KIM

Knowledge and
innovation management

Universidade Vigo

SESSION 3

FROM AN INDUSTRIAL ECONOMY TO A KNOWLEDGE ECONOMY: BEYOND CONVENTIONAL WISDOM

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In an agricultural economy land is the key resource. In an industrial economy natural resources, such as coal and iron ore, and labour are the main resources. A knowledge economy is one in which knowledge is the key resource, and new activities emerge...

Illustrative examples of the knowledge economy

- **Design:** creating new products, services, environments and experiences. E.g.: the design of a restaurant interior.
- **Engineering:** a branch of design that requires knowledge of math and science such as the design of a new type of high speed train.
- **Information Technology:** Creating and operating systems that automate things and applications that people use. For example, a software developer who creates tools for organizing and exploring data.
- **Business Processes:** Analysis and improvement of business processes. For example, a manufacturing manager who uses management accounting to discover improvements to efficiency and quality on a production line.
- **Marketing:** Marketing including promotion, product development, distribution and sales. For example, a creative individual who designs advertisements to engage and inspire customers.
- **Research & Development:** Discovering new knowledge or developing new value.
- **Media:** The development of information and entertainment such as movies, videos, books, newspapers, magazines, blogs and games.
- **Education:** The knowledge economy is based on an educated workforce whereby learning is viewed as a lifelong process. This represents a shift in education from systems that encourage memorization to education based on discovery and problem solving.
- **Culture:** Areas such as art, performance art, architecture, history and cuisine. For example, an expert in the history of an area who is involved in developing the region's tourism industry.

So what is really new in a knowledge-intensive economy?

1. Knowledge (public spending on education, total R&D, software) is quantitatively and in some sense qualitatively more important than before as an **input**, sidelining capital…
   - However, it is difficult to separate knowledge accumulation from capital accumulation…
   - … and physical investment still doubles knowledge investment in OECD countries.
2. Knowledge is more important **as a product** (basically knowledge-intensive business services) than it has been hitherto. Rise of new forms of activity based on the trading of knowledge products.
   - Statistical issues: “services” are not “KIBs” (Knowledge intensive businesses)
   - Are they primarily the effect of vertical desintegration?

So what is really new in a knowledge-intensive economy?

3. Codified knowledge is more significant as a component of economically relevant knowledge bases through formal education and science.
   - However both the education and patenting trends require careful interpretation: it is not clear either that they are new, or that they represent some new role for knowledge (is education always a production input or sometimes just a signalling tool?).
4. The knowledge economy rests on ICT, since they change both physical constraints and costs in the collection and dissemination of information.
   - Data moved and analized by ICT is always knowledge, or just information?
   - If it is often just information, does it really expand the realm of accessible knowledge?

So what is really new in a knowledge-intensive economy?

- **Therefore**, it is certainly true that knowledge accumulates over time, and that it changes the quality and quantity of inputs and output very significantly.
- **But** this does not mean we are confronting a new type of society in which old economic rules (e.g., access to resources, capital investment) are irrelevant.

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What are high-technology industries and what is their role?

- You will hear often “high-technology industry” and “knowledge-intensive industry” as interchangeable concepts. They are not.
- OECD distinguished industries according to the level of intramural R&D: high-tech, medium-high-tech, medium-low-tech and low-tech.
  - R&D is by no means the only measure of knowledge-creating activities. It furthermore overemphasizes the discovery of new scientific or technical principles as the point of departure of an innovation process ('linear model' of innovation).
  - It ignores the fact that the knowledge that is relevant to an industry may be distributed across many sectors or agents: thus a low-R&D industry may well be a major user of knowledge generated elsewhere.

Classification of manufacturing industries into categories based on R&D intensities

High-technology industries

Aircraft and spacecraft
Pharmaceuticals
Office, accounting and computing machinery
Radio, TV and communciations equipment
Medical, precision and optical instruments

Medium-high-technology industries

Electrical machinery and apparatus, n.e.c.
Motor vehicles, trailers and semi-trailers
Chemicals excluding pharmaceuticals
Railroad equipment and transport equipment, n.e.c.
Machinery and equipment, n.e.c.

Medium-low-technology industries

Building and repairing of ships and boats
Rubber and plastics products
Coke, refined petroleum products and nuclear fuel
Other non-metallic mineral products
Basic metals and fabricated metal products

Low-technology industries

Manufacturing, n.e.c.; Recycling
Wood, pulp, paper, paper products, printing and publishing
Food products, beverages and tobacco
Textiles, textile products, leather and footwear

What are high-technology industries and what is their role?

- The role of high-tech in the economy:
  - In the OECD, for example, the USA has the largest share of high-tech in manufacturing, but this is only 15.8% of manufacturing output, which in turn is only 18.5% of GDP. So the high-tech sector is less than 3% of GDP.
  - In OECD economies the share of high-tech in total manufacturing has risen in the longer term, but the share of manufacturing in total output has been in long-term decline.
  - Beyond high-tech relevance… notice the difference between high-tech industries and high-tech firms.

E. Kirner et al. / Research Policy 38 (2009) 447–458

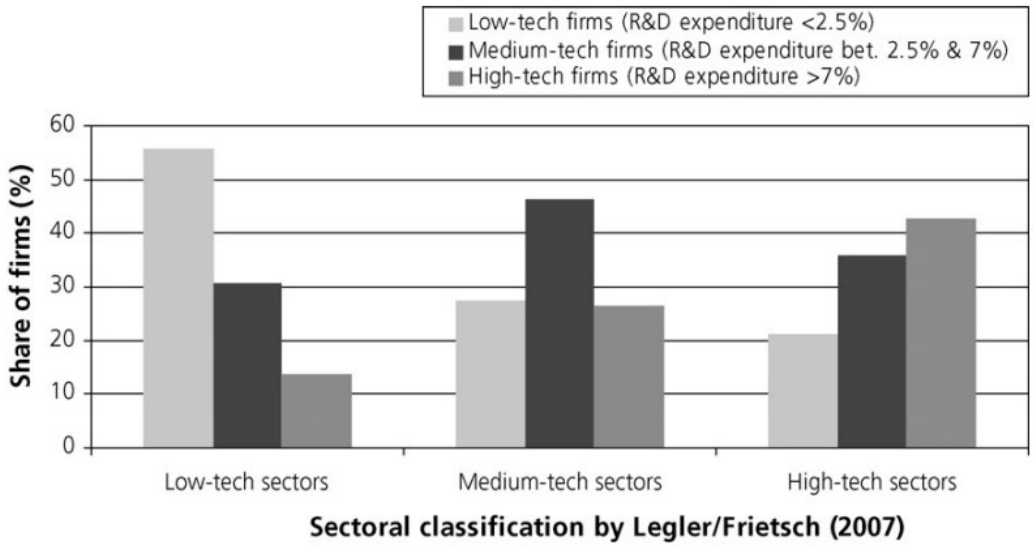

Fig. 2. Distribution of low-, medium- and high-tech firms within low-, medium- and high-tech sectors.

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Beyond high-technology industries: complementing R&D with learning, capital goods and market research

- Innovation rests not on discovery but on learning.
  - Not only R&D: Learning need not necessarily imply discovery of new technical or scientific principles, and can equally be based on activities which recombine or adapt existing forms of knowledge; this in turn implies that activities such design and trial production (which is a form of engineering experimentation) can be knowledge generating activities.
  - Not only intramural R&D: Firms interact with other institutions in a range of ways; these include purchase of intermediate or capital goods embodying knowledge. The installation and operation of such new equipment is also knowledge creating. Then there is the purchase of licenses to use protected knowledge.
  - Beyond intramural or external R&D: Finally, firms seek to explore their markets. Market research is key for learning (trade shows, expos, retail shelves…)

Beyond high-technology industries: complementing R&D with learning, capital goods and market research

- R&D is therefore very important, but should be seen as a problem solving activity in the context of innovation processes, rather than an initiating act of discovery. Accordingly,
  - Would you subsidize R&D in firms that have not systematized innovation management?
  - Does R&D expenditure make sense if innovation management does not exist at the same level as –say- quality management, operations management, financial management, etc.?
  - In the absence of innovation management, would you subsidize R&D in SMEs or increase capital investment to incorporate embodied knowledge spillovers from capital goods sector?

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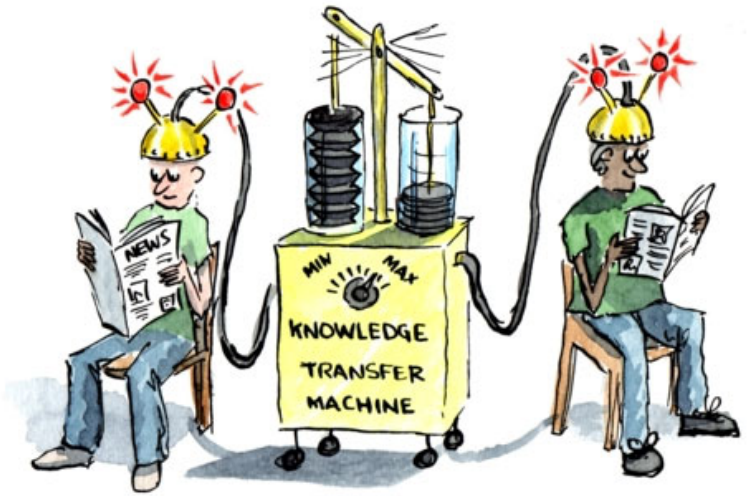
High technology vs. knowledge intensive industries: the existence of distributed knowledge bases

- Three areas of production-relevant knowledge: **firm-specific** knowledge, **sector or product-field specific** knowledge, and generally **applicable knowledge**.
- The relevant **knowledge** base for many industries is not internal to the industry, but is **distributed across a range of technologies, actors and industries**.
- A distributed knowledge base is a systemically coherent set of knowledge, maintained across an economically and /or socially integrated set of agents and institutions.

High technology vs. knowledge intensive industries: the existence of distributed knowledge bases

- These inter-agent or inter-industry flows conventionally take two basic forms: ‘embodied’ and ‘disembodied’.
  - Embodied flows involve knowledge incorporated in to machinery and equipment.
  - Disembodied flows involve the use of knowledge, transmitted through scientific and technical literature, consultancy, education systems, movement of personnel and so on.



High technology vs. knowledge intensive industries: the existence of distributed knowledge bases

- Consider fishing and fish farming (low-tech industries in terms of R&D).
  - Examples of embodied flows in **fishing** include use of new materials and design concepts in ships, satellite communications, global positioning systems, safety systems, sonar technologies (linked to winch, trawl and ship management systems), optical technologies for sorting fish, computer systems for real-time monitoring and weighing of catches, and so on.
  - Within **fish farming**, these high-technology inputs include pond technologies (based on advanced materials and incorporating complex design knowledges), computer imaging and pattern recognition technologies for monitoring (including 3D measurement systems), nutrition technologies (often based on biotechnology and genetic research), sonars, robotics (in feeding systems), and so on.

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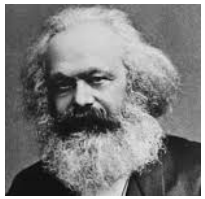
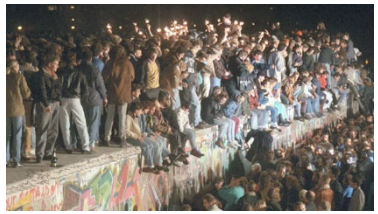
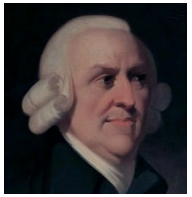
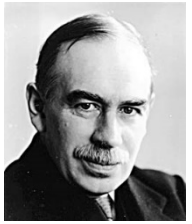
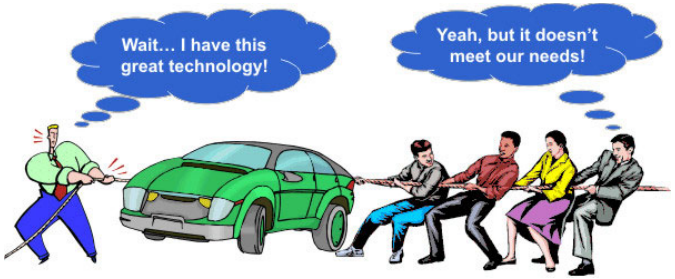
Why then knowledge and innovation management?

- Regardless of how different the knowledge economy is from the physical economy, change pushes economic science forward (and drives management thinking in particular).

- No more science-push linear R&D innovation models: things are more complex and innovation management tools tackle this complexity.



- Innovation strategy addresses economic and technological uncertainty.

Why then knowledge and innovation management?