LIUC
Università Cattaneo

Innovazione e Sviluppo del Prodotto

Technology intelligence

Some questions

- **What is technology intelligence?**
- **Which is the process of TI?**
- **Which are the tools to analyse it?**

Technology Intelligence Methods

- S-curve
- Patent analysis
- Publication analysis
- Scenario analysis
- Roadmapping
- Relevance trees
- Delphi method
- Brainstorming
- Lead users analysis
- Quality function deployment
- Skill – application matrix
- Technical innovation audit
- Benchmarking
- ……

Examples

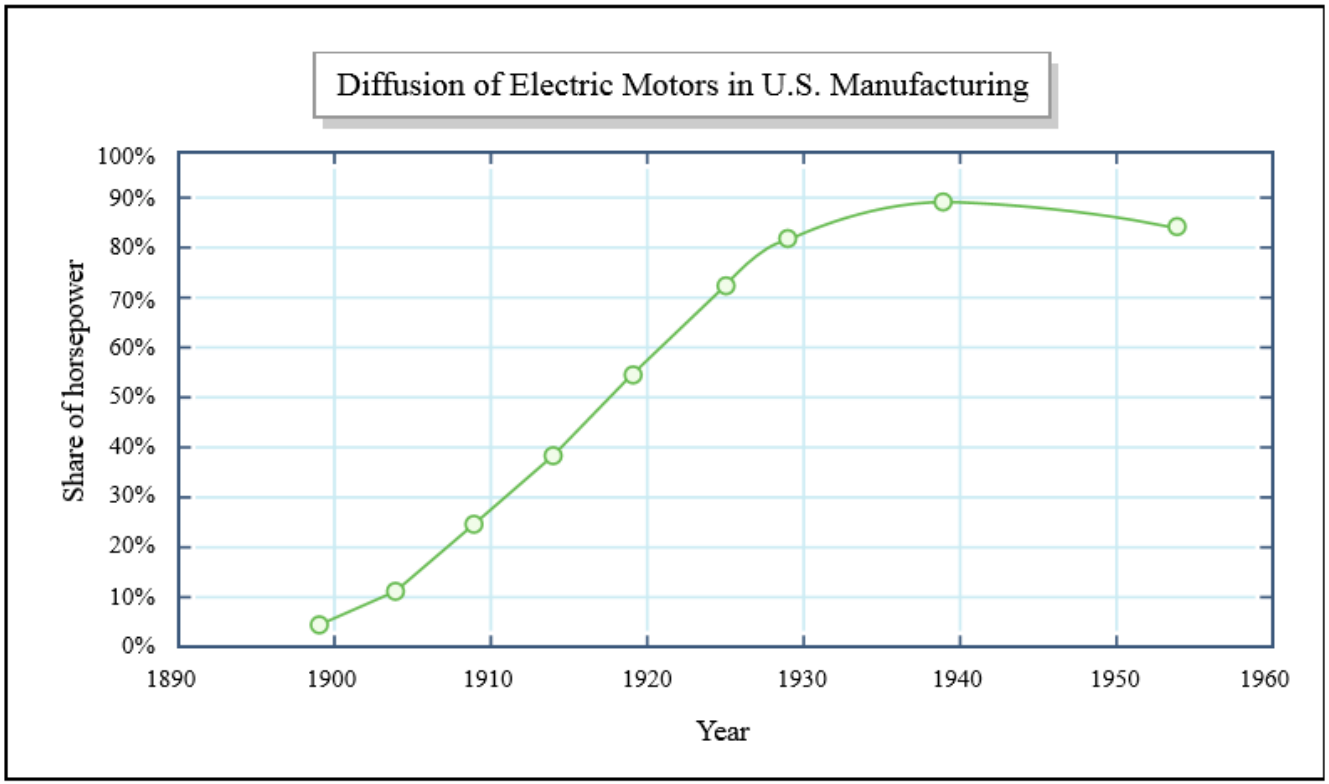
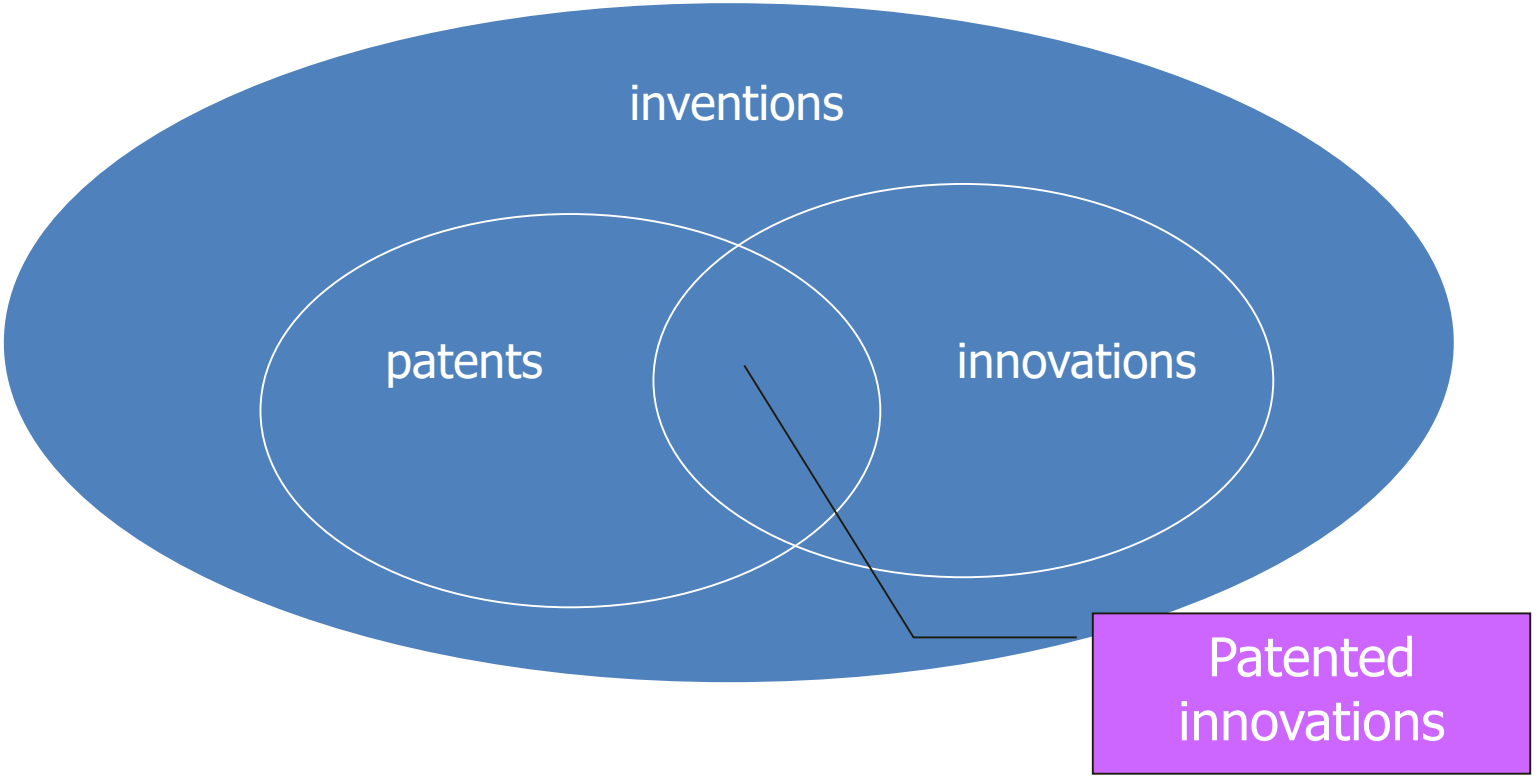


Image by MIT OpenCourseWare.

Hall, 2004

Patent analysis

- Patents represent a highly relevant information source, even if:
  - Not all innovations are patented
  - What is patented is not always an innovation



Example of patent indicators

- Top assignees identification
- Top assignees in main IPC classes;
- Top publication countries (and related evolution over time);
- Technology new comers identification;
- Main applications of a technology (patent classification classes frequency and relations);
- Technology new comers identification;
- Technology maturity definition;
- Average age of patents;
- Patent publication countries;
- Most cited patents;
- Patents classification analysis (e.g. IPC classes of patents);
- Bottom 10 IPC analysis (for technology niches identification);
- Top Priority Countries (and related evolution over time);
- Find-similar analysis per codes/keywords;
- Semantic analysis of patents;
- No. of alive and dead patents;
- Legal state/status analysis;

Publication analysis

- Use of databases of scientific and technical publications to verify:
  - The frequency of occurrence of papers on a specific technology
  - The citations of such papers
    - Indication of quality
    - Indication of correlations among different science – technology areas

Questions to answer

- For this specific technology, what are the implications of 'innovate vs wait' strategies?
- What advantages are available for investing 'early vs late'?
- Who might be potential partners? What are the options for 'make vs buy'?
- Are there research initiatives that we should consider joining? What are the licensing opportunities?

Scenario analysis

- Scenario analysis describes «realistic» future states and the different possible patterns towards those future states

- It is based upon:
  - Identification of variables that influence the future state of a system
  - Identification of the trend of the above variables
  - Elaboration of possible future scenarios, corresponding to different patterns of the above variables

- May exploit system dynamics theory

Scenario analysis

- Advantages:
  - Allows to explicitly consider uncertainty
  - Greatly supports strategic decision making
  - May be used with technological roadmaps

- Limits:
  - Expensive (time and resources)
  - Difficult to consider possible tehcnological discontinuities and breakthrough (i.e. the emerging of new relevant influence variables)

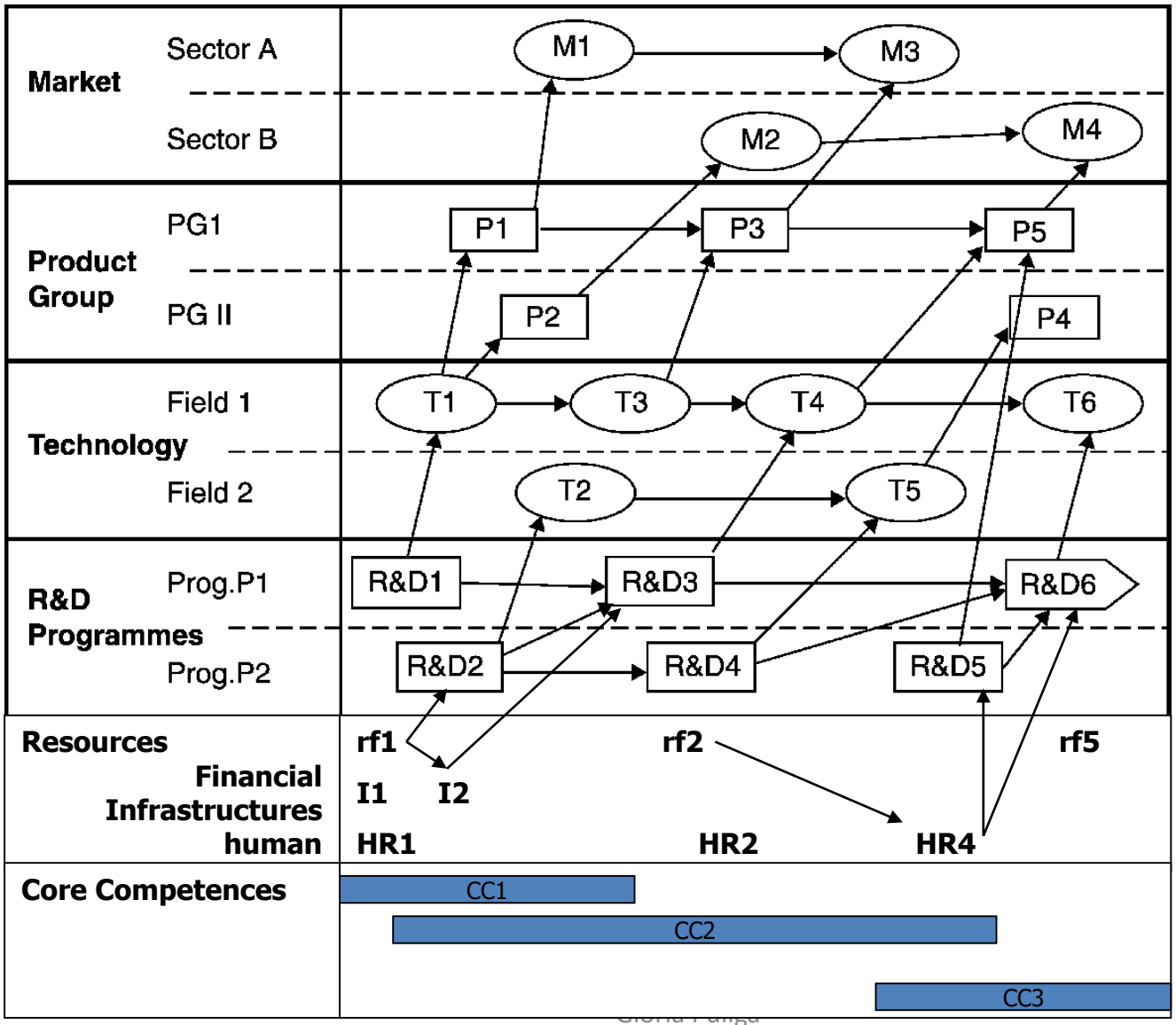
The objective of scenarion analyses not to state what the IEA believes will happen to the energy system in future. Rather, the aim is to **discuss the most important factors and uncertainties likely to affect the energy system** over the period to 2020 […] In fact, the IEA expects that the future for world energy will be quite different from that described in the business-as-usual (BAU) projection. This is partly because **economic growth, energy prices, technology** and **consumer behaviour** will turn out to be different from those assumed for the BAU projection. The most striking difference will most likely occur because governments in developed countries will want to change things.

Up until 2010, the structure tended to focus on a Reference Scenario, in which **policy assumptions were fixed** at the present day, with no account taken of announced intentions or targets. This was often accompanied by an alternative scenario to examine the impact of different policy choices to address a specific energy security or environmental issue. In 2010, the main focus shifted to the New Policies Scenario (and the old Reference Scenario moved to the background, becoming the Current Policies Scenario). The 450 Scenario made its initial appearance as a pathway to limit climate change to below 2 degrees Celsius (°C), cementing the position of climate and other environmental issues at the heart of the analysis (and becoming a global benchmark for climate trajectories). Since then, **scenarios have addressed a range of other uncertainties over prices and the deployment of specific technologies**.

Technology roadmapping

- Technology roadmaps:
  - Tools for strategic forecasting and planning
  - Integrate different organizational perspectives in the intelligence process: R&D, di marketing, manufacturing, finance
  - May evolve following actual events

Technology roadmapping



Adattata da: Lichtenthaler, 2002

Technology roadmapping

- Advantages:
  - Visual, clear and rapid representation
  - Integrates different data and information from different company's functional units
  - Integrates technological, scientific, organizational, marketing, manufacturing elements

- Limits:
  - Hard to consider technology breakthrough
  - Soft, non-technical information are often missed

Relevance trees

- Aimed at understanding the alternative paths for achieving a specific objective
- Starting form the desired objective, it is de-composed in different levels(for example, clean car):
  - (i) alternative solutions (electric cars, hybrid cars etc...)
  - (ii) functions (lithium cells, photovoltaic cells, etc…)
  - (iii) technological solutions for performing desired functions
  - (iv) ….
- Each level should be analysed in terms of feasibility, necessary resources, success probability, timing
- Relevance trees allow to:
  - (i) evaluate the feasibility of a path
  - (ii) identify the optimal path
  - (iii) select and plan projects
  - (iv) define performance goals for each R&D project
  - (v) identify the need for specific forecasting activities, relevant for defining possible paths

Brainstorming

- Expert judgment, critical when:
  - There are no historical data
  - New variables are emerging that influence the evolution of technology
  - Cause-effect relations cannot be understood
  - The focus is on the identification of Technological discontinuities

Brainstorming

- Team definition: need to introduce external competencies as well (even external people)
- Identification of the team coordinator, who stimulates the creative process and avoid not useful parenthesis
- Definition of the focus of the discussion
- Exploration of all possible ideas and opinions with the same commitment
- Exploration of ideas, not solutions
- Inhibition removal

Delphi study

- It is a sort of «structured» brainstorming, allowing to:
  - Reduce or remove psychological influences
  - Consider ideas coming from minority groups
  - Cleanse the expert judgement from subjective, personal, biased factors

- Characteristics:
  - Anonymous: avoids the influence of leaders (either hierarchical of charismatic)
  - Iteration with controlled feedback: judgements and forecasts are elaborated and filtered from the coordinator
  - Synthetic synthesis of answers: make expert judgement less subjective

Delphi method

- The technological focus of the process is identified and the coordinator (or moderator) elaborates the questionnaire
- A panel of experts is defined, each expert does not know others
- The questionnaire is sent to the experts

The sequence is launched

1. Experts answer to the questionnaire; the coordinator pool answers and defines the list of events / relevant items
2. Experts valuate the timing of relevant events / items and the coordinator statistically elaborates the answers (distributions, means, variances, medians…)
3. Statistic results are communicate to the experts, asking to motivate their positioning with respect to the mean and median values; experts may then change their answer
4. Iteration of point 3;

….

- Iterations end when there is a statistically robust convergence of answers and when subsequent iterations do not introduce significant statistic modifications

Delphi method

- Advantages
  - Precision
  - Reliability (higher with a high number of expert)

- Disadvantages
  - The identification of experts is critical
  - The identification of a neutral, unbiased coordinaotr is critical
  - May foster orthodoxy
  - Expert commitment in answering to the questionnaire cannot be verified

Technology – application matrix

applications

existing *new*

Tecnology - skill

existing

new

	A1	A2	A3	A4	A5	A6
T1						
T2						
T3						
T4						

Competence – application matrix an example

COMPETENCIES	APPLICATIONS			
	A1	A2	A3	A4
C1	X	X	X	
C2			X	
C3	X			
C4	X			
C5		X	X	
C6		X		X
C7				
C8				X
C9				X
C10				X
C11				X
C12				
C13				X
C14	X			
C15				X

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C4	X			
C5		X	X	
C6		X		X
C7				
C8				X
C9				X
C10				X
C11				X
C12				
C13				X
C14	X			
C15				X

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C3	X			
C4	X			
C5		X	X	
C6		X		X
C7				
C8				X
C9				X
C10				X
C11				X
C12				
C13				X
C14	X			
C15				X

Benchmarking:

- Comparison against technology “best in class”

- Phases:
  - Planning:
    - Defining the process / performance investigated
    - Identifying “best in class”
    - Defining the data collection process
  - Analysing:
    - Measuring current performance
    - “cleaning” data
  - Draw conclusions:
    - Positioning against “best in class”

Technology intelligence – Methods

- The choice of the intelligence method should take into consideration:
  - Information needs and the type of use expected for results
  - Time, resources, competences available
  - Familiarity with the methods
  - Time horizon
  - Uncertainty
  - Strategic relevance of the TI process