

TECHNOLOGY FORESIGHT IN A RAPIDLY GLOBALIZING ECONOMY

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STRUCTURE OF TALK

- Global Driving Forces and the Challenges for Technology Policy
 - What is Foresight and Why Is It Needed?
 - Evolution and Impact of Foresight
 - Early history - US, Japan
 - Last decade - US, Netherlands, Germany, France
 - UK Foresight Programme
 - Wiring Up the National/Regional System of Innovation
 - Conclusions
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GLOBAL DRIVING FORCES AND THE CHALLENGES FOR TECHNOLOGY POLICY

4 key drivers of change in the economy over coming decades - ***the 4 Cs***

- increasing **Competition**
 - increasing **Constraints** on public expenditure
 - increasing **Complexity**
 - increasing importance of scientific and technological **Competencies**
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C1 INCREASING COMPETITION

More ‘players’ in market economies + huge variations in labour costs + globalisation

→ Emphasis on innovation and knowledge-based economy, and on S&T

Also increasing concern about interaction between competitiveness and

- unemployment and working conditions
- inequality and social cohesion
- environment and sustainability
- new risks and their distribution cf. the benefits

→ Need for new national S&T policies that **balance** competitiveness against unemployment, inequality, sustainability, risk etc.

Requires new S&T policy analyses (e.g. of costs Vs benefits & their distribution, of national/regional strengths and weaknesses), indicators and policy tools (e.g. Foresight)

C2 CONSTRAINTS ON PUBLIC EXPENDITURE

Problem in most countries ∵ desire to balance budget

Constraints likely to grow ∵ (1) demography, (2) increasing costs/expectations of healthcare, education, social welfare, (3) reached political limits to tax-raising?

Will result in increasing demand for

- Accountability, effectiveness etc. → need new S&T policy tools
- Policies to develop technologies to deliver healthcare etc. more effectively
- Better justification for government funding of S&T

→ Need for a new ***social contract*** between researchers, funders and users

Challenge to S&T policy researchers to establish new/more effective mechanisms for linking researchers, funders and users - role for Foresight

C3 INCREASING COMPLEXITY

Driven by greater coupling and closer interactions of systems

Involves interactions between

- national, regional and global systems
- S&T and economy, politics, culture, environment
- public and private sectors (e.g. healthcare)
- different technologies - technology ‘fusion’
- different producers of knowledge (Mode 2)

→ Need for

- better understanding of complex systems
 - *flexible* policies/responses/systems
 - policy tools linking different partners and their needs, values etc.
 - increased and more effective networks, partnerships, collaboration
 - clear division of responsibility between national, regional & global policies
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C4 INCREASING IMPORTANCE OF SCIENTIFIC AND TECHNOLOGICAL COMPETENCIES

S&T **knowledge** becoming a strategic resource for companies and countries as well as vital to quality of life

Tacit knowledge especially crucial - best transferred through people/institutions interacting - need mechanisms to encourage

S&T **skills/expertise** ever more important in relation to wealth creation & quality of life

New technologies (1) demand new skills (2) make old skills obsolete

- Need for continuous **learning**
- individual - lifetime learning + technologies to support/encourage
- organisational - creation of 'learning organisation' - but how?

∴ Growing complexity and interaction of systems, need new/more generic and system-wide skills - interdisciplinary, team-working, networking, collaborating

Can be fostered through Foresight process

WHAT IS FORESIGHT? WHY IS IT NEEDED?

New generic technologies

- likely to have revolutionary impact on economy and society
- dependent on advances in basic research

Growing strategic importance of research and technology

Explicit longer-term policy for research and technology essential in era of growing international competition

Foresight is -

the process involved in systematically attempting to look into the longer-term future of science, technology, the economy, environment and society with the aim of identifying the emerging generic technologies and the underpinning areas of strategic research likely to yield the greatest economic and social benefits

Foresight is **NOT** the same as forecasting - a **process** not a technique

Not predicting but shaping or **constructing the future** by integrating S&T push with demand pull

ORIGINS AND EVOLUTION OF TECHNOLOGY FORESIGHT

United States

Early experiences with technology forecasting in 1950s and '60s - development of techniques (e.g. Delphi, scenarios), large forecasting exercises by DOD

Also Field Surveys (e.g. astronomy, life sciences) - provided overview of field + platform to educate industry and government but largely ignored economic and social demands and failed to identify priorities ∴ Impact limited

Japan

STA 30-Year Forecasts - provide a 'holistic' overview, incorporate economic & social needs as well as S&T advances, forecasts have 2 aspects - predictive + normative (setting goals)

Process benefits more important than specific forecasts - **the '5 Cs'** - Communication, Concentration on the longer term, Co-ordination, Consensus, and Commitment
==> high accuracy (1970 Forecasts - 64% fully or partially realised in first 20 years)
forecasts become goals and then self-fulfilling prophecies

Different levels of foresight - holistic, macro, meso and micro - each draws upon, and feeds into, higher and lower levels - i.e. **a national foresight system**

Technology Foresight in a Rapidly Globalizing Economy

DEVELOPMENTS IN LATE 1980s

US

Late 1980s - upsurge of interest in foresight ∵ concern about declining competitiveness

Foresight exercises by e.g. DOD, Department of Commerce, Council on Competitiveness, Aerospace Industries Association - to identify short list of critical technologies using explicit selection criteria applied to initial long list

Over-reliance on a committee - limited interaction with industrial and scientific communities ® less commitment to results

Netherlands

Foresight exercises by Ministry of Economic Affairs - consultation + 5 selection criteria
® 3 areas - analysis, strategic conf of stakeholders to test results, create consensus & commitment, then follow-up (e.g. pilot project, new institute). Repeated every 2 years

Time-consuming (especially to involve SMEs) but results valuable to participants (75%) and many implemented (60%)

Other foresight exercises by Ministries of Education and Science, and Agriculture

DEVELOPMENTS IN EARLY 1990s

Germany

Post-1990 - upsurge of interest in research and technology foresight

ISI and BMFT Projektträger - identified list of 100 emerging technologies

30-Year Delphi Survey of S&T - collaboration with Japan - used Japanese qu's - comparison with Japanese results - similar realisation times but differ over importance & constraints (different national systems of innovation). Repeated 5 years later

Other foresight exercises at level of Länder, industrial sectors (e.g. chemicals), in-house foresight by companies

France

Ministry of Industry - identification of 'key technologies' in 1994 - repeated in 1999

Ministry for HE & Research - Delphi survey (using Japanese qu's) → comparison of views of French experts with German and Japanese

Other lower-level foresight exercises e.g. at regional level

UK TECHNOLOGY FORESIGHT PROGRAMME (TFP)

1983 SPRU report - learn from Japan & try foresight on an experimental basis - little impact - 10 years too early!

1992 SPRU review - 1993 White Paper launched foresight programme

Aims = to increase competitiveness, create industry/science base/government partnerships, make better use of science base and identify exploitable technologies

TFP - Three Phases

1. **Pre-Foresight** - 'Focus on Foresight' seminars, 'co-nomination' to identify experts, selection of 15 sectors and panels

2. **Main Foresight Stage** - Initial analysis - panel discussions, consult expert pools, wider consultation (regional workshops etc.), Delphi survey

Panel reports - trends, driving forces, challenges, barriers ® identified S&T priorities + recommendations for implementing

Steering Group synthesis - identified **generic** S&T and infrastructural priorities

3. **Post-Foresight** - influence government R&D priorities & wider policy, influence company R&D strategies, & improve industry/science base partnerships

UK TFP (continued)

27 Generic Science and Technology Priorities

e.g. communicating with machines, bio-informatics, chemical & biological synthesis, security & privacy technology, product & manufacturing life-cycle analysis, risk assessment & management

Classified into 6 categories - ICTs, biotech, materials, management/business processes, environment, and social impact

Identified main bottlenecks e.g. getting potential of technology understood by managers, workforce, consumers; complementing new technology with right skills; freeing up markets

18 Generic Infrastructure Priorities

e.g. communication skills, incentives for multidisciplinary research, information superhighway, special incentives for SMEs, supportive regulations (environmental, financial & communications)

Classified into 5 categories - education, research, communications, financial, policy and regulatory infrastructures

UK TFP (continued)

Impact

- Process benefits (the 5 Cs) substantial - addressed areas of UK weakness
- Foresight Challenge Fund - >£90M of government + matching private funds
- Re-orientation of spending by Research Councils + Ministries (partly)
- Impact on companies - engaged decision makers, influenced sectors without track record of working with science base, provided case studies + industrial champions

1997 - Labour Government - review ® continue & strengthen Foresight

Second Foresight Programme, 1999-2001

- Learn from 1st and improve
- Getting foresight into boardrooms, City, SMEs etc. - change in title
- More emphasis on societal aspects (e.g. ageing population, crime)
- Delphi dropped but introduced digital 'knowledge pool'
- Panels reported and final results expected soon

ASSESSMENT OF 1ST UK FORESIGHT PROGRAMME

Strengths

- Learnt from overseas experiences but evolved approach suited to UK
- Pre-foresight developed enthusiasm in scientific and industrial communities
- Co-nomination ® large numbers of new people involved
- Generated impressive amount of info on longer-term future
- Process benefits substantial - **5 Cs** - all areas where UK previously weak

Weaknesses

- Time-scale too tight
 - Limited amount of data used by panels
 - Uncertain relationship between OST & Gov't departments (especially post -1995)
 - Over-emphasis on Research Councils spending cf. Government departments?
 - Weaker on implementation + action
 - Only limited success in encouraging other levels of foresight to take root
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FORESIGHT AS A TOOL FOR ‘WIRING UP’ THE NATIONAL SYSTEM OF INNOVATION

Concept of ‘national (or regional) innovation system’ - emphasis on *linkages*

Many important innovations characterised by technology confluence and fusion

Requires multi-disciplinary/institutional/sectoral effort - i.e. networks, partnerships

Need for systemic policies + mechanisms to strengthen innovation system so that it becomes more effective at learning and innovating

Technology Foresight ® more effective knowledge distribution

- ® enhanced learning
- ® greater capacity for innovating

Foresight = a tool for ‘wiring up’ the national innovation system

CONCLUSIONS

- Increasing importance of science and technology in knowledge-based economy
 - ⑧ need for more explicit policy for S&T
 - Growing recognition that foresight a useful tool for decision-making on research and technology at macro, meso and micro levels
 - Japan - 30 years of experience
 - Post 1990 - many other countries taken up Foresight and now deriving benefits
 - No approach to foresight is perfect - each has strengths and weaknesses
 - Balancing S&T push against demand pull crucial to success of foresight
 - Individual countries and organisations may adopt different approaches
 - Japan, Germany, France, UK - used Delphi
 - cf. Netherlands and Australia - panels, commissioned studies, networks etc.
 - Foresight offers policy tool for 'wiring up' the national/regional innovation system so can learn and innovate more effectively
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