White Paper

The Fruits of Technology

A slightly re-edited extract from

Hakkarainen, Kari (2006).
Strategic Management of Technology:
From Creative Destruction to Superior Resilience.
University of Vaasa, Vaasa, Finland.
Acta Wasaensia Nr. 162, 181 p. ISBN 952-476-147-5.

The Fruits of Technology

Just as some plants bear fruit only if they don't shoot up too high,
so in practical arts the leaves and flowers of theory must be pruned
and the plant kept close to its proper soil- experience.

Carl von Clausewitz, Prussian military philosopher

"Innovation" is a widely misunderstood and misinterpreted term. Many confuse innovation with "invention". In public media and discussion, use of the term is totally inconsistent.

Webster's (2005) definition for innovation is *"the introduction of something new"*, whereas invention means (1) "*a product of the imagination*" or (2) "*a device, contrivance, or process originated after study and experiment*." Rogers states in his classic book (1971) as follows "*Innovation is an idea, practice, or object perceived as new by an individual*".

He continues "*It is the perceived or subjective newness of the idea for the individual that determined his reaction to it. If the idea seems new to the individual, it is an innovation*". An innovation does not need to be new, it is sufficient to seem new to an individual. This might appear odd at first, but it certainly makes sense.

The practitioners of innovation processes and innovation management generally apply the term to mean turning an invention into a product, or into something having an economic impact. For example, Thecis (2005) uses the

term to *"mean the process that transforms ideas into commercial value"*. The distinction between **"**invention**"** and **"**innovation**"** is that "*invention is the creation of a new idea or concept, and innovation is turning the new concept into commercial success or widespread use.*"

Usually the practitioners presuppose that there is an invention behind an innovation, and that it is an essential part of it. Characteristics such as creativity and inventiveness are thus, at least implicitly, connected to and even emphasized with innovation.

The span of an innovation process is typically defined "from idea to launch" (e.g. Cooper 2002). It starts with brainstorming or idea generation. The most common process model is "funnelling" (see *Figure 1*) or "screening" (e.g. Cooper 2002). In both models the process starts with a broad range of inputs that get refined and evaluated in several sequential stages. Usually the process is a one-way, step-by-step development from idea to launch. Some process models may have iterative loops, which are very common in software engineering, but a linear one is dominant.

The emphasis of the innovation process is on the early stages, often called "the fuzzy front end" (e.g. Innovation Management 2005, IMI 2005).

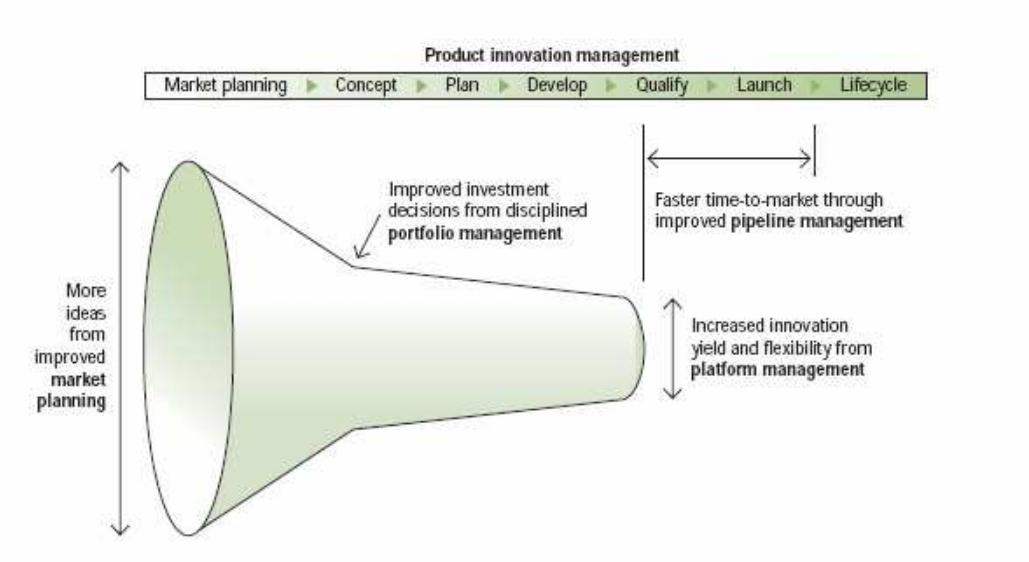

Figure 1. Simplified presentation of a funnelling model (IBM 2002).

As is the case with "strategy" (Kaplan & Norton 2004, p. 5), different organizations use the term innovation differently. Most use it, as mentioned before, for the process of "from idea to launch". Fewer, e.g. Metso (2003), use it in a very broad context, even to the extent of including what we call management of technology (MoT). And they have a right to do so. However, there are clear differences between the two, as illustrated in *Figure 2*.

The table is a summary of tens of literature sources. Naturally these sources have different viewpoints and definitions, and the table thus represents the author's subjective interpretation of generally agreed characteristics, commonalities and differences.

	Strategic Management of Technology	Innovation Management
Basic Driver	Sustainable Competitive Advantage	Economical and social utilization of technology
Field / discipline	Interdisciplinary	Engineering
Context / Scope	Strategic. Integrating technology and business	Dynamics of innovation. From idea to launch.
Means / Methods	Technology strategy. Communication and decision making.	Innovation process. Creativity.
Technology – market relationship	Coupling model (Both Technology Push / Market Pull in balance)	Market Pull / Technology Push
Starting Point	Strategic business challenges.	Customer needs / Idea generation.
Object / Result	**Technology as a strategic resource**	**Products and processes as competitive assets**

Figure 2. Technology management compared to innovation management.

The basic driver for MoT is the company's sustainable competitive advantage, whereas innovation management (IM) literature emphasizes the economic and commercial success of an innovation. There is also a social aspect, which is threefold. An innovation must be accepted in order to be commercially successful. Inversely, an innovation affects society by changing our life, work, etc. Thirdly, "innovation" generally has a tone of something good or positive, so innovation is connected to providing society with something better or more ethical. Seldom does one hear about e.g. military innovations, at least outside military circles. Rogers has discussed these social aspects at length in (Rogers 1971).

MoT is interdisciplinary by nature, whereas IM leans more towards engineering. The essence of MoT is strategy, and its most important means are communication and decision-making. IM emphasizes creativity and the subsequent innovation process. The starting point in MoT is the strategic business challenges, and in IM it is the customer's needs or ideas.

With regard to the market and customers, market pull or technology push is general in IM, while a coupled push/pull model dominates in MoT. Market pull in innovation management may sound odd, because the innovation process is thought to start from an idea. Innovation *management*, however, is interested in an innovation also being accepted.

In fact, technology push / market pull is a much more complex duality. One cannot actively seek out an innovation that is not known to exist, as Rogers (1971) points out. Individuals tend to expose themselves to those ideas that accord with their interests, needs and existing attitudes. It implies that a need for an innovation must usually precede awareness-knowledge. An individual can, however, develop a need when he learns that an improved method, an innovation, exists (Rogers 1971). Does a need precede the knowledge of a new idea or does knowledge of an innovation create a need for that new idea? Perhaps this is a chicken-or-egg problem, concludes Rogers (1971).

The biggest difference between the two is ultimately the results, or objects, they manage. MoT regards technology as a strategic resource. Innovation management exploits products and processes as competitive assets.

This is not to suggest that MoT is somehow more advanced or more extensive. It is only a matter of the angle of view selected. Generalization is always risky, but an innovation management approach is perfectly fitting for certain types of businesses. Examples are small and medium-sized enterprises; or companies with a considerable market share in highly specialized, narrow niche markets where there is a constant need for certain products with new features and characteristics.

The role and place of innovation in the context of technology management is poorly discussed in the literature. Where does it belong? How does it contribute to the rest of technology management? In innovation management literature, on the other hand, the innovation process is often considered as the entire mechanism that creates new products and services (see e.g. Dodgson 2000, Burgelmann 1996, or Christensen 1997). It seems that these two schools have different points of view that do not easily blend together.

Schumpeter (1939) declared that technological innovation covers much more than only new products. He defined the following types of innovation in the context of technological advance (*slightly reformulated*):

1. Introduction of a new product or qualitative change in an existing product
2. Process innovation new to an industry
3. The opening of a new market
4. Development of new sources of supply for raw materials or other inputs
5. Changes in industrial organization

Schumpeter's list of types of technological innovations impresses immediately because it is simple but still complete. It is exhaustive in respect of technological advance: it is very difficult to add anything, just as it is to remove some items. No wonder Schumpeter's list of innovations appeared essential, but their role in the strategic management of technology was not evident. Where in the process do they belong? The outputs are clear, but what and where are the inputs?

An initial enlightenment might come from an insight at the conceptual level. Innovations are the means to bridge the gaps between the current state and the vision. They implement the migration paths defined in *Figure 3*. They are the means to implement technology strategies.

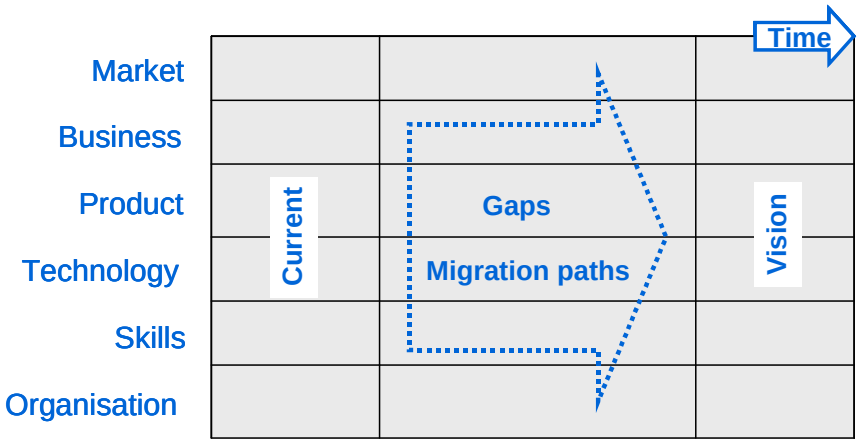

Figure 3. A roadmap focusing on the development of a vision of the future business, in terms of markets, business, products, technologies, skills, culture, etc. Adapted from Phaal, Farrukh & Probert (2001).

On a conceptual level the picture is clear, but how does it fit into practice? If innovations close the gap between current states and visions, do they not in the same manner stretch over and cover the entire area of the management of technology? They appear to be somehow contradictory to technology management process, or are they somehow orthogonal?

If the emphasis is at the front end, as is usually stressed, what comes *after* innovations?

Our concept of strategic management of technology has processes on three different levels that can be summarized as follows (Talonen & Hakkarainen 2005):

1. *Strategic Level* – Strategy positioning and generation
- *strategic positioning, renewal*
- competitive, product and technology strategies, business roadmaps

2. *Tactical Level* – Continuous planning and adaptation
- *continuous planning and strategy adaptation*
- product and technology roadmaps and portfolios

3. *Operational Level* – Implementation
- *strategy implementation, technology and product development*
- projects, technology and product development processes

The front-end of in model is the strategic level, but how can one put innovations there? They implement strategies, not create them. By intuition Schumpeter's five innovation types appeared important, but it was laborious to find a natural place and role for them in our model. That bothered the author for some time.

The key for a solution came from two sources and from different directions:

1. the definition of innovation we have used above, and
2. Schumpeter's list of technological innovations.

The author applied the most "naked" definition of innovation, "to introduce something new", i.e. take into use, or mobilize, something new. It does not imply that something must be invented. The "new" can be developed in-house, borrowed, copied, bought or licensed. It is enough that it is new for us! Naturally it does not exclude inventing.

The second key was Schumpeter's list itself. In general, the literature about innovation does not restrict the number, nature, types or targets of innovation. Schumpeter's exhaustive list[1], on the contrary, clearly defined the possible types of technological innovation, their purpose and objects. That helped to define the nature of innovations and fix their position within our framework. They all focus on the operative business processes!

That made innovations click nicely into place in the framework. Contrary to most of the prevailing approaches, innovations in our model are **the last, implementing step**, not the front-end (*Figure 4*).

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[1] *The author learned only afterwards that the original list was maybe not meant to be exhaustive, as Schumpeter had added "any 'doing things differently'". This slight misinterpretation, however, gave grounds for some fertile thinking.*

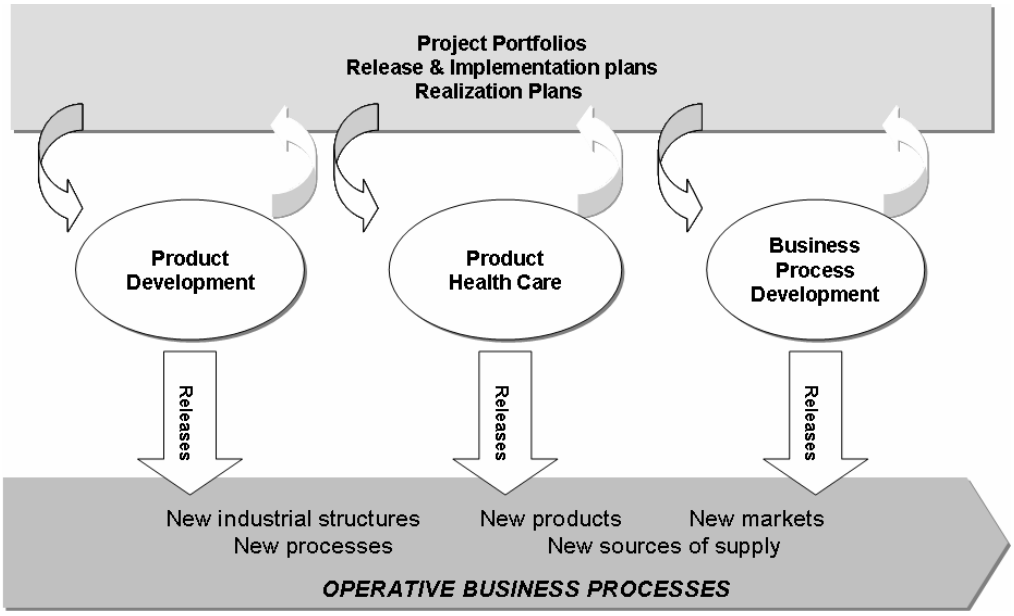

Figure 4. Innovations transfer the results of technology management activities to the operative business processes.

Innovations can be understood as end results or as activities. As end results they are the results of MoT planning, allocation and implementation processes. They are produced by product development projects, product health care activities, business process developments, organization changes, and so on. The essence is disciplined work to efficiently and effectively implement the strategy in practice.

Different developments are scheduled and controlled at the tactical level through project portfolio management. In essence it is linking short-term, project-level operational activities with long-term strategic objectives.

One can also perceive innovations as activities. In that sense they are the actions (in operative business processes) that are needed to take the new products, processes, and so on, into use.

In both views, innovations are the "glue" between MoT and operative business processes. They convey the results of MoT activities into business operations.

Innovations in our model have the objective of bringing commercial value, as defined in innovation literature, but the emphasis and location are totally different.

Cutting corners slightly, innovations provide an organization with the means, mechanisms, products and structures needed to create added value. They are the tools in competition among firms. They are the fruits of technology.

We can take the fruit tree analogy even further. As innovations are the fruits of technology, so is technology a fruit tree. Fruits start to grow until they are ripe for harvesting. After that, new fruits will start to develop, often after some kind of rest period. New fruits may appear that are similar to the previous ones, but they are inevitably different.

A tree changes slightly over time - it grows or evolves in other ways – and the quality of the fruits depends on the age and condition of the tree.

Even though the fruits differ in size and quality, they come from the same tree. Conversely, a tree cannot produce different fruits.

A tree lives longer than its fruits, its roots are deep in the soil, and the soil affects the condition of the tree and the quality of its fruits. As is the case with technologies, most trees need to be pruned and kept close to their proper soil-experience to bear good quality fruit in good quantities.

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