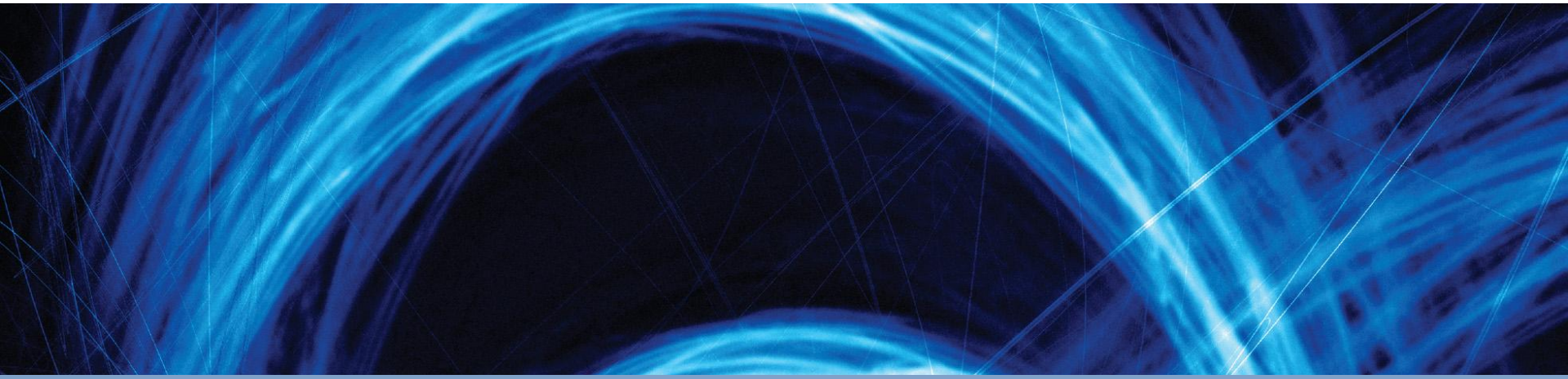

The History of Innovation Management

Chris Moody, 24th January 2011

Innovation is a Basic Part of Human Nature: The Beginning…

500,000BC	Humans learn to Use Fire
20,000BC	Invention of the bow and arrow
7,000BC	Pottery making began
6,000BC	Cloth weaving began
4,000BC	First use of metals – copper tools
3,500BC	The wheel came into use and writing appears
3,000BC	Abacus invented by the Chinese
2,800BC	Egyptians devise 12-month, 365-day calendar
2,737BC	Tea invented in China by Emperor Shen Nung
512BC	Chinese produce cast iron from blast furnaces
510BC	Greeks make the earliest surviving world map
210BC	Archimedes, Greek scientist, invents the Archimedean screw, for raising water, and the theory of levers

The Innovation Timeline: *The Next 700 Years*

- 105AD Paper invented in China by Ts'ai Lun
- 600 The heavy plough invented by the Slavs
- 1000 Chinese discover a weak form of gunpowder.
- 1041 Movable clay type invented in China by Bi Sheng
- 1180 The magnetic compass appears in Europe
- 1335 Mechanical clock is built in Italy
- 1440 Printing Press Johannes Gutenberg
- 1642 Adding Machine Blaise Pascal
- 1668 Reflecting Telescope Isaac Newton
- 1673 Microbiology Anton van Leeuwenhoek
- 1775 Mechanized Textile Loom Richard Arkwright
- 1783 Hot Air Balloon - Joseph and Jacques Montgolfier

The Innovation Timeline: The Industrial Age

- 1790 US patent system established
- 1796 Smallpox vaccine - Edward Jenner
- 1806 The electric battery - Alessandro Volta
- 1821 The difference engine - Charles Babbage
- 1827 Ohm’s Law - George Simon Ohm
- 1832 Electric Carriage - Robert Anderson
- 1866 Dynamite - Alfred Nobel
- 1876 Telephone - Alexander Graham Bell
- 1879 Electric light - Thomas Alva Edison
- 1887 AC electric power - Nikola Tesla
- 1889 Gasoline powered automobile – Karl Benz
- 1895 Wireless Telegraph - Guglielmo Marconi

Innovation Time Line: The 20th Century

- 1903 Powered airplane – Wright brothers
  Discovery of Radioactivity – Marie Curie
- 1905 Theory of relativity – Albert Einstein
- 1907 Moving Assembly line – Henry Ford
- 1912 Liquid fuel rocket – Robert Goddard
- 1920 Traffic light
- 1927 Television
- 1928 Penicillin
- 1935 Ballpoint pen
- 1940 Turing machine - Alan Mathison Turing
- 1942 Nuclear reaction - Enrico Fermi
- 1944 Mark I computer
- 1947 Instant photograph – Edwin Land

Innovation Timeline – 20th Century (cont.)

- 1945 Microwave oven
- 1947 Transistor - Bardeen, Brattain and Shockley
- 1958 Integrated circuit - Jack Kilby and Robert Noyce
- 1961 First manned spacecraft – Sergey Korolyov
- 1966 Handheld calculator
- 1967 Dynamic Random Access Memory – R. Dennard
- 1970 Microprocessor – Intel & TI
- 1973 Ethernet - Robert Metcalfe
- 1973 Cellular mobile telephone - Martin Cooper
- 1976 Personal Computer – S. Jobs and S. Wozniak
- 1990 Worldwide Web - "Tim" Berners-Lee

Innovation Policy and Management

- In the UK, Western Europe and the US, government's involvement in the innovation process has been to encourage through policies, direct funding and financial incentives to help private industry and universities, but generally not to directly manage programmes.
- The exceptions were programmes with military applications such as nuclear development and defence. The AEA (Atomic Energy Authority)and DERA(Defence Evaluation and Research Agency) in the UK, the Soviet space, atomic and military programmes and DOE (Department of Energy) and DARPA (Department of Defence) in the US.
- Another major source of innovations in the last 50 years has been NASA in the US. This is a civilian agency but directly manages research programmes in a number of fields as well as funding R&D in private companies.

University Research Management

- The approach has varied greatly depending on the country and university.
- The trend has been toward more centralised management structures within universities to cover all departments and schools within an institution.
- In the past 20 years, there has been increasing focus on protecting intellectual property and commercialising the fruit of university research.
- Most universities in Europe and the US who do research now have dedicated research management and technology transfer organisations.
- The structure, level of development and effectiveness of these efforts varies greatly from university to university and country to country.

Acronyms and Jargon

- TT — Technology Transfer
- TTO — Technology Transfer Officer
- *TLO* — *Technology Licensing Office*
- *ILO* — *Indusrial Liaison Office*
- KT — Knowledge Transfer
- KTPs — Knowledge Transfer Professionals
- IP — Intellectual Property
- IPR — Intellectual Property Rights

Innovation Management History in the UK

1949 National Research & Development Corporation

1950 NRDC First Right of Refusal (TC 5/50)

1983 Margaret Thatcher announced withdrawal of right of 1st refusal

1985 14th May Keith Joseph announced new arrangements

Universities to apply for authorisation to exploit research council funded work

In Oxford …

1987 27th November OURAD Ltd formed

1988 9th August OURAD became Isis Innovation Ltd

Ancient History - UK (before 2000)

- Industrial Liaison Offices
- 1985, British Technology Group [BTG] and all that
- 1992 Department of Trade & Industry Programmes
  - Strengthening Industrial Liaison Offices *
  - Technology Audits
- 1998 Higher Education Reach-out to Business and the Community [HEROBC]
- 1999 University Challenge Seed Funds [UCSF]
- 1999 Science Enterprise Challenge [SEC]

Modern History (2000 onwards)

- 2002 Higher Education Innovation Fund [HEIF]
- New Models emerging

Networks & Professionalisation

- University Directors of Industrial Liaison (Universities)
- Association of Industrial Liaison Offices (Polytechnics)
- 1993 UDIL & AILO became the Association of University Research & Industry Links - AURIL
- 1994 UNICO
- 2002 July Praxis
- 2004 Institute of Knowledge Transfer
- Licensing Executives Society / LES
- Association of European Science & Technology Professionals – ASTP
- ProTon
- USA – Association of University Technology Managers - AUTM, Science Research Association - SRA

What drives innovation?

A Need…

- Conflict (such as military – rocket technology)
- Medical expectations (penicillin, loss of limbs = prosthetics)
- Competition and freedom to respond (computer storage technology)
- Loss of established industries (telecommunications)
- Critical Mass (Silicon Valley)
- Catching the Wave (Google)
- Demographic trends (prosperous but aging population – at home disease management)

Conflict

- Technological escalation during World War II was more profound. More new inventions as measured by patent applications were during this period than any other period in human history.
- War escalates development and innovation through demand and necessity. Many existing inventions were developed to point of use during WW2
- Examples
  - The modern jet engine, Nylon, polythene, penicillin, anti-malarial drugs, and aerosol sprays are other examples of innovations which existed before 1939, but benefited from wartime development and the vast increase in demand.

Competition

Theories of industrial organization typically predict that innovation should decline with competition while empirical work finds that it increases. Why might that be?

Traditional theories of Salop, Dixit etc state that an increase in product market competition, or in the rate of imitation, has a negative effect on productivity growth by reducing the monopoly rents that reward new innovation.

Assumes that firms are profit seeking only. Other characteristics may be important.

A competitive advantage can be delivered by innovation that is technical, service, design, or business process driven etc

Innovation can be incremental or disruptive

Loss of established industries – Privatisation

Does privatisation increase or decrease innovation?

Depends on the time period. Likely to have a u-shape relationship.

In the short-term empirical evidence from various studies shows that R&D expenditure decreases following privatisation. The company needs to become profitable, and cuts are made, R&D is often the first to go.

R&D expenditure may continue to be lower, however, patents filed tends to increase. Suggests that R&D may be more targeted and efficient under private ownership.

How does R&D spend relate to innovation? Research shows that the amount of funding is important, but how it is spent/targeted is probably as important

Demographic Trends

Ageing Population – for example Japan

- Greater demand on healthcare system

- Employers need to accept that older employees can make a valuable contribution

- Greater tax burden on those of working age

Younger Population – for example India

- Birth rates mean a greater number of children

- Increased demand on educational system

- Opportunity to leverage a younger workforce to drive economic growth

Decreasing Population – Eastern Europe

- Driven by migration after the fall of the Soviet Union (Ukraine)

and also by entry into EU (Bulgaria)

younger, more skilled workforce is lost

More Prosperous Population – China

- Growing Middle Class, increased consumer consumption

- Increasing demands on infrastructure

Medical

Scientific discovery drives healthcare innovation

Higher patient expectations (particularly due to ageing population)

Generic drug manufacturers (existing Pharma companies looking to maintain a competitive advantage)

Charities – fund medical research in to areas such as cancer and vaccine development in response to social need

Economic/National interest

– Penicillin developed into a “product” in response to need to maintain fitness of military troops during the war

– Reduce illness/sick days for working population

Threat of epidemics such as Flu

Catching the Wave

"Google" is an example of the right technology, turned into the right product, at the right time

Another example is the Apple iPad, as opposed to the original Apple Newton, both tablet computers but the Apple iPad can take advantage of new technology and importantly the new trend of "software apps"

Another example of mis-timing is Pets.com, launched just as the dot-com boom went bust, and without a sustainable business model

Emerging trends such as Green Technology – low carbon technologies, reducing environmental pollution are current areas of opportunity

Critical Mass

Silicon Valley

- Same geographical location

- University driven innovation

- Access to investors (who understand that failure is a necessary part of risk taking)

Entrepreneurial culture (importantly, successful entrepreneurs put their money and expertise back in the system)

Emerging industries

- Competitors working together to open up market and build customer led demand

- An example is the “fuel cell” industry, where small companies developing potentially competing technologies collaborate and share information at industry events

Any Questions?