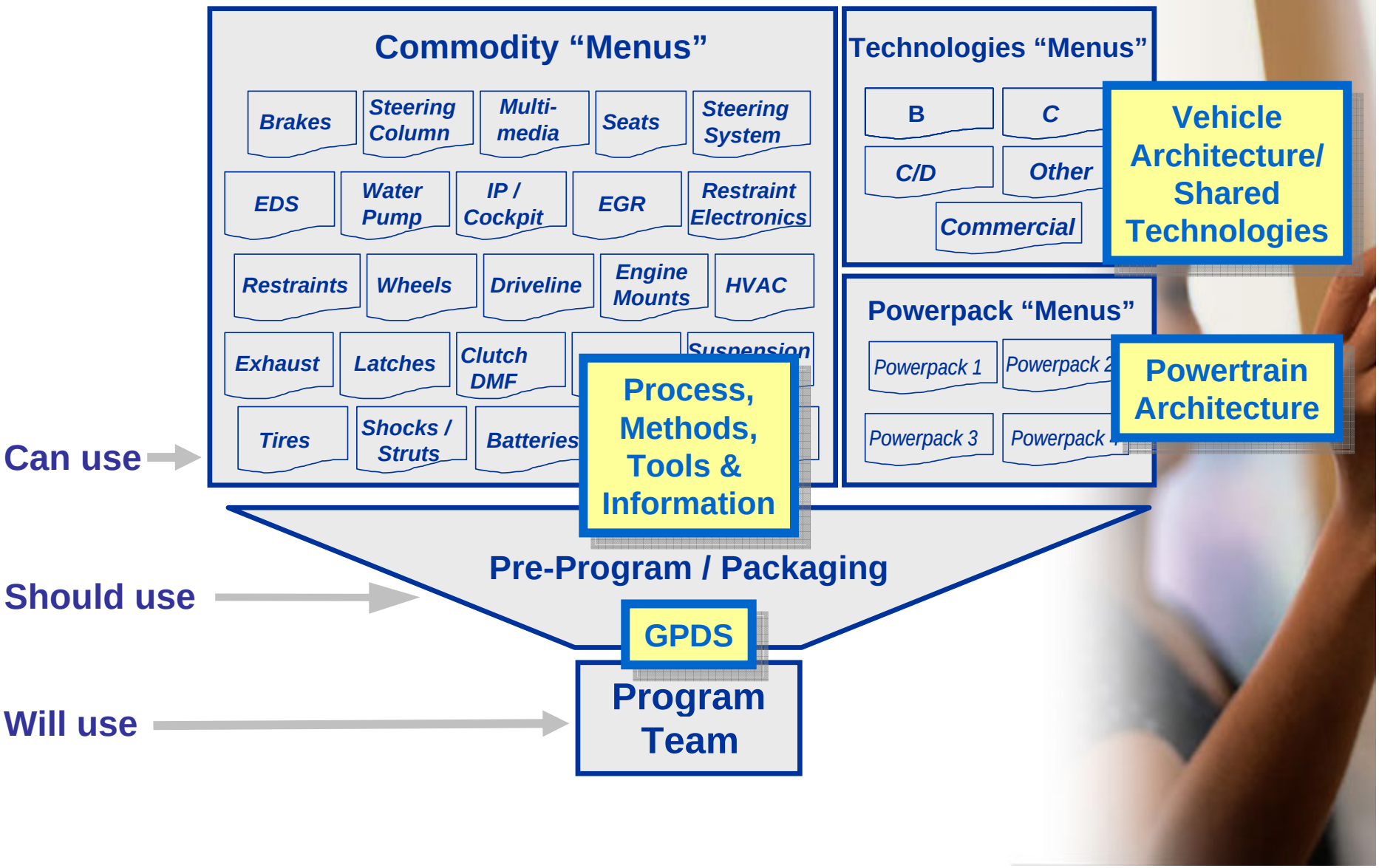

Design engineering & development

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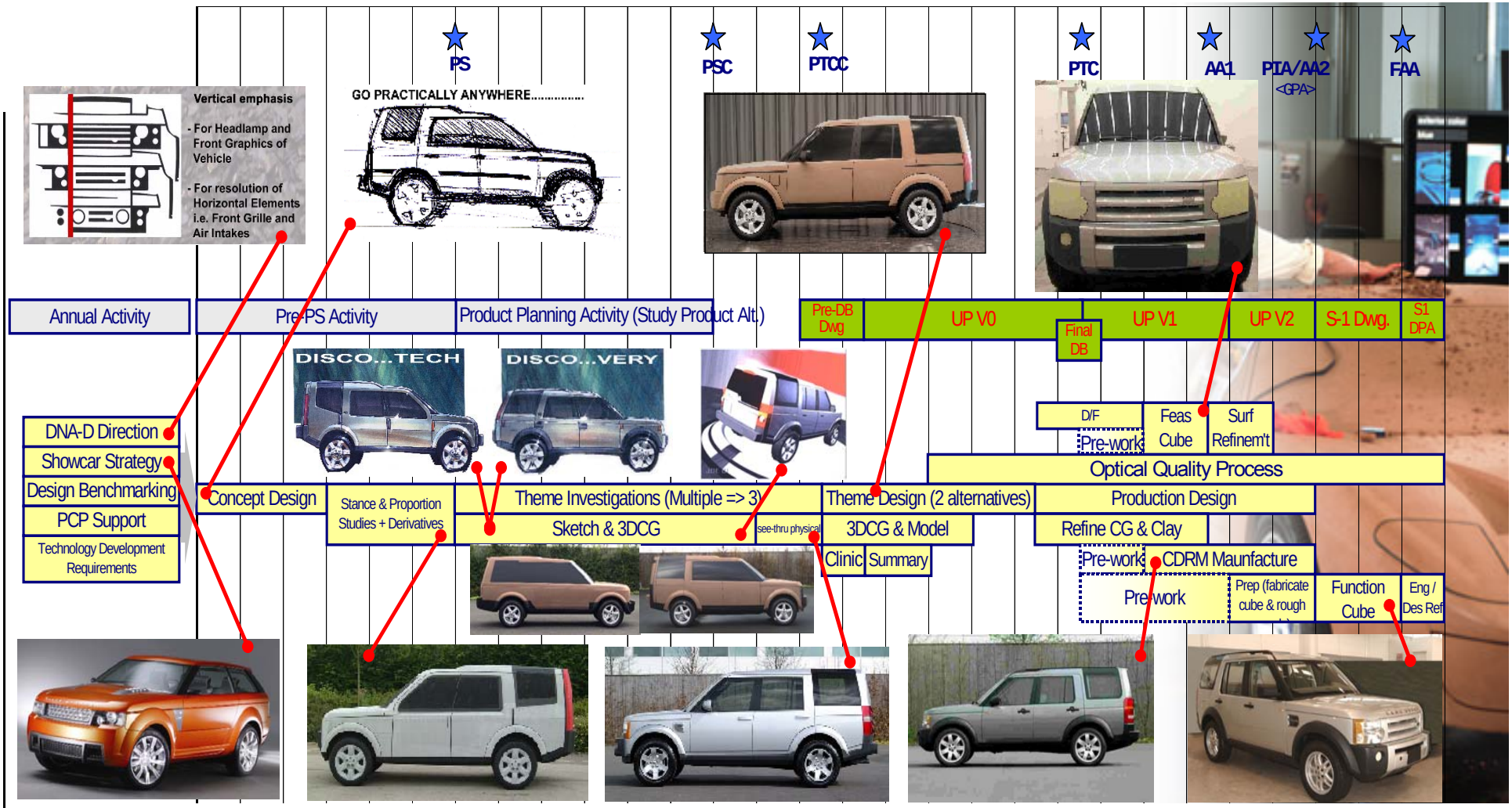

Develop Brand-Specific Aesthetic Design Language

Create ideas and concepts to anticipate future Consumer requirements

Design program exterior, interior, and under-the-hood and create CAD geometry

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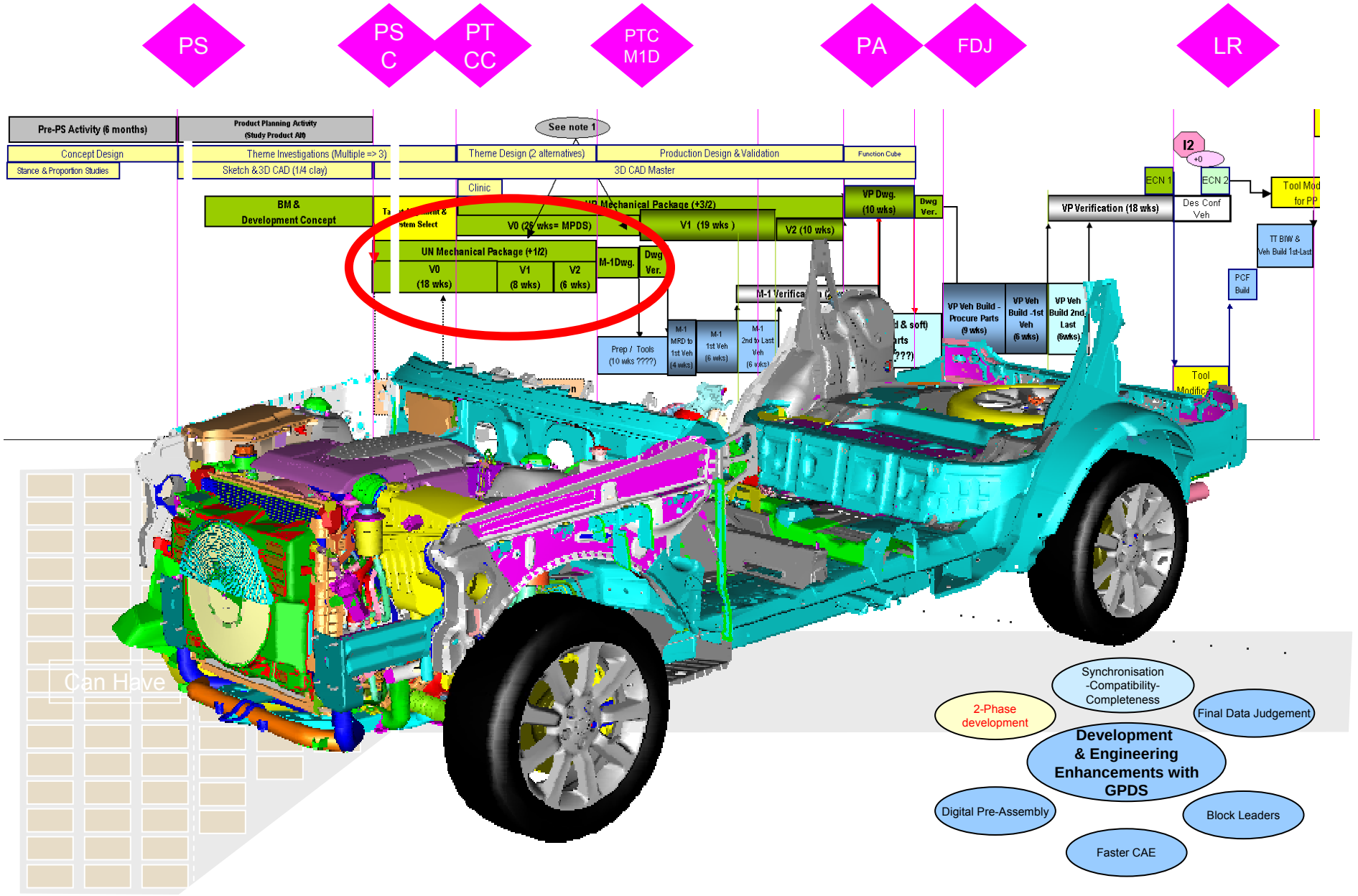

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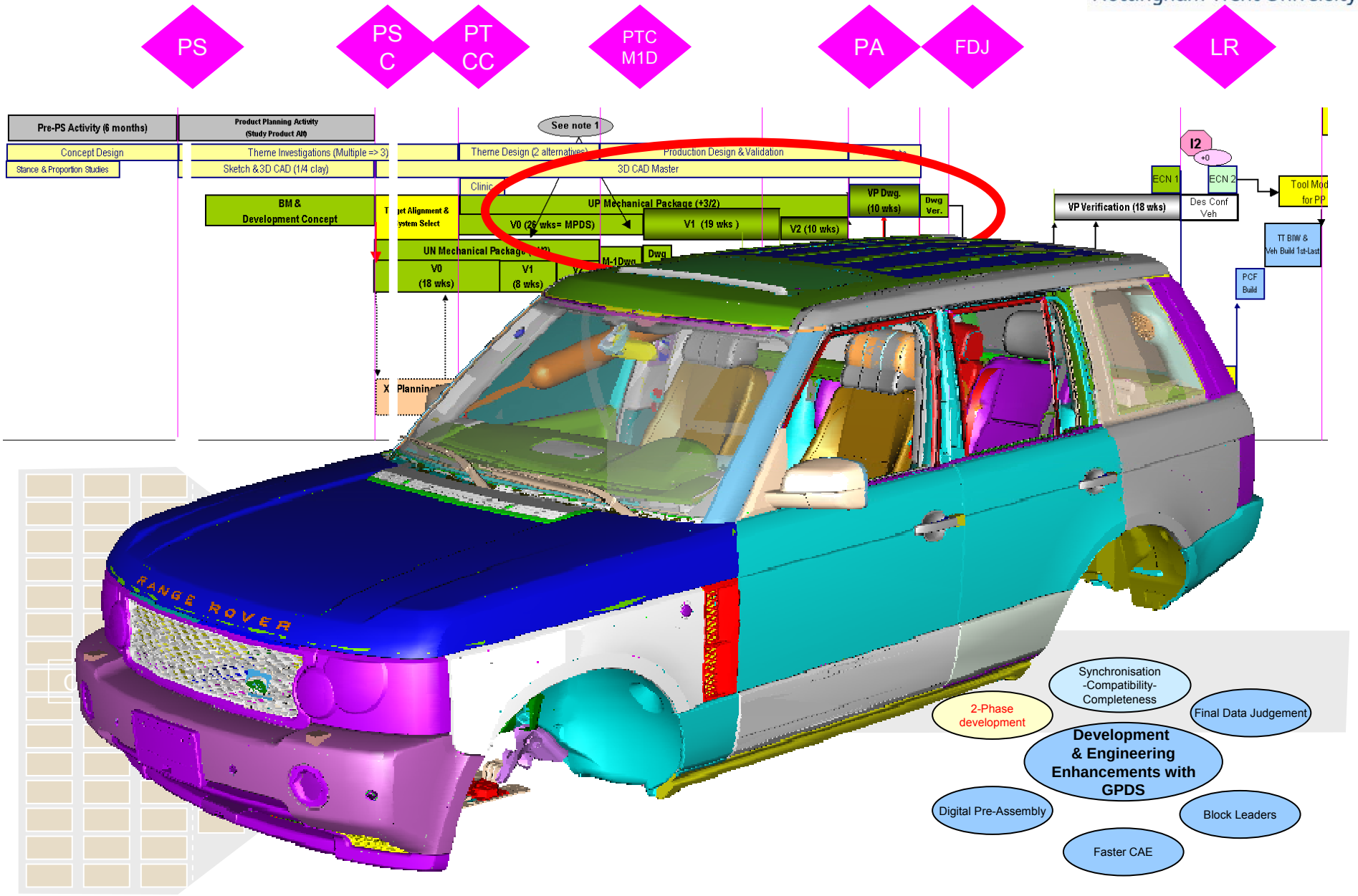

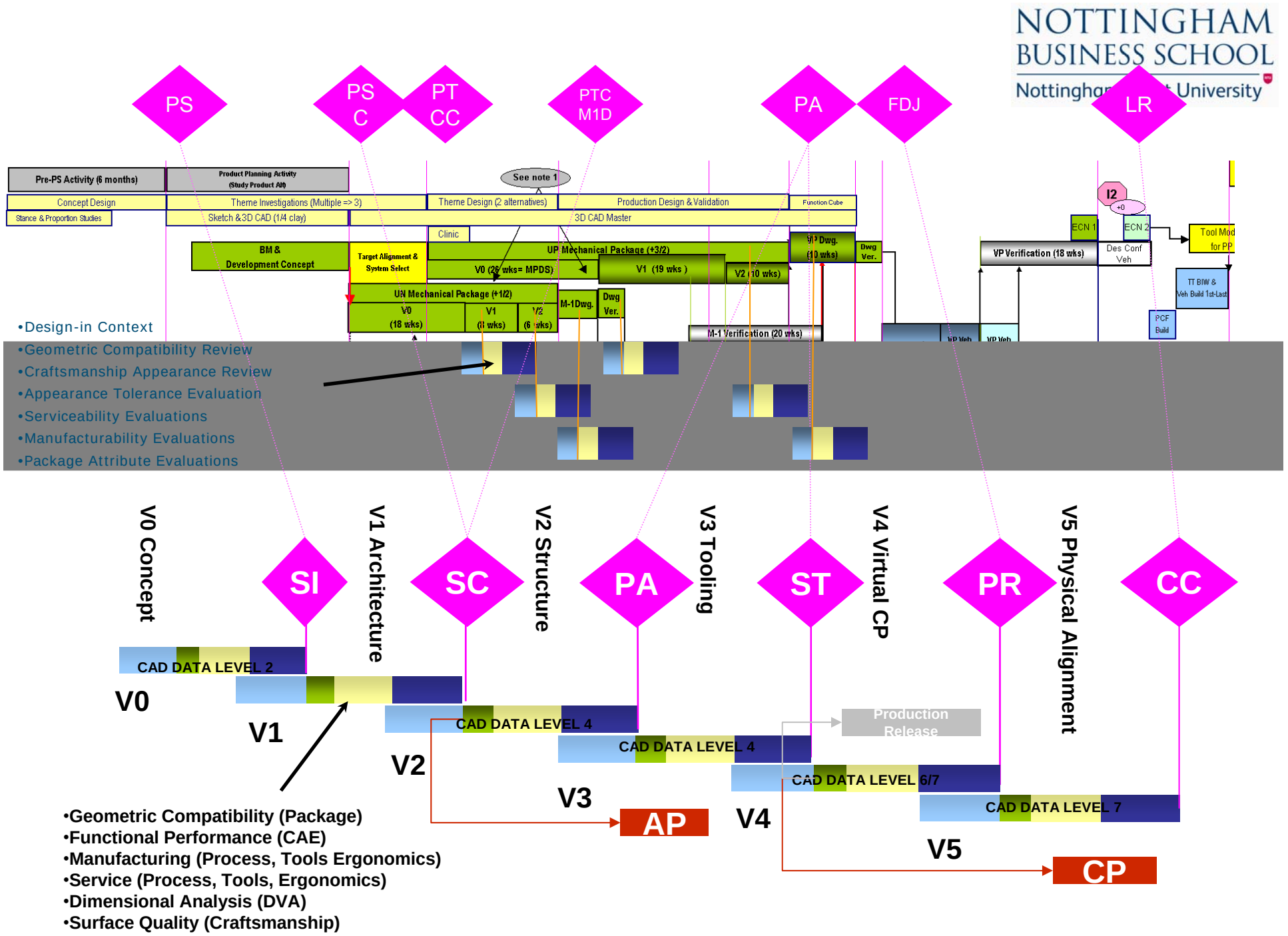
PS
PS C
PT CC
PTC M1D
PA
FDJ
LR
Pre-PS Activity (6 months)
Product Planning Activity (Study Product Alt)
Concept Design
Theme Investigations (Multiple => 3)
Theme Design (2 alternatives)
Production Design & Validation
Function Cube
Stance & Proportion Studies
Sketch &3D CAD (1/4 clay)
3D CAD Master
See note 1
Clinic
BM & Development Concept
Target Alignment & System Select
UP Mechanical Package (+3/2)
V0 (26 wks= MPDS)
V1 (19 wks)
V2 (10 wks)
Dwg Ver.
UN Mechanical Package (+1/2)
V0 (18 wks)
V1 (8 wks)
V2 (6 wks)
M-1Dwg.
Dwg Ver.
M-1 Verification (20 wks)
I2
+0
ECN 1
ECN 2
Tool Mod for PP
VP Verification (18 wks)
Des Conf Veh
TT BIW & Veh Build 1st-Last
PCF Build
•Design-in Context
•Geometric Compatibility Review
•Craftsmanship Appearance Review
•Appearance Tolerance Evaluation
•Serviceability Evaluations
•Manufacturability Evaluations
•Package Attribute Evaluations
V0 Concept
V1 Architecture
V2 Structure
V3 Tooling
V4 Virtual CP
V5 Physical Alignment
SI
SC
PA
ST
PR
CC
CAD DATA LEVEL 2
V0
V1
CAD DATA LEVEL 4
V2
CAD DATA LEVEL 4
V3
Production Release
CAD DATA LEVEL 6/7
V4
CAD DATA LEVEL 7
V5
AP
CP
•Geometric Compatibility (Package)
•Functional Performance (CAE)
•Manufacturing (Process, Tools Ergonomics)
•Service (Process, Tools, Ergonomics)
•Dimensional Analysis (DVA)
•Surface Quality (Craftsmanship)

Engineering & Prototyping

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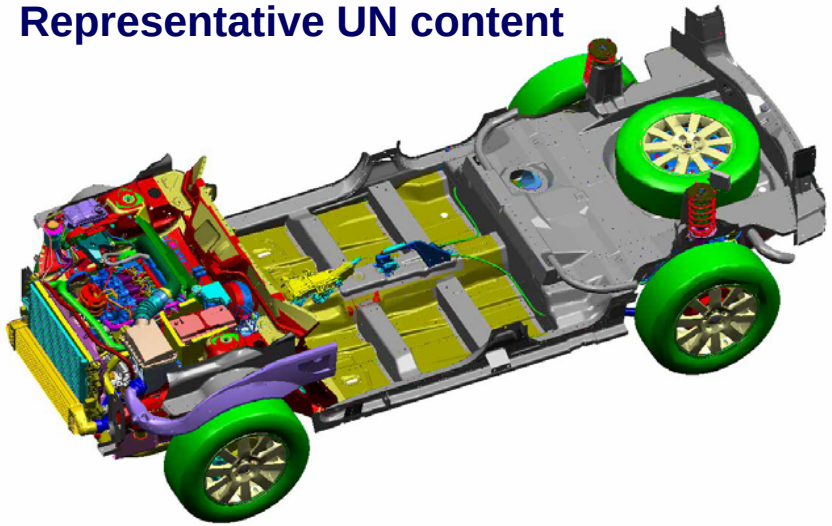
Representative UN content



Donor Top Hat – aesthetics not important

VP production and tooling

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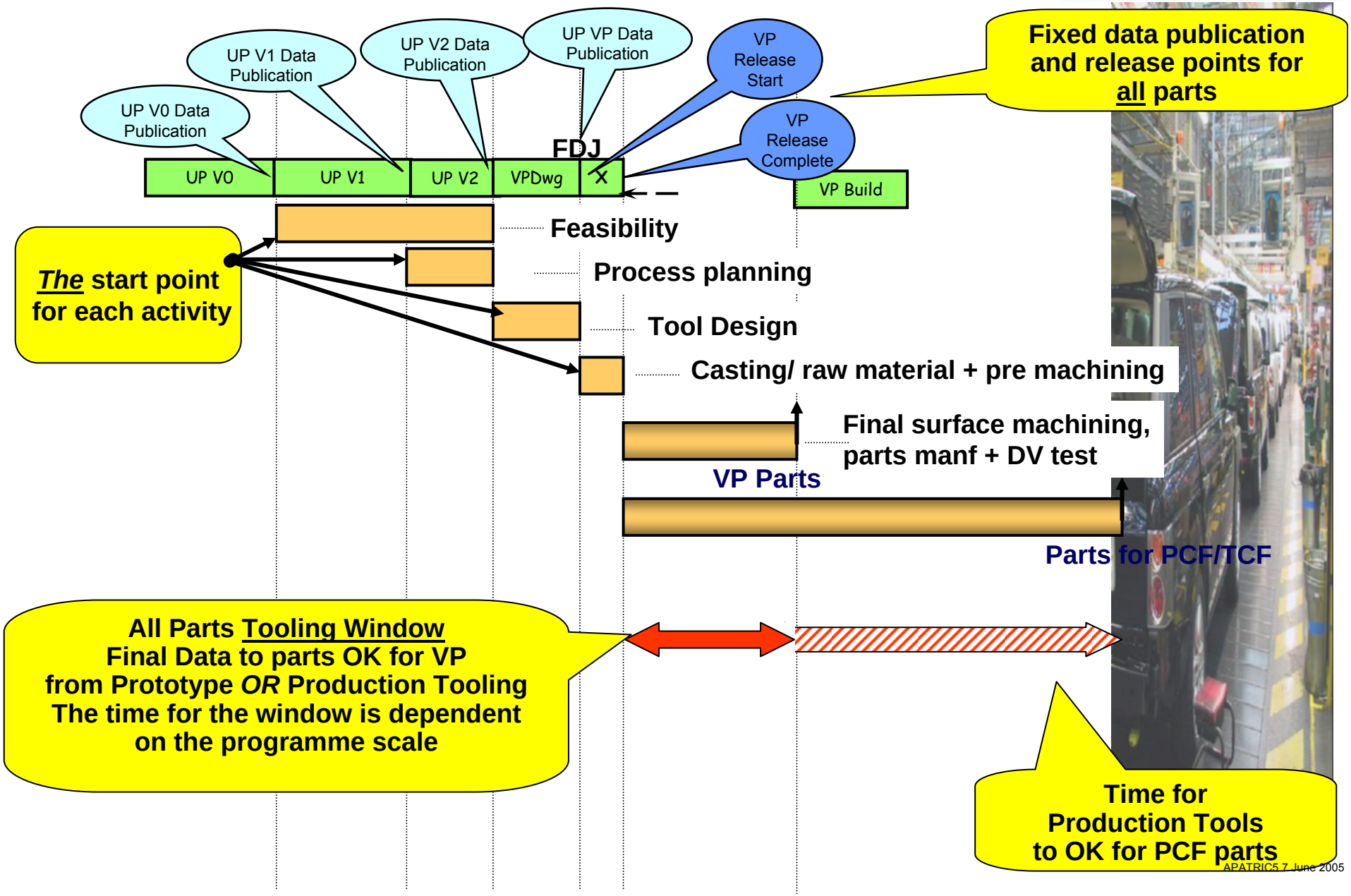

Verification and crash test

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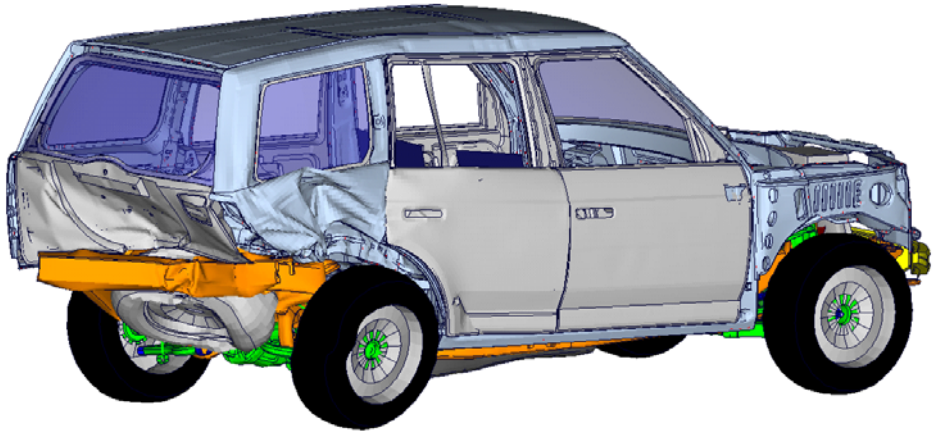

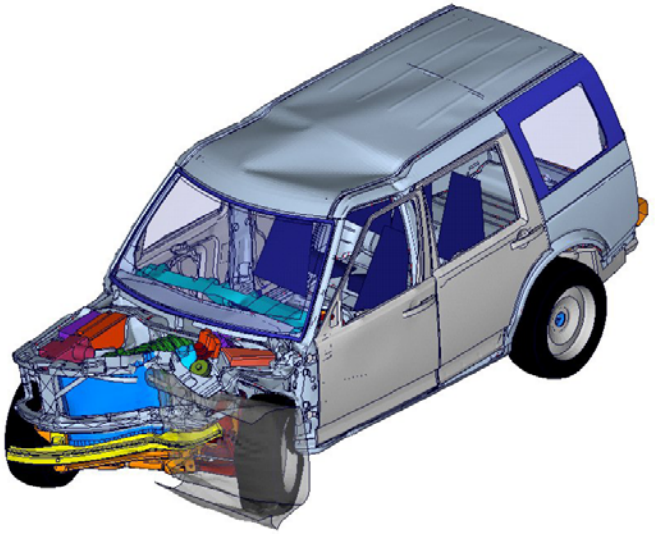

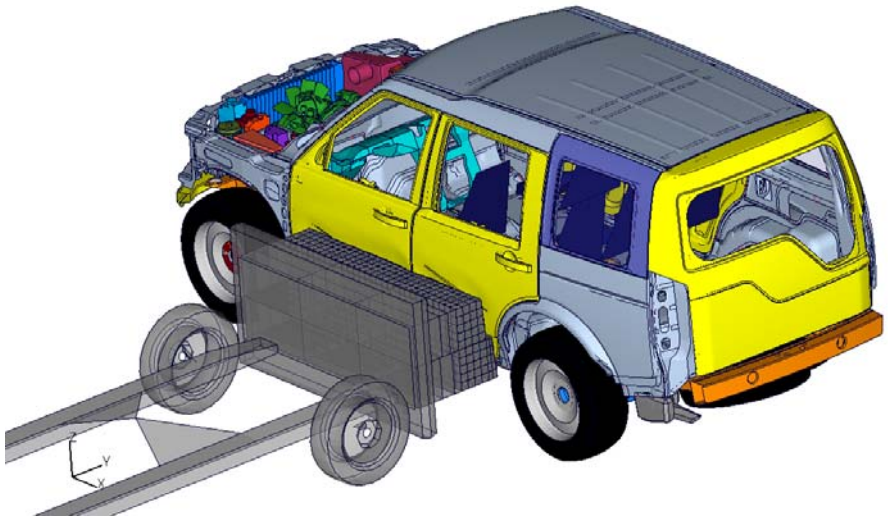

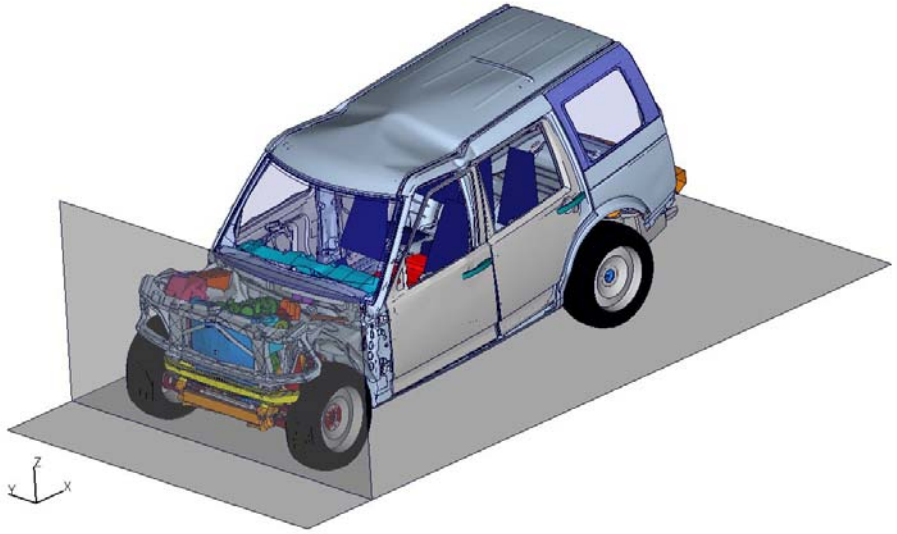

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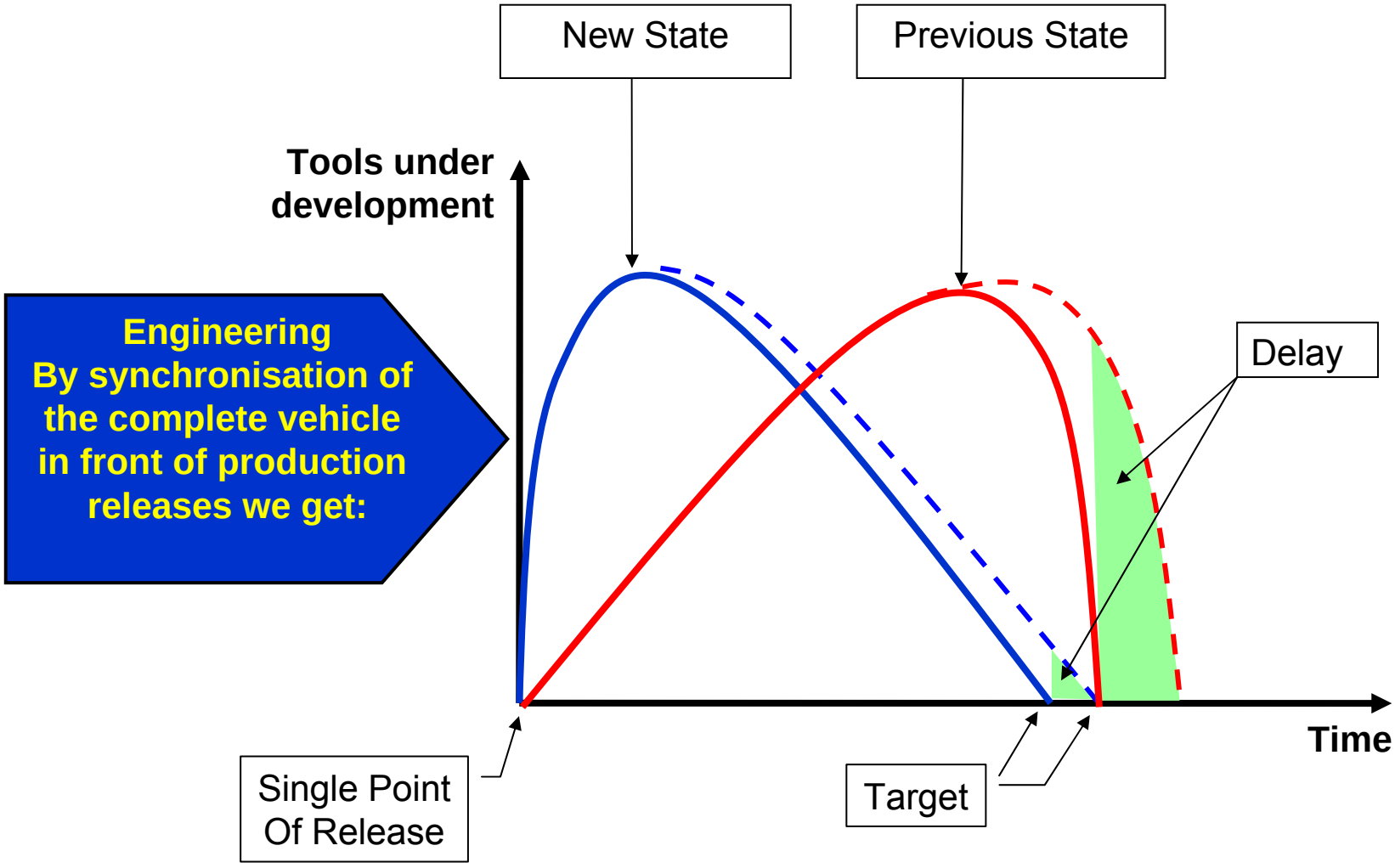
Would you like to see the actual crash test clips?

Synchronisation & mass production preparation



Improved PD System

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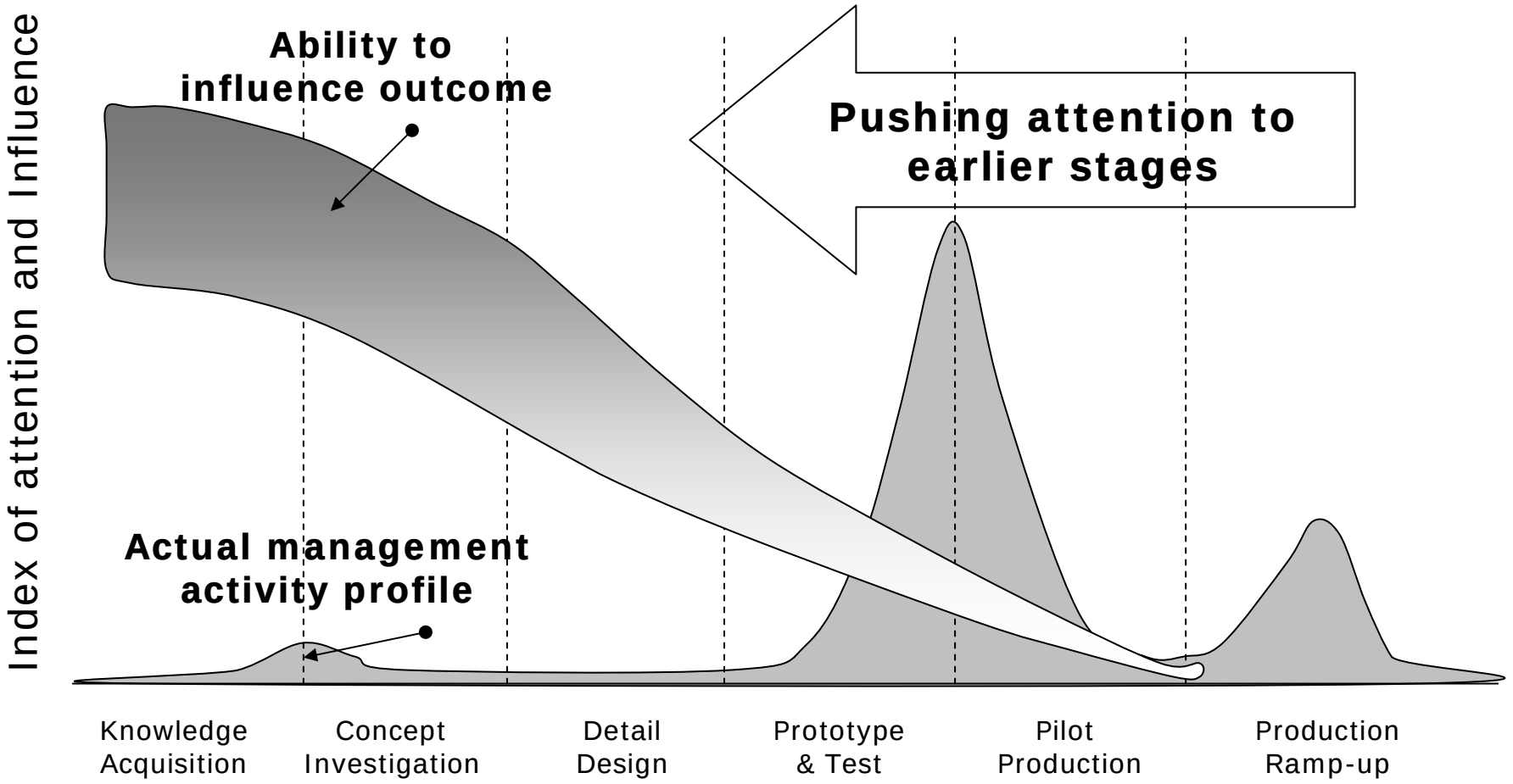

Decoupling and Alignment

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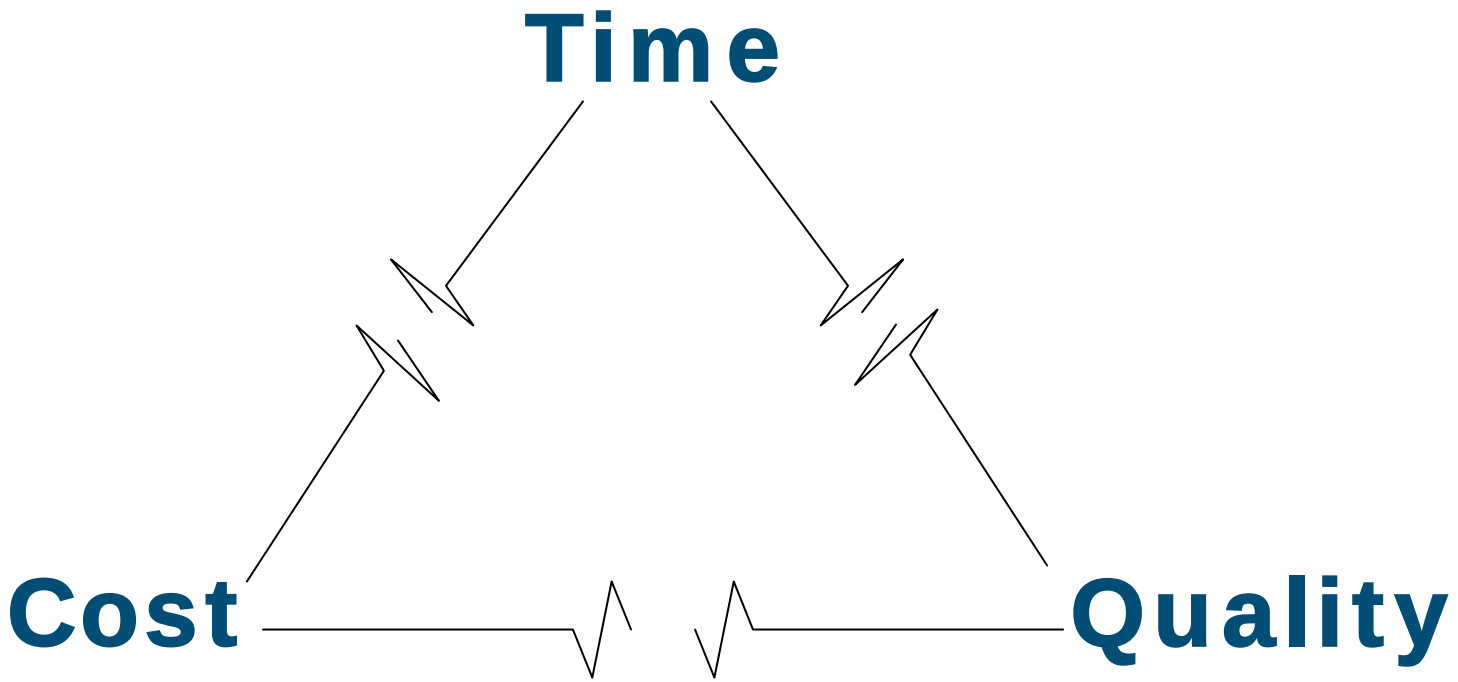

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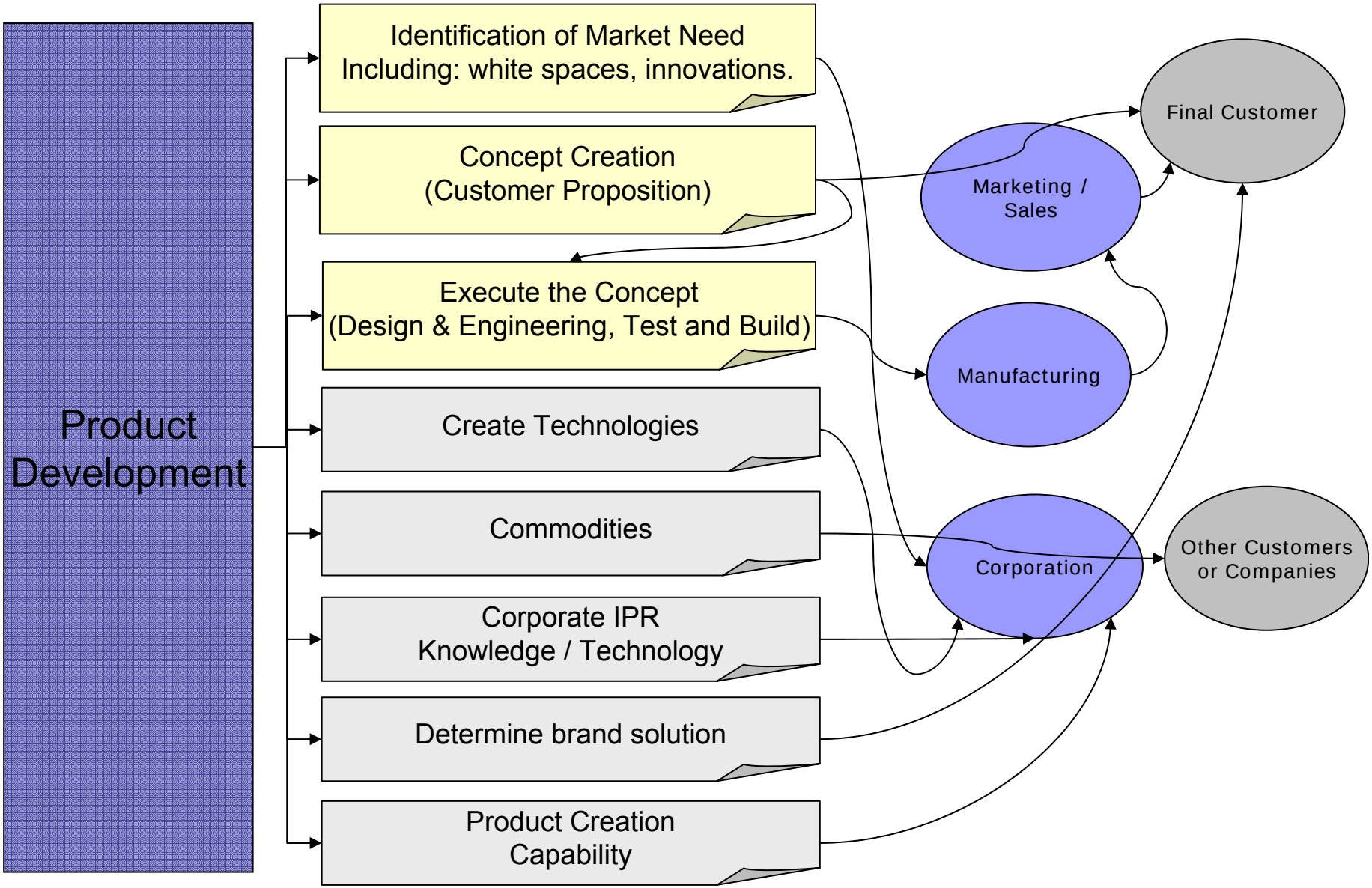
Product Development: Value-add outputs



Criteria for successful new products

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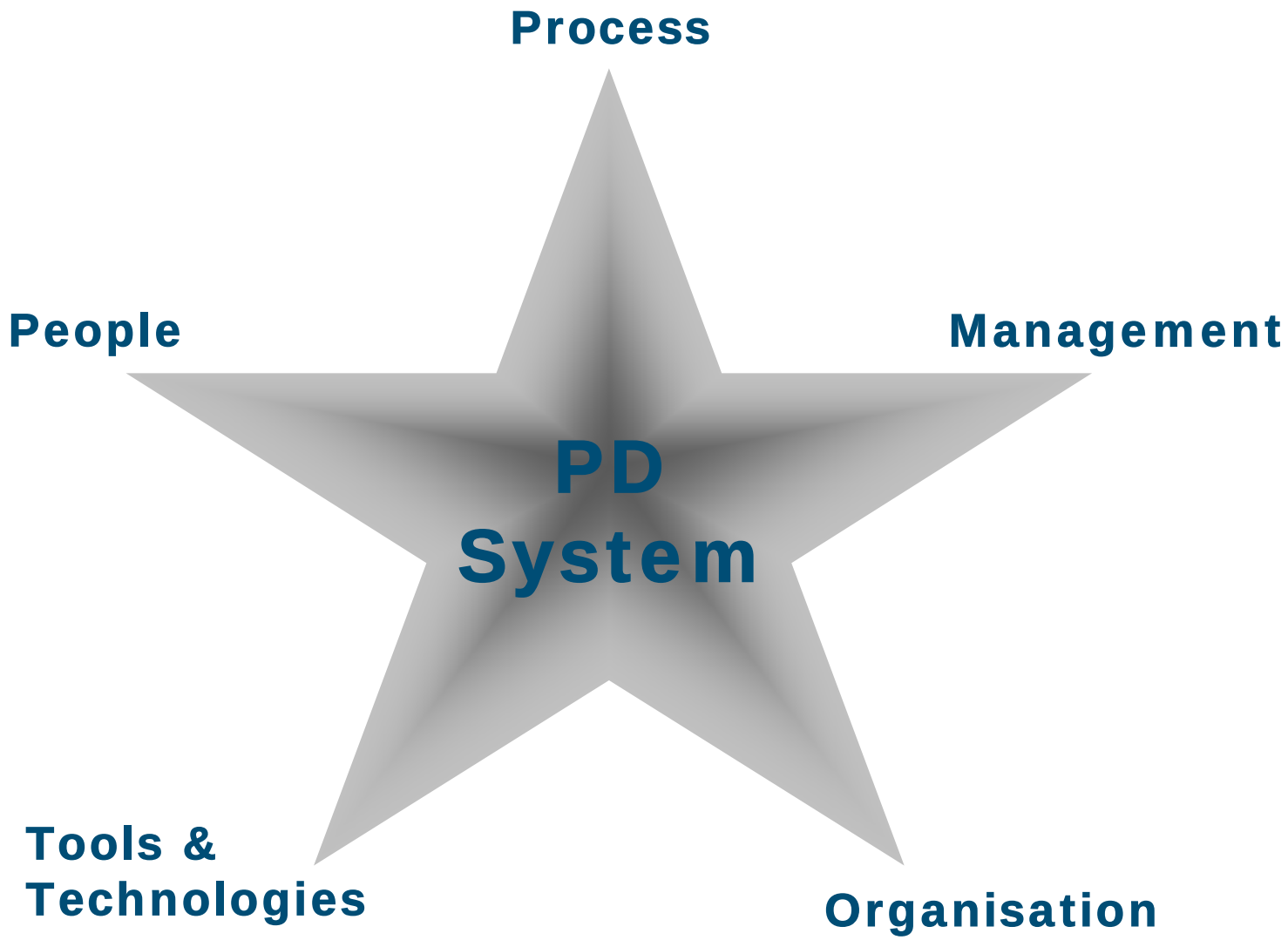
- Offer a unique feature
- Higher relative quality
- Solution to customers' problems
- Reduction of total customer costs
- Being the first of its kind

Product Development system



Product Development capability

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How fast = speed of development

How Many = throughput

How much investment = cost of development

Product Development capability

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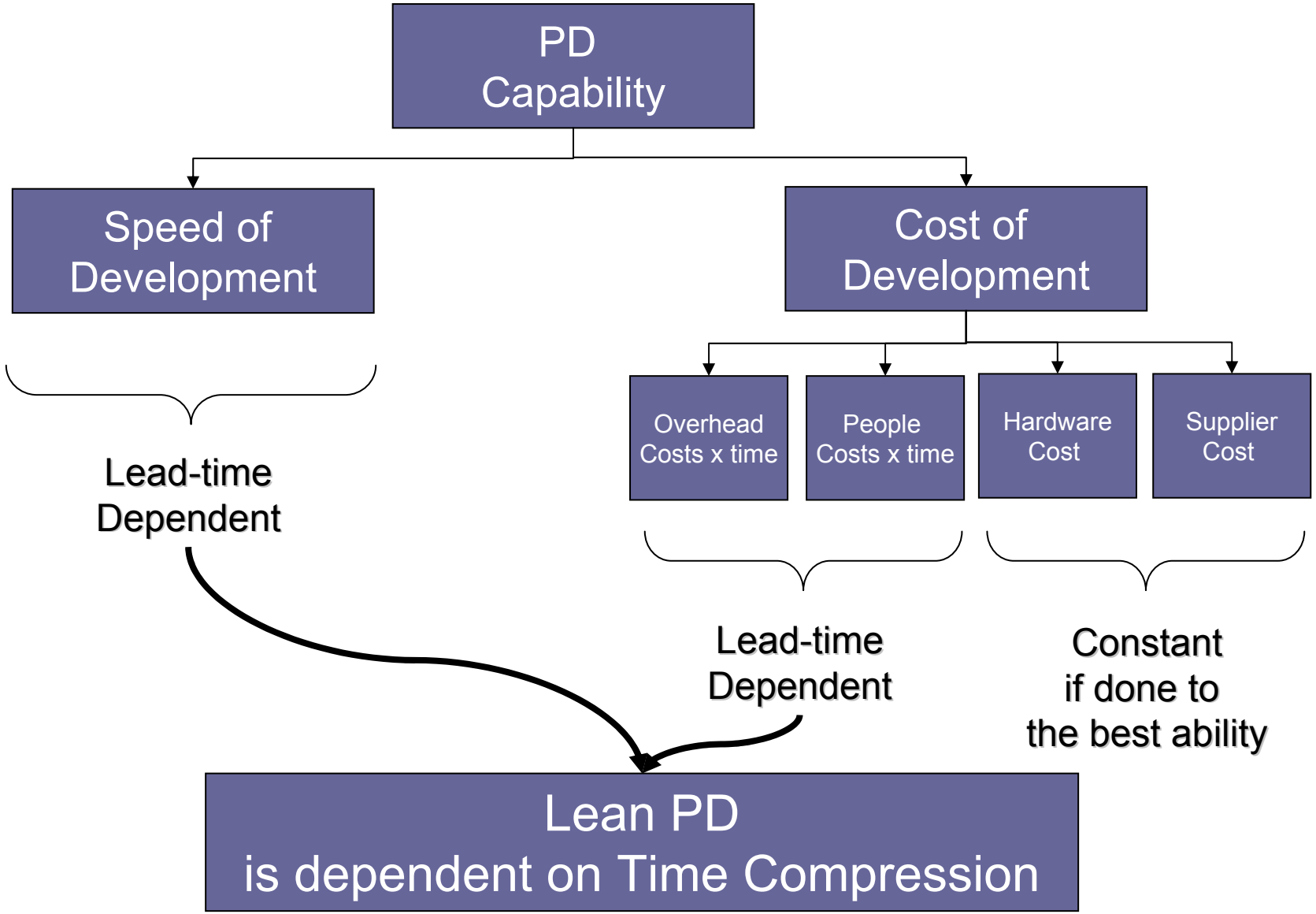

PD Capability Metric

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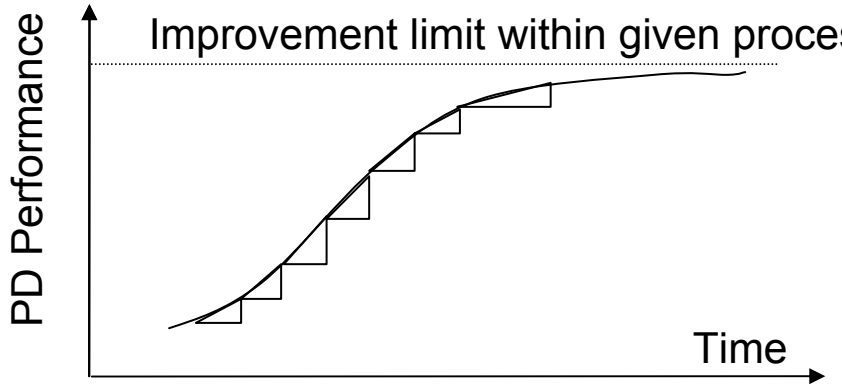
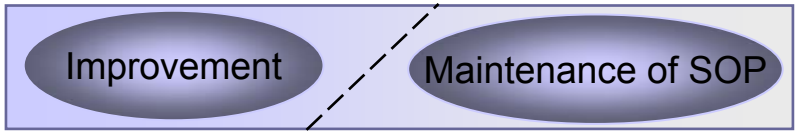
Time Compression

i.e. How much can you reduce the lead-time of Product Development

At Program Level : Program Time Compression
Program Performance = Δ tc

At Business Level : Rate of Time Compression
PD Performance = dtc / dt





Sources of Improvement

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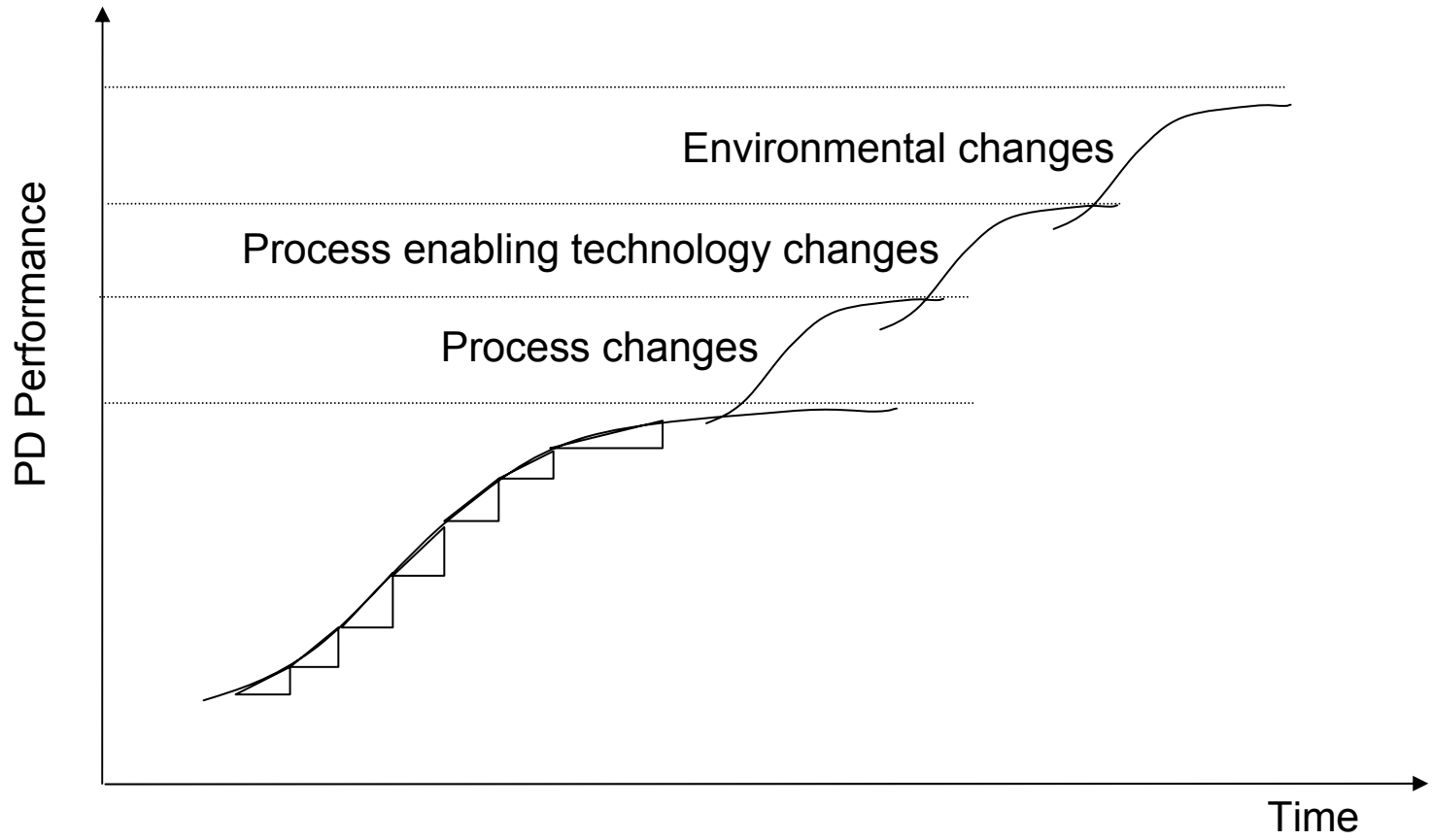

No new Products

=

No future for that company

Effective Product Development

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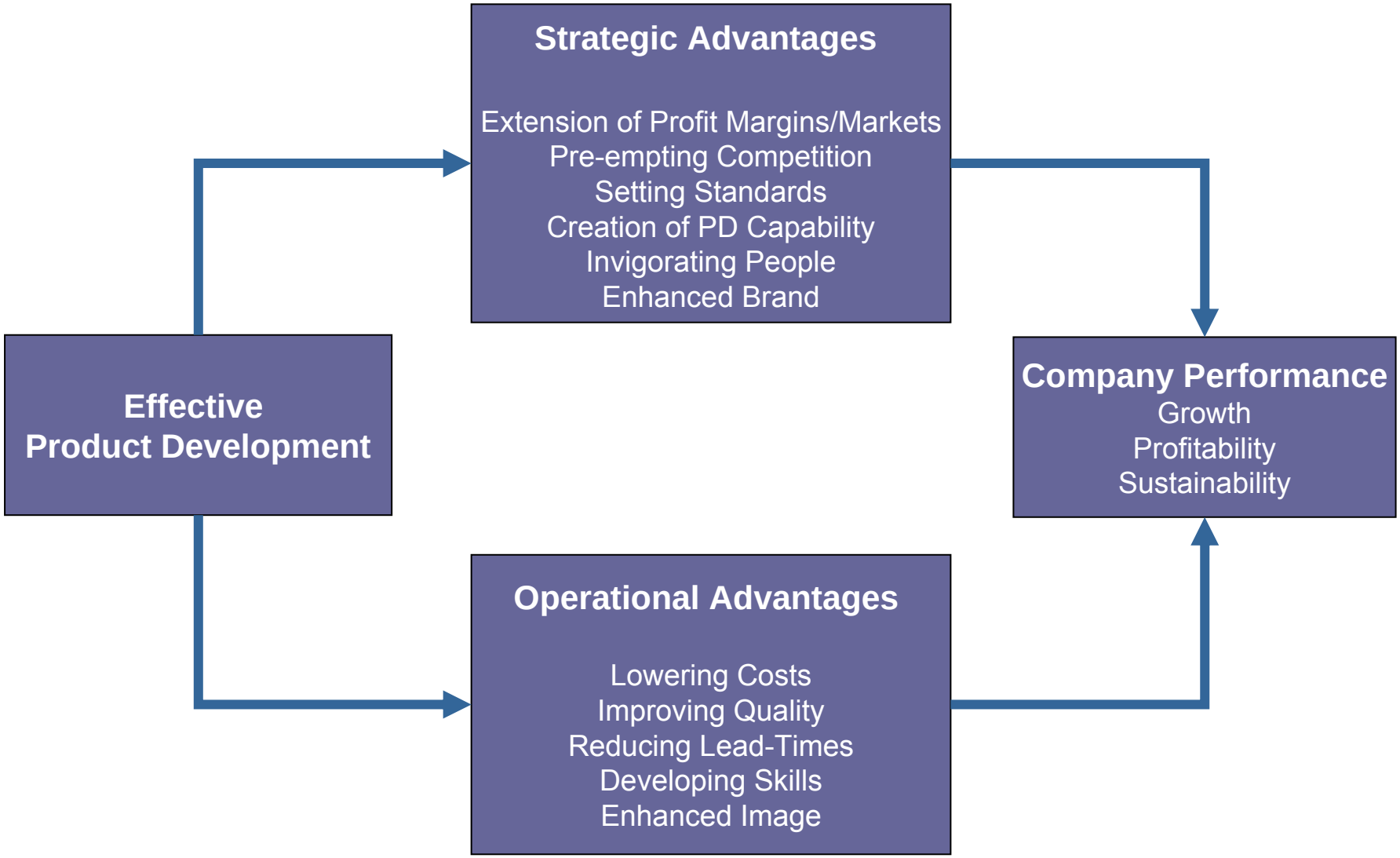

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The shape of things to come

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Do you want to see more ?

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Apologies for over-running on time !

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Cumulative flow diagram

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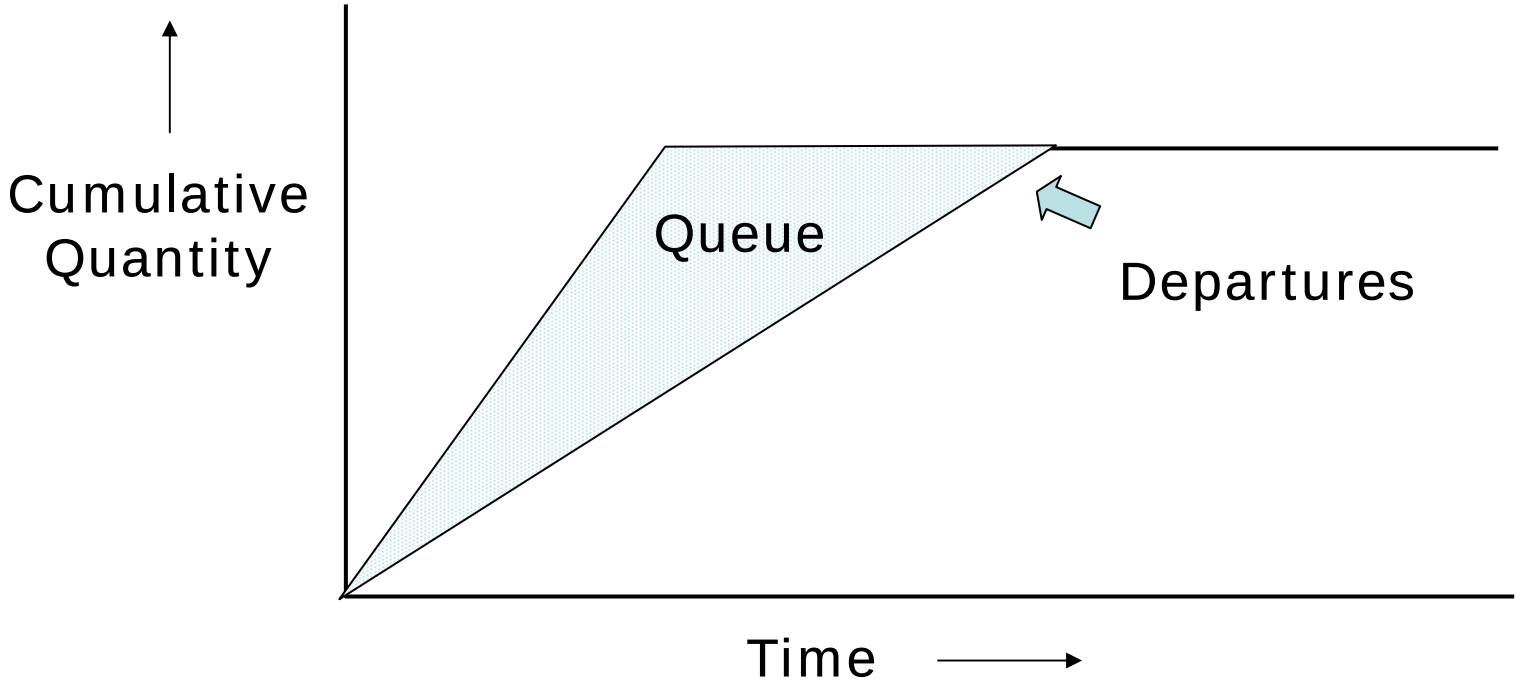

Monitoring queues

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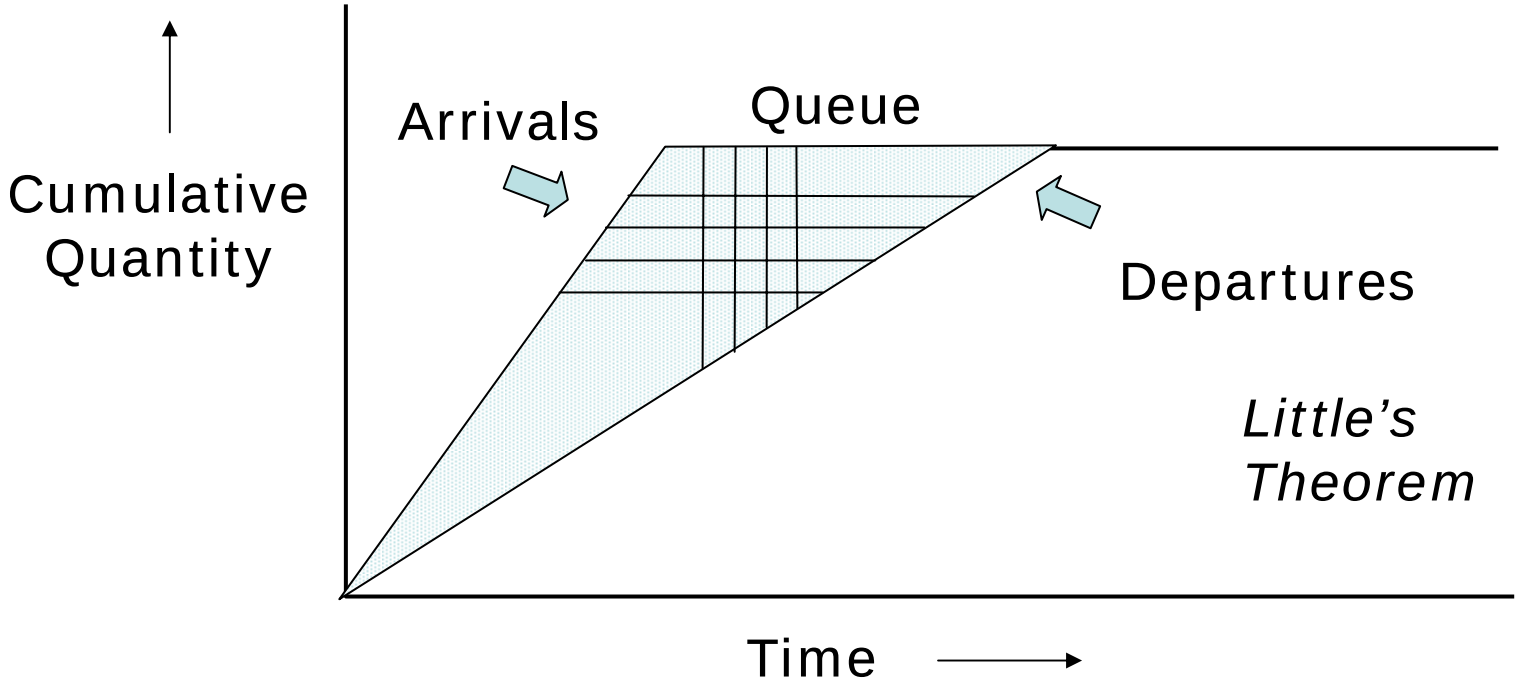

Batch size

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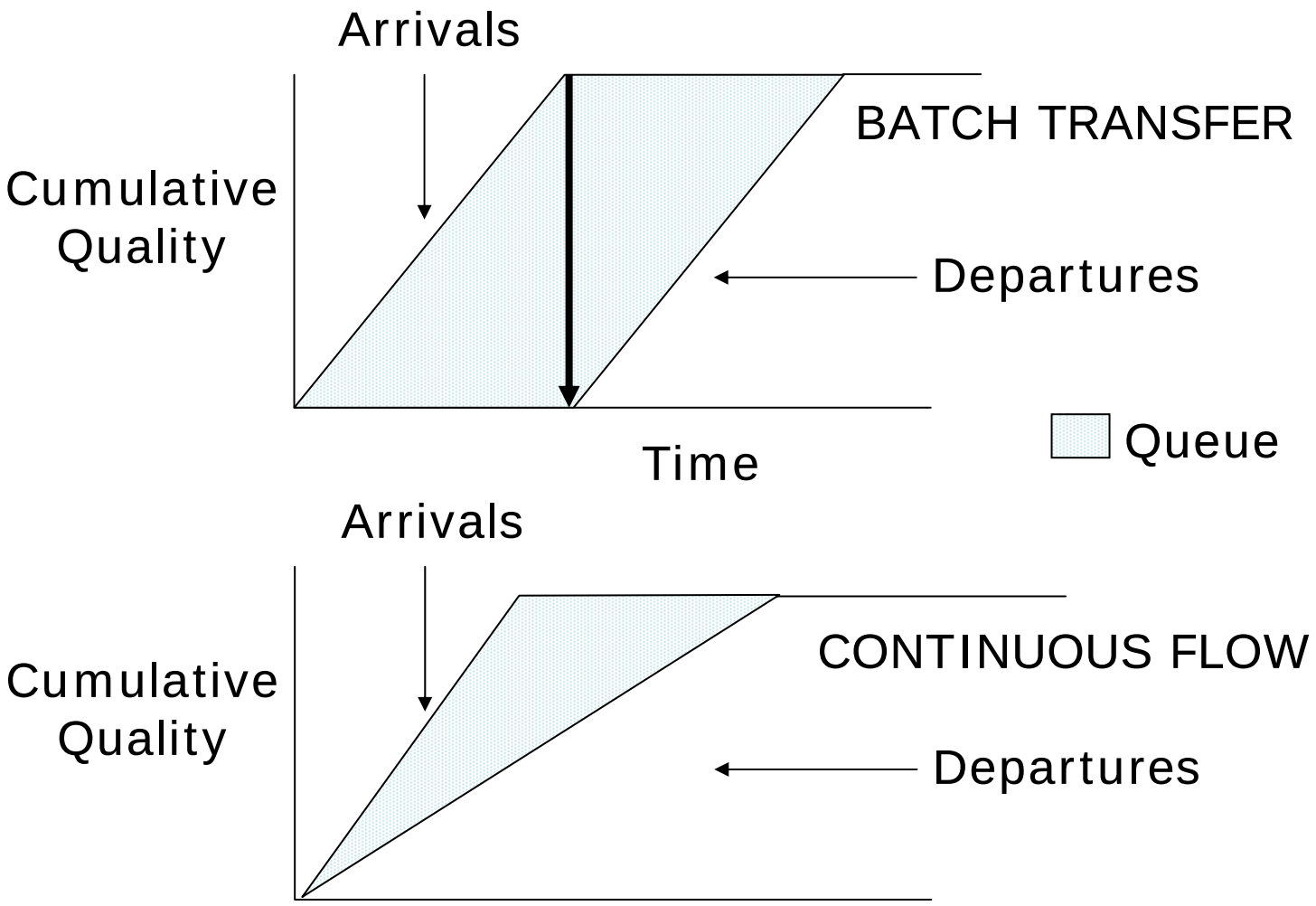

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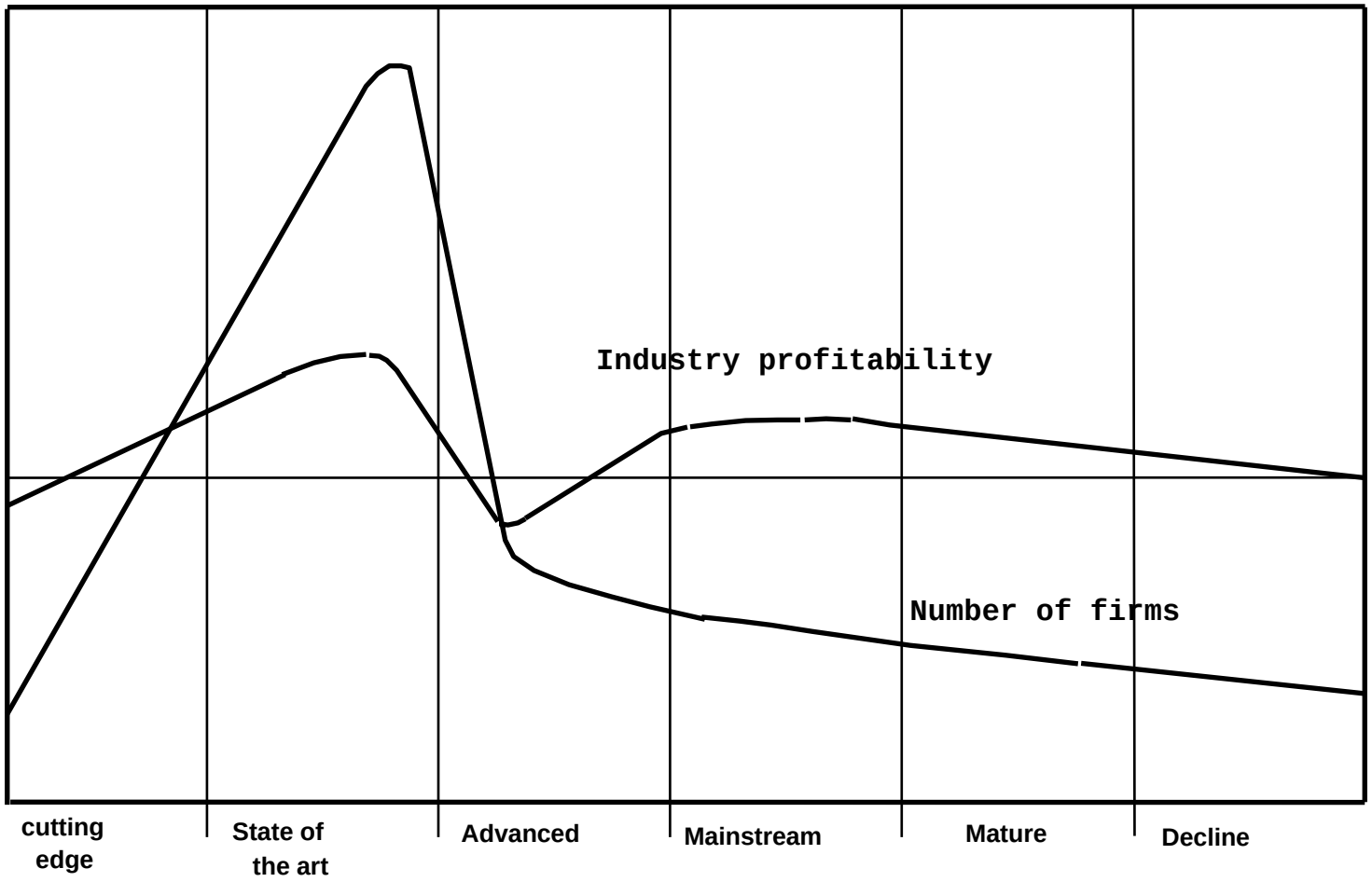
Technology Life Cycle



Dominant Design

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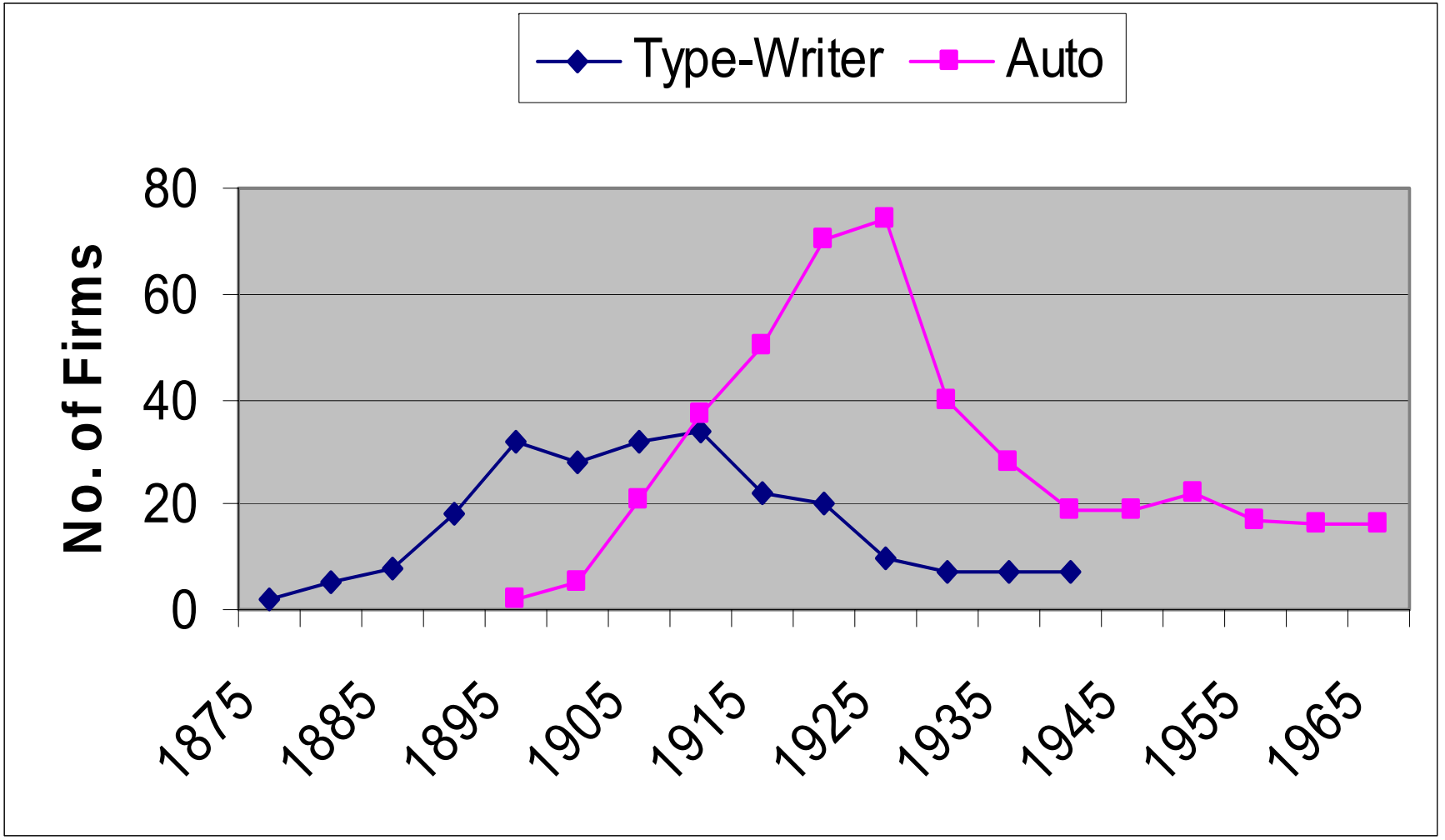
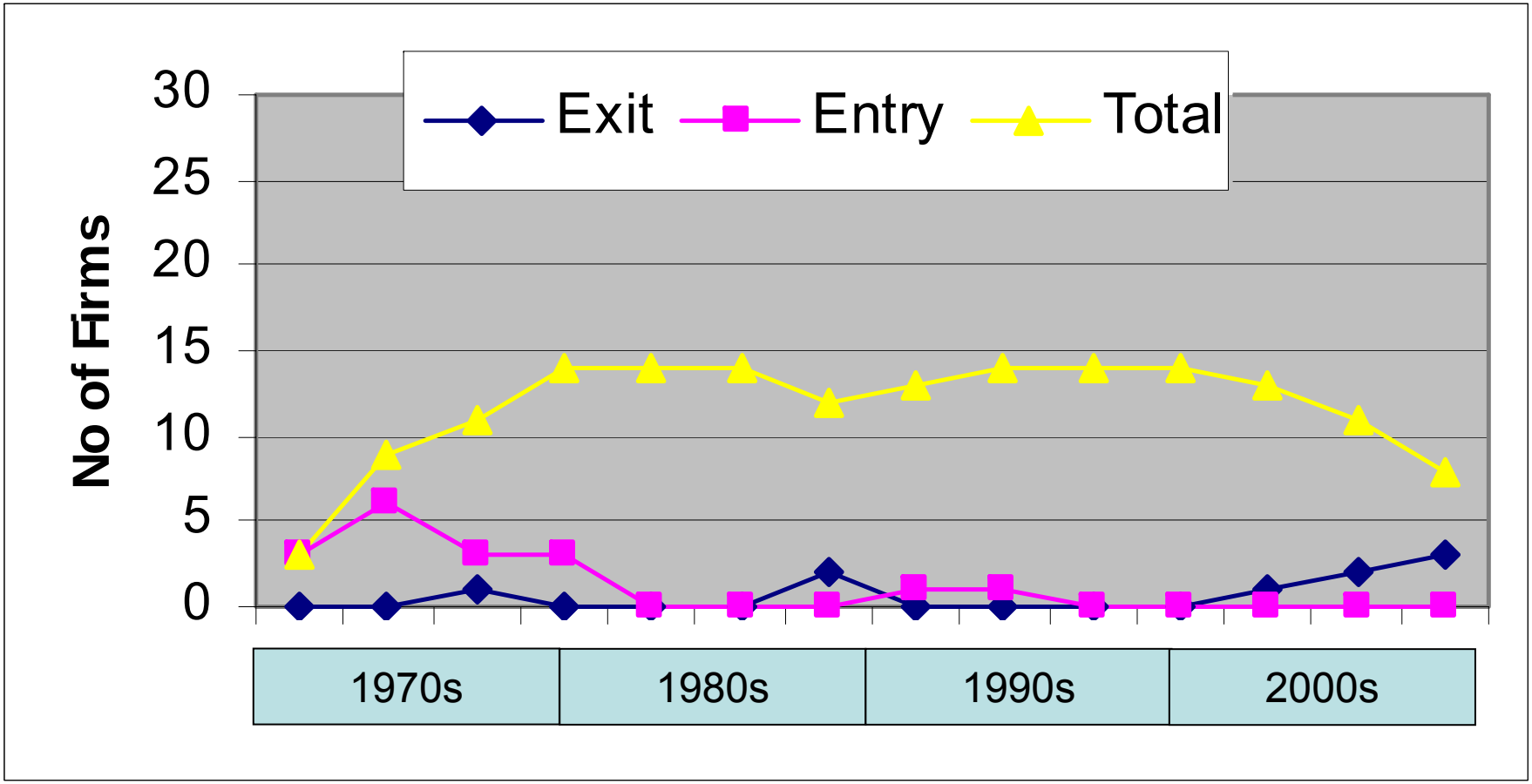


Non-convergent technologies



Firms participating in US integrated circuits industry

Product-type positioning

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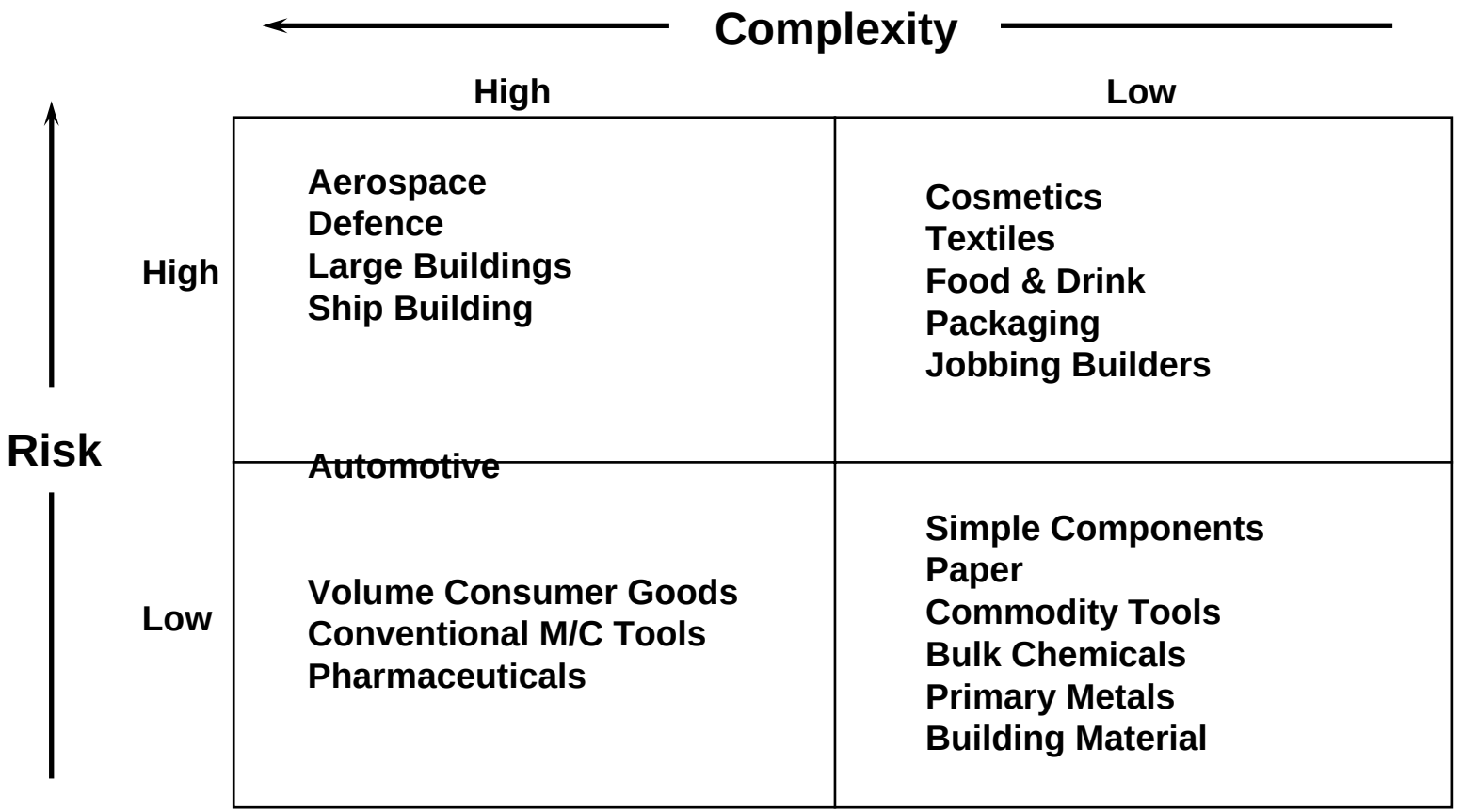

Causes of PD Failure

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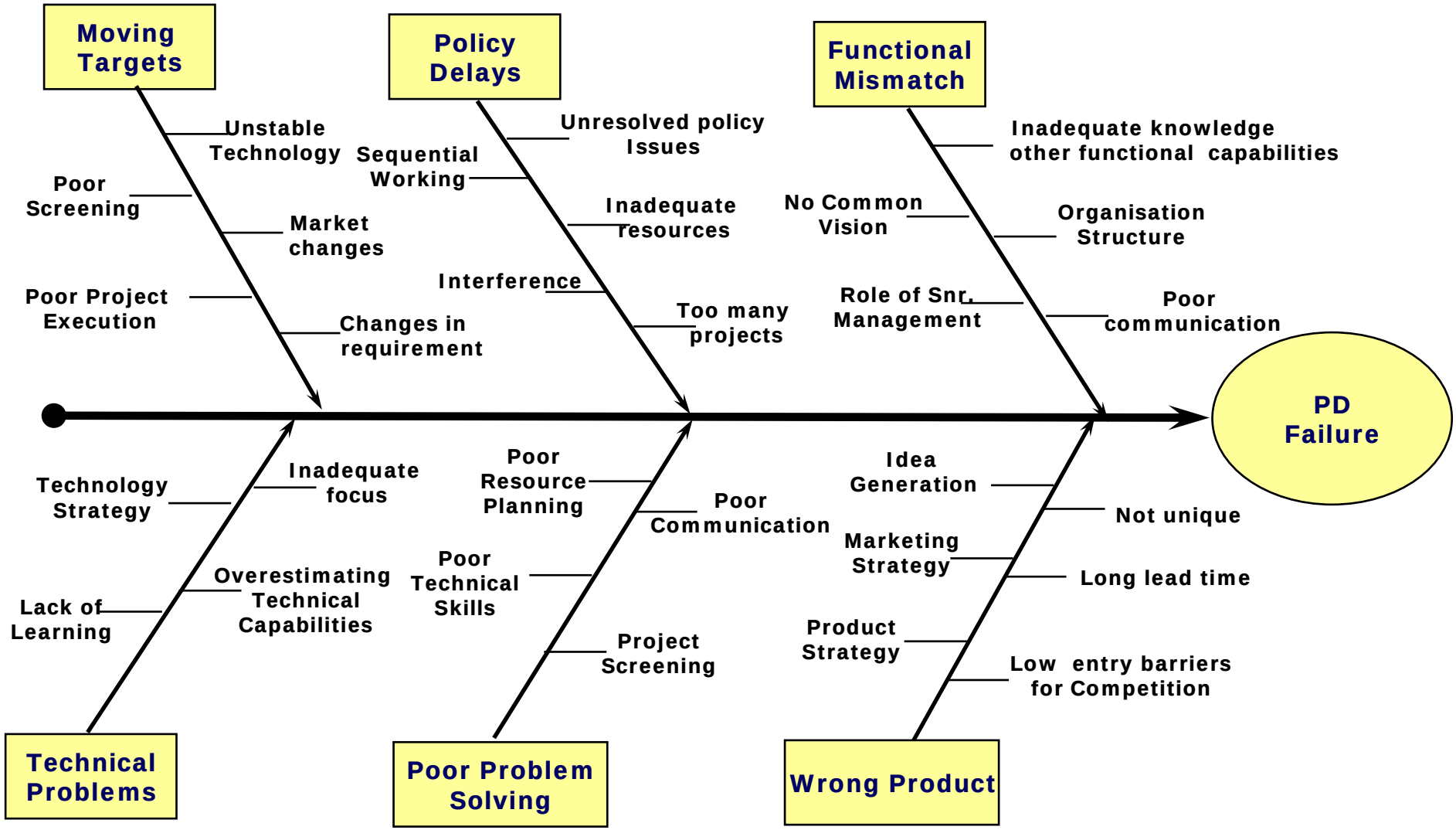

MPDS vs FPDS

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