DEFINITIONS ON TECHNOLOGY AND TECHNOLOGICAL INNOVATION

(notes)

Definitions on technology and technological innovations - index

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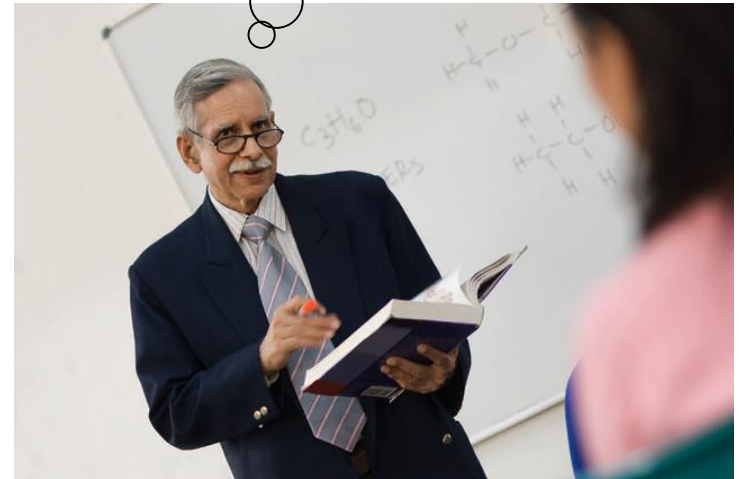
Definitions on technology and technological innovations - introduction (i/ii)

Why should we need definitions on technology and technological innovation?

Just because by the analysis of definitions we could find some ways for management, but …

Definitions on technology and technological innovations - introduction (ii/ii)

… but «there's a but», indeed:

"It is commonplace to talk about technology; the term is so all-pervasive that it is often taken for granted. Some regard it as the means by which man extends his power over his surroundings. …

The first thing to note about technology is that there is no agreed meaning of that word; non of the clarity of a mathematical term or a physical constant. …"

[P. Lowe, The Management of Technology]

… then one should take into account several definitions (technology's formulation) in order to get an exhausistive comprehension of the issue, that's …

Definitions on technology and technological innovations - technology's definition (i/v)

technology is the knowledge of the manipulation of nature [F. Betz - Managing technological innovation]

we define technology as the physical combined with the intellectual or knowledge processes by which materials in some form are transformed into outputs used by another organization or subsystems within the same organization [Hulin and Roznowski - Goodman Sproul , Technology and organization]

technology is "a family of methods of associating and channeling other entities and forces, both human and non human. It is a method, one method, for the conduct of heterogeneous engineering, for the construction of a relatively stable system of related pieces with emergent properties in a hostile or indifferent environment" [Law - Goodman Sproul , Technology and organization]

technology refers to a body of knowledge about the means by which we work on the world our arts and our methods. Essentially, it is knowledge about the cause and effect relations of our actions. … Technology is knowledge that can be studied, codified, and taught to others" [Berniker - Goodman Sproul , Technology and organization]

the ways and means by which humans produce purposeful material artefacts and effects [E. Braun , Technology in context, Routledge]

Definitions on technology and technological innovations - technology's definition (ii/v)

... a transformational system, from the proprietary know-how to the commercialization of products. This includes production operations, promised quality, people, processing of information, integrated together as projects and a pioneering vision [R. Gehani - Management of Technology and Operations]

technology refers to "the theoretical and practical knowledge, skills, and artifacts that can be used to develop products and services as well as their production and delivery systems. Technology can be embodied in people, materials, cognitive and physical processes, plants, equipment, and tools". [J. Ettlie - A General Approach to Managing Technological Change]

A technology is the structured application of scientific principles and practical knowledge to physical entities and systems. [P. Lowe, The Management of Technology]

Definitions on technology and technological innovations - technology's definition (iii/v)

Just a first comment about previous definitions. Let's extract some words:

- … knowledge of the manipulation of nature
- … physical combined with the intellectual or knowledge processes
- … methods of associating and channeling other entities and forces, both human and non human
- … knowledge about the cause and effect relations of our actions
- … theoretical and practical knowledge, skills, and artifacts that can be used to develop products and services as well as …
- structured application of scientific principles and practical knowledge to physical entities and systems
- …

… so **words that remind changes** (manipulation, channeling …) **and different interacting factors** (physical and intellectual, human and non human, theoretical and practical …), that's to say working on technology signifies to take into account different aspects.

… in other words it means to have a **system's vision**.

A **system** is a regularly interacting or interdependent group of units forming an integrated whole.[1] Every system is delineated by its spatial and temporal boundaries, surrounded and influenced by its environment, described by its structure and purpose and expressed in its functioning

[www.Wikipedia.com]

Definitions on technology and technological innovations - technology's definition (iv/v)
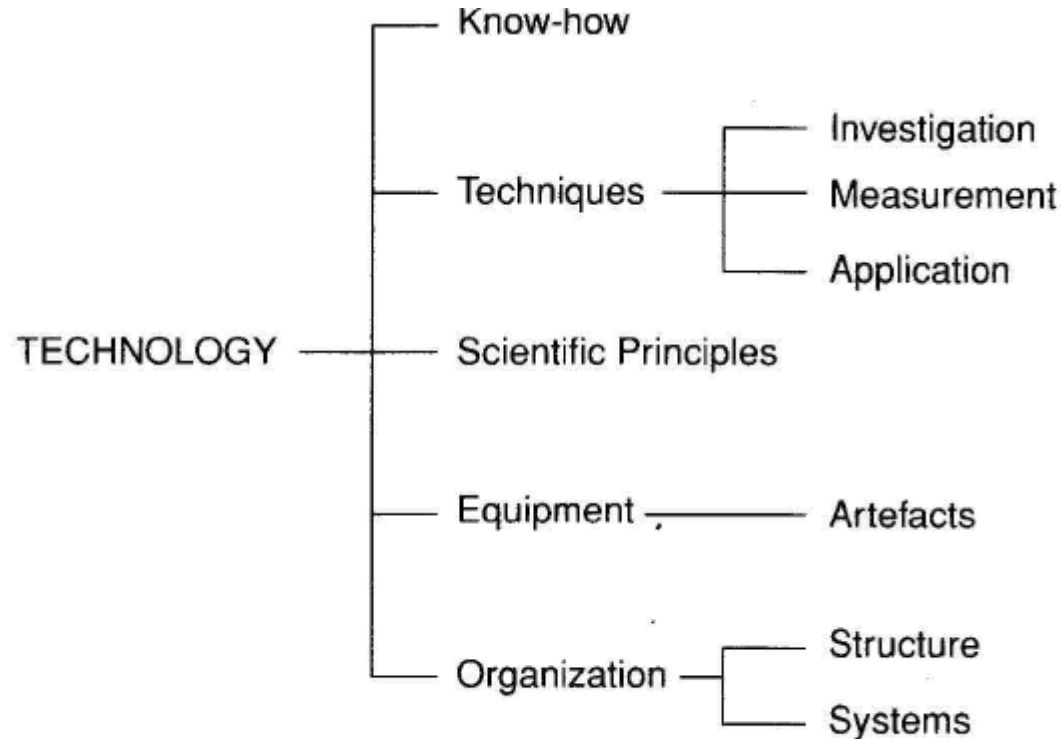
… an effective way to show technology meaning

Fig 1.1 The constituents of a technology.

[P. Lowe, The Management of Technology]

Definitions on technology and technological innovations - technology's definition (v/v)

… so, some key concepts for technology

- ✓ **the first thing to note about technology is that there is no agreed meaning; none of the clarity of a mathematical term or a physical constant.**
- ✓ **… indeed, thinking of technology as «way to get output things from some inputs ones», technology implies different factors: theoretical and practical knowledge, human and non human entities etc.**
- ✓ **in other words: for technology management it's necessary to have a system vision.**

Definitions on technology and technological innovations - exercise

Exercise

Having in mind previous technology's definitions, how should you describe the technologies by which the showed pens are got?

Definitions on technology and technological innovations - technological innovation's definition (i/ii)

And what about innovation?
Innovation simply is about the aims of a technology. In other words: innovation for what?

A very summarized defintions of innovation is

➢ **innovation is defined as invention + exploitation**

    [J. Ettlie - Managing Technological Innovation]

… and another may be more complete one is:

➢ **innovation is: production or adoption, assimilation, and exploitation of a value-added novelty in economic and social spheres; renewal and enlargement of products, services, and markets; development of new methods of production; and establishment of new management systems. It is both a process and an outcome.**

[M. M. Crossan, M. Apydin – A multidimensional framework of Organizational Innovation: a sistematic review of the literature – Journal of Management Sciences 2010]

Definitions on technology and technological innovations - technological innovation's definition (ii/ii)

Just a specification before going on: the word «invention» doesn't necessarirly mean something like important scientific discoveries (or similar things), but the invention is related to the subject. In other words let's conisder that some group of people are familiar with bicycling for a long time and that another group doesn't know them, As soon as the second group will be aware, bicycles will be an important innovation for them.

... so, invention or **technological innovation's depth is something related to the context**.

Again, such definitions help on the managerial process:
- indeed, first the exploitation's meaning logically requires to know the subject of the end user of the invention.
- Innovation simply is about the aims of a technology. In other words: innovation for what?

Such considerations are such to enlarge the meaning of «system vision» mentioned in previous pages. As a matter of fact, such system will include not only items related to the technological process (physical and intellectual, human and non human, theoretical and practical means etc.) but will be extended to the use of the technology output.

Definitions on technology and technological innovations - survey on some technology management's patterns (i/ix)

That said, such issues related to the «system vision» are efficaciously described by some patterns. Among them first is

Management of Technology (MOT)

Management of technology is defined as linking "engineering science and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization"

[J. Ettlie - Managing Technological Innovation]

Definitions on technology and technological innovations - survey on some technology management's patterns (ii/ix)

...

Key concepts in MOT

1. Organizational analysis
2. Systems analysis
3. Technology forecasting and planning
4. Innovation procedures
5. Technical project management
6. Marketing experimentation
7. Entrepreneurship

[F. Betz- Managing Technological Innovation]

...

MOT paradigm

Integration of technology systems into enterprise systems

In this paradigm the following kinds of issues are central to MOT:

1. understanding long-term economic development.
2. understanding how national S&T (Science and Technology) infrastructures contribute to competitiveness.
3. forecasting change in products, production, and service technologies.
4. effectively managing the engineering and research functions in business systems.
5. integrating technology strategy into business strategy.

... in other words: in order to properly manage a new technology (or a technological innovation) one should scan the items listed by «key concepts in MOT» and «MOT paradigm».

Definitions on technology and technological innovations - survey on some technology management's patterns (iii/ix)

Of course, and consistently just with the initial words of this lecture note (that's: «The first thing to note about technology is that there is no agreed meaning of that word; non of the clarity of a mathematical term or a physical constant ...») there isn't only MOT pattern, some others are available.

Following pages show some additional references. Of course, (and, by the way, consistently wth the system theory) the related interpretations depend by the observer. In other words: the observer must focus what could be useful for his-own work.

Definitions on technology and technological innovations - survey on some technology management's patterns

Organizational Innovation

Potential Failures

Successful Cases
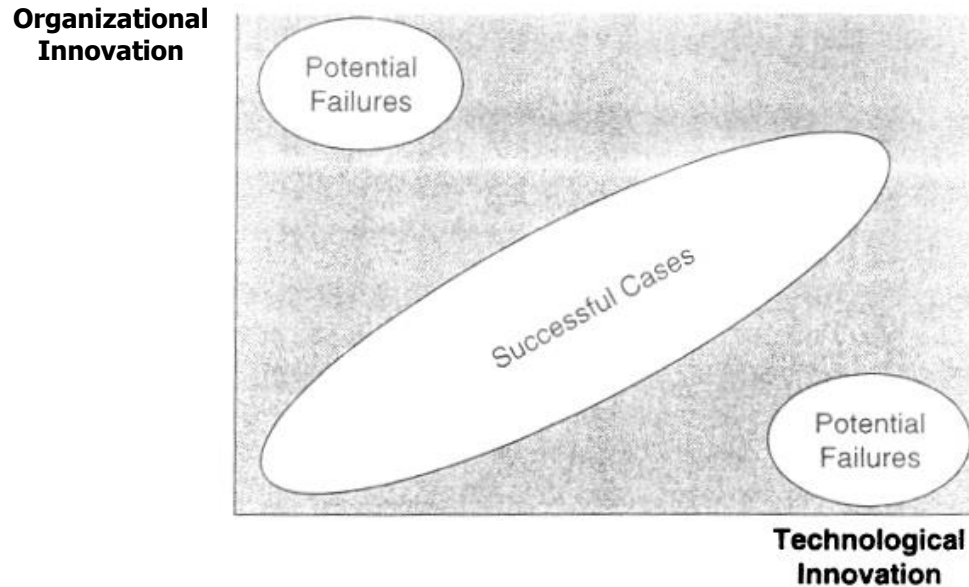
Potential Failures

Technological Innovation

Figure 1-1   Successful Management of the Innovation Process

It simply (… and obviously) means that any technological innovation must go with the organization, that's any technological innovation (likely) involves an organizational innovation (modification) … anyway that means as well that one should have abilities of organization's analysis.

Definitions on technology and technological innovations - survey on some technology management's patterns (v/ix)

Figure 11.1 The basic set-up of the PET system

R. Coombs, K. Green, A. Ricahrds, V. Wlash – Technological Change and Organization]
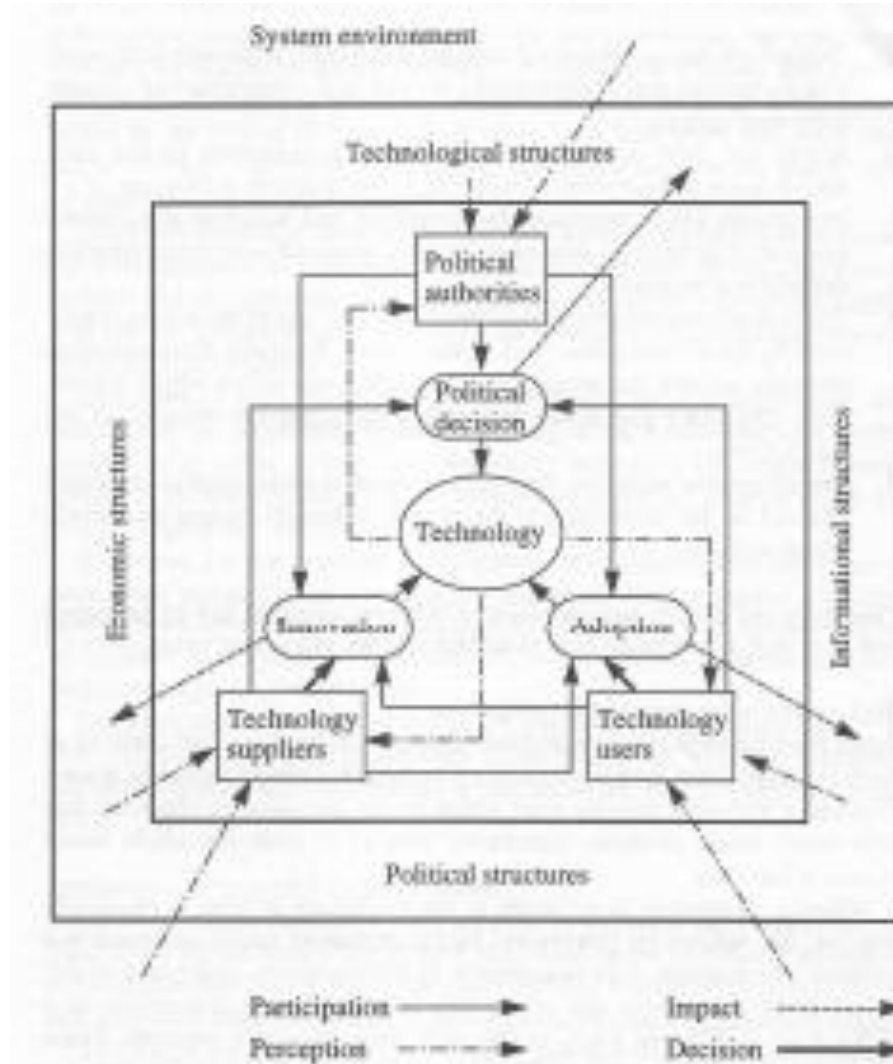
PET: Politics, Economics, Technology

Definitions on technology and technological innovations - survey on some technology management's patterns (vi/ix)

EXHIBIT 1 The Relationships Between Key Concepts Concerning Technological Innovation.

[R. A. Burgelman, M.A. Maidique, S.C. Wheelwright – Strategic Management Technological Innovation]
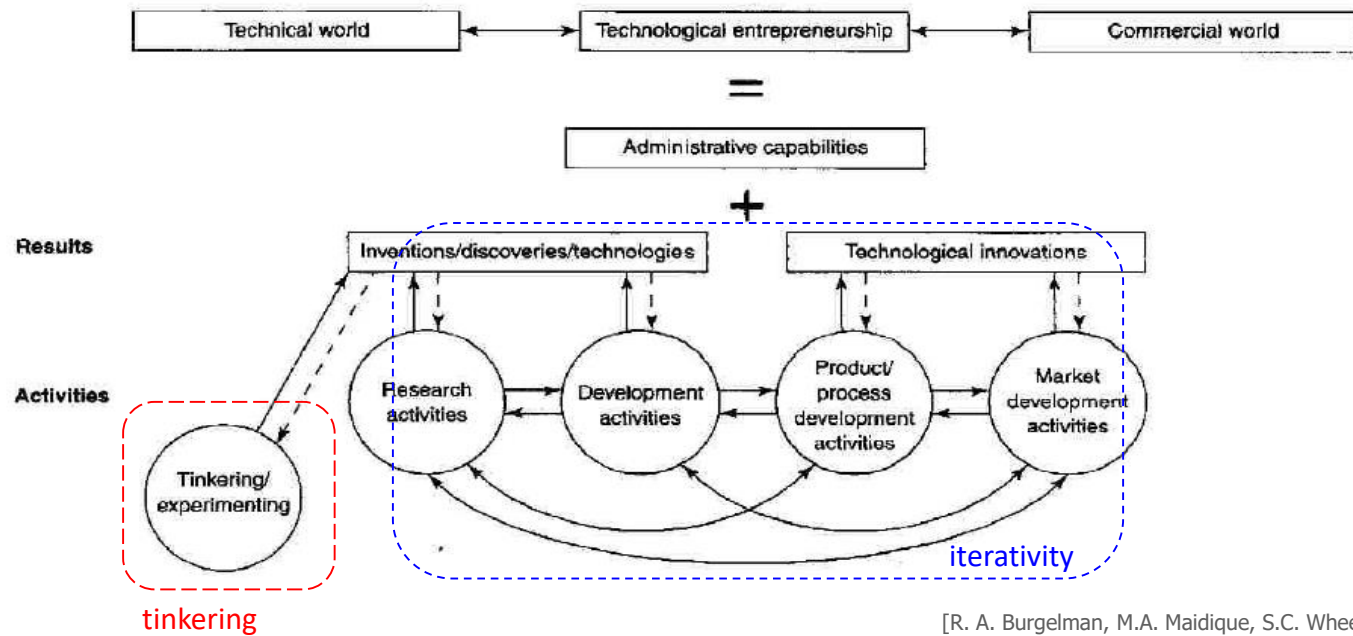
The pattern is similar to the definition of innovation as invention + exploitation, anyway some other usefullness hints are given:

- new thiings arise from tinkering/experimenting that is important to trace (rif to the «innovation procedures» mentioned in MOT's key concepts).
- The whole process is iterative.

Definitions on technology and technological innovations - survey on some technology management's patterns (vii/ix)
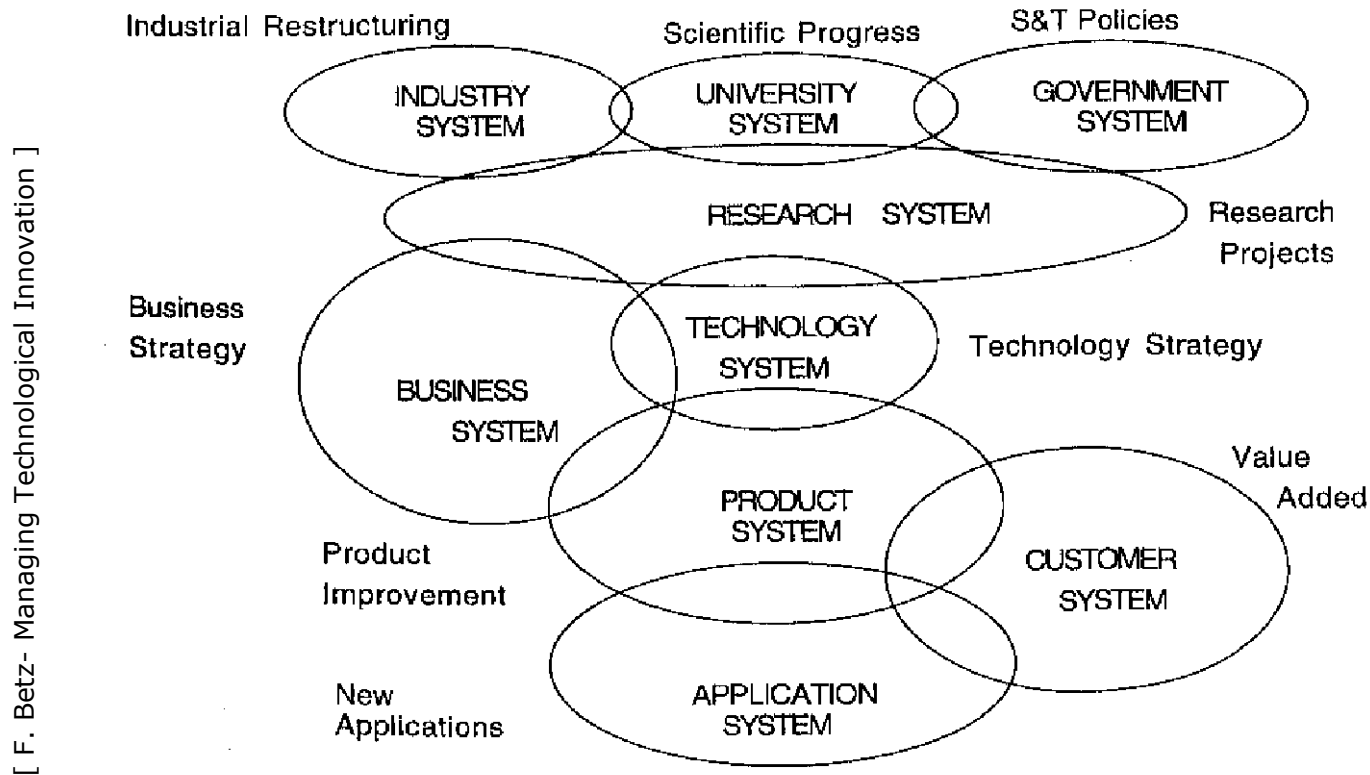

Figure 1.1c. Changes in systems involved in technological innovation.

It underlines the need of «system vision». For instance: change in the technology system must comply the business system and, at the same time, should come from the research system and targetted to the product system etc. That means that each technological innovation (or the implementation of a new technology) should be checked towards its implications.

Definitions on technology and technological innovations - survey on some technology management's patterns (viii/ix)

… Strategy making is the process of matching an organization's *internal resources* with *environmental opportunities and risks* to *accomplish goals.*

… one way to define technology strategy is by understanding the products and services a firm brings to market and the intersection of these outputs with their underlying technologies

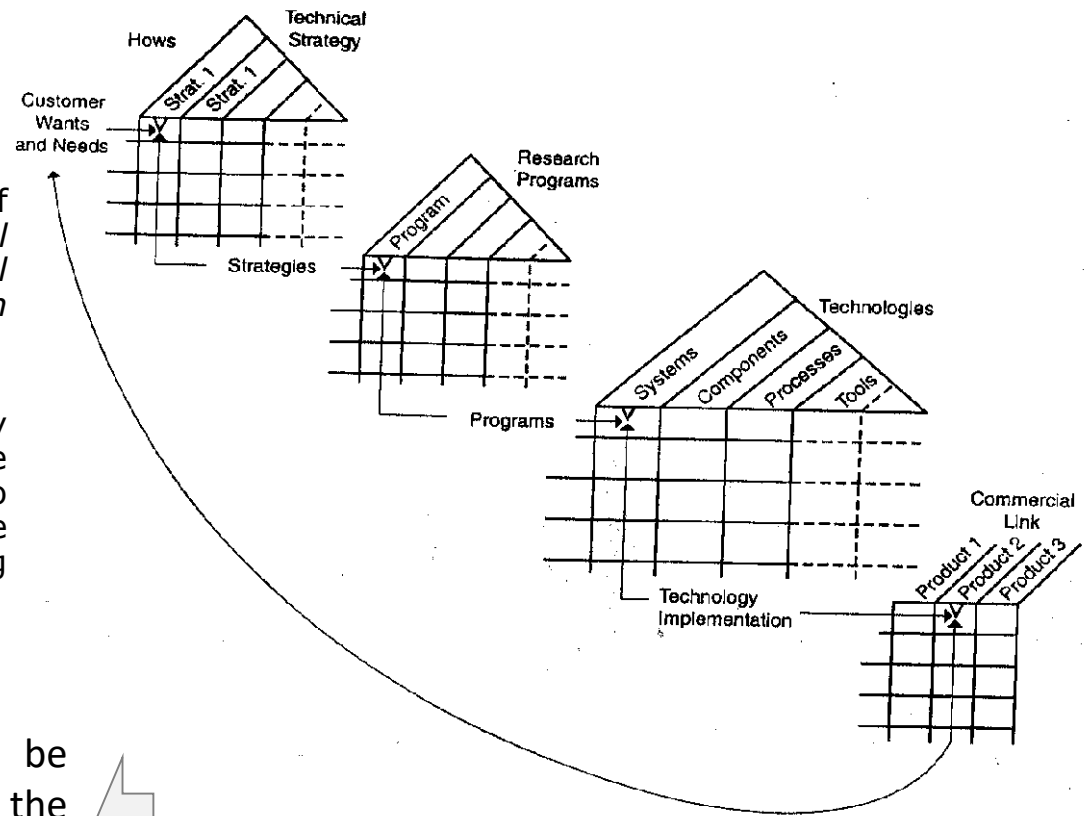[J. Ettlie- Managing Technological Innovation]

Figure 4-5 Managing Technology at Caterpillar

Technologies choices should be accomplished by a verification on the expectations of the end users (of the products for which the technology is applied).

The drawing shows a QFD application (QFD: Quality Function Deployment) that's a method which starts from the end user expectations, translates them in product's functions, then, in relation with such functions, investigated on the technologies' suitability.

FIGURA 1.1   LO SCHEMA INTERPRETATIVO
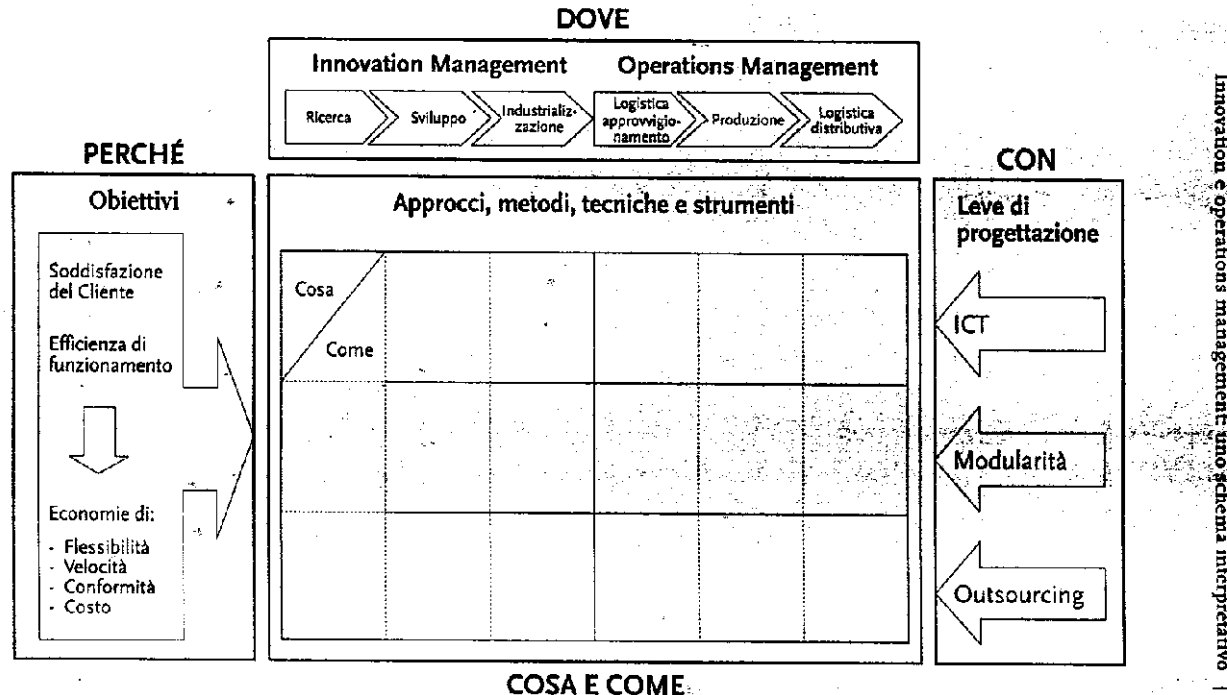
[A. Grando - Innovazione. Produzione e Logistica nell'era dell'economia digitale]

Innovation, Manufacturing and Logistics in the digital economy age.

The above drawing shows main tools for innovation management and for the subsequent operations management. Such tools are summed up in ICT, modularity and outsourcing.

Some lectures will deal with modularity and outsourcing.