

Research for Business Making it Work

Pointers for New Graduates and Research Practitioners

Dr Mourad Kara

Global Design Authority (GDA)

Internet Services - Cable & Wireless PLC

Mourad.kara@cw.com

mourad@autonomic-labs.com

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Research for Business

Outline

- **Aim and context of this talk**
- **Why research for business?**
- **Framework for research cycles, standards & product roadmaps**
- **Internet and telecom case study (IMT)**
- **Investment, business and research**
- **UK Perspective – How do we compare? Review and Challenges**
- **Attitude, approach, behaviour at work – What can you do?**
- **Summary**

Aim and Context

- To be aware of business environment and challenges to deliver research in/for UK businesses (where appropriate)
- To actively contribute and influence the right business environment and to deliver research and innovation in/for UK businesses
- To ensure that innovative ideas make it beyond the drawing board and become successful products and services.
- To appreciate the research cycle and its relationship to research labs, standard institutions and business & industry (products)

Aim and Context

- To make the most of the UK investment in science, engineering and technology
- Discuss current challenges faced by UK companies in investing in research for medium to long term
- UK research compared to rest of the world
- Top down & bottom up view of research, business and investment

Aim and Context – scenario example

So you work for a company – how to influence the company, buy-in towards innovation, research if the environment and your readings are right

- You need to speak their language and help them convince others in the decision making pipeline (paymasters?) that the decisions are right and investment returns and benefits
- Set your proposition right (e.g. business cases)
- They are the decision makers
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Roles – Different parties

- **The researcher**
- **Business leaders (Board)**
- **The investors (VCs)**
- **Government and research councils**
- **City and Economy**
- **Society**

Why research?

Let's throw some keywords

Market share

Growth

Exciting to do

Brand enhancing

Good PR

Reputation

Growth

High risk

Return investment

High margins

New products

Better society

Obsolescence

Long term

High profile

Applies to individuals, corporate, communities, countries ...

Why research? Faster – Better - Cheaper

- **The way we create wealth is changing ...**
- **Knowledge-based businesses account for over half the job growth in the UK during the past two decades**
- **Ensure that the living standards of UK citizens continue to improve to increase the amount of output**
- **We need to increase productivity**
- **Continue to innovate and devise new and more productive ways of working**
- **Continued investment in research and development is essential to the future of the UK.**

Why research?

- **Important role in the innovation process which is increasingly vital to current and future profits for UK companies**
- **Key driver of UK prosperity in the decades ahead. Without it, our industries won't be able to compete with the growing economic powers of East Asia**
- **The technology that brings new products and services to the market place.**
- **High quality jobs, successful businesses, better goods and services and more efficient processes**
- **International research: positive correlation between sustained R&D investment intensity and company performance measures**
- **Some sectors (industry segments) do better than others: Pharmaceutical, chemical, Computer & hardware, Aerospace**

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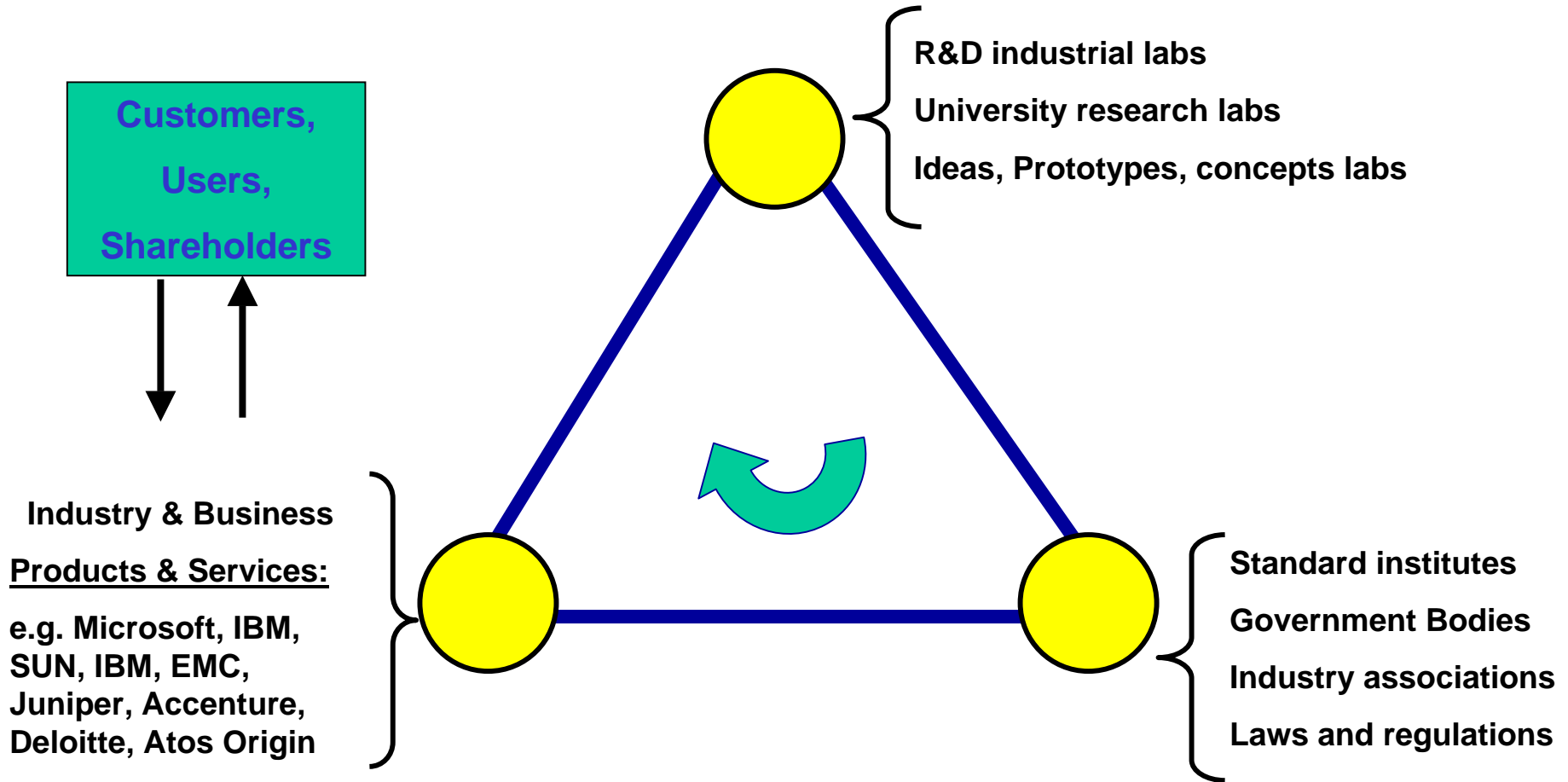
What is research – find out your context?

- **Research is a planned activity aimed at discovery of new knowledge with the hope of developing new or improved products and services.**
- **R&D can be defined as any project to resolve scientific or technological uncertainty aimed at achieving an advance in science or technology. Advances include new or improved products, processes and services.**
- **Development is the translation of research findings into a plan or design of new or improved products and services**

Research: Three key phases

- **(a) pure (or basic) research:** Experimental or theoretical work undertaken primarily to acquire new scientific or technical knowledge for its own sake rather than directed towards any specific aim or application;
- **(b) applied research:** Original or critical investigation undertaken in order to gain a new scientific or technical knowledge and directed towards a specific practical aim or objective;
- **(c) strategic (development):** Use of scientific or technical knowledge in order to produce new or substantially improved materials, devices, products or services.

Three Main Pillars



The good news: The three poles have learnt to work in a synchronised and timely fashion for the past 10 years, enabling products to be deployed soon after prototyping, inter-operability tests and open standards adoption!

Business: How do you engage in R&D? (1/2)

Different levels of engagements

- Large companies usually open to R&D and risks
- Are early adopters, penetrate new markets for high margins and market share
- New small companies – spin-offs created to sell new innovative products
- In general other medium and large companies just want to follow by promoting a value and quality of service, products.

Research labs are costly to run

- Between 20 to 40 projects at any one time
- 2 in 10 projects make it to next stage ready for prototype (incubators)
- 1 in 10 in incubator stage, ready for roll-out.

Business: How do you engage in R&D? (2/2)

Cost of engagement – What is your strategy?

- Participate and actively research – like research labs
- Participate in standard committees and general policy setting
- Can't afford research or committees – influence product suppliers and roadmap with suppliers
- Have your key suppliers share roadmaps with you – Technology transfer and education
- Market research led – Gartner, Ovum, Aberdeen, etc. (trend and future)
- Have your own research roadmap aligned with products/services roadmap
- Active in standard committees
- Long term versus short term research

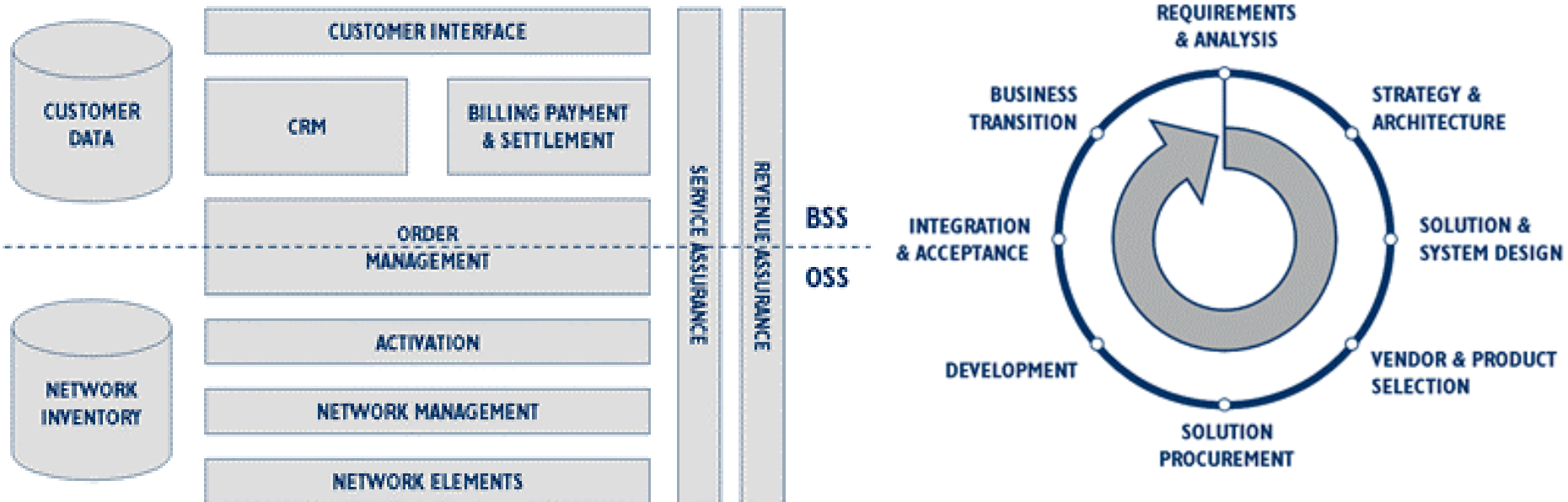
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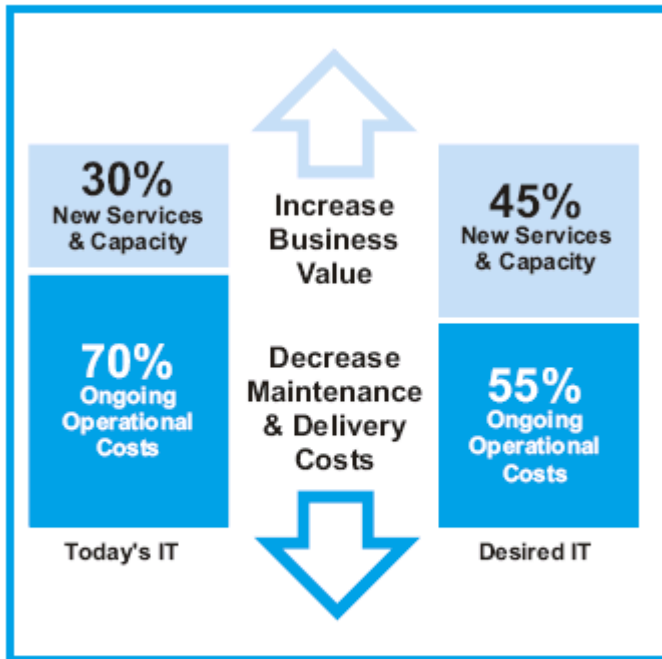
OSS/BSS – Service management

OSS/BSS Life Cycle



OSS: Operations Support Services
BSS: Business Support Services

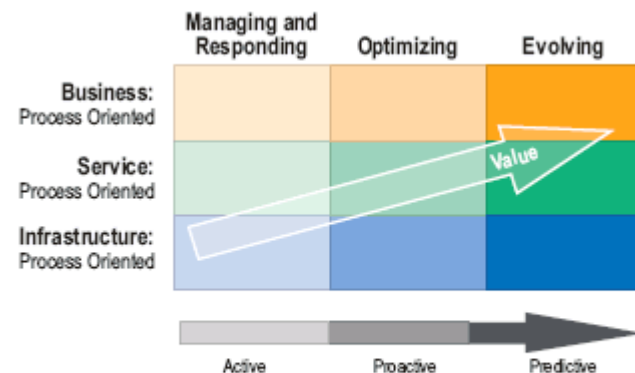
Ensuring Business Values in New investment



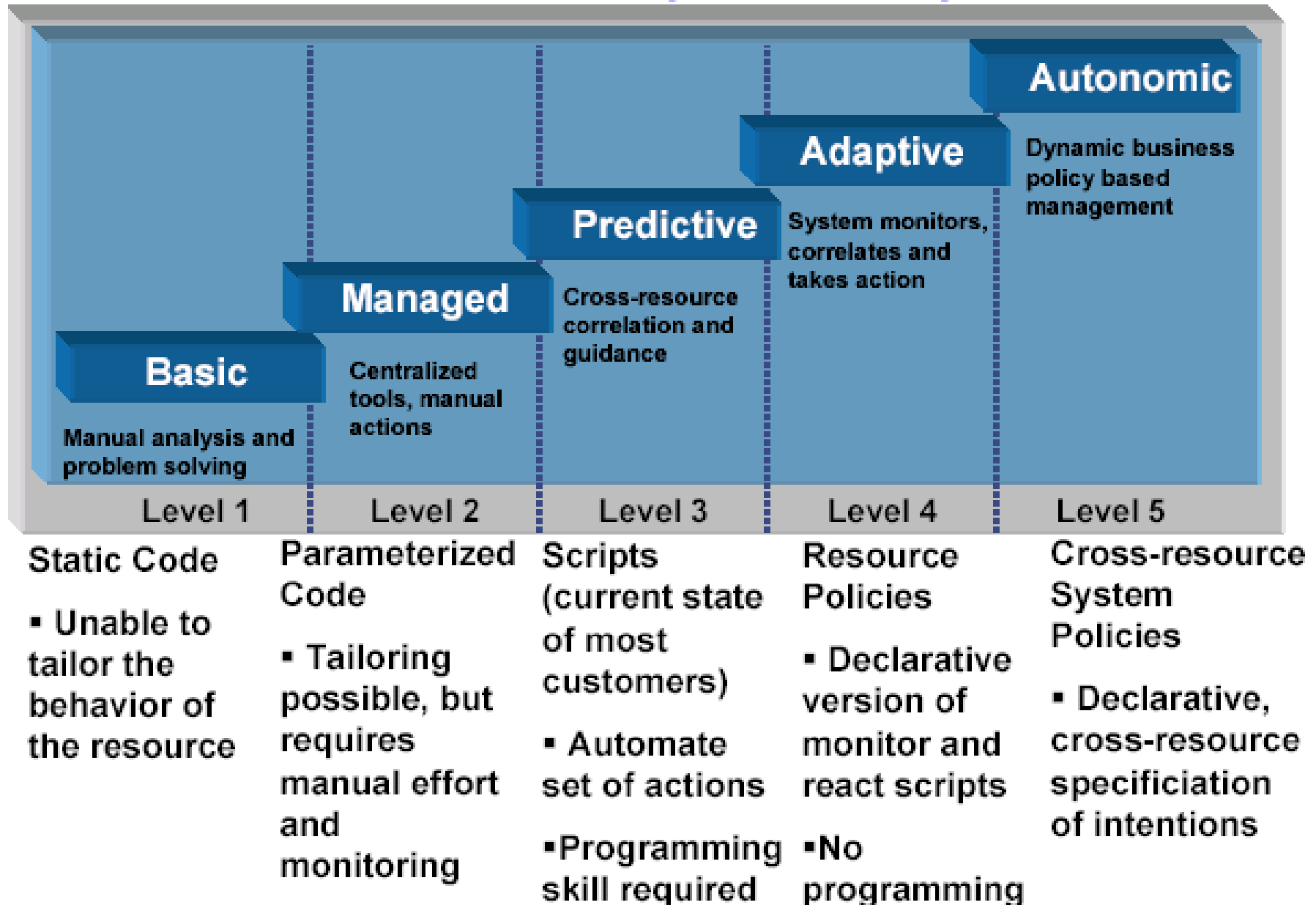
- Compare your Operations budget with industry norms.
- Move towards better alignment with business goals.
- Move towards standardisation.
- Emphasize manageability in all new investments.

• Deploy manageable platforms on open standards.

• Automate, consolidate and innovate



Autonomic computing, Policy Driven System



Great progress in research - examples

- Fast switching and fast routing (non-blocking hardware) -multiple Tbps backplanes: High port density 10GE
- Search/sort algorithms allow for fast IP routing and switching
- Power and cooling technologies for blades and large routers
- Pattern matching and analysis (to identify RCA)
- Traffic engineering and optimisation – converging networks
- QoS and cost modelling – DPI, traffic Profiling, virtual routing
- Getting there with virtualisation – great hope and expectation from Internet services industry.

Examples: Research problems and challenges

- Complexity and scalability at zero downtime: Software (OS) deployment on large scale networks
- Complex OS (e.g. IOS, JunOS) modular and micro-kernel – software engineering – modular in-service upgrades
- Research needs to deal with new OS and hardware as well as legacy: Legacy OS is sometimes three years old!
- Self-managing computing - Autonomic computing - zero touch flow-through provisioning
- Billing and mediation – we don't bill properly – data analysis and correlation

Examples: Research problems and challenges

- High density routers & switches: 10Gbps, 40Gbps, 100Gbps
- Networks: resilience, redundancy, optimisation and peering
- 50+ Mbps broadband residential
- Very large backbones – new networks (100Gbps +)
- Triple play services (QoS)
- Server computing – purpose appliances (bus arch.)
- Security IDS and DDOS
- Methodologies & development cycles (inc. testing)

Example: IEEE Infocom 2008 – main (hot) topics

- Economics, Pricing and Measurement
- Wireless ad hoc networks
- Optical Networks and Switching
- Congestion Control and Network Coding
- QoS and performance evaluation
- Peer-to-Peer Networks and Applications
- Router/Switch Design
- Internet Measurement
- Wireless: IEEE 802.11 issues
- Cross Layer Design
- Multicast
- Network Security

Journals and magazines

- IEEE communications
- IEEE Network
- IEEE Wireless communications
- IEEE Internet Computing

- IEEE/ACM Transactions on Networking
- IEEE Transactions on Parallel & Distributed Systems
- IEEE Transactions on Network and Service Management

Standard Bodies

- **IETF**: Internet Engineering task Force “ rough consensus and running code”
- **ITU-T (CCITT)**: Internet Telecommunications Union – traditional, top down, government institutions appointed, thoroughly tested
- **IEEE**: Institute of Electrical and Electronic Engineers: well established, great reputation
 - Ethernet 10M, 100M, 1GE, 10GE and towards 100GE – wireless

IETF – main areas

- Applications Area
- General Area
- Internet Area
- Operations and Management Area
- Real-time Applications and Infrastructure Area
- Routing Area
- Security Area
 - **RFC791 (IP)**
 - **RFC793 (TCP)**
 - **RFC2131 (DHCP)**
 - **RFC1631 (NAT)**
- Transport Area

Technology shows and magazines

- CeBIT “trade fair showcasing digital IT and telecommunications solutions for home and work environments”
- ToT’2008 – Technology of Tomorrow
- Computing and "IT week" (silicon.com) magazines
- Attend local conferences and also industry conferences (~ vendor-focus conferences)
- TM Forum OSS/BSS - service management (TM Forum Management World 2008).

Industry associations, forums (1/2)

- UKNOF (UK Network Operators Forum)
- RIPE (Réseaux IP Européens)
- NANOG (North American Operator Group)

For example, NANOG conference in 2008

- 1. Network Operations**
- 2. Deployment Experience**
- 3. Research, Policy, and New Technology**

Industry associations, forums (2/2)

Research, Policy, and New Technology

- Approaches to securing the global routing system
- Routing system scalability
- Capacity planning standards and tools
- Inter-provider MPLS/QoS/PCE
- RIR policy (e.g., implications of HD ratio)
- Active standards organizations and areas of interest
- IPv6: economics, deployments, and adoption rates
- Approaches to IPv6 scalability,

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Recall: Aim and Context – scenario example

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Basics in Accounting for Research funding

- Company's account summarise annual revenue and profit and often have a "forward looking" statement
- Profit is split into dividend and part re-invested in the business
- The re-invested part is split into opex and capex
- Opex (Operational expenditure) is the funds required to run (operate) the business
- Capex (capital expenditure) is the part that looks at new products, services etc.
- Part of the Capex can be allocated to R&D activity.

Financial instruments for research funding

Item	Definition
OPEX	Operating Expenditure (to run existing products, services customers).
CAPEX	Capital Expenditure (to run new development for growth)
PRR	Price Research Ratio
PER	Price Earnings Ratio
RoI	Return on Investment
Gearing	Level of debts relative to company value
Growth	Percentage growth in profit (revenue) year on year + forecast

- Compare your PER to industry or sector
- Compare your PRR to industry or sector
- Take into account your company's business cycle

Top 10 companies in UK telecoms sector (Public listed)

Name	PER	Market Cap (£m)
Vodafone Group	n/a	£80,648.65
BT Group	9.5	£16,710.71
Cable & Wireless	23.3	£3,661.71
Inmarsat	40.2	£1,943.53
COLT Telecom Group S.A.	32.4	£1,057.96
KCOM Group	8.7	£247.81
Thus Group	4	£220.10
Telecom Plus	22.4	£185.06
Vanco	4.6	£178.88
Alternative Networks	11.3	£69.09

Data taken on 24/04/2008

Investment, exec and the City

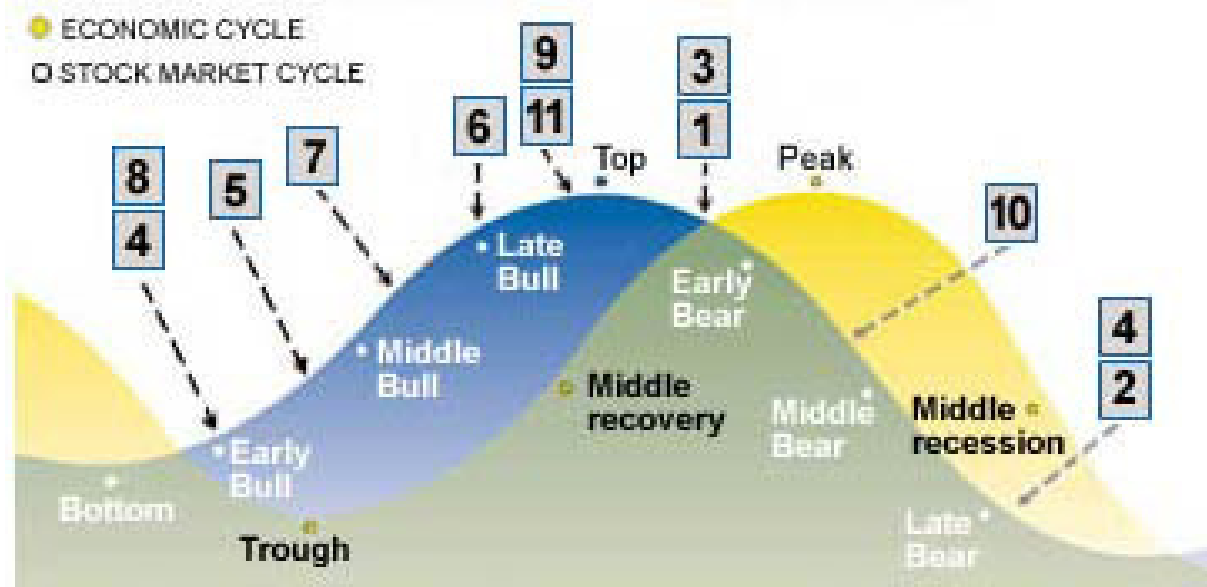
- UK PLC culture and City drive towards short term return
- Difficult to express risk and likelihood of return
- Relationship investment in research and return (avoid it coming from PR budget)
- Difference between marketing innovation and product research
- CFO, COO and CTO: what's their role and their reaction to research funding.
- Do all companies have CTOs?

R&D tax relief – Two schemes

SME scheme	Large company scheme
150% rate of enhanced deduction	125% rate of enhanced deduction
Payable credit of up to £24 for every £100 of qualifying expenditure on R&D	No payable credit
Company can claim for expenditure on R&D it sub-contracts to others	Company can only claim for expenditure on R&D it carries out itself, unless it sub-contracts R&D to certain qualifying bodies, individuals or partnerships of individuals
Company cannot claim for contributions to independent research	Company can claim for contributions to independent research
Claim can be reduced if the R&D project is subsidised or a grant is received in respect of it	No reduction for grant or subsidy
Company must own the intellectual property arising out of the R&D	Company need not own the intellectual property arising out of the R&D

Business cycles – Different levels (timing - when?)

- Your company's own business cycle following merger, acquisitions
- Sector cycles, market cycles, global cycles



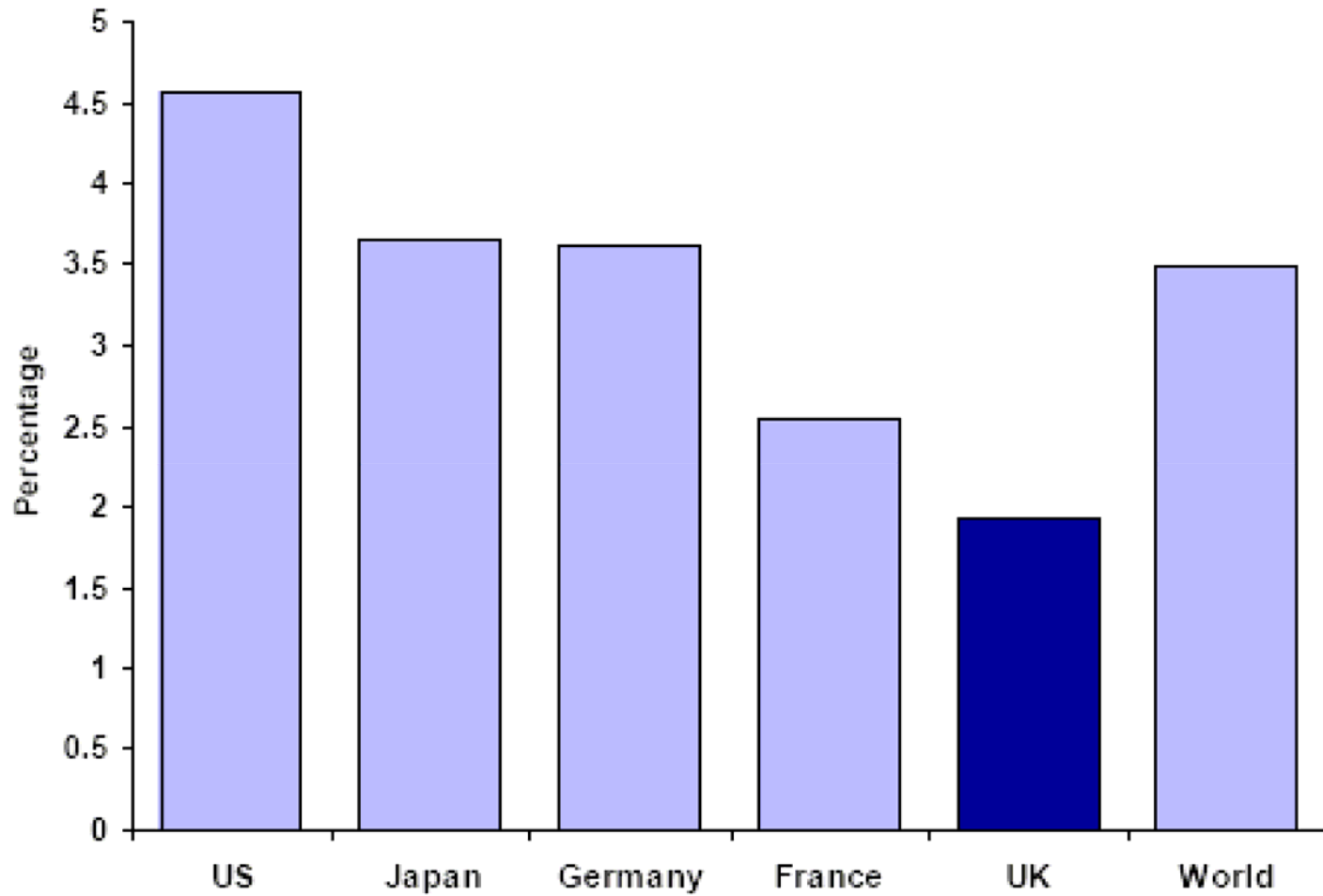
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|--|--|--|
| 1 Consumer Non-Cyclicals | 5 Technology | 9 Energy |
| 2 Consumer Cyclicals (durable and non) | 6 Basic Industry | 10 Utilities |
| 3 Health Care | 7 Capital Goods | 11 Precious Metals |
| 4 Financials | 8 Transportation | |

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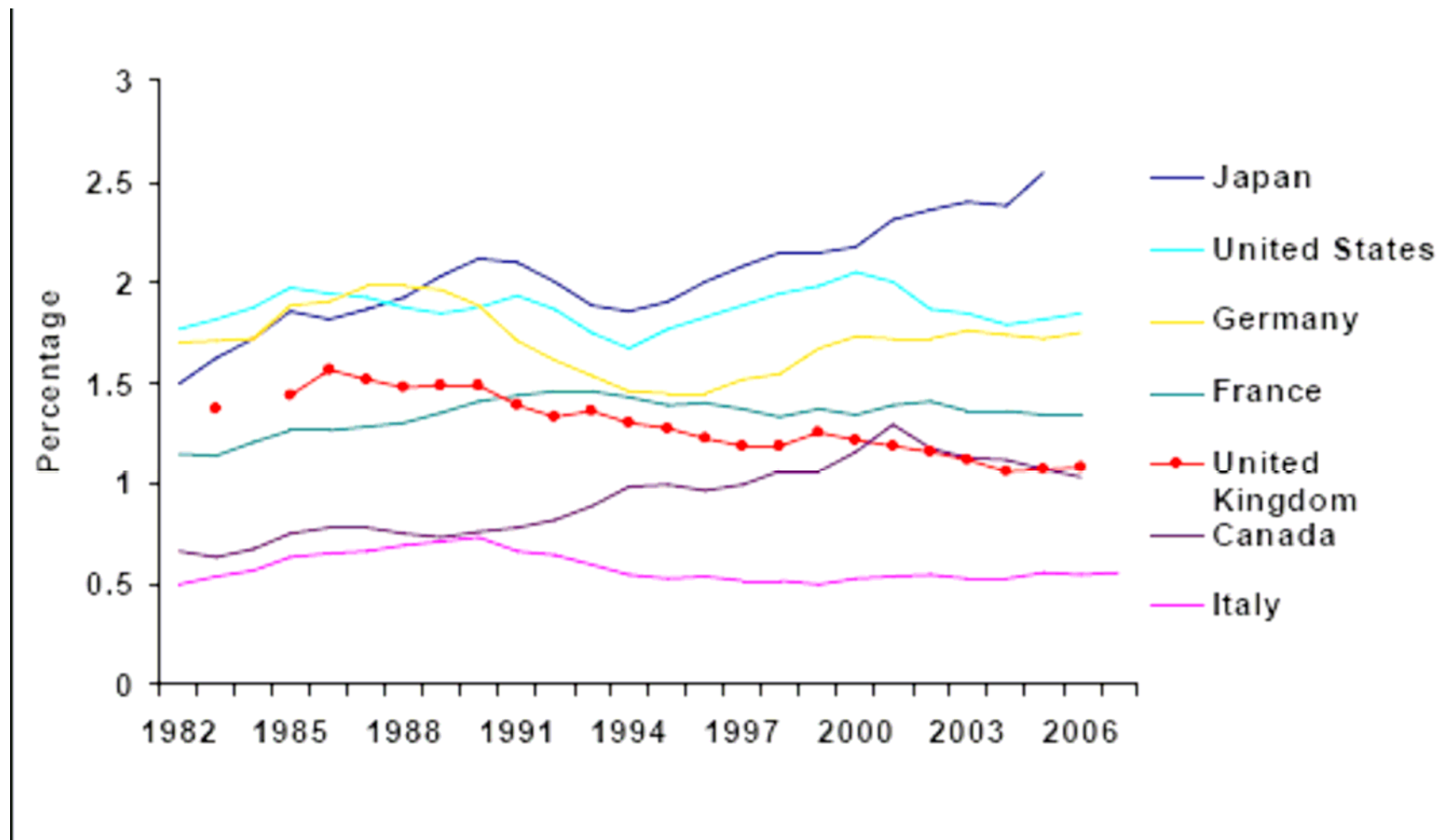
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International comparison of R&D Intensity (R&D/Sales)



Business R&D as % of GDP, G7 countries



Top 10 global companies by R&D spend (2007)

Company	Sector	Country	R&D (£M)
Pfizer	Pharmaceuticals & biotechnology	USA	3883
Ford Motor	Automobiles & parts	USA	3679
Johnson & Johnson	Pharmaceuticals & biotechnology	USA	3640
Microsoft	Software & computer services	USA	3638
DaimlerChrysler	Automobiles & parts	Germany	3526
Toyota Motor	Automobiles & parts	Japan	2485
GlaxoSmithKline	Pharmaceuticals & biotechnology	UK	3457
Siemens	Electronic & electrical equipment	Germany	3385
General Motors	Automobiles & parts	USA	3372
Samsung Electronics	Electronic & electrical equipment	S. Korea	3140

Top 10 UK companies by R&D spend (2007)

Company	Sector	R&D(£M)
1 GlaxoSmithKline	Pharmaceuticals & biotechnology	3457
2 AstraZeneca	Pharmaceuticals & biotechnology	1994
3 BAE Systems	Aerospace & defence	1248
4 BT	Fixed line telecommunications	1119
5 Unilever	Food producers	610
6 Ford*	Automobiles & parts	584
7 Royal Dutch Shell	Oil & gas producers	452
8 Airbus*	Aerospace & defence	445
9 Rolls-Royce	Aerospace & defence	411
10 Royal Bank of Scotland	Banks	382

Key Sector trends across UK850

Sectors	R&D (£M)
Pharmaceuticals & biotechnology	7420
Aerospace & defence	2392
Software & computer services	1208
Fixed line telecommunications	1127
Automobiles & parts	1087
Banks	869
Technology hardware & equipment	862
Food producers	847
Oil & gas producers	701
Electronic & electrical equipment	602
Other sectors	3813

Research for Business: Why do research in the UK?

- A very good science, engineering and technology base
- Stable macroeconomic environment
- Seen an increase in the levels of overseas business investment for commercial R&D conducted in the UK
- This investment is a good indicator of the continued competitiveness of the UK as a location of choice for the increasing globalisation of corporate R&D
- Support such as Grant for Research and Development and Knowledge Transfer Partnerships
- R&D tax credits works by allowing companies to deduct 150% under the SME scheme or 125%
- Regulations and guidelines to protect and resolve IPR issues between R&D labs and companies.

University Concerns	Business Concerns
sustainability and income	seeing IP in perspective
fairness (for institution and researcher)	failure to recognise non-cash input from business
academic freedom	protracted negotiations
commercial freedom	value for money
incentives to researcher	competitiveness of UK research (FEC, having to go abroad)
complying with rules/expectations of public funders	fairness
protecting the public good	commercial freedom
creating long term relationship	competitive advantage
getting long term buy-in from researchers	long term access to researchers

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Research for business: What you can do (1/2)

- Work out your company's current position in the business cycle
- Appreciate the current business and economic climate of your sector, UK and world
- Understand strategic roles of your CFO, COO, CTO, CIO (if available)
- Identify colleagues at work who can help steer R&D and meaningful investment in the company
- Identify what is already being done in your company from R&D and investment perspective

Research for business: What you can do (2/2)

- What is your company's product roadmap and long term perspective – How can R&D help?
- Understand your company's account – e.g. Opex, capex, Forward looking statements – are we in a growth cycle?
- Understand the tax incentives for R&D – Your company applied?
- Negotiate your manager 10-20% of your workload for research and innovation and have measurable objectives
- Define your level of engagements for R&D.

Active participation

- Key research elements – relate to conferences, magazines, online newsletters, forums, topics in your area
- Identify best industrial research labs, University research labs
- Find out about research councils and possible grants, joint projects
- Join, participate or contribute to Standard committees
- Government research or supporting research (e.g. DTI, CBI)
- Understand your key vendors roadmap and align your product roadmaps if appropriate – have you got an R&D roadmap?
- What are your sector's associations or forums? Join and actively participate

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