60 Years of Innovation Studies – What Have We Learned? What Are the Challenges?

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Introduction

Structure

- Nature of field
- Evolution of research agenda over last 60 years
- 20 major advances in understanding
- Impact on policy/management agenda?

- Have we kept up with changing world?
- 15 Emerging challenges
- Some concluding questions

Scope of field

"Economic, policy, management and organisational studies of science, technology and innovation (STI) with a view to providing useful inputs to decision-makers concerned with policies for and the management of STI."

Primary focus = policy/management issues rather than theory

Research multi/inter-disciplinary – 'Mode 2'

Grown from a dozen or so researchers in 1950s to several thousand today

Scope of field

Terminology changed over time

- Science/research policy, eng/R&D management
- S&T policy, technology & innovation management
- Neo-Schumpeterian/evolutionary economics, innovation studies

'Innovation studies'

- Policy – science/research, technology, innovation
- Economics – science, technology, innovation
- Management – R&D, technology, innovation, knowledge
- Organisational studies – innovation, resource-based view of the firm, organisational learning
- Sociology – e.g. diffusion of technology & innovation (but excluding 'science and technology studies'/STS)
- History of technology and innovation, econ/bus history
- Psychology – org psychology, psychology of creativity

What have we learned?

Field now ~60 years old

Evolution of research agenda?

What have we learned about the interaction between science, technology and innovation, and the nature of the innovation process?

What have been the key developments in our understanding?

How have these helped us with improving policies for, and the management of, innovation?

Previous reviews

Reviews of literature in books, review articles

But most based on

- subjective assessment
- limited aspect/perspective

Tried to adopt

- rigorous approach to identifying main contributions
- global perspective on entire field of science policy & innovation studies

Identified 20 key advances in our knowledge (Martin, 2012)

Methodology

Search for high-impact publications

- No obvious measure of impact on policy/practice
- Use HCPs as indicator of high academic impact, then subjectively assess impact on policy/practice
- Assumes most highly cited = most influential
- Also various problems and biases with *SSCI*

Starting point

- List of ~600 leading STI policy authors
- Surveyed ~80 journals
- Key word search

Identified ~200 publications with >250 citations (smaller threshold for more recent publications)

From these, synthesised 20 major advances

1. From individual entrepreneur to corporate innovators

Schumpeter (1934, 1939, 1942)

- One of few economists in early 20th Century to recognise importance of innovation
- Innovation central in competition between firms
- Key distinction between 'invention' and 'innovation'
- 'Schumpeter Mark I'
  - stressed central role of individual entrepreneur
- 'Schumpeter Mark II'
  - gave increasing importance to collective innovative activities of large firms and in-house R&D
  - reflected changes in US industry in mid-20th Century
- But still examples of Schumpeter Mark I (especially in IT)

2. From *laissez faire* to government intervention

Pre-WWII – limited involvement of govt in R&D & innovation, except in agriculture & medicine

WWII – Manhattan project, radar, cryptography etc.

Post-WWII – major R&D programmes in defence, nuclear energy, space, health etc.

Based on belief in 'linear model' of innovation (Bush, 1945)

Basic res → Applied res → Tech devlpt → Innovation

Simple, clear (and convenient!) model

1950-60s – Gov't emphasis on supply-side policies

- Public investment in R&D
- Training of QSEs

2. From *laissez faire* to government intervention

Economic justification for gov't intervention in STI based on 'market failure'

Nelson (1959), Arrow (1962)

- Scientific knowledge a 'public good' – i.e.
  - 'non-rival'
  - 'non-excludable'
- Because they can't appropriate all the benefits from their investment, private firms tend to under-invest in R&D
- To achieve socially optimal level of investment in S&T, govt ∴ needs to fund R&D
- Public funding thus expands pool of economically useful knowledge

3. From 2 factors of prod'n to 3

Solow (1957)

- Economic growth not just ∴ changes in labour & capital
- A large 'residual' – attributed to technical change

Griliches (1957, 1958)

- High rates of return to R&D
- Social rate of return > private rate of return

Other important contributions by

- economists, e.g. Mansfield (1961, 1968), Schmookler (1966), Scherer (1965, 1970)
- economic historians, e.g. Gerschenkron (1962), David (1975), Rosenberg (1976)
- Freeman and SPRU colleagues
  - *The Economics of Industrial Innovation* (1974 + later editions)
  - 'Long waves' and economic development (1982)

4. From single division to multi-divisional efforts

Burns & Stalker (1961), *Management of Innovation*

- Technological innovation influenced by different forms of organisation (e.g. mechanistic VS organic) with associated communication patterns
- Successful innovation requires integration of R&D with knowledge of market etc. – often hindered by internal divisions in the firm

Zaltman et al. (1973), *Innovations and Organisation*

Allen (1977), *Managing the Flow of Technology*

- Importance of communication flows
- Certain organisational structures enhance innovation

5. From technology adoption to innovation diffusion

Adoption of technology not just a single point event but a gradual process of diffusion

Coleman et al. (1957, 1966)

- individ's/org'ns respond to innov'n opportunities in different ways
  ➔ 'social contagion' model of diffusion

Rogers (1962 + later editions), *Diffusion of Innovations*

- diffusion of tech'y & innovation often follows logistic 'S-curve'
  - slow diffusion, rapid growth, growing saturation, then slow-down
- different categories of innovators
  - early adopters, early majority, late majority, laggards

Vernon (1966)

- four-stage model of the product cycle
  - new goods (i.e. innovations) generally developed first in industrialised countries, then diffused to LDCs as product matures

Model later formalised by Krugman (1979)

6. From sc push to demand pull

Science-push model – Bush (1945)

- Provided rationale for govt funding
- Favoured by scientists

Demand-pull model – changed market demand 'calls forth' innovation

Mkt demand ➔ App res ➔ Tech devlpt ➔ Innovation

- Often attributed to Schmookler (1966)
- Model picked up by e.g. Myers and Marquis (1969)
  - Study of >550 innovations in 5 industries
  - "Recognition of demand is a more frequent factor in innovation than recognition of technical potential"

2 models have very different policy implications, so various empirical studies to investigate

Science push VS demand pull

- Project Hindsight (1967) – DoD funded
  - Study of 20 military innovations
  - Critical research events primarily ‘technology’ rather than ‘science'
  - 95% of critical research events directed towards a DoD need
    ➔ demand pull more important
  - BUT arbitrary cut-off point of 20 years
- TRACES (1968) – NSF funded
  - Study of 5 civilian innovations
  - Much longer time-period
  - 70% of critical research events ‘non-mission-oriented’
    ➔ science push more important
- Battelle (1973) – NSF funded
  - Study of ~10 civilian innovations
  - ‘Recognition of technical opportunity’ important in 89% of decisive events, cf. 69% for ‘recognition of need’

Science push VS demand pull

- Comroe & Dripps (1976) – NIH funded
  - Key research underpinning advances in cardiovascular medicine
  - 62% of the research 'basic' – pays off "twice as handsomely"
- Langrish et al., *Wealth from Knowledge* (1972)
  - Study of 84 innovations
  - Innovation "must involve synthesis of some kind of need with some kind of technical possibility"
  - Rejected simple linear models – "the sources of innovation are multiple"
- Mowery & Rosenberg (1979) review
  - Innovation an "iterative process, in which *both* demand and supply forces are responded to"
  - i.e. both demand and supply side influences crucial to understanding the innovation process

7. From single factor to multifactor explanations of innovation

Early studies – focus on ***successful*** innovations

Project SAPPHO (Rothwell et al., 1974)

- 43 matched pairs of successful & unsuccessful innovations
- Most important factor = 'user needs understood'
- Other significant factors include
  - attention to marketing
  - size of project team
  - good communication with ext scientific community
  - support of senior 'product champion'
  - coordination of R&D, production & marketing
- Success not greatly affected by
  - R&D organisation, incentives, academic qualifications of staff, size of firm, no. of QSEs, project planning, growth rate of firm

Subsequent work on how best to manage & exploit innovation

- e.g. Hayes & Wheelwright (1984), Abernathy & Clark (1985), Teece (1986), Womack et al. (1990), Clark & Fujimoto (1991), Utterback (1994), Christensen (1997)

8. From a static to a dynamic model of innovation

Abernathy & Utterback (1975 & 1978) – dynamic model of product & process innovation

- Initial period dominated by radical product innovation
- Attracts new entrants ➔ several competing designs
- Process innovations then become more important
- Emergence of a dominant design
  - QWERTY typewriter
  - Model T Ford
  - Hoover
  - Boeing 747
  - IBM PC
  - iPhone

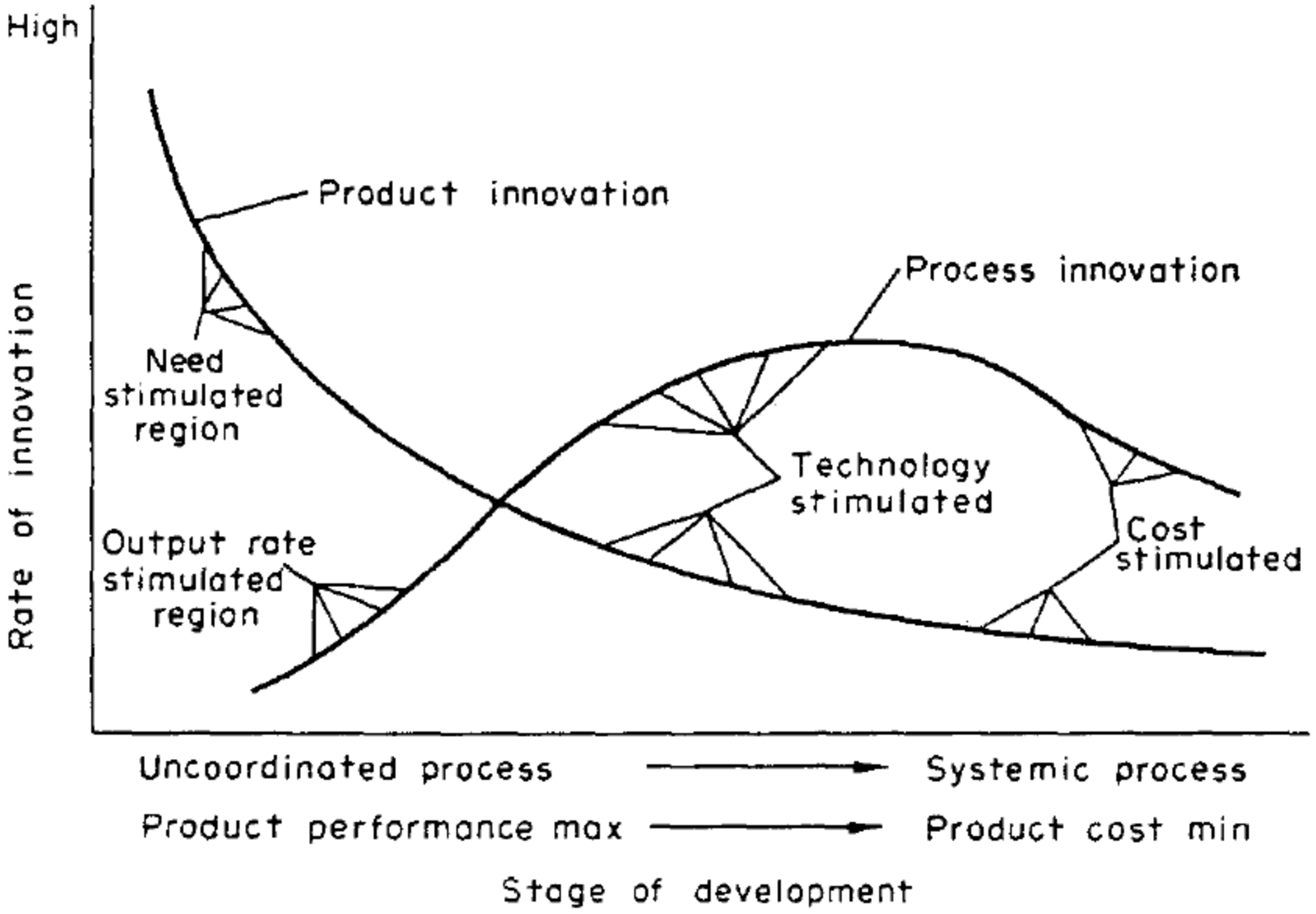


FIG. 1. *Innovation and stage of development.*

9. From the linear model to the interactive ‘chain-link’ model

Kline and Rosenberg (1986)

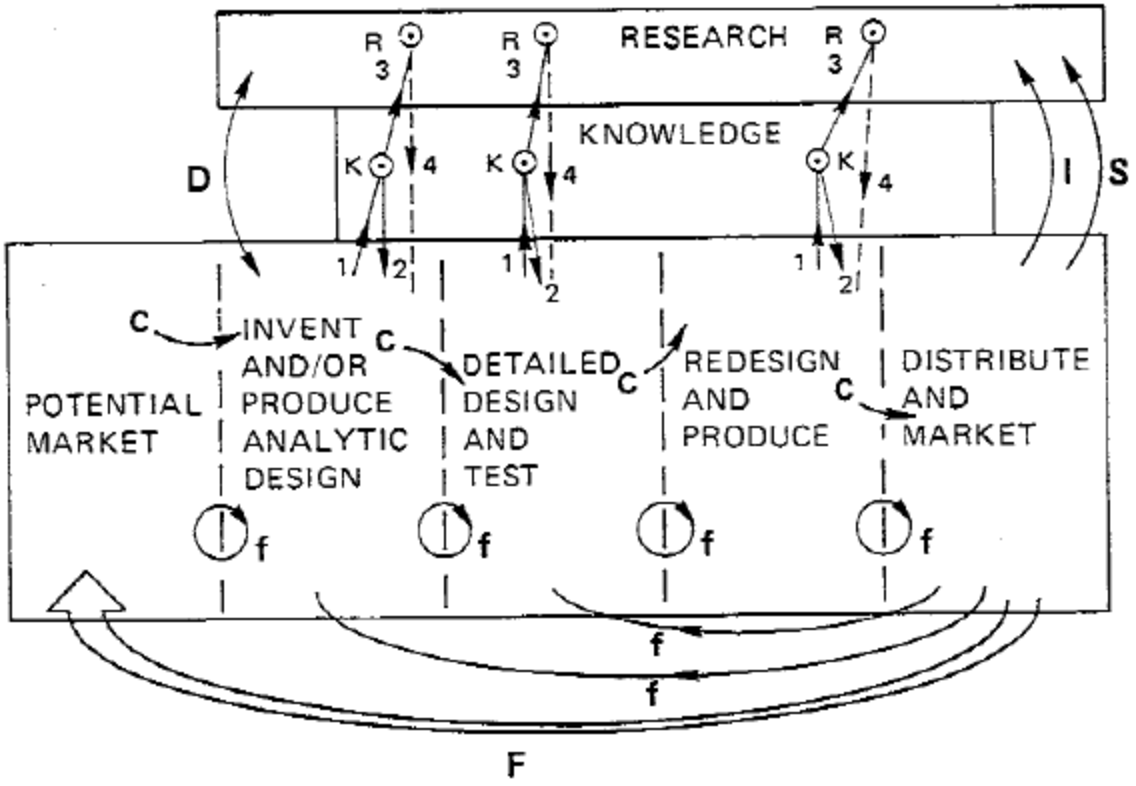


FIGURE 3 Chain-linked model showing flow paths of information and cooperation. Symbols on arrows: **C** = central-chain-of-innovation; **f** = feedback loops; **F** = particularly important feedback.

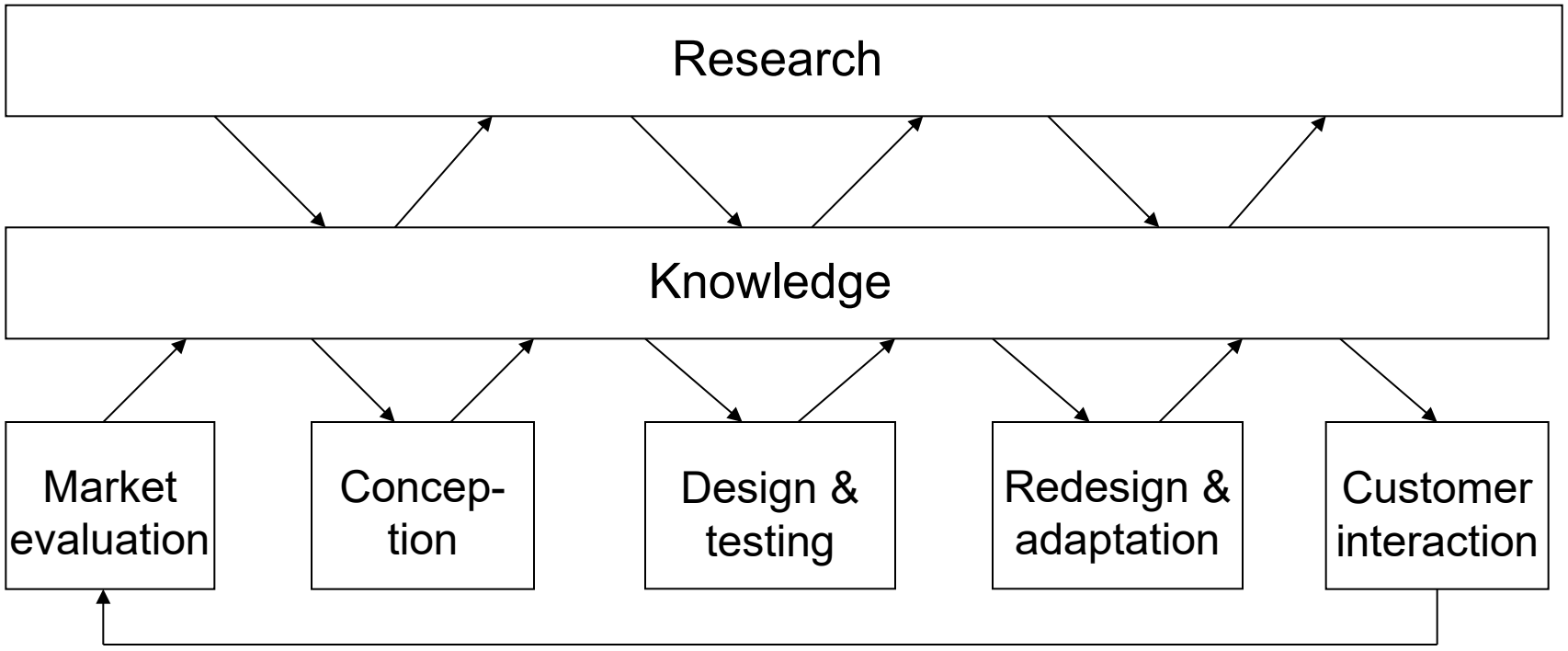
K–R: Links through knowledge to research and return paths. If problem solved at node K, link 3 to R not activated. Return from research (link 4) is problematic—therefore dashed line.

D: Direct link to and from research from problems in invention and design.

I: Support of scientific research by instruments, machines, tools, and procedures of technology.

S: Support of research in sciences underlying product area to gain information directly and by monitoring outside work. The information obtained may apply anywhere along the chain.

9. From the linear model to the interactive 'chain-link' model



Adapted from Kline & Rosenberg (1986)

A better representation of (complex) reality

- But harder to use for policy/management purposes

STI researchers keep 'slaying' ***the*** linear model

- But what happened to the other linear model?

10. From one innovation process to several sector-specific types

From earlier empirical studies, clear that sources & nature of innovation process vary with sector

Pavitt (1984) – analysed sectoral patterns

- SPRU database of ~2000 innovations
- Taxonomy of sectors
  - supplier-dominated
  - scale-intensive
  - specialised equipment suppliers
  - science-based
- Taxonomy resolves some earlier differences in empirical findings re
  - S&T push VS demand pull
  - product VS process innovation
  - relationship between firm size and innovation

Later work shows this sectoral approach too static

11. From neo-classical to evolutionary economics

Nelson & Winter (1977)

- 'In search of a useful theory of innovation'
- Existing economic literature fundamentally flawed

Nelson & Winter (1982), *An Evolutionary Theory of Economic Change*

- Technological change and innovation central – generate '**variation**' in form of new products, services etc.
- Firms compete with these products/services – market provides '**selection**' mechanism
- Products/services strongly influenced by 'routines' within firms – provide '**self-replication**' mechanism
- Analogy with biological evolution and 'survival of the fittest'
- Single most cited publication in field
- Cited by most social scientists apart from economists!

12. From old to new growth theory

Solow (1956) – neo-classical economic growth theory

- Technology treated as exogenous

David (1985), Katz and Shapiro (1986)

- Technology adoption ➔ network externalities

Romer (1986, 1990) – 'New/endogenous growth theory'

- Neo-classical econ's – can't explain rate of growth – depends on exogenous factors e.g. rate of savings, rate of tech change
- Human capital and new technologies crucial – latter can generate 'increasing returns' (Arthur, 1989)
- R&D can create important 'spillovers' (Jaffe, 1986)
- Investment in education & R&D can boost growth, as can other incentives to innovate (e.g. patents)

  ➔ investment in 'intangibles' cf. previous emphasis on investment in 'tangibles' (e.g. capital goods)

Further developed by Grossman & Helpman (1991) and Aghion & Howitt (1992, 1998)

13. From the optimising firm to resource-based view of the firm

Neo-classical economists

- Firm = an optimising organisation, with perfect information & rationality

Resource-based view of the firm (RBV)

- e.g. Wernerfelt (1984), Grant (1991, 1996)
- Firm = a collection of resources (human, physical, etc.)
  - e.g. brand names, technological knowledge, equipment, skilled personnel, trade contacts, efficient procedures, capital
- Built on earlier work by Coase (1937) and Penrose (1959)

13. From the optimising firm to the resource-based view of the firm

Subsequent work on e.g.

- knowledge & competence as strategic assets (Winter, 1987)
- absorptive capacity (Cohen & Levinthal, 1990) (see below)
- core competences (Prahalad & Hamel, 1990)
- the learning organisation (Senge, 1990)
- organisational learning & 'communities of practice' (Brown & Duguid, 1991)
- learning 'myopia' (Levinthal & March, 1993)
- core capabilities & rigidities (Leonard-Barton, 1992)
- dynamic capabilities (Teece et al., 1997; Eisenhardt & Martin, 2000; Zollo & Winter, 2002))
- social & intellectual capital (Nahapiet & Ghoshal, 1998)

14. From individual actors to systems of innovation

Freeman (1987) – success of Japan heavily dependent on wider national system of innovation (NSI)

Lundvall (1988, 1992), Nelson (1993) – extended to other countries

NSI definition

> "that set of distinct institutions which jointly and individually contribute to the development and diffusion of new technologies and which provides the framework within which governments form and implement policies to influence the innovation process. As such it is a system of inter-connected institutions to create, store and transfer the knowledge, skills and artefacts which define new technologies." (Metcalfe, 1995)

How effectively a NSI operates depends not just on the strength of the individual actors (companies, gov't labs, universities etc.) but more particularly on **the strength of the links** between them

15. From market failure to system failure

Nelson (1959) & Winter (1962)

- Private firms tend to under-invest in R&D
- To overcome this 'market failure', government needs to fund R&D

cf. new rationale – govt needs to overcome '**system failures**' & develop/strengthen links in NSI (e.g. Smith, 2000)

- From 'picking winners' to building/strengthening links
- e.g. via networks, collaboration, strategic alliances etc.
- Technology Foresight as a means of 'wiring up the national system of innovation'

16. From one to 'two faces' of R&D

Cohen & Levinthal (1989 & 1990) – two roles (or 'faces') of in-house company R&D

- to develop new knowledge internally
- to identify potentially useful external knowledge, access and quickly exploit it

Concept of 'absorptive capacity' – crucial for

- combining technologies (see below)
- successful open innovation (see below)

Jaffe et al. (1993) – R&D generates 'spillovers'

- firms need to be in position to exploit effectively spillovers generated by others

17. From Mode 1 to Mode 2?

Gibbons et al. (1994), *The New Production of Knowledge*

- Mode 1 – discipline-based, largely in academic institutions, primarily concerned with furthering knowledge, subject to internal scrutiny
- Mode 2 – transdisciplinary, in variety of institutions, pursuing knowledge 'in the context of application', subject to ext accountability
- Shift over time from Mode 1 to Mode 2?
- But disputed by historians of science and technology

'Pasteur's Quadrant' – Stokes (1997)

- Research that is aimed **both** at increasing knowledge **and** at generating useful results – cf.
  - Bohr's Quadrant – aimed solely at increasing knowledge
  - Edison's Quadrant – aimed solely at generating useful results

'Triple Helix' (Etzkowitz & Leydesdorff, 1997)

- Growing 3-sided interaction of universities, industry and government
- 'The second academic revolution' – adoption of '3rd Mission'
  ➔ emergence of 'the entrepreneurial university'

18. From single-technology to multi-technology firms

Many major innovations involve bringing together previously separate streams of technology

- 'confluence' or 'technology fusion' (Kodama)

Granstrand, Patel & Pavitt (1997)

- Technological diversity of growing importance to innovation
- In some sectors, firms need to combine several technologies

  ➔ Need for strategic alliances, links with universities etc.

19. From national to multi-level systems of innovation

NSI concept extended to other dimensions

- ***Regional system of innovation*** – e.g. Saxenian (1994), Jaffe et al. (1993), Audretsch & Feldman (1996), Morgan (1997), Cooke & Morgan (2000)
- ***Sectoral system of innovation*** – e.g. Malerba, Breschi, Orsenigo, McKelvey
- ***Technological systems*** – e.g. Bijker & Hughes, Carlsson

Regional system of innovation also influenced by e.g. cultural factors

- R Florida (2002) – cities/regions with more cultural diversity & 'bohemian' lifestyles more creative/ innovative?

Firms need to have effective links with all these different levels of systems if to benefit fully

20. From closed to open innovation

Knowledge required for innovating becoming more organisationally dispersed (?)

Locus of innovation shifting from within the firm to networks, alliances, collaborations etc. – i.e. innovation increasingly co-produced with partners (suppliers, users, universities etc.)

Variously characterised (e.g. by Powell et al., 1996; Chesborough, 2003; von Hippel, 2005) as

- open innovation
- networked innovation
- distributed innovation
- interactive innovation
- democratic innovation

Firms need good links with external knowledge sources + ability to exploit these promptly & effectively

20 developments in innovation studies

From individual entrepreneur to corporate innovator

From *laissez faire* to government intervention

From 2 factors of production to 3

From single division to multi-divisional efforts

From technology adoption to innovation diffusion

From science push to demand pull?

From single factor to multi-factor explanations of innovation

From static to dynamic model of innovation

From linear model to interactive 'chain-link' model

From one innovation process to several sector-specific types

From neo-classical to evolutionary economics

From neo-classical to new growth theory

From optimising firm to resource-based view of the firm

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From one to 'two faces' of R&D

From Mode 1 to Mode 2

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Impact on T&I management

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Where next?

Have we kept up with our changing world?

Or are we

- like generals, still ‘fighting the last war’?
- like politicians, “in the thrall of the ideas of some long-dead economist”?

Focus of many innovation studies still reflects central issues of previous decades

Need to refocus research agenda on new/emerging challenges

But how to identify?

MATHEMATICAL PROBLEMS.*

LECTURE DELIVERED BEFORE THE INTERNATIONAL CONGRESS OF MATHEMATICIANS AT PARIS IN 1900.

BY PROFESSOR DAVID HILBERT.

WHO of us would not be glad to lift the veil behind which the future lies hidden; to cast a glance at the next advances of our science and at the secrets of its development during future centuries? What particular goals will there be toward which the leading mathematical spirits of coming generations will strive? What new methods and new facts in the wide and rich field of mathematical thought will the new centuries disclose?

History teaches the continuity of the development of science. We know that every age has its own problems, which the following age either solves or casts aside as profitless and replaces by new ones. If we would obtain an idea of the probable development of mathematical knowledge in the immediate future, we must let the unsettled questions pass before our minds and look over the problems which

Identifying the challenges

- Can one identify a set of challenges for IS?
- Challenges need to be “difficult in order to entice us, yet not completely inaccessible” (Hilbert)
- Harder than in maths as IS more subject to unpredictable external influences
- Many of the challenges not ‘new’ – but tried to bring together in systematic comprehensive way
- First need to construct a robust viewing platform
- Given continuity & path-dependence, past may offers clues to future directions

The challenges

- Hard to be as precise in formulation of challenges confronting innovation studies as in mathematics
- First ten are couched in similar terms to major shifts in past – i.e. 'from X to Y'
- Five represent more general challenges for field of innovation studies and its practitioners
- Identified 15 challenges in total

1. From visible innovation to 'dark innovation'

- 'Innovation' conceptualised, defined & measured in terms of dominant forms of innovation from several decades ago
- Developed indicators to 'measure' this – e.g. R&D funding, no's of researchers, patents
- These 'missing' much innovative activity – (i) incremental, (ii) not in form of manufactured product innovations, (iii) involves little formal R&D, (iv) not patented – e.g.
  - incremental process innovations in factories of China etc.
  - financial innovations, organisational innovations, social innovations
- cf. cosmology – observations reveal only a fraction (~5%) of universe – rest = dark matter or dark energy
- Challenge = to conceptualise, define and devise methods for measuring, analysing and understanding 'dark innovation'

2. From ‘boy’s toys’ to mundane but liberating innovations

- Many in IS made names in 1980s/90s when focus on high-tech manufacturing
- Empirical focus of their work?

Sector focus of *RP* papers

Search on *Google Scholar* – "innovation" AND

computer/PC	717
car/automobile	284
television/TV/radio	209
camera/video	134
video/electronic/interactive game	120
hard disk/disk drive	42
cell/mobile phone	37
VS	
refrigerator/freezer/fridge	11
washing machine/tumble drier	6
vacuum cleaner	2
washing powder/detergent	2
domestic/toilet/kitchen/bathroom cleaner	0

2. From ‘boy’s toys’ to mundane but liberating innovations

- Many in IS made names in 1980s/90s when focus on high-tech manufacturing.
- Tendency to focus on ‘boy’s toys’ cf. other innovations that have improved human lives
- Skewed our search for methodological tools, indicators, analytical frameworks, models?
- Those developed less applicable to other forms of innovation
- Challenge = to give more equal treatment to mundane innovations that have done/could do more for humanity e.g. in liberating women from household drudgery or the poor from poverty

3. From national and regional to global systems of innovation

- Concept of 'national system of innovation' one of most important to emerge from IS in last 25 years
- But not all innovative activity 'national'
- Key players in innovation are MNCs – increasingly operate on global scale
- Forging links between national systems of innovation – starting to see emergence of *global* systems of innovation
- Challenge to IS researchers = to analyse these global systems & interactions with national systems
- Likely to have major policy implications e.g. for policies for tackling global problems

4. From innov'n for productivity to innov'n for sustainability

- During 1980s/'90s, political & economic agenda dominated by concerns with economic competitiveness, productivity, wealth creation etc.
- Innovation seen as key ➔ policies to stimulate
- Little concern with sustainability etc. so concepts, indicators, models etc. all oriented to innovation for productivity
- Reflected in choice of empirical topics by IS scholars

Productivity VS Sustainability

Search on *Google Scholar* among *RP* papers

	1980-89	1990-99	2000-09	2010-2019
Productivity	90	228	595	919
Sustainability	0	11	113	335

4. From innov'n for productivity to innov'n for sustainability

- During '80s/'90s, pol & econ agenda dominated by concerns with econ competition, productivity, etc.
- Innovation seen as key ➔ policies to stimulate
- Little concern with sustainability etc. so concepts, indicators, models etc. all oriented to innovation for productivity
- Reflected in choice of empirical topics by IS scholars
- Late 1990s, increasing concern ➔ a few IS scholars became interested in innovation for sustainability
- Drew extensively upon inputs from STS ➔ work on socio-technical transitions, niches etc.
- Starting to have an impact but still much to be done before we complete transition to 'green innovation'

5. From innovation for econ growth to innovation for sustainable dvlpt

- Despite removing 100s of millions in China etc. from poverty, billions yet to benefit from econ development (and innovation)
- Poses challenges for IS community
  - Lundvall (2012) – ideas on linking IS research to development economics
- Even after efforts of GLOBELICS, still far to go
- Challenge for IS scholars = to develop the conceptual, methodological and analytical tools to facilitate shift to innovation for sustainable development through appropriate policies

6. From risky innovation to socially responsible innovation

- STI central in improving econ & social conditions
  - e.g. increased life expectancy (~80% due to tech progress – Jamison et al., 2016)
- But also brought risks and unintended consequences
  - e.g. damage to environment, adverse effects on quality of life
- Technology led to increase in overall risk (Beck)?
- Previous IS work to address risk e.g. tech'y assessment
- Substantial inputs from STS
  - e.g. on constructive technology assessment; public understanding of science; ethical, legal & social implications of research; the precautionary principle
- Given rise to a call for 'responsible innovation'
- Although some begun to respond to this challenge, still much to do in coming decades

7. From innov'n for wealth creation to innovation for well-being

- For centuries, 'progress' seen in terms of 'more is better'
- Political agenda driven mainly by economic growth – tyranny of GDP
- Assumed more wealth and 'stuff' ➔ improved well-being – probably true for most of history
- Again, reflected in IS studies

Wealth VS Happiness

Search on *Google Scholar* among *Research Policy* papers

	1980-89	1990-99	2000-09	2010-19
wealth/profit	94	206	523	693
happiness/ well(-)being	8	13	35	109

7. From innov'n for wealth creation to innovation for well-being

- For centuries, 'progress' seen in terms of 'more is better'
- Pol agenda driven mainly by econ growth – tyranny of GDP
- Assumed more wealth and 'stuff' ➔ improved well-being – probably true for most of history
- But (i) research on well-being suggests assumption only true up to a certain income – the Easterlin paradox;
  (ii) world can't support population of ~9 billion, all with US living standards
- ∴ Pol & econ agenda and notion of progress must change
- Shift from innov'n for wealth to innov'n for well-being
- Need policies to stimulate this – implies development of appropriate methods, indicators, conceptual frameworks
- Work begun by a few, but need to build on this if shift to innovation for well-being to be achieved

8. From ‘winner take all’ to ‘fairness for all’?

- “Polarisation and growing inequality inherent in the globalising learning economy” (Lundvall, 2012)
- Growing incidence of ‘winner take all’ phenomenon
  - i.e. one organisation benefits from an innovation to a far greater extent than competitors with only marginally inferior products
  - e.g. IT (Microsoft, Intel, Oracle, Apple, Google, Facebook)
- IS not to blame for this, but are we complicit?
- Can’t simply claim “not out fault” – moral responsibility
- Have a duty to explore whether we can say something about how firms might generate innovations that, instead of creating a few billionaires, result in ‘fairness for all’
- Lundvall (2012) – IS needs to adopt more critical perspective? Forge closer links with STS?
- Carlota Perez (2012) – ‘Innovation systems and policy: not only for the rich?’

9. From government as fixer of failures to the entrepren'l state

- Under neo-liberalism, gov't seen as playing restricted role
  - Task = to ensure the macro-economic climate OK for free-market capitalism, then 'get out of the way'
- Contrast between public and private sector
  - Former lumbering, bureaucratic, inefficient, while latter nimble, efficient and 'entrepreneurial'
- Underplays entrepreneurial role of state with regard to crucial innovations
  - e.g. pharmaceuticals, microchips, Internet, World-Wide Web, cell phones, GPS
- Unrealistic to assume that *all* policies will be successful
  - cf. research, entrepreneurial initiatives
- If govt's don't take risks in policies, may not have failures, but won't have any great successes either
- Need to change our conception of gov't from fixer of failures to 'the entrepreneurial state' (Mazzucato, 2011)

10. From faith-based policy to evidence-based policy?

(Steinmueller, 2012)

- Underpinning philosophy of IS pioneers based on assumption that STI fundamental to econ & social progress, but need effective policies
- Further assumed STI could ➔ better policies, and resulting evidence-based policies would ➔ benefits for humanity
- But often found policy-makers already wedded to particular (faith-based) policy – only willing to take on board evidence supporting it (i.e. policy-based evidence) not evidence pointing to a different policy (i.e. evidence-based policy)
- Little evidence our efforts have ➔ better policies, and virtually none that those policies have ➔ the world becoming a better place
- Providing such evidence & encouraging shift to evidence-based policy another crucial challenge to IS researchers

11. Pricking academic bubbles

- Economic history characterised by periods of unbridled optimism giving rise to a 'bubble' (Perez)
  - e.g. Dutch tulips, canal building 'mania', railway mania, US stock market bubble in 1920s
- Not learned from these, viz Dotcom bubble of late 1990s, and feeding frenzy around financial derivatives in 21st C
- Even scientists not immune from such herd instincts
  - e.g. 'string theorists', 'chaos'/'complexity' researchers
- Do we in the IS community sometimes fall prey to such manias or bubbles?
  - e.g. Japanese production processes in 1980s? Hype over biotechnology? Exaggerated benefits of clusters, or innovative potential of SMEs?
- Challenge to younger IS scholars = to maintain ability to assess if a popular line of research becoming a fad
- Need a few 'contrarians' willing to suggest the new emperor has no clothes!

12. Avoiding disciplinary sclerosis

- Initially IS populated by 'immigrants' from other disciplines – intrinsically interdisciplinary
- Driven by policy issues
- Mainly qualitative (e.g. case-studies)
- Now have dedicated centres, train own PhD's, own journals & conf's, own methodologies (mostly quantitative)
- Beginning to exhibit some disciplinary characteristics
  - At a Kuhnian transformation? (Steinmueller, 2012)
- BUT increasing homogeneity, more paradigm-driven & less policy-driven, less adventurous
- Economics – from heterogeneous mix to neoclassical dominance as 'grey squirrels' chased out the red ones
- What sort of field do we want to be? A disciplinary 'pedigree' or an interdisciplinary 'mongrel'?

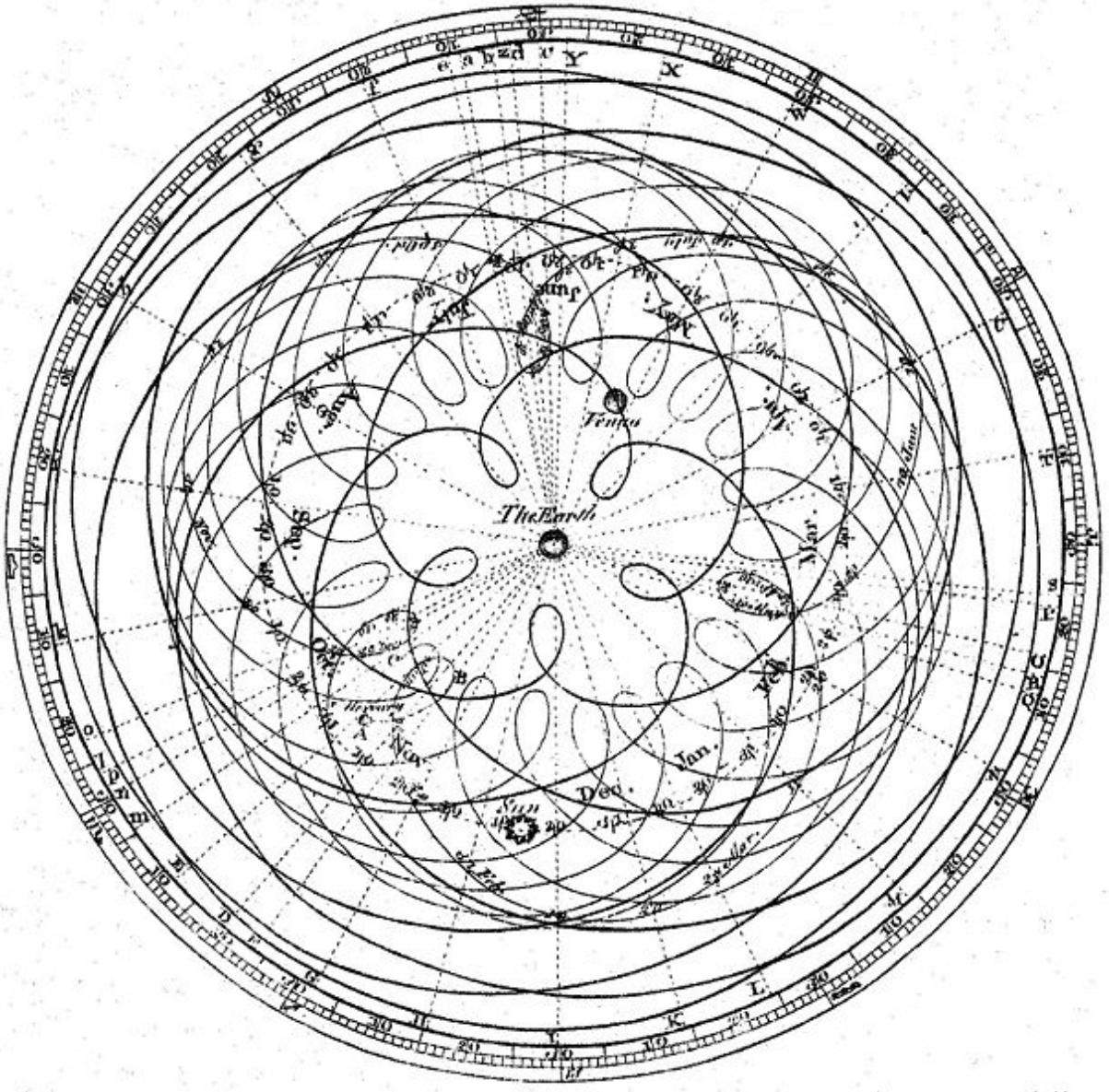
13. Identifying the causes of the 2007/08 economic crisis

- 2007/08 econ crisis most serious since 1930s – causes?
- Innovations played a part
  - e.g. mortgage-backed securities, collateralised debt obligations, credit default swaps
  - Introduced to reduce risk
  - But spiralled out of control into trillion dollar 'casino banking'
- Problem not that IS contributed to these innovations, but that we failed to provide any analysis (with a few exceptions e.g. FINNOV)
- Even sociologists (e.g. Mackenzie) had more to say – 'The curious incident of the dog that failed to bark'
- Challenge = to provide an understanding of role played by financial innovations in creating the economic crisis, and lessons one can draw to minimise risk of happening again

14. Helping to generate a new paradigm for economics

- Lundvall – "the economics profession … has a major responsibility for the current crisis … there is a strong need for a paradigm shift" (cf. Freeman)
- See also Giovanni Dosi and Carlota Perez (both 2012)
- Cf. Ptolemaic astronomy (Dosi) – to explain why planets don't move in circles as meant to, added epicycles

Ptolemy's Epicycles



14. Helping to generate a new paradigm for economics

- Lundvall – "the economics profession … has a major responsibility for the current crisis … there is a strong need for a paradigm shift"
- Cf. Ptolemaic astronomy – to explain why planets don't move in circles as meant to, added epicycles
- Neo-classical economics seeks to protect core beliefs
  - e.g. equilibrium, rational agents, perfect information, efficient markets, representative firms etc.
- But had to invoke growing panoply of ad hoc 'fixes'
  - e.g. bounded rationality, imperfect information, information asymmetry, satisficing, cognitive bias (e.g. 'anchoring')
- Kuhn – accumulation of 'anomalies' often a prelude to end of normal science and transition to new paradigm
- Opportunity for IS to introduce evolutionary element

15. Maintaining our research integrity and sense of morality

- Professional communities operated on basis of 'self-policing' – assumed external regulations unnecessary
- But succession of scandals (doctors, accountants, MPs, journalists, bankers) suggest self-policing ineffective
- 'Republic of Science' one last bastion where misconduct is rare, low-level and self-correcting?
- IS – fortunate in our 'founding fathers' (e.g. Freeman, Nelson) – shaped culture & norms – openness, intellectual generosity (NSI example), integrity
- But now warning signs – secrecy, 'borrowing' of data
- Plagiarism – rare (?) but increasing
- Growing problem of 'salami publishing' – difficult to police, & can shade into self-plagiarism
- Where is the boundary between acceptable and unacceptable research behaviour? How to maintain?

15 challenges for innovation studies

From visible to ‘dark’ innov’n

From ‘boy’s toys’ to mundane but liberating innovations

From national to global SIs

From productivity to sustainability

From economic growth to sustainable development

From risky to socially responsible innovation

From wealth creation to well-being

From ‘winner take all’ to ‘fairness for all’?

From gov’t as fixer of failures to the entrepreneurial state

From faith to evidence-based policy

Pricking academic bubbles

Avoiding disciplinary sclerosis

Identifying causes of current economic crisis

A new paradigm for economics

Maintaining our research integrity & sense of morality

Early response to the challenges?

From visible to 'dark' innov'n **- ?**

From 'boy's toys' to mundane but liberating innovations **- ?**

From national to global SIs **- some**

From productivity to sustainability **- Yes**

From economic growth to sustainable development **- some**

From risky to socially responsible innovation **- Yes**

From wealth creation to well-being **– a little**

From 'winner take all' to 'fairness for all'? **- No**

From gov't as fixer of failures to the entrepreneurial state **- some**

From faith to evidence-based policy **- some**

Pricking academic bubbles **- ?**

Avoiding disciplinary sclerosis **- ?**

Identifying causes of 2008 economic crisis **- some**

A new paradigm for economics **- No**

Maintaining our research integrity & sense of morality **- ?**

Concluding comments

- With IS 60 years old, time to look forward and discuss future challenges and what sort of field we want to be
- Focus of IS empirical work not kept pace with changing world (e.g. services, sustainablility)
- Tend to ignore ‘dark innovation’ (e.g. financial)
- Opportunity to help shift economics to new paradigm
- Need better understanding of interaction between policy research and policy making
- Efforts needed to maintain vitality and integrity of IS
- List of 15 challenges not intended to be prescriptive
- Purpose = to join with others in launching a debate
- May shape our future for decades to come