

Innovation and Technology Transfer

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It has been long understood that the generation, exploitation and diffusion of knowledge are fundamental to economic growth, development and the well being of nations [5].

Innovation

Innovation is widely recognized as essential condition for business success ensuring growth, sustainability and competitiveness. Innovation is a very broad concept and involves many different stakeholders varying from governments and scientists to business executives, marketing specialists and consumers. The diversity of the involved parties leads to different perspectives to innovation, thus resulting in different understanding of the concept.

From the very general point of view innovation can be understood as a process from idea generation to commercialization – bringing the idea or invention to the market as a new product, process or service through the phases of idea generation, research and development, product development, marketing and selling a new product or service. The idea becomes an invention, when it is converted into a tangible new artifact. The inventions are necessary seed for innovations, but the inventions do not inevitably lead to the innovation. Innovation is mostly regarded as the commercial and practical application of ideas or inventions [12], [13].

Innovations are classified by the type, the degree of novelty and the nature [9], [10]. Four types of innovation are distinguished: product or service innovations, process innovations, marketing innovations and organizational innovations together with three degrees of novelty: new to the firm, new to the market and new to the world [5]. There is also three types of innovation nature defined: incremental, radical, disruptive [9]. Types of innovation, degree of novelty and innovation nature define the three dimensions of innovation space. [Table 1](#), [Table 2](#) and [Table 3](#) present this classification in more detail.

Table 1 - Types Of Innovation [5]

<i>Type of innovation</i>	<i>Characteristic</i>
Product or service innovation	A product innovation is the introduction of a product or service that is new or significantly improved with respect to its characteristics or intended uses.

<i>Type of innovation</i>	<i>Characteristic</i>
Process innovation	A process innovation is the implementation of a new or significantly improved production or delivery method. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or to produce or deliver new or significantly improved products.
Marketing innovation	A marketing innovation is the implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing. Marketing innovations are aimed at better addressing customer needs, opening up new markets, or newly positioning a firm's product on the market, with the objective of increasing the firm's sales.
Organizational innovation	An organizational innovation is the implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Organizational innovations can be intended to increase a firm's performance by reducing administrative costs or transaction costs, improving workplace satisfaction (and thus labour productivity), gaining access to non-tradable assets (such as non-codified external knowledge) or reducing costs of supplies.

Table 2 - Degree of Novelty [5]

<i>Degree of Novelty</i>	<i>Characteristic</i>
New to the firm	The minimum entry level for an innovation is that it must be new to the firm. A product, process, marketing method or organizational method may already have been implemented by other firms, but if it is new to the firm (or in case of products and processes: significantly improved), then it is an innovation for that firm.

<i>Degree of Novelty</i>	<i>Characteristic</i>
New to the market	Innovations are new to the market when the firm is the first to introduce the innovation on its market. The market is simply defined as the firm and its competitors and it can include a geographic region or product line. The geographical scope of new to the market is thus subject to the firm's own view of its operating market and thus may include both domestic and international firms.
New to the world	An innovation is new to the world when the firm is the first to introduce the innovation for all markets and industries, domestic and international. New to the world therefore implies a qualitatively greater degree of novelty than new to the market.

Table 3 - Innovation Nature [9], [10], [13]

<i>Innovation nature</i>	<i>Characteristic</i>
Incremental	Incremental innovations build on existing knowledge and occur continuously in the organization. These innovations lead to small improvements in products, services or processes.
Radical	Radical innovations produce fundamental changes in products, services or processes.
Disruptive	In their most extreme form, innovations can even change the basis of society, for example the transformations resulting from today's computing technologies

Over time a number of literature texts describing the management and the phases of innovation process have been published. Six generations of innovation process models have been developed ranging from simple linear models that cover the basic stages of innovation process to complex interactive models that take into account the complexity of innovation process by introducing internal and external factors influencing innovation. The summary of these models is presented in [Table 4](#).

Table 4 - Innovation Process Models (Adopted from [2], [13])

<i>Model</i>	<i>Generation</i>	<i>Characteristic</i>
Technology Push [13]	First	Simple linear sequential process. Emphasis on R&D and science. Innovation is pushed by technology and science.

<i>Model</i>	<i>Generation</i>	<i>Characteristic</i>
Market Pull [13]	Second	Simple linear sequential process. Emphasis on marketing. Innovation is pulled by market needs.
Coupling Model [7]	Third	Recognizes interaction between different elements and feedback loops between them. Innovation is a result of simultaneous coupling of knowledge within all three functions: R&D, manufacturing and marketing.
Interactive Model [7]	Fourth	Combination of push and pull models, integration within firm. Innovation process is viewed as parallel activities across organizational functions.
Network Model [12]	Fifth	Recognizes influence of external environment and the effective communication with external environment. Innovation happens within a network of internal and external stakeholders.
Open Innovation [1]	Sixth	Innovation processes does not take place only within the firm boundaries. Internal and external ideas as well as internal and external paths to market can be combined to advance the development of new technologies or introduction of innovative products, services and processes.

It is important to note that innovation can occur in any sector of the economy, including public sector, however less is known about innovation processes in non-market oriented sectors [5]. Innovation is still not fully understood concept. In reality innovation processes are complex, nonlinear, iterative, and they include the element of randomness [8], [13]. Industry is developing methods to manage those processes to control added value, cost and risk while academia transforms information from observations and case studies into scientific knowledge to better understand the success and failures in innovation thus improving the chance of success [12].

Technology Transfer

Discussions by the publications implies that there are two significant components of innovation process: knowledge and successful diffusion of that knowledge resulting in new products or services being offered to customers or in other more common words – invention and successful implementation. Inventions are very often made in universities and research institutes. To turn those inventions into successful innovations they must be

transferred to organizations with adequate marketing experience, global presence and real implementation power [6]. This is the responsibility of technology transfer process.

In general the concept technology transfer covers not only the technology transfer from academia to industry. It is a broad field that ranges from internal corporate technology transfer to international technology transfer [11].

Technology transfer can be defined as the process of sharing of or acquiring/providing/licensing skills, knowledge, technologies, intellectual property, technology development personnel or entire teams, methods of manufacturing, samples of manufacturing and facilities among governments, companies, research institutions and other organizations to enable the accessibility of scientific and technological developments to a wider range of users who can then further develop and exploit the technology into new products, processes, applications, materials or services (adapted from [14]).

The ways of technology transfer depend on the involved parties and the reasons behind technology transfer. They vary from acquisitions of companies through technology transfer in order to release a new product or service based on the technology acquired, to collaborations in technology transfer efforts among companies located in a cluster.

Innovation and Technology Transfer Process

An expected output of the WP3 of BONITA is to create an enhanced innovation and technology transfer (I&TT) model based on regional I&TT models and to implement it in the regions of the partners of BONITA. The goal of WP3 is to find a way to express and codify this I&TT knowledge and experience possessed in a form suitable for accumulation and transfer. The starting point of this effort is achieving the common understanding of the innovation and technology transfer in the context of BONITA by answering a question "What is being done in the field?". An abstract high level innovation and technology transfer process is presented below with the intention to be used as a framework for building BONITA's enhanced innovation and technology transfer model.

In the context of BONITA we are referring to a technology transfer from academia to industry. The intention is to cover the overall innovation and technology transfer process including activities performed by the involved parties. The challenge of the effort lies in the complexity of innovation and technology transfer process. It involves many different organizations that collaborate in the process and have a different perspectives to it, and has no clear differentiation of activities by involved organizations, especially the managerial ones that seems to be of the highest importance.

The abstract innovation and technology transfer process tries to overcome these issues by introducing three roles that act in the field of innovation and technology transfer: technology supplier, technology receiver, and technology transfer facilitator. Organization can perform more than one role in innovation and technology transfer process as well as one role can be performed by more than one organization.

Technology supplier

Technology supplier organizations focus on technology development. Primary candidates for this role are universities and research institutes. The technology development process can be defined as a set of five steps: basic research, applied research, in vitro prototyping, in vivo prototyping and industrial replication [6].

The challenge lies in trying to define the creative nature of technology development process, however it seems that collaborative activities in the context of innovation and technology transfer should be focused on here.

Technology receiver

Technology receiver organizations are the ones that take new technology and implement it to improve their products, services, processes or work environment. This process is called innovation and can be defined as consisting of five activities: maintaining new technology awareness, selection of new technologies, preparation for infusion, infusion of new technologies and innovation management [3].

Technology transfer facilitator

Technology transfer facilitator organizations are the ones that enable and in many cases drive technology transfer. These might be technology transfer broker organizations, technology transfer offices established in research institutions or collaborative university-industry consortiums, consulting companies or any organizations that facilitate and support technology transfer process. The technology transfer support process can be defined as consisting of such activities as contacts development, market needs identification, search for available technology, search for industrial application and contractual support.

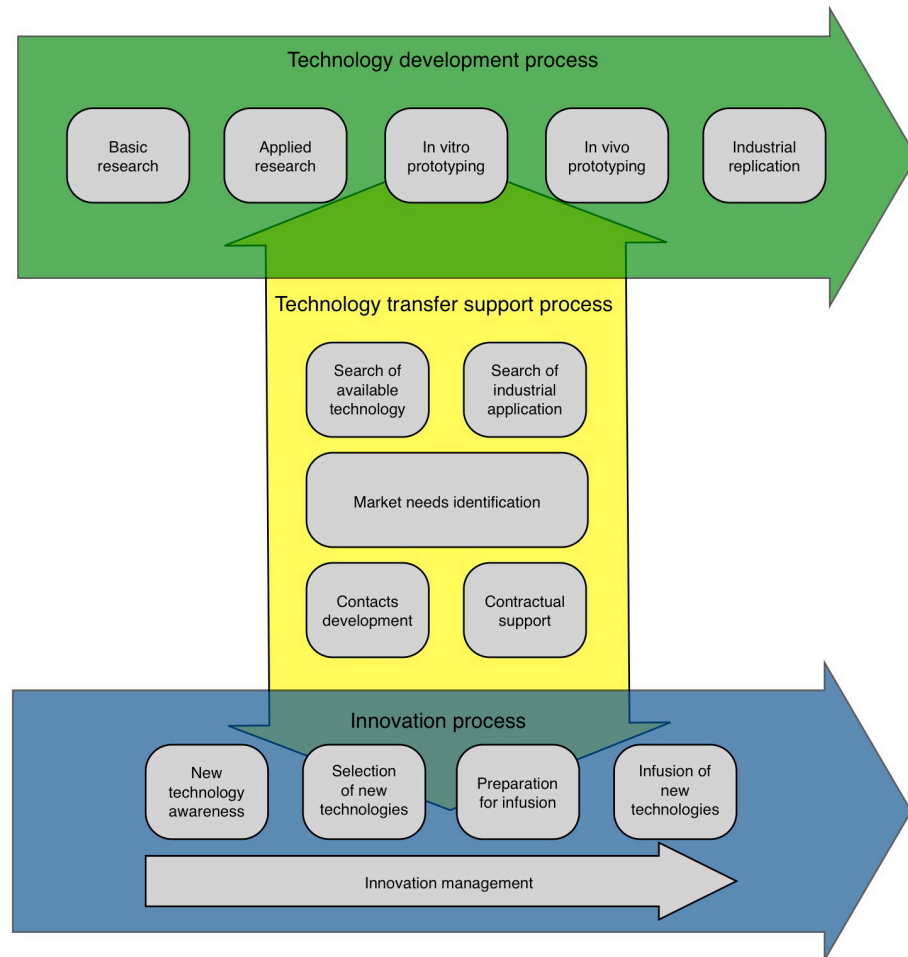
Technology transfer broker organizations can be defined as a bridge between technology supplier and technology receiver. Technology transfer broker supports technology transfer process by bringing together the ones that develop new technology and the ones that need it.

Technology transfer offices established in research institutes can be characterized as the ones mainly focusing in diffusing the research results by finding the technology application partners in industry.

Collaborative university-industry consortiums seems to provide an effective mechanism for fostering innovation and technology transfer, especially when having government involved as a third partner and managed to be working together to benefit through achieving technology transfer outcomes that could not be achieved by working apart [4].

Process Diagram

The following diagram represents the abstract high level innovation and technology transfer process that has been described. The gray boxes represent activities performed by each role of innovation and technology transfer process. These activities stand for proposition purposes only and are intended to be the placeholders for ideas, knowledge and experience in the field of innovation and technology transfer possessed by the partners of BONITA.



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