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The course of lectures on discipline

Innovation Management

Study material
for the 4th year students
of the specialty «Management»

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1.1. THE IMPORTANCE OF INNOVATION.

Innovations are an important factor of success in a competition which is getting increasingly intense. Only those who are able to invent themselves over and over again and thus gain new competitive advantages will be able to survive in the long run. This is true for companies, organizations, teams, employees and countries.

". . . not to innovate is to die" wrote Christopher Freeman (1982) in his famous study of the economics of innovation. Certainly companies that have established themselves as technical and market leaders have shown an ability to develop successful new products. In virtually every industry from aerospace to pharmaceuticals and from motor cars to computers, the dominant companies have demonstrated an ability to innovate (*see* Table 1.1).

Table 1.1 Market leaders

Industry	***Market leaders***	***Innovative new products***
Aerospace	Airbus Ind; Boeing	Passenger aircraft
Pharmaceuticals	Pfizer; GlaxoSmithKline	Impotence; ulcer treatment drug
Motor cars	Toyota; DaimlerChrysler; Ford	Car design and associated product developments
Computers and software development	Intel; IBM and Microsoft; SAP	Computer chip technology, computer hardware improvements and software development

Indeed, the industrial revolution of the nineteenth century was fuelled by technological innovations (*see* Table 1.2).

Table 1.2 Nineteenth-century economic development fuelled by technological innovations

Innovation	***Innovator***	***Date***
Steam engine	James Watt	1770–80
Iron boat	Isambard Kingdom Brunel	1820–45
Locomotive	George Stephenson	1829
Electromagnetic induction dynamo	Michael Faraday	1830–40
Electric light bulb	Thomas Edison and Joseph Swan	1879–90

Today there is more and more discussion about the necessity for innovation in companies, which is subject to various factors [5]. Few markets are stable and four main factors (*see* Figure 1.1) create the need for innovation: *technological advances, changing customers, intensified competition* and *changing business environment*.

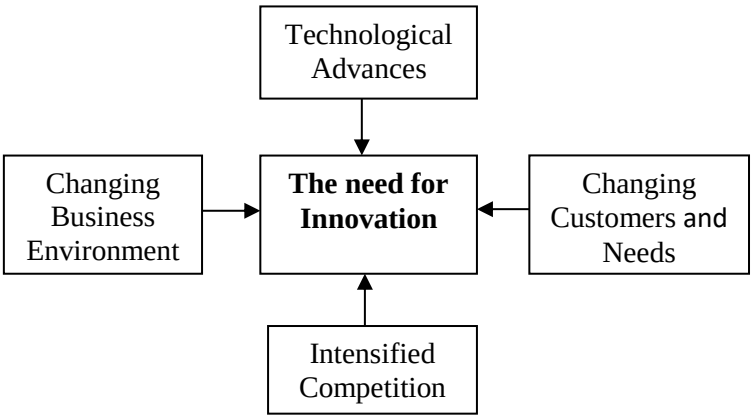


Figure 1.1. *Drivers of the Need for Innovation [1]*

1. **Technological Advances.** There are numerous examples of new technologies having a major influence on business. For instance, nanotechnology is increasingly being used in products, such as "easy to clean" surfaces. New technologies often create new industries and both biotechnology and multimedia have created significant employment over the past decades. In addition, new applications of established technologies are constantly emerging. With the vast array of technological developments, even multinational companies that used to conduct all their own basic research cannot keep abreast of all of the developments, using internal resources alone. Organizations need to monitor the progress of both the technologies they currently use and also that of potential substitutes. Technology is equally important for service companies and R&D is increasingly having a major impact on how service companies do business.

2. **Changing Customers and Needs.** The second driver of innovation is the changing characteristics and requirements of customers. Demographics show that many markets will evolve. For instance, the ageing population in the West will change many consumer markets. In contrast, other markets (for example, Southeast Asia) are largely made up of young consumers with different aspirations. The earnings in many newly industrialized countries will soar and demand for particular products and services will develop. For instance, the Whirlpool Corporation has recently launched the 'Ideale', the world's cheapest automatic washing machine, which retails at around $150 in countries such as Brazil and China.

Changing customers also means that traditional market segments are disappearing or fragmenting and companies will need to adjust their product ranges accordingly – for example, car manufacturers now target over fifteen key segments in the US, as opposed to only five in the late 1960s. At the same time, there is the pressure for more environmentally acceptable, better value for money products and services. As basic needs are met, there is an additional challenge to innovation – determining customers' hidden needs.

3. **Intensified Competition.** The third driver shown in Figure 1.1 is growing competition. Logistics costs have plummeted and, consequently, 'safe, home markets' are being threatened by foreign competition. Companies may also face competition from sources normally outside their industries.

4. **Changing Business Environment.** Business environments change and are always subject to change – sometimes gradual and sometimes radical.

Gradually markets have become more open as the market economy has been embraced by most governments. Many companies have focused on cost cutting. A gradual reduction in the resources required for key business processes has been achieved. A continued focus on efficiency gains will bring only diminishing returns and cost-reduction myopia needs to be

replaced by a focus on increasing revenues and profits through new products and services.

Economic cycles have a radical impact. Downturns drive many companies to cut their investments in innovation but the winners which emerge have continued to invest.

1.2. DEFINITION OF INNOVATION.

There are many misunderstandings about what innovation, in a business context, truly is. Innovation should not be restricted to:

- ✓ Big ground-breaking ideas or technological leaps forward.
- ✓ Creative jumps of the imagination which cannot be planned or prepared for.
- ✓ The R&D department or the "creative types" in marketing.
- ✓ Creativity "workshops".
- ✓ Product based companies.

The term "Innovation" seems to derive from the Latin *novus* [3], which means new or young or novel. Too many companies focus on just one area of innovation management – typically ideas generation – although there are other aspects of innovation management that are equally important.

There are different definitions of the term *"Innovation":*

- ✓ a new idea, for others it means an invention (a materialized new idea);
- ✓ a new product (a developed invention);
- ✓ the act of creating a new product or process;
- ✓ to create a new business.

Innovation is the application of better solutions that meet new requirements, in articulated needs, or existing market needs. This is accomplished through more effective products, processes, services, technologies, or ideas that are readily available to markets, governments and society. The term innovation can be defined as something original and, as consequence, new that "breaks in to" the market or into society [6].

Innovations result from ideas, if they are implemented in new products, services and processes, which find real usage and thus penetrate the market. Commercial success in the future will therefore depend mainly on the companies' abilities to create new products, ideas and processes or take up innovations quickly.

Innovation = ideas + new products/services + market implementation

Innovations do not always have to be completely new ideas. The term innovation rather means the implementation of something new and results in a noticeable improvement for the user. They are characterized by a special characteristic, clear originality and a noticeable user benefit. Innovations are as a result qualitative new products, services, processes, structures, markets and cultures [5]. Innovation is an opportunity for something new, different. It is always based on change. Innovators do not view any change as a threat but as an opportunity.

1.3. STUDY OF INNOVATION.

Innovation has been a topic for discussion and debate for hundreds of years. Nineteenth-century economic historians noticed that the acceleration in economic growth was the result of technological progress.

Schumpeter was among the first economists to underline the importance of new products as stimuli to economic growth. Indeed, early observations suggested that economic

development does not happen in any regular manner, but seemed to occur in "bursts" or waves of activity, thereby indicating the important influence of external factors on economic development.

This macro view of innovation as cyclical can be traced back to the mid-nineteenth century. It was Marx who first suggested that innovations could be associated with waves of economic growth. Since then others such as Joseph Schumpeter (1883-1950, was an Austrian American economist and political scientist), Nikolai Kondratiev (1892-1938, was a Russian economist, he is best known for proposing the theory that called "Kondratiev waves"), James Utterback (professor at Massachusetts Institute of Technology, Sloan) have argued the long-wave theory of innovation.

After the Second World War economists began to take an even greater interest in the causes of economic growth. One of the most important influences on innovation seemed to be industrial research and development. After all, during the war, military research and development (R&D) had produced significant technological improvements and innovations, including radar, aerospace and new weapons.

There was a need to understand how science and technology affected the economic system. A series of studies of innovation were undertaken in the 1950s which concentrated on the internal characteristics of the innovation process within the economy. A feature of these studies was that they adopted a cross-discipline approach, incorporating economics, organisational behaviour and business and management.

In particular, these studies realised that firms behaved. This led to the development of a new theoretical framework that tried to understand why some firms appeared to be more successful than others. The firm and how it used its resources was as the key influence on innovation.

Neo-classical economics is a theory of economic growth that explains the rate of technological change influences the rate of economic growth, but economic growth does not influence technological change. Rather, technological change is determined by chance. Also, neo-classical economic theory tends to concentrate on industry or economy-wide performance. It tends to ignore differences among firms in the same line of business.

Besides that, the activities that take place within the firm that enable one firm seemingly to perform better than another, given the same economic and market conditions, has been the focus of much research effort since the 1960s.

The Schumpeterian view sees firms as different – it is the way a firm manages its resources over time and develops capabilities that influences its innovation performance.

As the twentieth century drew to a close there was probably as much debate and argument concerning innovation and what contributes to innovative performance as a hundred years ago. It was Schumpeter who argued that modern firms equipped with R&D laboratories have become the central innovative actors. This theory has a significant impact on the study of business and management today. Success in the future, as in the past, will surely lie in the ability to acquire and utilise knowledge and apply this to the development of new products. Uncovering how to do this remains one of today's most pressing management problems.

The importance of uncovering and satisfying the needs of customers is the important role played by marketing and these activities feed into the new product development process. Recent studies suggest that listening to your customer may actually stifle technological innovation and be detrimental to long-term business success.

In previous centuries it was easier in many ways to mobilise the resources necessary to develop and commercialise a product, largely because the resources required were minimal. Today, however, the resources required, in terms of knowledge, skills, money and

market experience, mean that significant innovations are synonymous with organisations. It is important to note that more recent innovations and scientific developments (such as significant discoveries like cell phones or computer software and hardware developments) are associated with organisations rather than individuals.

Hence, today's innovations are associated with groups of people or companies. Innovation is invariably a team game.

1.4. BASIC CONCEPTS OF INNOVATION MANAGEMENT.

Now is considered that there are 5 innovation management concepts as being important for the years ahead [2]:

1. Customer-based innovation. Customer-based innovation' is all about finding new and more profound ways to engage with customers and develop deeper relationships with them. It based on:

- *Total customer experience* driven by a desire to build a deeper relationship with the customer.
- *Design-in emotion:* The second trend emerging in this space is the realization that, as technology allows manufacturers to deliver as much and often more functionality than the typical consumer can use, the bases of competition will change. Rather than compete on yet more features and functions we will see manufacturers compete even more on style, on design and on emotional connection, with approaches used in the luxury and fashion markets being increasingly adopted in more traditional sectors. As one of the world's leading designers said at one conference: "Apple is a community and an ethos, of which the products are merely souvenirs". Apple is perhaps the most visible exponent of design as differentiator, but there is considerable work going on in leading research centers, in the automotive industry, and in software development to understand how to make an emotional connection with the customer through design of products, services and experiences, and how to build community, loyalty and advocacy.
- *Social networking:* The third converging trend is closely linked, i.e. the use of social networks to underpin companies' propositions and relationships with their customers. Software, hardware and media companies such as IBM, Sun and Microsoft have already well-established user-led innovation processes.

2. Proactive business model innovation. A business model defines how to create and capture value within a value chain, considering both operations and strategy. Business model innovation as a concept is certainly nothing new, but there is still much to be done to develop a convincing innovation management approach that is sufficiently systematic and repeatable to generate new, innovative business models.

There are three key trends in successful business model innovation in the future:

- *Deliver "thick value":* When companies deliver goods and services that truly leave the world better off, that's "thick value". That means creating real economic value; not simply capturing it from customers or suppliers, but genuinely making everyone better off.

Today business still often focuses on the creation of "thin value", i.e. purely profit-driven transactions between the organization and its stakeholders, as opposed to "thick value", which considers more lasting stakeholder value, for example increasing the resilience of stakeholders in the face of global societal and economic pressures such as climate change, demographics or energy security.

- *Modular approaches:* The need to be global and act local greatly increases the complexity of managing the business. Companies will increasingly need to take a modular

approach to business models – innovating so that different modules can be used as building blocks in a range of market environments, each supporting the overall strategy of the company. One simple example of this is Unilever who employ the "Unilever Ladies" to distribute Unilever products to small villages.

- *More market adaptation:* There is an important need for companies to find better ways to generate innovative business models proactively to meet the needs of new markets, or to respond to new developing world competitors.

3. Frugal Innovation. Frugal Innovation is about originating and developing innovations in lower-income, emerging markets, taking the needs of poor consumers as a starting point, then transferring, adapting, applying and distributing them in developed markets. This is the opposite of the traditional innovation approach, which has been to develop innovations in the higher value "knowledge economies" of the developed world, to use the emerging markets as a low-cost manufacturing resource, and sometimes to strip the product or service of unnecessary cost and functionality to enable it to compete in the emerging markets.

Frugal innovation brings about a rethinking of the nature of innovation. Instead of "more" it is often striving for "less", using clever technology to create masterpieces of simplification in mobile phones, computers, cars and financial services. Frugal innovation clearly is not just about innovating products, often changes in the whole supply chain are involved.

4. High Speed/Low Risk Innovation. One aspect that is set to become increasingly critical is the importance of getting to market not just fast, but also accurately and without flaws. Due to the rise in global brands and the arrival of vivid, uncontrolled, ubiquitous mass communication, there is the potential for immense destruction of shareholder value from any flaw in product or service. So that is expected to see further development of approaches and tools to drive fast, de-risked product and service innovation. For instance:

✓ *Gradual product rollouts* (It is expected to see less dramatic big launches and more of a continuing roll-out when new products and services are released to their markets. The approach reduces risk both for the manufacturer and the user and will become crucial as systems become ever more complex and inter-related).

✓ *Global 24/7 product/service development* (Global teams with virtual organizations will allow 24/7 development in pursuit of speed. More importantly they will allow a wider range of cultures and perspectives to be brought to bear in product creation).

✓ *Trial and experiment* (It is expected to see ever-increasing use of the trial and the experiment, starting already in the functional specification phase).

5. Integrated Innovation. Integrated Innovation is about taking innovation approaches that were once the domain of New Product Development (NPD) only – such as idea management, stage gates and portfolio optimization – and applying them consistently as an integral part of business strategy to achieve not only growth but also competitiveness.

The following aspects of Integrated Innovation as being important for the future:

✓ *Systematic non-NPD innovation*: This means greater and more consistent application of formal innovation tools and approaches to improve the effectiveness of proactive innovation in non-NPD areas such as management processes, manufacturing operations, business models, supply chain and sustainability. This will also include greater application of innovation management tools for cost reduction and competitiveness improvement.

✓ *Radical/disruptive innovation*: There will be a need for increasing proficiency and effectiveness in applying techniques to focus especially on radical innovation and new growth opportunities in adjacent or completely new business areas.

✓ *Embedded innovation process ownership*: They expect to see ownership of the innovation process shifting increasingly outside the Technology and R&D functions, ultimately becoming fully embedded in other business functions.

✓ *Innovation integral to business strategy*: Many companies already claim innovation as being integral to business strategy, but struggle to explain exactly how this happens – more post-event justification than reality. As innovation tools, including especially radical innovation tools, become more embedded throughout the organization, leading companies will become much better at applying them more purposefully and effectively in a corporate strategy context.

1.5. CLASSIFICATION OF INNOVATIONS.

There are different approaches and features of the classification of innovation. Their critical analysis and synthesis allowed to create a classification system that contains classification features and selected according them types of innovations (*see* Table 1.3, 1.4).

Table 1.3 A classification of innovations

Classification's features	***Type of innovations***
Subject matter of innovations	Product innovation
	Process innovation
	Management innovation
	Commercial/marketing innovation
Field of operation (activity)	Production innovation
	Commercial/marketing innovation
	Social innovation
	Ecological innovation
	Legal innovation
Degree of novelty	Radical innovation
	Incremental innovation
	Systemic innovations
Scale of novelty	New for enterprise
	New for branch
	New for country
	World novelty
Addressee innovation	Producer
	Consumer
	Society
Degree of physical tangibility	Product innovation
	Process innovation
	Objects of intellectual property
Causes of occurrence	Strategy, which is prospective in nature and serves to ensure the competitiveness of the goods or services of the enterprise in the future Reactive, which arises as a reaction to the actions of competitors and aimed at improving the competitiveness of the goods or services
Kind resulting effect	Scientific and technological effect
	Economic effect
	Social effect
	Ecological effect

Table 1.4 A typology of innovations

Type of innovation	***Example***
Product innovation	The development of a new or improved product
Process innovation	The development of a new manufacturing process
Organisational innovation	A new internal communication system; introduction of a new accounting procedure
Management innovation	TQM (total quality management) systems; BPR (business process re-engineering); introduction of SAPR3 (SAP is a German software firm and R3 is an Enterprise Resource Planning (ERP) product.)
Production innovation	Quality circles; just-in-time (JIT) manufacturing system; new production planning software, e.g. MRP II; new inspection system
Commercial/marketing innovation	New financing arrangements; new sales approach, e.g. direct marketing
Service innovation	Internet-based financial services

Most scientists believe that the greatest practical importance has the classification of innovations for subject matter and the level of innovation novelty.

Comparing the various definitions of innovation, it can be seen that there are several common elements *what* is changed (such as product or process changes); *how much* is changed (whether it is completely new or only perceived as such); the *source* of the change (sometimes technology); the *influence* of the change (for example, its social or commercial value).

TOPIC 2. THE INNOVATION PROCESS AND CHARACTERISTICS OF ITS MAIN STAGES

2.1. The innovation process.
2.2. Main stages characteristics of new product life cycle.

2.1. THE INNOVATION PROCESS.

The innovation process consisting of the sub processes input, project management and implementation. Organizational factors embrace the main field consist of strategy, corporate culture, human resources, budget and cooperation. These tell us if the environment is also suited for promoting innovations. To put it another way the whole process from idea to the implementation of new products/services to the market is pictured.

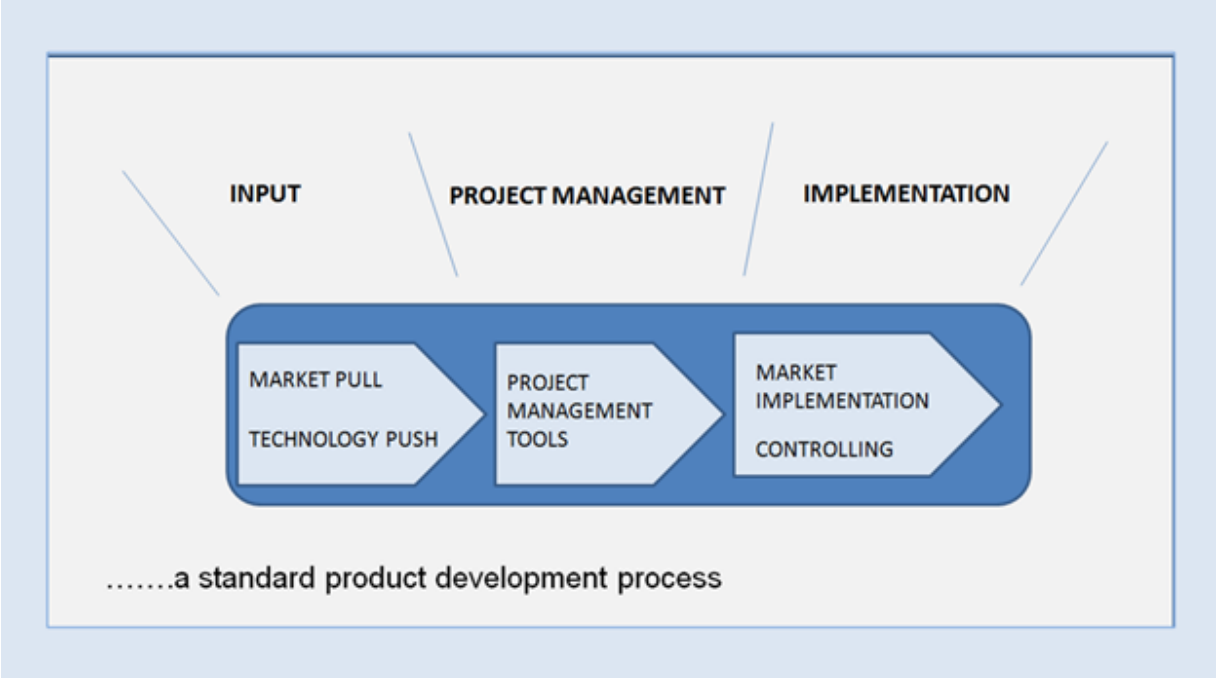


Figure 2.1 *Innovation Circle in a narrower sense*

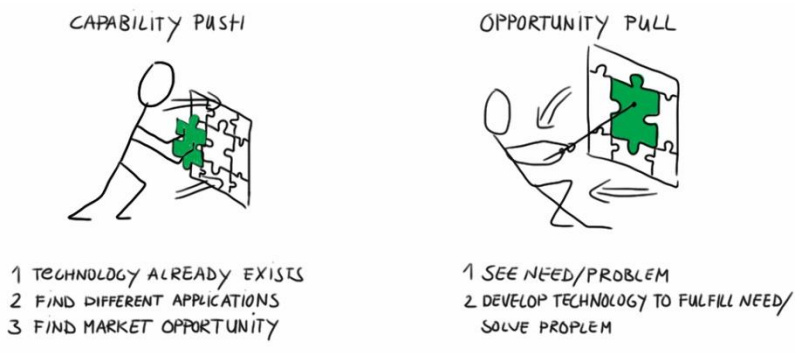
- **INPUT:** The following questions will be answered: Where do the ideas come from? How can you act actively and systematically in this early innovation phase?

The starting point for successful new products and services are initially ideas, which can be derived from various company-internal and external sources. Finding those ideas can be significantly supported by different organisational and methodological measures.

Technological advancements and market needs are some of the significant forces fueling the introduction of products and services in a wide range of business sectors. Many product and service providers have utilized the so-called *technology-push* and *market-pull*, the simple linear views of innovation which prescribe the use of technological discoveries and the involvement of the market respectively to produce goods and services.

➢ The term "**Technology Push**", refers to advances in technology and the way in which these are introduced to the public / consumers, in the form of commercial products. In this model, research and development in new technology drives the development of new products. The technology push models starts with a technological development.

A good example is touch screen technology. The developments in electronic engineering have enabled smaller, smarter electronic components to be fitted into everyday products such as the mobile phone, personal hi-fi and cameras.



➢ The term "**Market Pull**", refers to the need/requirement for a new product or a solution to a problem, which comes from the market place. The need is identified by potential customers or market research. A product or a range of products are developed, to solve the original need. Market pull sometimes starts with potential customers asking for improvements to existing products.

A good example of market pull influencing product evaluation is seen in the development of the digital camera. Twenty years ago, there was a "market" requirement for a camera without a film that could take endless photographs that could be viewed almost immediately. The technology of the time did not lead to the manufacture of such a device. However, technology has a habit of catching up on market needs. Market pull eventually led to the development of digital cameras, once miniature digital storage, processing power and improved battery performance was available. Market pull ensured that photo editing software also developed, in parallel with the development of digital camera technology.

Market pull does not always work. Sometimes the market "calls" for a innovative new product, but the technology does not exist to support its development / manufacture. For example, electric cars are becoming more popular and the commuter market place, is open to the development of an environmentally friendly electric motor bike. A motorbike that can match the performance of petrol driven motor bikes. However, current electric motor and battery technology means this is not possible. Eventually, market pull will influence investment in research and development, ensuring the continued evolution of electric motorbikes.

➢ **INNOVATION MANAGEMENT:** How systematically should the innovation process be organized?

The goal of innovation management is the systematic support of the whole innovation process from the generation of ideas to the implementation of new products or services on the market.

The scope of duties of innovation management includes:

- Compilation and evaluation of innovative developments within and outside of the company.
- Development and maintenance of the company-internal innovation potential
- Acquisition of company-external innovations and their implementation in the company
- Planning, supervision, implementation and controlling of the company's innovation activities
- Determination of the time for innovation to enter the market.
- Planning and realisation of possibilities to protect innovative developments (patents, licensing).

➢ **IMPLEMENTATION OR REALIZATION:** How can or should new products be introduced to the market? Accompanied by a controlling of the whole process.

The marketing instruments (4 Ps: product, price, place (distribution), promotion) are oriented on the events on the market. Because marketing is the for a company profitable satisfaction of its customers' needs, customer habits and requirements must be recognized and analysed and the competitors' behavior must be known.

Innovation controlling signifies all activities for the planning and supervision of innovation activities with the goal to ensure success:

- Efficiency: prevention of economic inefficiency in regard to time and costs
- Effectiveness: reaching of goals.

The following potential hurdles may occur for the market implementation of innovative products:

✓ **Complexity:** Highly complex products are hard to convey to the customers.

Remedy:

- Lay special care on professional communication, if needed include external experts.
- Argue in such a way that the customer sees a relation between his problems and the product.

✓ **Novelty of the problem solution:** Products that use new technology normally have a high need of explanation. You should be prepared for questions regarding process safety, quality and integration ability.

Remedy: Discuss all possible objections to the product in advance.

✓ **Product positioning:** Customers must see a reward for changing to the new product. Especially if the new product is more expensive than existing products, the advantage must be clearly recognizable.

Remedy: Wear "customer glasses" when positioning the product.

✓ **Social commitments and business history:** A product's performance advantage is only one parameter for a buying decision. This means that even new and better products may not guide fixed customer relations into new ways without further ado.

Remedy: Assure the fulfilment of demands.

✓ **Access to and dependence from distribution channels:** Due to an increasing concentration of companies access to the large distribution channels gets increasingly decisive.

Remedy: Adapt to the conditions of future distribution and trading partners as early as possible. This makes sure that you are not somehow hindered when trying to introduce a new product to the market.

✓ **Regulations and admission procedures:** Products interesting in regard to the market or its technology may still fail because of legal and social frameworks.

Remedy: Take into consideration legal regulations, admission procedures and customer specific standards as an important framework for the marketing of products.

2.2. MAIN STAGES CHARACTERISTICS OF NEW PRODUCT LIFE CYCLE.

Ideally the aim of every innovation process is to build up a new successful business with products that can successively be transformed into standard products and sold on one or more geographical markets. Figure 2.1 shows in principle the situation from the birth of a new product – i.e. from when new discoveries and/or new product ideas have emerged – to when the product is removed from production and sales.

1. Analysis of correspondence between internal and external development opportunities. To do this market opportunities and threats should be compared with the strengths and weaknesses of the company. On this basis we can identify how the present and prospective directions and activities of the company correspond the conditions and the situation on the market. As a result, activities which should be curtailed and which are worth developing could be determined.

Assessment of correspondence of company' internal and external development opportunities generated by the market can be accomplished using SWOT-analysis.

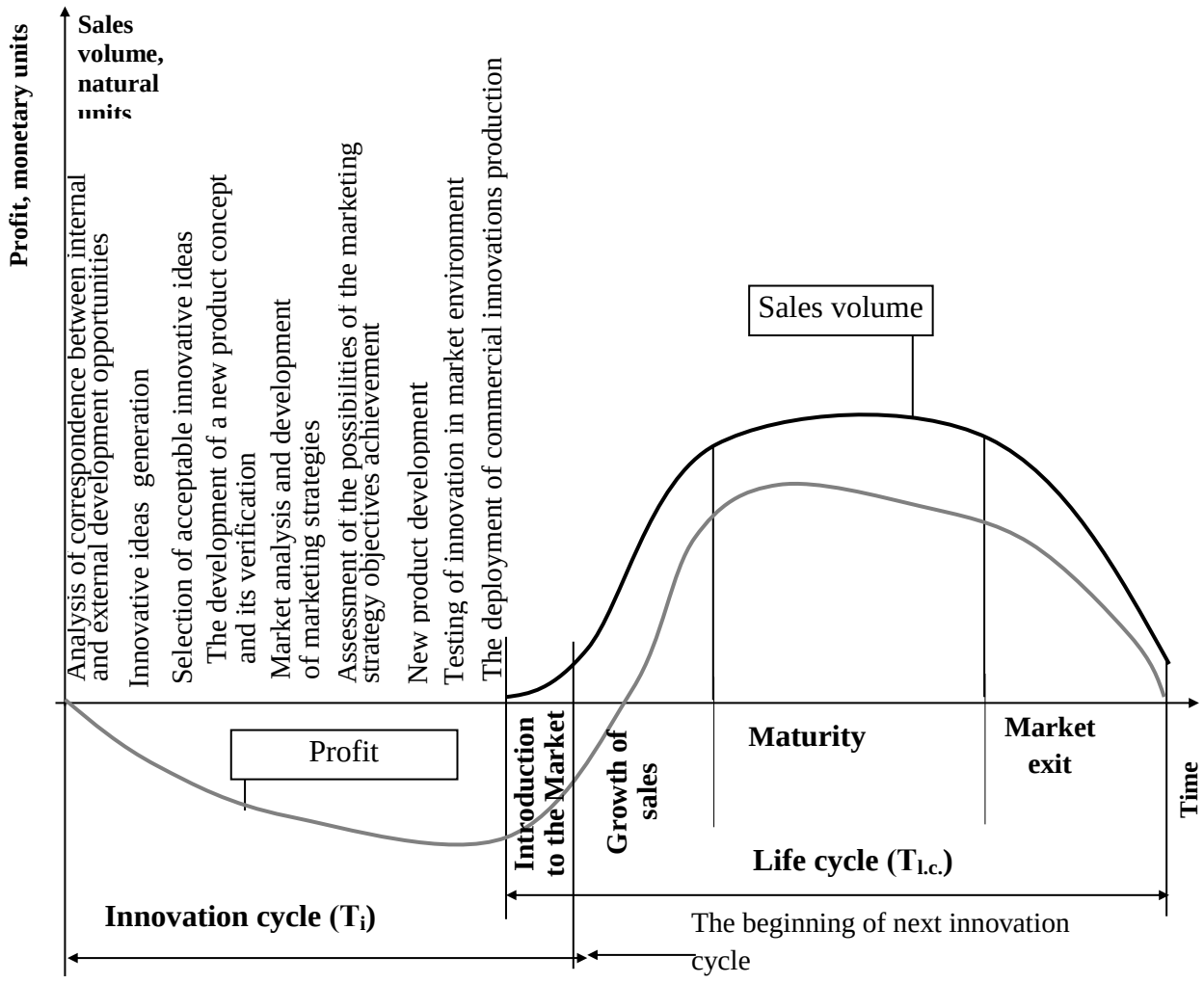


Figure 2.2 *The Innovational and life cycles of the product innovation*

2. Innovative ideas generation. The ***idea*** is a general concept of the product that can be offered on the market.

The main sources of innovative ideas are:

- analysis of consumer needs;
- sales staff and dealers of the company;
- analysis of developments in science and technology;
- development of ideas by company's own scientific and technical personnel;
- analysis of competitors activities including analysis of their promising developments;
- the results of situational and simulation modeling of the consumer behavior in the present and the future;
- an analysis of development trends in the technological, economic, social, political, cultural, legal, ecological, demographic and other components of management environment.

There are many methods for generating the innovative ideas (intuitive and ordered). The most popular among the latter are: improving the prototype, brainstorming, synectics, elimination of deadlocks, morphological maps. Any criticism of ideas is prohibited at this stage, since the purpose of the stage is to generate their greatest possible number.

3. The selection of innovative ideas. At this stage most appropriate ideas for a particular company should be chosen from the variety of new ideas.

The verification may be performed on the basis of:

- conformity assessment of the innovative ideas that were accepted appropriate in similar situations;
- conformity assessment of innovative ideas to predetermined requirements;
- comparison of innovative ideas according to the list of criteria and indicators and their optimal choice.

Preliminary assessment of innovative ideas involves obtaining answers to the following questions:

- the probability of existence of a future market for innovation;
- is there a technical and economic feasibility of development, production and promotion of innovations to the market;
- whether the innovation is profitable and how it will affect the enterprise?

Such evaluation is often performed using the expert method, since elements of uncertainty are very influential at this stage due to an inaccurate, incomplete and conflicting information.

Note: *In Ukraine the percentage of the implemented ideas does not exceed 20 % of their whole number. For comparison, in Japan it is 68 %, USA – 52 %, Sweden – 45 %, Poland – 30%. Combined with low innovation activity of domestic producers this indicates going away from the accelerating economic prospects.*

4. Development of the innovative product concept and its verification (concept is considered as innovation idea easily understandable for consumers). Typically, the testing of innovation plan (a new product or service) is carried out by questioning of users and analysis of the results.

Herewith the idea of the product should be considered at three levels, where each subsequent one describes a higher degree of specific innovations, and therefore the degree of elaboration and consumer appeal (*see* Figure 2.3).

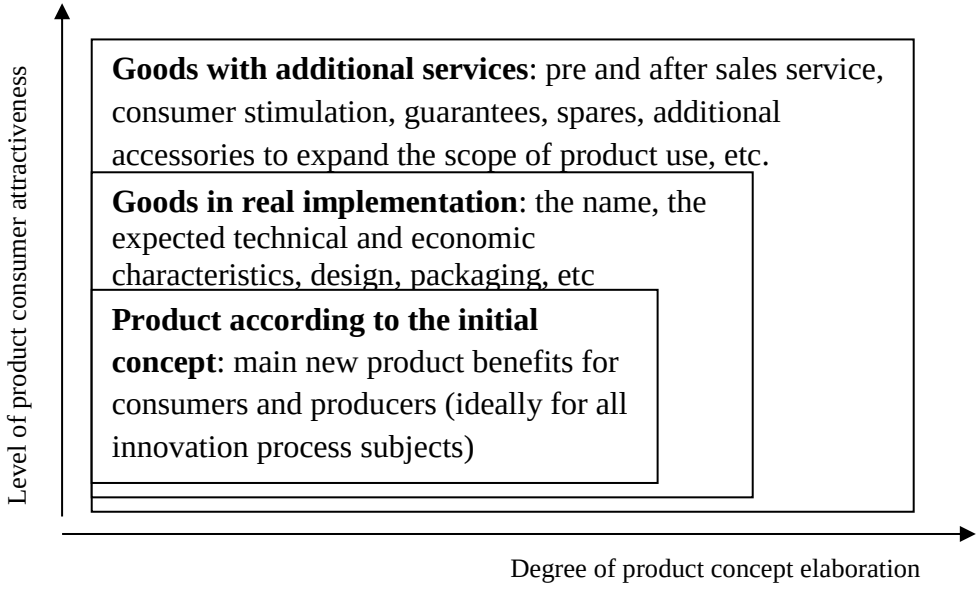


Figure 2.3 *New product concept representation levels*

5. Developing a marketing strategy to promote innovation to the market. It involves a serious research and leads to marketing strategy development and promotion the innovation to the market. The main tool for this analysis is segmentation.

In general, the marketing strategy includes: a strategy of formation and development of target market, product strategy, pricing strategy, products promotion strategy (including sales and goods movement), strategy of demand creation and stimulation.

6. Evaluation of the economic feasibility of the enterprise goals presented in the marketing program. Evaluation is performed according to the following criteria:

- intellectual and technological capabilities of innovations implementation in the new product that meets the needs and demands of consumers;
- possibility of implementing an innovative idea into a commercial product;
- market opportunities of promoting an innovation on the market and bringing it to consumers;
- innovative project resource supply: information, raw materials, finance, etc. (existing and needed);
- sources of investment in R&D and development activities, testing, pre-production, promotion, distribution and marketing;
- risk degree and the possibility of its prevention, reduction or compensation;
- expenditures for the design, production and promotion of innovation on the market;
- profitability.

7. Development of design and technological innovation documentation, manufacturing of prototypes and testing.

At this stage a prototype is produced and if necessary is tested in laboratory with the following documentation specification. Based on the laboratory tests results, operating documentation will be specified (please, see above). When designing innovations to assess the possibility of its concept implementation to the new product, one can use the recommendations of J. Jones. It should be noted that computer-aided design (CAD) tools are widely used to develop the design and technological documentation including software and computer systems.

8. Testing of innovation in market conditions.

It is performed by test marketing. Its goal is to simulate the process of introduction and promotion goods to market in certain market areas. The results of this process will later be used throughout the entire target market.

Recently, computer modeling is used for testing the product innovations. In particular this is virtual shops where product modifications are being sold, using different versions of its design and packaging, shops showcase decoration, etc.

9. Deployment of commercial innovations production in the amount specified in the marketing program.

At this stage an existing market opportunities and threats, emergence of new ones and transformation of one into the other (transition of the opportunities into threats and backwards) should be constantly monitored.

Despite a large number of stages of the innovation process, they are certainly necessary. The cost of works at each subsequent stage is nonlinearly increase compared to the previous stage therefore the thorough elaboration of possible solutions can reduce the probability of possible adverse consequences (*see* Table 2.1). Finally it should be noted that only 1 or 2 innovative ideas out of 100 reach the commercialization stage, while those which remained, have the probability of market success of 25-50%.

Table 2.1. Shares of success and failure on the stages of the innovation process [2]

Indicators	**Stages**				
	Ideas generation and selection	*Business analysis*	*Product development and manufacturing*	*Product testing*	*Commercial production*
The share of expenditures at the stages of typical completed project, %	7,3	3,7	22,7	18,6	42,7
Share of expenditures on product innovation both successful and not, %	14,7	6,1	36,9	16,7	25,6
Successful projects, %	34,7	45,2	52,1	58,8	66,3
Unsuccessful projects, %	65,3	54,8	47,9	41,2	33,7

TOPIC 3. SOURCES OF IDEAS FOR ORGANIZATIONS

3.1. THE IMPORTANCE OF DIFFERENT SOURCES OF IDEAS.

The use of creativity techniques is generally appropriate for generating new ideas within project teams or groups within an organization. However, in a study of 350 "great ideas", it is reported that less than 2% of the 350 great ideas came out of scheduled meetings. 23% resulted from informal discussion and 43% came while the person was alone.

Interviews with top level managers of 21 small and medium sized German businesses (SMB) in six industries revealed that internal sources for ideas are not limited to the employees of the R&D or marketing departments. Every employee of a company has ideas on how to improve their workplace, speed up their work or improve a function of their job. In addition to gathering ideas from current personnel, old ideas, research and concepts that were developed during an organizations history can be used as a source of innovative ideas, if a company has appropriate knowledge and idea management systems in place.

But other sources and methods for collecting ideas should not be ignored (see Fig. 3.1). According to the results of the above mentioned study customers are the most important source for innovations. The study concluded that due to a lack of personnel and resources (for instance for R&D activities), SMBs were more likely to pursue external ideas than large companies.

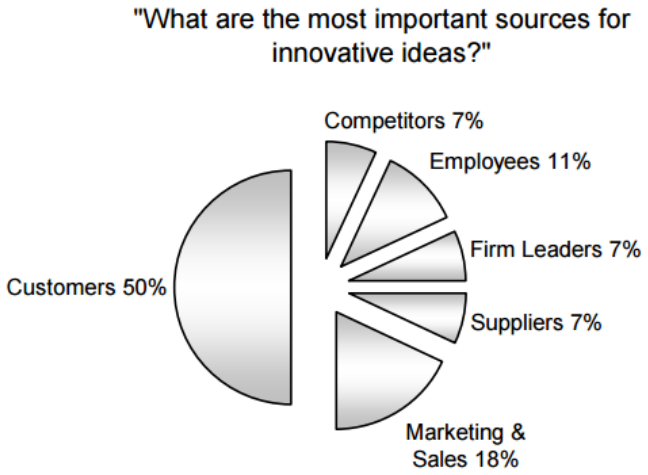


Figure 3.1: *Most Important Sources for Innovative Ideas*

Old ideas from outside a company are excellent sources for innovation ideas as well. Old patents are rich with ideas that may not have been fully developed enough to succeed on the market. The telephone answering machine was patented in 1935. It was about three feet (approx. 1 meter) tall, and used very primitive recording technology. Casio introduced the first commercially successful telephone answering device in 1971. The idea had been in the

United States Patent Office for over 35 years before making it to market.

Furthermore, the Internet is a very fertile source for ideas. The United States Patent and Trademark office and the European Patent office have made patents available for viewing online. In addition, there are many free patent search services, including for instance *freepatentsonline.com*, which offers over 100 Gigabytes of patent data. There are many inventors' networks on the Internet as well. These formal and informal networks provide individual inventors with resources to develop, patent and market their ideas. Businesses seeking ideas for innovation can view and opt to purchase ideas and inventions for prices that are often below comparable corporate development costs.

Other external sources for innovative ideas and technological spillovers in general include business partners, such as financial institutions, service providers and firms offering complementary products or services. Many large innovative businesses have close ties with academic institutions. Thereby, academic research is not limited to basic research but extends to applied research.

However, it should be kept in mind that besides the relevance of the different sources for innovative ideas, the difficulties of transferring innovation across functional and organizational boundaries have to be accounted for. Among the factors that determine the effectiveness of innovation transfer are the nature of the innovation, i.e. its degree of complexity, the timing (when does the window of opportunity close?) as well as the absorptive and transmission capacity of the organization under consideration. In this sense, all agents within and at the gateways of a company can be interpreted as receiving and transmitting units. To reduce the impedance mismatch between transmitter and receiver due to complex and implicit knowledge underlying the innovation process is one of the main tasks to perform.

3.2. HARVESTING EMPLOYEE IDEAS.

In 2009, 1.1 million suggestions for improvements were submitted by the employees of 438 German businesses. The realization of these suggestions saved companies about 0.95 billion € in costs. The additional revenues generated by suggestions were estimated to be worth an additional about 165 million €. However, a study of innovation management in small and medium sized businesses found that the overwhelming majority of SMBs lacked systematic approaches to collecting ideas from employees. Most of the ideas were collected in informal ways, and evaluated without any type of system or criteria in place.

The **suggestion box** is one of the most common methods of collecting employee ideas. The first such box in an industrial setting was set up in 1886, by Scottish ship builder William Denny. But the suggestion box might have several weaknesses as an idea submission system. The majority of organizations do not have evaluation criteria for ideas, or a system for routing the ideas to company decision makers for implementation. In addition, it is often not possible for the ideas to be viewed by anyone besides the reviewer.

Web-based Idea Management systems overcome many of these weaknesses. The ideal system should be easily accessible from the Internet for all employees, including those working at satellite locations and traveling.

The software should be designed so that from the employee perspective it is intuitive, interactive, has a clear procedural flow and a reliable feedback mechanism. The system should provide information on what areas the company is seeking ideas in, the status of ideas, and especially a way to view a broad repository of ideas from others. Mechanisms for developing and refining the ideas submitted by others are a key component. Systems should also include an option for anonymity, allowing ideas to be submitted in confidence. From the reviewer's or

manager's perspective, an ideal idea management software system should include opportunities to seek expert opinions, analysis tools for examining the idea pools to identify trends, and most importantly, a clear evaluation process. Scoring methods which use defined criteria ensure greater consistency of evaluations from multiple reviewers and reduce source biased evaluation.

Many larger organizations have developed their **own proprietary tools** for the internal management of ideas, with varied degrees of success. Furthermore, idea management systems software is currently marketed by a wide variety of companies. Some of the commercially available software systems on the market offer industry or organizational type specific packages and modules. JPB Inc. offers their *"Jeni" ideas management software* in multiple forms, including "JeniLITE" for small businesses, *"JeniGov"* for public and government agencies and *"SylviaWeb Brainstorm"* for idea generation in multinational organizations (*http://www.jpb.com/jenni/index.php*). DaimlerChrysler uses a web-based ideas management system. In 2011, the system received over 69,000 suggestions. The implementation of some of these suggestions is credited with saving the company 62 million € that fiscal year.

The ideas that should be pursued by ideas management are not the 'big bang' radical innovation ideas. Small ideas are most easily implemented, and collectively the most profitable risk to pursue. The competitive advantage they provide is often not easily copied by competitors, and the implementation risks are generally low.

Robinson and Schroeder published a study of the power of small ideas (Robinson; Schroeder 2004). Included in the study are numerous examples of organizations worldwide that have cut costs and generated profits from seemingly small ideas. Robinson and Schroeder also establish links between the number of ideas submitted per employee, the implementation rate for ideas, and the sales growth and profitability of a company. They cite numerous companies around the world with high submission rates and extraordinary profits. Those companies have average annual idea submissions per employee ranging from 25 to 110 ideas a year.

Toyota is an example of a corporation that gathers and implements employee suggestions. As a part of the company's innovation strategy, oobeya (trans: big open office) meetings are conducted at least twice annually, during which employees and managers reexamine the processes and methods of their functional areas. These meetings have produced major cost savings based on simple suggestions. Furthermore, every employee of the company is empowered and obligated by the strategy of Kaizen, to continually improve their work and workplace. Toyota has received over one million improvement suggestions per year since the 1970s. An employee idea is submitted through a formal process for evaluation, and if feasible, implemented. The company has an 80% implementation rate for employee ideas. Employees who submit ideas receive recognition such as a certificate or story in the company newsletter and small non-monetary rewards.

3.3. IDEAS FROM SUPPLIERS AND PARTNERS

Among the keys to successful innovation is **collaboration**. Companies that have undertaken TQM (total quality management) programs have found partnerships developed with suppliers and other business partners to be valuable sources of ideas for innovation. Verworn et al. found that suppliers were a relatively untapped source of innovation ideas for German small and medium businesses. Among large businesses, suppliers and partners are more highly valued. A survey of international business leaders found that 40% of CEOs believe suppliers to be an important source of innovation, and about 35% feel the same way about alliances (partnerships).

What is critical to gathering ideas and suggestions from partners and suppliers is structure. Networks to connect partner companies require both a common strategy and an established framework. Online document and information sharing portals, with mechanisms for access by partners and suppliers are a major step toward this goal. In addition, some companies have found that establishing joint ventures and joint work facilities to enhance face-to-face collaboration on problems to be helpful. What is required for this to happen is communication between company leaders, to develop a shared innovation strategy, and establish the ground rules and process framework for collaboration.

3.4. IDEAS FROM CUSTOMERS

By far, the most important source for ideas in surveys of small and large businesses is customers. The importance of customers and users is stressed especially in the research conducted by von Hippel (1986, 1988, 2005). Von Hippel coined the term "lead-user", i.e. users who face new needs months or years before they become general in the marketplace. Lead-users do not only serve as a "need-forecasting laboratory for marketing research", but also develop products and services themselves (Hippel 1988, 2005). The latter applies for example to cases where lead-users identify a drawback in the construction of technical devices. Since they anticipate a relatively high benefit from obtaining a solution to their problem (Hippel 1986), lead-users may innovate. Several works in this field were able to provide empirical evidence for the "lead-user"-theory. Franke and Shah (2003) for example studied several sports enthusiastic communities, finding that almost 38% of the group members surveyed developed and built products for their own use. Ranging from incremental innovations to more "radical" innovations, there were still 23 % among these user-developed innovations that had commercial potential.

The challenge in business lies in collecting ideas from customers and users. The methods for doing so are highly dependent on the industry and type of company. Companies that sell products or services to other companies have perhaps the least complicated methods of generating feedback and ideas. Many companies are seeking to develop innovation partnerships with their suppliers. Suppliers are no longer only responsible for several parts to deliver, but for whole systems that have to fulfill certain functions. These functions are essential in the further production process or even in the later usage of the product. In this respect often the supplier's role has changed from just being a supplier to become an important, market-orientated partner in the innovation process.

The companies selling in the B2C (Business to Consumer) industries tend to have greater challenges. Methods for gathering ideas are highly dependent on the nature of the product or service. Some companies, such as Harley Davidson motorcycles, are able to tap into consumer ideas by becoming customers. Every executive of that company attends motorcycle rallies around the world, and is a regular rider of the company's products. By seeing the company's products from the customer perspective, the executives develop an empathy with the customer, and are able to listen to and understand feedback.

Apart from this there are many more methods of researching customer use in the consumer products industry. Feedback surveys, customer focus groups and blind preference testing have value, but can lead to skewed results.

The Coca Cola Corporation found itself losing shares in the North American market to Pepsi in the 1980s and became increasingly concerned over the "Pepsi Challenge," where consumers sipping small cups of the beverage in blind taste tests greatly favored Pepsi. Relying on focus groups and blind taste testing, the company developed "New Coke," also known as "Coke II." The formula was much sweeter than original Coca Cola, and tasted almost

like Pepsi. When New Coke debuted on the North American market in 1985, the customer feedback the company received was almost universal – they hated it. Coca Cola made several mistakes, the most important of which was putting too much faith in blind taste tests. Because the consumers performing the tests were only taking small sips, the sweeter beverage was nearly always more popular. The 200,000 customer interviews that Coke performed were skewed, because, as the researchers had tried to point out, the questions were wrong and the methods used were not appropriate for trying to reformulate a flavor. Had Coca Cola performed real life user testing, such as sending cases of the sample product home with the customer and recording their reactions after a few weeks, the results would have been different. Coca Cola reintroduced its original formula to the North American market as Coca Cola Classic. The decision to tamper with a 99-year-old formula that was loved around the world is regarded as one of the largest business blunders in history. One thing that the Coca Cola Corporation did right during the fiasco was not to fire, demote or reprimand the managers who made the decisions that led to "New Coke." "They had the courage to put their jobs on the line, and that's rarely done today at major American companies," said Herbert A. Allen, President of the Compensation Committee at Coca Cola. Roger Enrico, then President of Pepsi USA, has argued that mass firings would have put everyone on notice that risk-taking was discouraged at Coca Cola, and would have caused a major drop in work performance.

Whirlpool, a North American manufacturer of home appliances, makes customer observation research a major part of the design process for new products. By observing customers as they interact with appliances – loading a dishwasher, washing and drying laundry, changing the filter for the water dispenser system of a refrigerator, cross-functional teams of engineers, designers and anthropologists are able to make products more intuitive to use.

Another way for companies to gather ideas from their customers is through contests and idea suggestion sites. Church & Dwight, manufacturers of Arm & Hammer, the leading brand of baking soda in North America, have kept a 170-year-old brand fresh by holding contests for alternative uses and having feedback forums. The alternative uses that resulted have earned Arm & Hammer a place in 95% of American homes. The company's marketing team promotes the customer ideas of using the bicarbonate of soda (baking soda) as a deodorizer, cleaning product, antacid, etc. The customer submitted ideas have even been used to extend the Arm & Hammer brand to include toothpaste, deodorant and laundry soap, all based on bicarbonate of soda.

TOPIC 4. CREATIVITY AND INNOVATION

4.1. The precondition of creativity.
4.2. Creativity and the thought processes.
4.3. Factors influencing creativity.
4.4. Creativity in Organizations and Popular Myths.

4.1. THE PRECONDITION OF CREATIVITY.

In many fields, technical or economic as well as personal, problems may arise which require solutions that go beyond commonly acknowledged experience. Such problems need innovative solutions which can only be found by creative thinking. Many people believe that creativity is an innate personal trait but, in fact, it can be learned and trained. A number of training courses and exercises can help to discover and enhance the creative potential of employees or even a company as a whole.

Creativity is not an isolated part of humans' thinking. It is not a luxury which only artists can afford. Creativity is such a central part of humans' thinking that it exists in all areas. All definitions of creativity stress the novelty of ideas – *the qualitative aspect* – and the abundance of ideas – *the quantitative aspect*. Creative thinking can thus also be defined as the **ability to bring something new into being, something that did not exist before**. In this sense creativity has to go beyond previous experience and to revolutionize in a certain way.

In addition to day-to-day business, a company has to face the challenge of finding and introducing new products. Whereas years ago innovation was often a product of coincidental findings, nowadays especially big companies have set up innovation teams which are responsible for the targeted development of new ideas, products and services. Ideas are born when people who are looking for a new way of solving a problem intellectually break new ground. This requires a high degree of creativity. In the following a summary of the most accepted definitions of creativity is provided.

- **Creativity** can be defined as the ability to generate new ideas in order to find the most practicable solution for problems.
- **Creativity** is not limited to a few. Each person has a more or less high creative potential. So far, the problem has been that this creativity was neither trained nor fostered.
- Every innovation requires a creative strategy which, in turn, uses **creative thinking** as an evolutionary variable and successfully introduces innovations as an impulse for social change.
- **Creative solutions** involve not necessarily entirely new inventions but often combine already known, but not yet linked elements. Creativity thus summarizes and restructures knowledge by establishing new relations and connections.

4.2. CREATIVITY AND THE THOUGHT PROCESSES.

The most widely used model of the creative process was developed by Henri Poincaré (1921). The model of the creative process consists of four phases:

1. preparation,
2. incubation,
3. illumination and
4. verification.

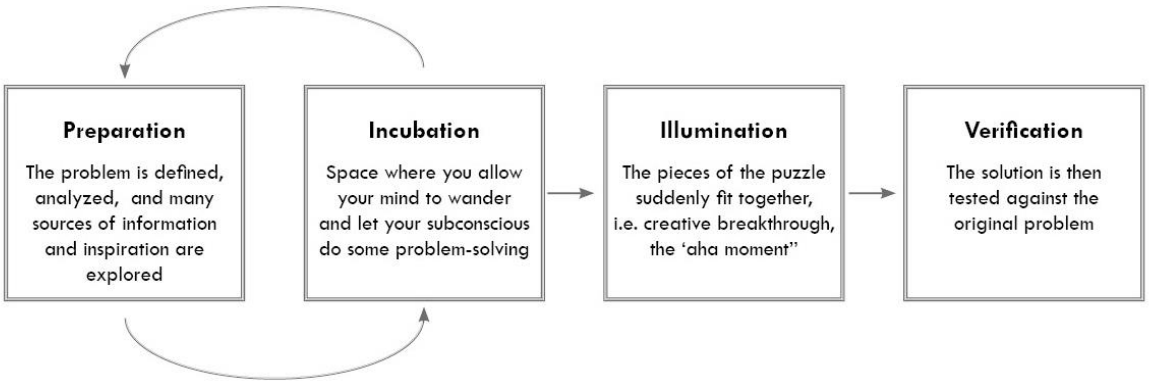


Figure 4.1 *The creativity process*

I. The **preparation** phase begins with the recognition, analysis and understanding of the problem. This involves gathering and analyzing available knowledge and background material relating to the problem, to build a solid general working knowledge of the subject. The phase also includes working intensively with the problem; attempting to break the problem into components, attempting to solve sub-problems, and to understand the interdependencies of the problems components.

II. The **incubation** phase involves doing nothing. The preparation phase worked with the problem in the conscious mind and prepared the subconscious to produce new ideas. During this phase, the creative thinker should push the problem out of his or her mind, and occupy him or herself with something else. Working on a parallel problem may be helpful during this stage.

III. What all of these practices do, is free the subconscious mind and allow it to work with the problem. This will lead into the third phase, the **illumination**. This phase has also been referred to as the enlightenment, the lightning strike, and the mind blitz. The creative thinker will be hit with a creative insight, a sudden idea, or a vision. These lightning bolt ideas can strike unexpectedly, and often go unrecognized or are forgotten in a short time. Many creative thinkers report that ideas come to them during dreams. It is therefore important for the creative thinker to have resources available and train him or herself to recognize and express these ideas. Illuminating ideas can sometimes be triggered by various experiences, using metaphors, observing nature, listening to music, etc.

IV. The fourth phase of the creative process is **verification**, also known as validation. The ideas developed during the third phase are presented and analyzed. During this phase the focus is on the solution to the problem. Ideas are looked over to determine if they make sense, and then analyzed to determine if the workable ideas are practical. Solutions are then developed and implemented, and the creative process cycles to the next problem.

Usually peoples distinguish between convergent and divergent thinking. While convergent thinking is a fixed, narrow but also very structured and logical way of thinking, divergent thinking is a free, disordered and imaginative way of thinking which cannot be followed logically. Productive creativity could be called "controlled divergence".

Creative thinking is a type of divergent thinking which is adapted to reality. Creativity is a synthesis of divergent and convergent thinking.

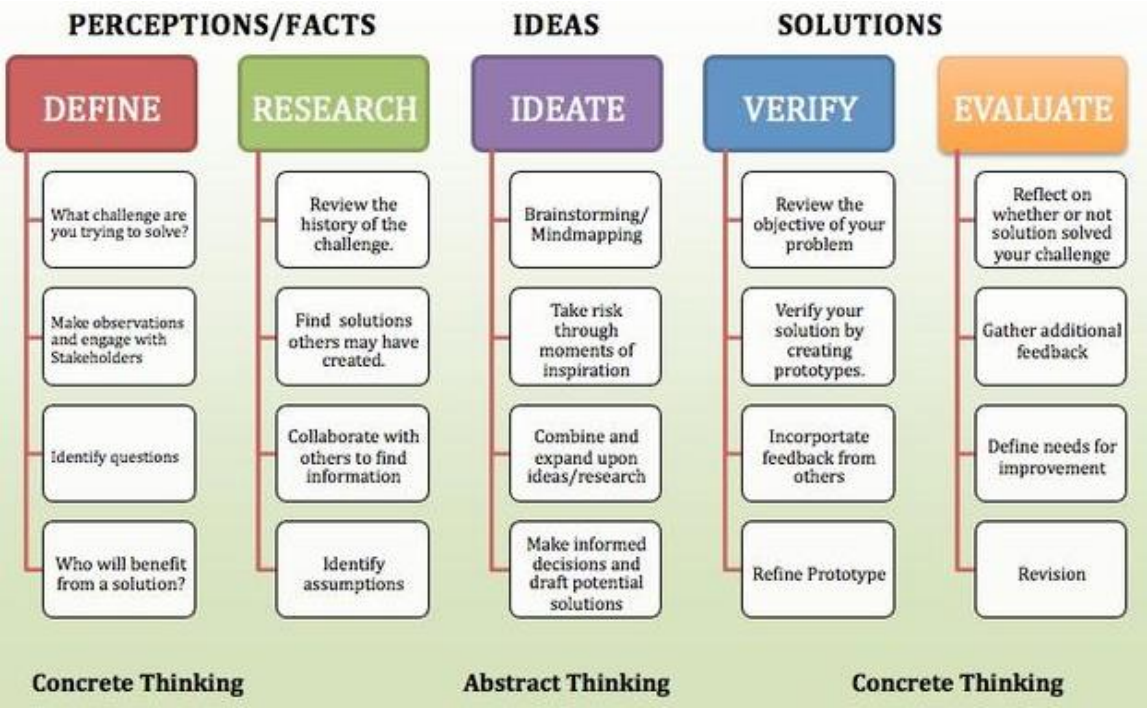


Figure 4.2 *Creative thinking process*

The creative process starts with a logical sequence, in which the problem is analysed in a rational way (convergent). On the one hand the problem and the solution are considered from all possible points of view, on the other hand people go beyond their usual behavioural patterns. The second stage could be described as the creative process itself. This stage is characterized by the transfer from the rational to the intuitive-creative level (convergent).

Hence it follows that convergent and divergent thinking do not stand in contrast to each other but that they complement each other. Creative problem solving involves summarizing and restructuring partial systems which per se do not fit together. Thus the idea that scientific progress can only be achieved by logical thinking is considered obsolete today.

4.3. FACTORS INFLUENCING CREATIVITY.

A number of factors have a positive or negative effect on creative thinking: on the one hand organizational settings such as working conditions or corporate culture and on the other hand individual factors like motivation, qualification and willingness to accept risks.

Managers play the key role in the emergence of innovative initiatives. They may either actively support the creation of innovations or explicitly as well as implicitly hamper innovation activity. The main problem, hampering the innovations, could consist of unsuitable or inappropriate management style.

The reasons for limiting innovative initiatives include **psychological** and **emotional factors**, such as fear of being wrong, misunderstood, criticized, regarded as incompetent. They also include **professional factors**, such as competitiveness and related conflicts, lack of experience, over-categorical judgments, lack of alternative options, narrow knowledge. The **perception factors**, limiting the innovative initiative, include categorical and narrow thoughts, lack of adequate intellectual level. Finally, **personal factors** include ambition, sensitivity, idleness, arrogance, self-interest, and conservatism.

The **sociological barriers** to creativity that are possibly the most prevalent in

organizations are tradition and criticism. *Traditions, taboos and sacred cows* are creativity killers. They prevent creativity and innovation. *Negative criticism* is a strong social barrier to creativity. It exists in many forms in organizations. These include blatant and subtle verbal criticism, poor evaluations of creative employees deemed 'eccentrics,' and body language and non-verbal cues during presentations, meetings and conversation. In order to support and encourage creativity within an organization, it is important that managers understand the effects, both intended and unintended, of their communications.

Among the other obstacles, there are *inadequate or ineffective motivation techniques used by managers*. The reference to an employee that made a mistake as a negative example or the support of the employees that lack the innovators' features could serve as an illustration of such inadequate techniques. The employees should have the room for mistakes in order to reveal their innovative potential.

In addition, the *excessive bureaucracy* of organizational structures hampers the innovative process to a large degree and prevent both the generation of ideas and introduction of innovations. This situation involves fear and constraints that discourage creativity.

Another problem for innovation is the *manager's conservatism*. Manager does not see or is unwilling to see the innovative idea as feasible. As a result, an idea lacks the support and further practical development. However, the experience of successful companies proves that many brilliant ideas seem, at the first sight, unfeasible or inadmissible in that organization or even in the society.

Often the problem that is related to the lack of creativity includes the *differences in the situation assessment between the employees and the senior management* that lead to unfavorable perception of innovation. This might be explained by the fact that the company management possess the important and valuable information which is not available for employees. Such a problem could be solved by building the efficient vertical communication networks.

The next problem is *the lack of horizontal connections or their weak or inefficient coordination in the organization*. Successful innovations require the experience engagement of several departments all together, whereas unsuccessful innovations are often the result of the weak cooperation. Therefore, the big companies working on innovations actively involve the employees of different departments into the innovation process. The small innovation organizations solve this problem by modifying the team roles.

Many employees lack creativity in their work due to the *permanent time issues related inadequate allocation of tasks or lack of time management*. At the same time the senior management is often in a stress that leads them to grasp the very first idea and stop searching for new creative ideas. These and other problems could be addressed by the efficient innovation management.

4.4. CREATIVITY IN ORGANIZATIONS AND POPULAR MYTHS.

Individual creativity and organizational creativity are two interdependent aspects. As mentioned above, there may be organizational barriers that hamper creativity, no matter how creative the individuals are. This is why it is important not only to concentrate on the creativity of the individual, but to stimulate the creativity in an organizational context.

In this context there are three important factors: *information flow*, *integration*, and *cooperation*. To achieve a better *flow of information* requires open communication by means of a minimum of regulated work-flow, projectoriented teams, and "job-rotation". *Integration* serves to minimize rivalry within an organization and can be achieved if clear goals are

communicated, human resources development and their promotion are done in a systematic way and innovative ideas are generally appreciated. Finally, *cooperation* is needed to make the process of problem-solving more efficient and to strive for a synergetic surplus.

Teresa M. Amabile (Professor of Harvard University) developed a model of creativity based on her earlier research of creativity under controlled conditions. The model identifies five environmental elements that affect creativity (Amabile et al. 1996):

I. *Encouragement* – organizational, supervisory and work group encouragement. They all foster creativity as for example a risk-taking mentality, goal clarity and diversity in team member background encourage employees to generate and appreciate new ideas.

II. *Autonomy* – the freedom to organize the work and responsibility to make decisions foster intrinsic motivation and thus creativity.

III. *Resources* – extreme resource restrictions impede creativity, because they give the impression that the project is less valuable.

IV. *Pressure* – to a certain degree it is perceived as challenging; i.e. this kind of pressure has a positive effect on creativity. It turns out to be negative when it is perceived as excessive work load pressure.

V. *Organizational barriers* – conservative thinking and rigid management structures impede creativity. It is argued that these factors are perceived as controlling and thus intrinsic motivation necessary for creativity decreases.

Open communication is essential between and within all levels of an organization. Intrinsic motivation is also key. The aim of managers should be to facilitate creativity in their employees. To help achieve this goal, employees should be given autonomy and allowed (and encouraged) to take ownership of their work. Managers should work to eliminate barriers in communication, and to make sure that employees understand why their work (and deadlines) is meaningful. Managers should also act to shield employees from distractions when they are under pressure. Another key role of the lower level managers is to shield the creative employees from criticism of their ideas. Simply put, the key to smart management is to value and recognize the employee.

Although there are models that aim to describe creativity and creative processes it is difficult or almost impossible to enforce creativity. Nevertheless, organizations can try to provide conditions that support creativity. As discussed earlier an innovation culture supports the occurrence of innovations and promotes creativity at the same time. Apart from measures that advance creativity there are also aspects that hinder creativity. These are discussed as myths of creativity:

Myth 1. **Creativity Comes from Creative Types**

During interviews with senior managers, Amabile asked “where in your organization do you want to see creativity?” The responses were almost invariably “R&D, Marketing and Advertising.” When asked where they did not want to see creativity, the most frequent reply was “Accounting”. What the managers failed to understand was that any person with normal intelligence can be creative. Creativity is not limited to certain occupations. As an example, there have been (completely ethical) creative innovations in the financial field, such as activity based accounting, which are major assets for companies. Creativity is dependant on experience (including knowledge and technical skills), talent, the ability to think in new ways and intrinsic motivation.

Myth 2. **Money is a Creativity Motivator**

Employees do not actively think about their salary on a daily basis. Pay for performance plans have been shown to have a negative effect on creativity. The reason for this is that employees become risk-shy, and are afraid of trying out new ideas, because every move they make affects their compensation. Employees need to feel that they are

compensated fairly and they place more value to a work environment where creativity is supported, valued and recognized, than on monetary compensation.

Myth 3. **Time Pressure Fuels Creativity**

The diary study found that many employees believed that they worked most creatively under the pressure of extreme deadlines. Analysis of their journals actually showed the opposite to be true. Employees were least creative under the stress of extreme time pressure. In addition, they often had a "time pressure hangover" for two days afterwards, in which creative thought was impossible. Workers facing impending deadlines do not have adequate time for the incubation of creative ideas. For many employees, the only time they can eliminate or reduce the distractions in their work environment and focus is when faced with urgent deadlines. Of vital importance, is that employees understand the reasons for urgent deadlines – not just that an assignment needs to be done by a certain time.

		Time Pressure	
		low	**high**
Likelihood of Creativity	**high**	Creative thinking under low time pressure is more likely when people feel as if they are **on an expedition**. They: • show creative thinking that is more oriented toward generating or exploring ideas than identifying problems • tend to collaborate with one person rather than with a group	Creative thinking under extreme time pressure is more likely when people feel as if they are **on a mission**. They: • Can focus on one activity for a significant part of the day because they are undisturbed or protected. • believe that they are doing important work and report feeling positively challenged by and involved in the work. • show creative thinking that is equally oriented toward identifying problems and generating or exploring ideas.
	low	Creative thinking under low time pressure is unlikely when people feel as if they are **on autopilot**. They: • receive little encouragement from senior management to be creative. • tend to have more meetings and discussions with groups rather than with individuals. • engage in less collaborative work overall.	Creative thinking under extreme time pressure is unlikely when people feel as if they are **on a treadmill**. They: • fell distracted • experience a highly fragmented workday, with many different activities. • don´t get the sense that the work they are doing is important. • feel more pressed for time than when they are „on a mission" even though they work the same number of hours. • tend to have more meetings and discussions with groups rather than with individuals. • experience lots of last-minute changes in their plans and schedules.

Figure 4.3 *Time Pressure/Creativity Matrix*

Myth 4. **Fear Forces Breakthroughs**

The analysis of journal entries that were coded for emotions found that creativity is positively associated with feelings of joy and love, and negatively associated with anger, fear and anxiety. The journal entries showed that employees were happiest when they had a creative idea, and that creative ideas were more likely to occur if the employee had been happy the previous day.

Myth 5. **Competition Beats Collaboration**

In several industries (especially high-tech), there is a belief among managers that internal competition fosters innovation. There is other point of view according that creativity and innovation are more likely to result from collaboration between individuals and teams within an organization. When faced with internal competition, information and idea sharing ceases and this is particularly destructive because "nobody in an organization has all off the information to put all the pieces of the puzzle together".

Myth 6. **A Stream-Lined Organization Is a Creative Organization**

This myth is largely the result of Public Relations spin and consultants attempting to justify layoffs. The exact opposite is true. Amabile's team studied a 6,000 employee division of a global firm during the entire 18-month course of laying off 25% of the workforce. Every single stimulant of creativity dropped, and was down five months after the layoffs were completed. The anticipation of the layoffs had a greater negative effect on creativity than the actual downsizing did. Insecurity and fear of the unknown led employees to disengage from their work, and stifled the intrinsic motivation that generates creativity.

TOPIK 5. GENERATING NEW IDEAS AND EVALUATING OUTCOME

5.1. *Idea Generation Techniques.*
5.2. *An overview of intuitive idea generation methods.*
5.3. *An overview of analytical idea generation methods.*
5.4. *Metrics for evaluating outcome.*
5.5. *Decision styles and the need for quality and acceptance.*

5.1. IDEA GENERATION TECHNIQUES.

Idea generation, or the act of generating novel, applicable ideas, is the activity most frequently associated with creative problem solving.

Ideas have been the driving force of humanity. Now in very competitive world, ideas have become more important to people than actions. Companies have begun asking designers to generate solutions that meet the needs and desires of the customer.

As such, there was a need to streamline and increase the efficiency of producing and sharing ideas within teams. This gave birth to several idea generation techniques, which allowed everyone to play a part in the creative process, a role allotted strictly to designers and engineers for the last few years.

Idea generation techniques meant anyone could participate in creating new ideas. It allowed people to share and build up on existing solutions, to foresee future problems, and essentially, to think big in terms of design. It brought different specializations together to create a more diverse think-tank that can tackle problems from several perspectives.

Formal idea generation methods are broadly classified into two categories – ***intuitive*** and ***logical***, as shown in Fig. 5.1. Intuitive methods work by stimulating the unconscious thought processes of the human mind. The outcome is rather unpredictable, yet they may facilitate finding a novel solution. Logical or rational methods involve systematic decomposition and analysis of the problem. These methods make use of science and engineering principles and/or catalogs of solutions or procedures.

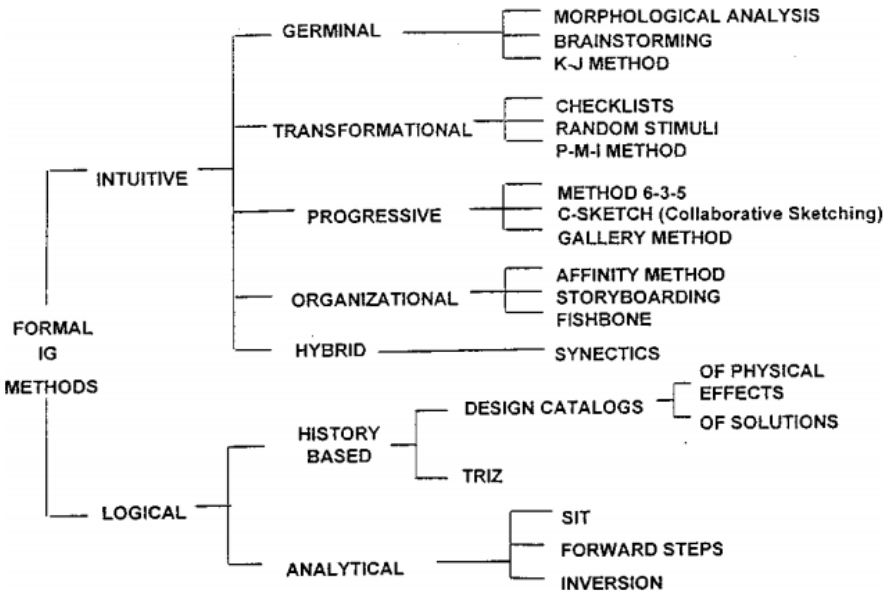


Figure 5.1 *Classification of idea generation methods*

I. **Intuitive Methods** have been sub-classified into five categories:

i. *Germinal:* Germinal methods are those used when a designer is starting with a clean sheet of paper, when there are no existing solutions. Some examples are Morphological Analysis, Brainstorming and the K-J Method.

ii. *Transformational:* Transformational Methods are used to generate ideas by modifying existing ideas. They include methods like Checklists, Random Stimuli, and PMI Method.

iii. *Progressive:* In Progressive Methods ideas are generated by repeating the same set of steps a number of times, thus generating ideas in discrete progressive steps. Examples of Progressive Methods are: Method 6-3-5, C-Sketch, and the Gallery Method.

iv. *Organizational*: Organizational Methods are those that help designers group together in some meaningful way, the ideas that have been generated. The Affinity Method, Storyboarding, and Fishbone Diagrams belong to this class of methods.

v. *Hybrid:* Hybrid Methods such as Synectics combine many different techniques to address varying needs at different phases of idea generation.

II. **Logical methods** may be classified into two categories:

i. *History Based:* History Based Methods involve the use of past solutions that have been catalogued or archived in some form of database. Examples of History Based Methods are: Design catalogs, TRIZ.

ii. *Analytical:* Analytical methods develop ideas from first principles by systematically analyzing basic relations, causal chains, and desirable/undesirable attributes.

5.2. AN OVERVIEW OF INTUITIVE IDEA GENERATION METHODS.

I. GERMINAL METHODS:

- **Morphological Analysis**: Morphological Analysis was developed by Fritz Zwicky (the Bulgarian-born, Swiss-national astrophysicist based at the California Institute of Technology) in 1967-1969 as a method for systematically structuring and investigating the total set of relationships contained in multi-dimensional, usually non-quantifiable, problem complexes.

Imagine you have a product that could be made of 3 types of material, in 6 possible shapes, and with 4 kinds of mechanism. Theoretically there are 72 (3x6x4) potential combinations of material, shape and mechanism. Some of these combinations may already exist; others may be impossible or impractical. Those left over may represent prospective new products. This method of can be extended to virtually any problem area that can be structured dimensionally.

Below is the example of using this algorithm to solve the problem (Table 5.1).

Dark shading shows the traditional centralized water heating system. Lighter shading shows innovative option. It involves the use of heating element that heats using electricity during nighttime when it is cheap. In this case the heat is accumulated in the oil cooler and is used during the daytime.

Table 5.1. *Morphological map*

The main parameters	Intermediate solutions				
	1	**2**	**3**	**4**	**5**
Air temperature	warm air from the central source	convector in the room	convector radiator in the room	source of regulated thermal radiation	other
Air circulation	natural circulation	forced circulation	natural convection	forced convection	other
Air humidity	unregulated	humidifier - vaporizer	other		
Heating element	High temperature electric heater	High temperature electric heater with an open flame	panels with low temperature fluid circulation	low-temperature heater	Surfaces heated by convection
Temperature gradient	due to the placing of the heating element	due to the placing of the heating element	other		
Heating mode	constant throughout the day	periodical turning on during the day	daytime	at night, with the periodic turning on in daytime, to maintain temperature control	other
Heat carrier	water	air	oil		Other
Energy source	coal	fuel oil	gas	electricity	Other

Brainstorming: Brainstorming was introduced by Alex Osborn, founder of the Creative Education Foundation. The basis of Brainstorming is a generating ideas in a group situation based on the principle of suspending judgement – a principle which scientific research has proved to be highly productive in individual effort as well as group effort. The generation phase is separate from the judgement phase of thinking.

The basic rules are:

1. Arrange the meeting for a group of the right size and makeup (typically 5-6 people)
2. Write the initial topic on a flipboard, whiteboard or other system where everyone can see it. The better defined, and more clearly stated the problem, the better the session tends to be.
3. Make sure that everyone understands the problem or issue
4. Review the ground rules

– Avoid criticising ideas / suspend judgement. All ideas are as valid as each other

– Lots, Lots & Lots – a large number of ideas is the aim, if you limit the number of ideas people will start to judge the ideas and only put in their 'best' or more often than not, the least radical and new.

– Free-wheeling. Don't censor any ideas, keep the meeting flow going.

– Listen to other ideas, and try to piggy back on them to other ideas.

– Avoid any discussion of ideas or questions, as these stop the flow of ideas.

5. Have someone facilitating to enforce the rules and write down all the ideas as they occur (the scribe can be a second person)
6. Generate ideas – either in an unstructured way (anyone can say an idea at any time) or structure (going round the table, allowing people to pass if they have no new ideas).
7. Clarify and conclude the session. Ideas that are identical can be combined, all

others should be kept. It is useful to get a consensus of which ideas should be looked at further or what the next action and timescale is.

- **The K-J Method**: The K-J Method was developed as the Affinity Diagram by Jiro Kawakita in the 1960s and has become one of the Seven Management and Planning Tools used in Total Quality Control.

The Basic Cycle:

1. *Card making*: all relevant facts and information are written on individual cards and collated (Post-its would do). In a group-work version, this step could be adapted to use Brainstorming to generate a supply of ideas on cards. The KJ-Method tends to place emphasis on the ideas being relevant, verifiable and important.
2. *Grouping and naming*: The cards are shuffled, spread out and read carefully. Cards that look as though they belong together should be grouped, ignoring any 'oddities'. For each group write an apt title and place it on top of its group of cards. Repeat the group making, using new titles and any 'oddities' to create higher-level groups. If you have more than about 10 groups, repeat this iterative process at yet higher levels.
3. *Redistribution*: At this stage in the group-work version, the cards are collected and reallocated in order than no one is given their own cards. One card is read out, and all contributors look through the cards in their own 'hand' of cards, and find any that seem to go with the one read out, so building a 'group'. A name is selected for the set that clearly portrays the contents of the cards in the set, but is neither too broad nor a simple aggregation of the cards in the group
4. *Chart making*: Now that you have less than 10 groups, some of which may contain sub-groups, sub-sub-groups, etc. arrange them carefully on a large sheet of paper in a spatial pattern that helps you to appreciate the overall picture.
5. *Explanation*: Now try to express what the chart means to you, writing notes as you go and being careful to differentiate personal interpretations from the facts contained in the chart. Ideas for the solution are often developed whilst explaining the structure of the problem.

Multiple Cycles: The basic cycle can be used to build up a problem-solving method through repetition.

A simple two-cycle version will do it once for problem definition and once for problem solution.

A more complex six cycle version will do it for:

1. Problem identification
2. Defining the circumstances
3. Diagnosis and problem-formulation
4. Solutions and working hypotheses
5. Activation of solutions
6. Programmed application of solutions.

II. TRANSFORMATIONAL METHODS:

- **Checklists**: A checklist was formulated as a means of transforming an existing idea into a new one. The checklist is designed to have a flexible, trial and error type of approach. The Checklist:

– Put to other uses? As it is? … If modified?

– Adapt? Is there anything else like this? What does this tell you? Is the past comparable?

– Modify? Give it a new angle? Alter the colour, sound, odour, meaning, motion, and shape?

– Magnify? Can anything be added, time, frequency, height, length, strength? Can it be duplicated, multiplied or exaggerated?

– Minify? Can anything be taken away? Made smaller? Lowered? Shortened? Lightened? Omitted? Broken up?

– Substitute? Different ingredients used? Other material? Other processes? Other place? Other approach? Other tone of voice? Someone else?

– Rearrange? Swap components? Alter the pattern, sequence or layout? Change the pace or schedule? Transpose cause and effect?

– Reverse? Opposites? Backwards? Reverse roles? Change shoes? Turn tables? Turn other cheek? Transpose '+/-'?

– Combine? Combine units, purposes, appeals or ideas? A blend, alloy, or an ensemble?

- **Random Stimuli**: A random stimulus is any class of creativity techniques that explores randomization.

The concept is often used informally; a formal approach may look like this:

1. Identify your criteria for ideas – e.g. ideas for solving a problem or tackling some aspect of it, an idea to be built on, a hypothesis to be investigated, etc. Spend some time on this stage for better-quality outcomes later.
2. Pick a stimulus at random, by looking or listening to everything around you indoors and outdoors, something that catches your attention, opening a newspaper, dictionary, catalogue, book of pictures, throwing a dice at random or any other method that appeals to you.
3. You should now relate this random stimulus back to your original problem; this could be done using simple Free Association.
4. On the other hand you could go for a full Excursion, by describing the stimulus (how it works, what it does, what effects it has, how it is used, size, position, etc.). Followed by 'force-fit' pieces of this comprehensive description back to the problem to recommend relevant ideas.
5. Should a random stimulus fail to work, pick another and keep trying.

- **Plus, Minus, Interesting (PMI) Method**: A list or table with the categories Plus/Minus/Interesting should be formulated e.g.

Plus, positive reasons
Minus, negative reasons
Interesting, points of interest
PMI Score = (Plus) + (Minus) + (Interesting)

For each reason/point in each category a score (positive/negative) is assigned. The final PMI score will be the result of adding each categories scores together.

III. <u>PROGRESSIVE METHODS</u>:

- **Brainwriting Method 6-3-5:** The name Brainwriting 6-3-5 comes from the process of having 6 people write 3 ideas in 5 minutes. Each person has a blank 6-3-5 worksheet (below)

Problem Statement: How to...			
	Idea 1	Idea 2	Idea 3
1			
2			
3			
4			
5			
6			

Figure 5.2 *A blank 6-3-5 worksheet*

Everyone writes the problem statement at the top of their worksheet (word for word from an agreed problem definition). They then write 3 ideas on the top row of the worksheet in 5 minutes in a complete and concise sentence (6-10 words). At the end of 5 minutes (or when everyone has finished writing) pass the worksheet to the person on your right. You then add three more ideas. The process continues until the worksheet is completed.

There will now be a total of 108 ideas on the 6 worksheets. These can now be assessed.

- **Collaborative sketching (C-Sketch):** C-Sketch is an idea generation method that was proposed originally in 1993 in the Design Automation Lab (DAL) at Arizona State University under the name of 5-1-4 G. It originated as an extension of Method 6-3-5 in which 6 designers generate 3 ideas at each of 5 passes. The method, 5-1-4 G, was so named for the number of designers (5), the number of ideas upon which the designers worked at a time (1), and the number of passes (4). The "G" indicated that the method was a graphically oriented method.

The method was renamed to C-Sketch in an attempt to provide a more descriptive name.

In the C-Sketch method, designers work on developing graphical representations of solutions to a design problem. The method is suitable for use after the problem definition and clarification stage in the engineering design process. Designers work independently, developing a sketch of their proposed solution to the problem for a predetermined length of time (cycle- 4 time). At the end of each cycle, the sketch is passed to the next designer. This designer may then add, modify, or delete aspects of the design solution.

The fundamental limitation to changes in the sketches is that the entire design may not be erased. In this manner, the sketches are passed sequentially through the design team. Designers add their own contribution to the design sketches. At the conclusion of the exercise, a set of solutions will be available, the number of which equals the number of designers participating in the method.

- **The Gallery Method**: The Gallery method is a mixture of physical and mental activity whilst generating ideas. The participants move past the ideas (as in an art gallery) rather than the ideas moving past the participants. The down side of this method, no anonymity is offered for idea generation and there is a risk of competition between participants during the break and view:

1. Position flip chart paper round the room, with the problem statement displayed so everyone can see it (groups should be between 5-7 people). The statement should be discussed briefly for clarification.
2. Each group member chooses a sheet and privately writes ideas onto it (they can write directly onto the sheets, or on post-its and stick these on the flip-charts). The writing should be large, clear and concise to enable other to read it easily.
3. When the group appears to be running low on ideas, they should be encouraged to take a break, walk around the room viewing ideas on the other flip charts and making notes. All participants should have the break at the same time, so that certain members of the groups do not feel that others are looking over their shoulder whilst they are still generating ideas.
4. Participants return to their own work areas and continue generating their own ideas or building on the ideas of others.
5. When the group appears to be running low on ideas again, repeat steps 3 and 4 or else close the idea-generating phase.

Ideas are then pooled together, sorted, classified, etc… as it is required.

IV. <u>ORGANIZATIONAL METHODS</u>:

- **Affinity Method**: The affinity diagram is a business tool used to organize ideas and data. It is one of the Seven Management and Planning Tools. People have been grouping data into groups based on natural relationships for thousands of years; however, the term affinity diagram was devised by Jiro Kawakita in the 1960s and is sometimes referred to as the KJ Method.

The tool is commonly used within project management and allows large numbers of ideas stemming from brainstorming to be sorted into groups, based on their natural relationships, for review and analysis.

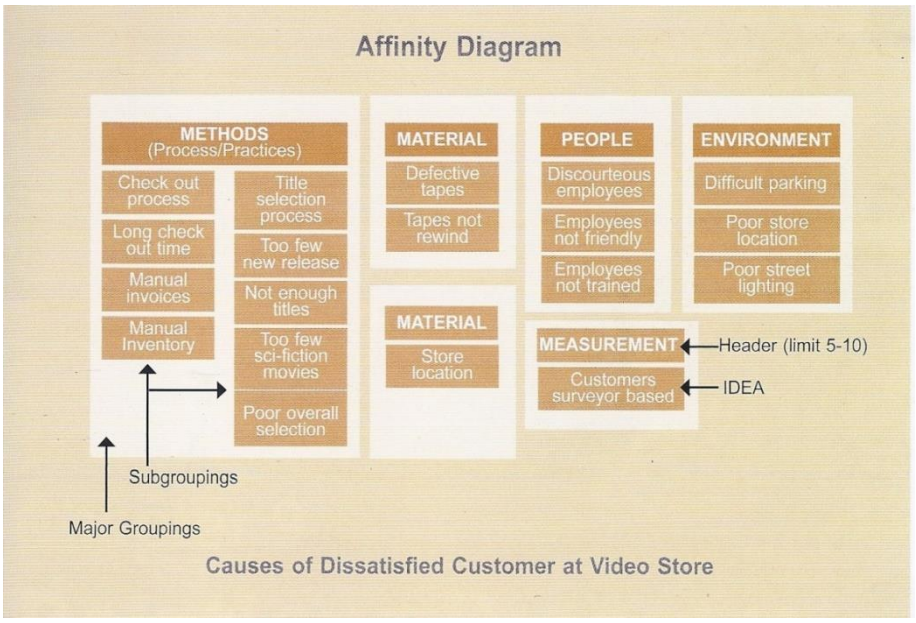


Figure 5.3 *An example of using the affinity diagram*

The affinity diagram organizes ideas with following steps:

1. Record each idea on cards or notes.
2. Look for ideas that seem to be related.
3. Sort cards into groups until all cards have been used.

Once the cards have been sorted into groups the team may sort large clusters into subgroups for easier management and analysis. Once completed, the affinity diagram may be used to create a cause and effect diagram.

In many cases, the best results tend to be achieved when the activity is completed by a cross-functional team, including key stakeholders.

- **Storyboarding**: The idea of storyboarding was developed at the Walt Disney Studio during the early 1930s. Disney credited animator Webb Smith with creating the idea of drawing scenes on separate sheets of paper and pinning them up on a bulletin board to tell a story in sequence, thus creating the first storyboard.

More recently the term storyboard has been used in the fields of web development, software development and instructional design to present and describe, in written, interactive events as well as audio and motion, particularly on user interfaces and electronic pages.

When to use it?

- Use it when defining a problem situation to bring it to life.
- Use it to explore the dynamics of a solution.
- Use it to communicate a story about your idea.
- Use it to plan implementation of a solution.

One advantage of using storyboards is that it allows the designer to experiment with changes in the sequence before production begins. It can also be a useful way to get client buy-in for linear designs.

- **Fishbone Diagrams**: The fishbone diagram (see below) originally developed by Professor Kaoru Ishikawa, is often referred to as an Ishikawa Diagram. The technique can help to structure the process of identifying possible causes of a problem.

The method is ideally organized over a number of meetings, enabling the team to become deeply immersed in the problem. Fresh suggestions regarding possible causes can arise during the break and members are more likely to forget who originated every idea, thus making subsequent discussions less inhibited.

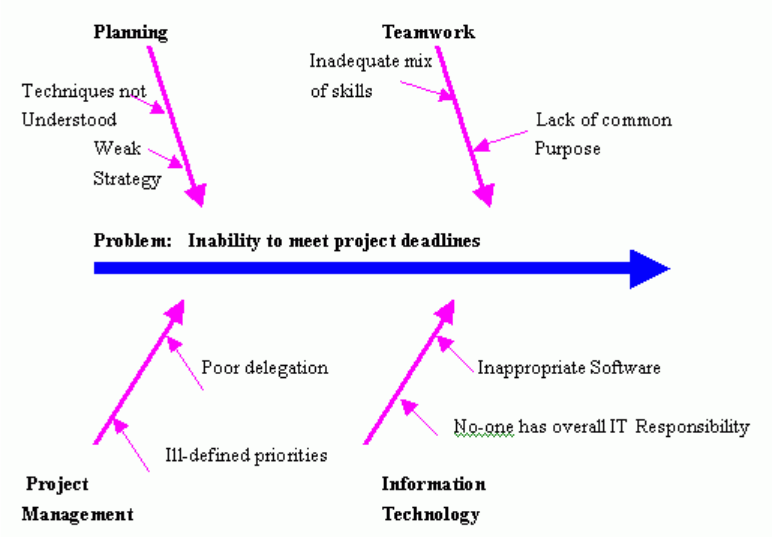


Figure 5.4 *An example of using the fishbone diagram*

The procedure is as follows:

- On a broad sheet of paper, draw a long arrow horizontally across the middle of the page pointing to the right, and label the arrowhead with the title of the issue to be explained.

This is the 'backbone' of the 'fish'.

– Draw spurs coming off the 'backbone' at about 45 degrees, one for every likely cause of the problem that the group can think of; and label each at its outer end. Add sub-spurs to represent subsidiary causes. Highlight any causes that appear more than once – they may be significant.

– The group considers each spur/sub-spur, taking the simplest first, partly for clarity but also because a good simple explanation may make more complex explanations unnecessary.

– Ideally, it is eventually re-drawn so that position along the backbone reflects the relative importance of the different parts of the problem, with the most important at the head end.

– Circle anything that seems to be a 'key' cause, so you can concentrate on it subsequently.

V. HYBRID METHODS:

- **Synectics**: Synectics is based on a simple concept for problem solving and creative thinking – you need to generate ideas, and you need to evaluate ideas. Whilst this may be stating the obvious the methods used to perform these two tasks are extremely powerful.

This method involves search (generation) of the idea which can solve the problem (the idea of innovation) in several stages.

1. To choose a group of experts that will generate the idea of innovation. This group should include invited specialists in different areas of expertise and employees of an innovative enterprise (they have to represent different structural units).

2. Provide this unit with an opportunity to acquire practical skills in the use of analogies to guide the spontaneous brain activity to solve a problem or task, such as the development of innovation.

Often the following types of analogies should be considered:

– *direct* (real): for example, from biological systems: modern submarines sheathing which reduces the friction of the water and the noise made by analogy with the skin of dolphins and other animals living in the water;

– *subjective* (corporal): for example, when a developer is trying to imagine himself as a certain product or unit, imagine what it would feel like been, for example, the wing of the aircraft, which forces would affect him in this case, etc.;

– *symbolic* (abstract), when the characteristics of certain object or phenomenon are equaled with the characteristics of the other one. In particular, a decision tree, bolt head, the noise of the ship or aircraft, etc., sound absorption, radiation trapping;

– *fantastic* (unrealistic) when things or phenomena are imagined as those required by designer, developer or researcher, although they cannot be such as those inherently.

For example, a daemon that can let molecules of a certain substance to pass one by one, a giant who can move the whole building to a certain distance and etc.

3. To set a task to a new developers group which they have to complete (to find a solution to a particular problem). Mostly synectics is used to develop new products and solve problems that arise meanwhile.

5.3. AN OVERVIEW OF ANALYTICAL IDEA GENERATION METHODS.

HISTORY BASED METHODS:

- **Design catalogs**: The German school has produced catalogs of both physical

effects and solutions corresponding to a variety of mechanical functions.

- **TRIZ**: **TRIZ** (*teoriya resheniya izobretatelskikh zadach*, literally: "theory of the resolution of invention-related tasks") is "a problem-solving, analysis and forecasting tool derived from the study of patterns of invention in the global patent literature". It was developed by the Soviet inventor and science-fiction author Genrich Altshuller and his colleagues, beginning in 1946.

The research has produced three primary findings:

1. problems and solutions are repeated across industries and sciences
2. patterns of technical evolution are also repeated across industries and sciences
3. the innovations used scientific effects outside the field in which they were developed

TRIZ practitioners apply all these findings in order to create and to improve products, services, and systems.

ANALYTICAL METHODS:

- **Inversion:** Inversion is a standard method used in kinematics to create new types of mechanisms.
- **Systematic Inventive Thinking (SIT): SIT** is a thinking method developed in Israel in the mid-1990s. Derived from Genrich Altshuller's TRIZ engineering discipline, SIT is a practical approach to creativity, innovation and problem solving, which has become a well-known methodology for Innovation. At the heart of SIT's method is one core idea adopted from Genrich Altshuller's TRIZ which is also known as Theory of Inventive Problem Solving (TIPS): that inventive solutions share common patterns. Focusing not on what makes inventive solutions different – but on what they share in common – is core to SIT's approach.

Five Thinking Tools:

1) *Subtraction*. Remove an essential component from a product and find uses for the newly envisioned arrangement of the existing components. This abstracted arrangement is known as a 'virtual product'.

2) *Multiplication*. Add to a product a component of the same type as an existing component. The added component should be changed in some way. The 2 keywords for this tool are: 1) more and 2) different. These represent the two stages for applying the tool: 1) add more copies of something that exists in the product and 2) change those copies according to some parameter.

3) *Division*. Divide the product and/or its components and rearrange them to form a new product. Using this tool forces consideration of different structures, either on the level of the product/service as a whole, or on the level of an individual component. Dividing a product to many pieces gives the freedom to reconstruct it in many new ways – it increases our Degrees of Freedom for working with the situation.

4) *Task Unification*. Assign a new and additional task to an existing resource. Less affluent cultures are more likely to adopt the Task Unification mindset. For example, the Bedouins use camels for a number of different tasks: transportation, currency, milk, skin for tents, shade, protection from the wind, burning feces for fuel. More affluent societies tend to jettison resources.

5) *Attribute Dependency*. Creating and dissolving dependencies between variables of a product. Attribute Dependency works with variables rather than components. Variables are easy to identify as those characteristics that can change within a product or component (e.g. color, size, material).

- **Forward Steps**: In Forward Steps one analyzes variations of an initial solution.

5.4. METRICS FOR EVALUATING OUTCOME.

There are two fundamental values used in judging the worth of a conceptual design method: how effective is it in expanding the design space and how well does it explore this space. Based on that, four effectiveness measures are proposed: *quantity, quality, novelty*, and *variety* of the ideas generated using that method. These constitute four independent measures.

I. **Quantity** is the total number of ideas generated by a group when it uses a certain idea generation method. Since it is believed that generating several ideas increases the chances of occurrence of better ideas, the quantity of ideas generated is an important comparative.

II. **Quality**, in this context, is a measure of the feasibility of an idea and how close it comes to meet the design specifications.

III. **Novelty** is a measure of how unusual or unexpected an idea is as compared to other ideas. Not every new idea is novel since it may be considered usual or expected to some degree and this is only known after the idea is obtained and analyzed.

IV. **Variety** is a measure of the explored solution space during the idea generation process. The generation of similar ideas indicates low variety and hence, less probability of finding better ideas in other areas of the solution space.

To create a framework for analysis, the problem should be first decomposed into its key functions. Weights can be assigned according to the importance of each function to the problem's solution. Further, each function may be addressed at the conceptual and/or embodiment stage. Every idea produced should be analyzed by first identifying which functions it satisfies and describing how it fulfills these functions, at the conceptual and/or embodiment level. Each description is then graded for quality and novelty according to the grading method. It is possible to compute a total score for quality and novelty for each idea, by applying the weights to each function and stage level.

Table 5.2 shows an example of an analysis for an idea generated during an earlier experiment on idea generation methods conducted. The designers were assigned a design problem called "The Cuckoo's Nest," and had to design a device to be used in a game that involved collecting eggs by capturing them on a playing field. In the example of Table 5.2, two functions were identified for the Cuckoo's Nest problem, namely Reach/Transport and Abduct/Deliver; in this case equal weights are given to both functions. All ideas were then analyzed using these two functions. For the particular idea analyzed in this example, features were found for each function at the conceptual and embodiment stage. In this example, higher weights were given to concepts than the embodiment of concept.

Table 5.2 *An analysis for an idea generated on the basis of grading method*

Function		Concept ($p_1 = 0.7$)			Embodiment ($p_2 = 0.3$)		
Name	f_j	Description	Quality S_{1j1}	Novelty S_{2j1}	Description	Quality S_{1j2}	Novelty S_{2j2}
Reach/ Transport	0.5	2 tracks, forward and reverse	10.00	4.00	Caterpillar tracks	8.00	7.00
Abduct/ Deliver	0.5	Gear drives, right angle drives, pushes 1 egg	6.00	8.00	Curtain, up and down / swinging door	8.00	8.00
Total	1.0	Weighted Sum	5.60	4.20	Weighted Sum	2.40	2.25

Total Scores: Quality $M_1 = 8.00$, Novelty $M_2 = 6.45$

The quality of an idea is an independent measure since it can be based on a physical property or ratio related to the performance of the artifact (time, weight, energy, etc.). At the conceptual stage, quality can usually be adequately estimated even though there is not enough quantitative information to do formal analysis. At the embodiment stage it may be possible to do some quantitative analysis and ratios of expected value to desired value of key attributes. These could be computed to quantify quality. It should be noted that the number of design phases evaluated (physical principle, concept, embodiment, detail, etc.) will depend on the type of idea generation method. For example, brainstorming and 635 will have only one phase (concept) while C-Sketch and Gallery may have two or three. The feasibility and/or desired characteristics of each design can be evaluated qualitatively or quantitatively and normalized on a scale of 1–10 to get the quality rating M_1.

Overall scores for each measure (quality and novelty) in Table 5.2 are found from formula (5.1):

$$\mathrm{M}_1 = \sum_{j=1}^{m} f_j \sum_{k=1}^{n} S_{ijk} p_k \,, \tag{5.1}$$

Where,

M_i is the overall score for the i-th measure of an idea (in this case i equals 1 or 2 for quality and novelty respectively);

m and n are the total number of functions and stages respectively;

f_j is the weight assigned for function j;

p_k is the weight assigned to stage k; and

S_{ijk} is the score given for measure i at function j and stage k.

Two approaches may be taken to measure novelty. The universe of ideas for comparison can be obtained by defining what is not novel (what is usual or expected), preferably before analyzing any data to avoid biasing. Alternatively, we can collect all ideas generated by all participants from all methods, identify key attributes such as motion type, control mechanism, propulsion, etc. Then find all the different ways in which each of those attributes is satisfied (example: motion = rotating, sliding, oscillating, etc.). Then we can count how many instances of each solution method exist in the entire collection of ideas. The lower is the count the higher the novelty. Overall novelty of each idea can be computed from formulas (5.2) and (5.3).

$$\mathrm{M}_2 = \sum_{j=1}^{m} f_j \sum_{k=1}^{n} S_{2\,jk} p_k \,, \tag{5.2}$$

$$\mathrm{S}_{2\,jk} = \frac{T_{jk} - C_{jk}}{T_{jk}} \times 10, \tag{5.3}$$

Where,

$M2$ is the overall novelty score metric for the idea;

Tjk is the total number of ideas produced for function (or key attribute) j and stage k; and

$C\,jk$ is the count of the current solution for that function (or key attribute) and stage.

Multiplying by 10 normalizes the expression.

This metric has also been used by psychologists to measure creativity.

To measure variety, one examines how each function is satisfied. Ideas are grouped based on criteria shown in Table 5.3. This rating is based on how different two ideas are from each other. The use of a different physical principle to satisfy the same function makes two ideas very different (maximum score). A variety rating applies to an entire group of ideas, not an individual idea.

Table 5.3 *Variety rating scale*

Score	Description of idea
10	Ideas use different physical principle
7	Same physical principle, different working principle
4	Same working principle, different embodiment
1	Same embodiment, different detail

The overall variety score is computed from formula (5.4).

$$M_3 = \sum_{j=1}^{m} f_j \sum_{k=1}^{n} S_{3jk} p_k \,. \tag{5.4}$$

Where,
M_3 is the overall variety score for the idea and
S_{3jk} is the given score for the idea at function j and stage k.

Quantity and variety scores apply to the entire session, while novelty and quality scores are computed for each idea. The total quality and novelty scores are found by multiplying each idea by its respective score in that category and summing all of them to get the overall score for that category (novelty or quality).

5.5. DECISION STYLES AND THE NEED FOR QUALITY AND ACCEPTANCE.

There are two dimensions that correlate reliably with a decision's effectiveness: quality and acceptance. The effectiveness (E) of a decision is a function of the quality (Q) of the decision times the acceptance (A) of the decision, or $E = f(Q \times A)$.

The *quality* of a decision is objective; it depends on the decision maker's utilization of the known facts (external reality). *Acceptance* of the decision is subjective; it refers to how favorably those who must implement the decision react to it – how they feel about it. A high-quality decision that does not have the full support of the persons who are expected to implement it may lack the necessary support to ensure its success. Thus, decisions may be ineffective because they lack quality, acceptance, or both.

A problem arises in decision making because the methods for dealing with facts are different from those for dealing with feelings. The difference is not always apparent because feelings are often hidden behind rationalizations.

FOUR TYPES OF DESIRED OUTCOMES

Problems differ in the degree to which quality and acceptance are vital to success. Normally, and regardless of the nature of the problem, an individual or group will pay more attention either to quality or acceptance. The required degree of quality and acceptance varies

with each decision. Basically, there are four types of desired outcomes.

I. High quality – High acceptance
II. High quality – Low acceptance
III. Low quality – High acceptance
IV. Low quality – Low acceptance

The proportion of these two factors determines the decision style that is most likely to be effective. The following discussions show how they relate.

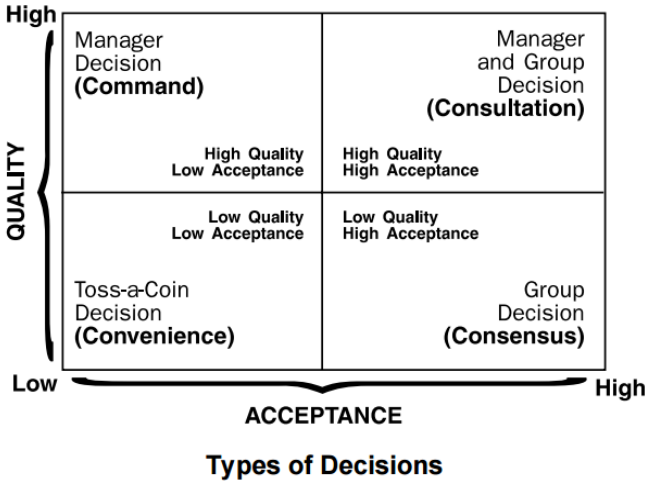


Figure 5.5 *The decision-styles model*

I. **High Quality – High Acceptance: The Consultative Decision**

A high quality-high acceptance decision might involve a manager and a work team in a problem-solving process to reorganize the work distribution and work flow. The quality is in the examination of the existing situation with a logical assessment of areas that could be improved. Although the final decision may be the manager's, all decisions are based on facts presented by the group. Each participant has a psychological investment in the success of the new procedures, thereby enhancing acceptance. In another case, the manager might make the decision after consulting with individuals, but without bringing them together as a group.

II. **High Quality – Low Acceptance: The Command Decision**

An example of a high quality-low acceptance – or command – decision is the way in which the price is set on a product. In making the decision, management must take into account such facts as production and distribution costs, competition, marketing opportunities, and profit margin. The employees who produce the item are not really concerned with the selling price because they lack the information necessary to analyze it, and the salespeople readily accept the price that is set by the company.

Similarly, solving a mathematical equation is a high-quality, low-acceptance decision – a logical, rational, cognitive process based on fact.

In an organizational setting, when quality is a requirement but acceptance is not, the leader uses the available information and makes the decision without involving the people who will be executing it.

III. **Low Quality – High Acceptance: The Consensus Decision**

A low quality-high acceptance decision is made when quality is of minor importance but acceptance among the people affected by the decision is very important. For example, two of three employees of equal ability are required to work on Saturday. The manager may be satisfied with any of them, but it may be an important issue for the employees. In an example

cited by Maier, three secretaries in such a situation were asked to decide for themselves which of the two of them would work. All had dates for the Saturday: one with her husband, one with her fiance, and one with a man she had just met. Because this date was, to the last woman, critical in the development of the relationship, the other two women decided that they would work so that she could have the day off. The acceptance dimension was met.

In this case, the persons affected by the decision are brought together and the consensus decision evolves from shared information, ideas, and feelings. The decision must be acceptable in some degree to all group members.

IV. **Low Quality –Low Acceptance: The Convenience Decision**

A low quality-low acceptance decision is made in a situation in which the choices are equal, the outcome is not really important to anyone, and so on. The manager may make the decision or the group may flip a coin to decide. The leader generally chooses whatever method is most convenient at the time. No special consideration is given to finding the "best" method.

However, this does not assume that only the two factors of quality and acceptance are to be considered by a leader in selecting a decision style. Other factors, such as time, capability of subordinates, and the level of trust in the group, must be considered as well. For example, regardless of the quality and acceptance factors, time constraints may require the use of the command model. If the level of trust in the group is low, a consensus decision may be difficult or impossible to achieve. If the trust level in the group is high, a consultative decision style may be very effective for achieving acceptable decisions of high quality.

TOPIC 6. VARIOUS ORGANIZATIONAL FORMS OF INNOVATIVE ENTERPRISES AND THEIR ACTION STRATEGY

6.1. *Innovation strategy of enterprises.*
6.2. *Models of innovation activities in small and medium-sized innovative enterprises (SMEs).*
6.3. *The advantages and importance of SMEs.*
6.4. *Forms of support for innovation companies.*
6.5. *Financial forms of support and stimulation for innovation activities of SMEs.*

6.1. INNOVATION STRATEGY OF ENTERPRISES.

General Strategy of Organization

Strategy is the creation of the unique and advantageous position which provides certain choices of activities. Michael Porter's different variants of common strategies reduced to the three basic types of strategies: ***stability, growth, reduction***.

1. The **stability strategy** is focusing on existing lines of business and supporting them. It is typically used by large firms.
2. **Growth strategy** involves organization increase, often through penetration and capture of new markets. Growth strategy could include vertical or horizontal integration.
3. **Reduction strategy** may be applied in cases when the survival of the organization is threatened. Its varieties shown below:

- *Reversal Strategy*. It is used if the organization is not effective but has not yet reached its critical point. This strategy means giving up producing unprofitable products, surplus labor force, poor working distribution channels and further search for effective ways of using resources mechanism.
- *Separation Strategy*. If a company has several types of business and at the same time one of them does not work well, it can be waived. Sale of this business unit or its transformation into a separate operating company is a good way to proceed.
- *Liquidation Strategy*. When approaching critical point (bankruptcy) closing process (liquidation) and selling business assets will occur.

The main innovation strategy

The basis for the development of innovative strategy constitutes the theory of product life cycle (PLC), the market position of the organization and its science and technology policy. As a model, usually one of the following types of investment strategy is taken:

1. *Offensive innovation strategies* are typical for firms whose activities are based on the principles of business competition. They are inherent to small innovative organizations.
2. *Defensive innovative strategies* are aimed at keeping the organization's competitive position on existing markets. The main function of such strategy is to strengthen the relation "input-output" in the innovation process. This type of strategy requires intensive research and development (R&D).
3. *Innovation imitation strategies* are used by organizations or those having strong market position and technology but are not pioneers in the market of various innovations. The essence of the model is the production of basic consumer properties using copied (but not necessarily technical features) innovations and placed on the market by small innovative organizations or leaders.

Choice of innovation strategy

Innovation strategy is based on the principle of "time is money". Choice of innovation strategy is based on the stage of the product life cycle. According to modern science, in any given time period the competitive production unit (organization, institution), specializing in the production of products to meet specific social needs, is compelled to work on the goods directly relating to the three generations of technology: the outgoing, the prevailing and emerging (prospective).

Professor Porter identifies three types of strategies: ***cost leadership***, ***differentiation*** and ***focus***. They were first set out by Michael Porter in 1985 in his book "Competitive Strategy: Techniques for analyzing industries and competitors" (Figure 6.1).

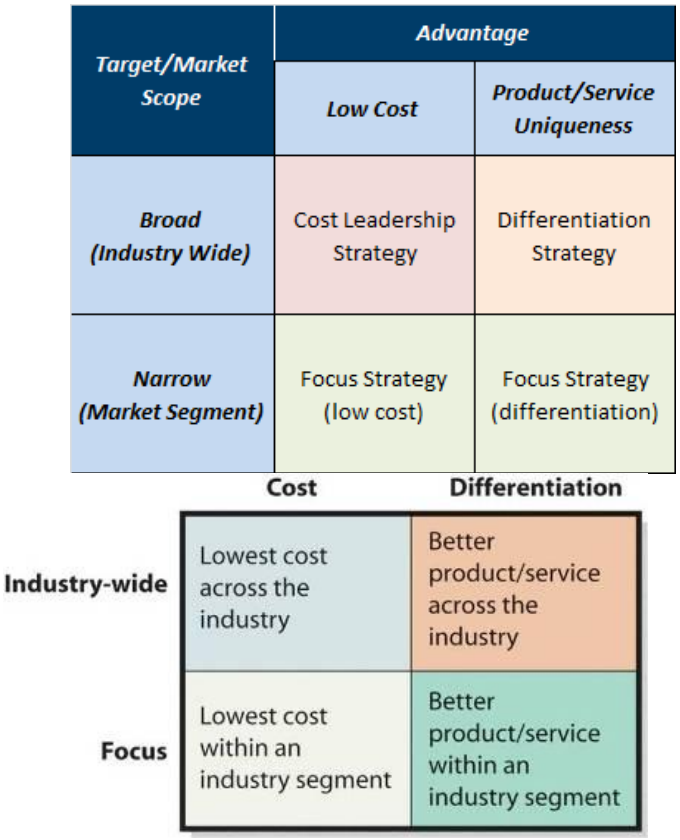


Figure 6.1. Porter, M.E. "Competitive Strategy: Techniques for analyzing industries and competitors" New York: The Free Press (1980)

The low cost leader in any market gains competitive advantage from being able to produce at the lowest cost. Factories are built and maintained; labor is recruited and trained to deliver the lowest possible costs of production. "Cost advantage" is the focus. Costs are shaved off every element of the value chain. There are two main ways of achieving this within a ***cost leadership strategy***:

- Increasing profits by reducing costs while charging industry-average prices.
- Increasing market share through charging lower prices while still making a reasonable profit on each sale because you've reduced costs.

Differentiated goods and services satisfy the needs of customers through a sustainable competitive advantage. This allows companies to desensitize prices and focus on value that

generates a comparatively higher price and a better margin. The benefits of differentiation require producers to segment markets in order to target goods and services at specific segments, generating a higher than average price.

To create a successful ***differentiation strategy***, organizations need:

- Good research, development and innovation.
- The ability to deliver high-quality products or services.
- Effective sales and marketing so that the market understands the benefits offered by the differentiated offerings.

The ***focus strategy*** is also known as a **'niche' strategy**. Where an organization can afford neither a wide scope cost strategy nor a wide scope differentiation strategy, a niche strategy could be more suitable. Here an organization focuses its effort and resources on a narrow, defined segment of a market. Competitive advantage is generated specifically for the niche. A niche strategy is often used by smaller firms. A company could use either a cost focus or a differentiation focus.

Hybrid Strategy *(combination of* ***cost leadership*** *and* ***differentiation strategies****).*

This new ***hybrid strategy*** may become even more important and more popular with increase of global competition. Compared to companies relying on a single generic strategy, companies that integrate the generic strategies may position themselves to improve their ability to adapt quickly to environmental changes and learn new skills and gain new technologies. This would more effectively leverage core competencies across business units and product lines, and would also help produce products with differentiated features or characteristics that customers value, and provide these differentiated products at a low cost, compared to competitors' products.

This is because of the multiple, additive benefits of successfully pursuing the *cost leadership* and *differentiation* strategies simultaneously. *Differentiation* enables the company to charge premium prices and *cost leadership* enables the company to charge the lowest competitive price. Thus, the company is able to achieve a competitive advantage by delivering value to customers based on both product features and low price.

Michael Porter did not solely define the basic competitive strategy.

6.2. MODELS OF INNOVATION ACTIVITIES IN SMALL AND MEDIUM-SIZED INNOVATIVE ENTERPRISES (SMEs).

In general terms there are the following schemes (models) of innovation activity in SMEs:

1. *Individual entrepreneurs* engaged in research and inventions.

2. *Venture company* is the company that takes risks, presumably with the expectation of high gains. Venture capital firms operate mainly in the stages of new products and technologies development. They take interest in market prospects for innovation at the stage of research and development, but usually do not manufacture, and transmit the finished advanced design to large companies.

Venture companies pursue the aim of obtaining profit from subsequent sales of shares in innovation firms. Having a share in a common cause, a venture capitalist will share the risk, and if the company succeeds, it will get the profits. Taking into account the high risk, he usually takes interest in the case only when he sees an opportunity to receive a high return on investment. In such cases, 80% per annum or more – is not uncommon. For comparison, the holders of ordinary shares with much less risk receive an annual income of 10-15% only.

Venture companies live by the formula – *high risk – high technology – high standard of*

living (high life).

3. *Explerents* are the pioneers of business *("Focus strategy" by M. Porter)*. The strategies they realize are oriented on risky innovations based on applying the newest highly-efficient technologies leading to maximum profit and venture investments. According to expert's estimations, risks of this type of strategy are extremely high. The most positive approximations give three out of ten venture projects reaching the break-even point; six loose and only one can become highly profitable. Explerents can't independently replicate innovations. Delay is threatened too with the emergence duplicating copies or analogues. Union with a strong firm (even under condition of uptake and subordination) allows to achieve favorable conditions and even save a certain autonomy.

In order to reduce the risk, managers work out typical financing schemes for a specified period during which the Eksplerent firm should succeed if it is intended to be. Investment capital is divided into five temporary segments according to two rules:

- each new investment is made only if the previous justified itself;
- any new investments are in excess of a previous and on more favourable terms for Eksplerent.

Eksplerent firms as venture companies, small in size.

4. *Patients* *("Differentiation strategy" by M. Porter*) are placed into (tied to) niche specialism and production of small batch of elite goods and overcharge purchasers. Usually their goods are of very elastic demand and is what commits them to the tough forms of competitive struggle; meeting the needs of the market generated by the action of fashion, advertising and other media. Patients operate on the stages of growth of output and simultaneously on stage of decreasing inventive activity.

Their motto is: "Expensive, but quality". These firms are not fight directly with leading corporations but ferret out available for them spheres of activity.

5. *Violents* *("Overall-cost Leadership strategy" by M. Porter)* defined as a firm with a "power" strategy. They have high capital and technology development. Violents engaged in large-scale and mass production of products for a wide range of consumers, impose "middle terms" for quality and are satisfied an average price level. Company Violents (as Patient) are profitable. *Profitableness* is an indispensable condition of firms. They should have a position of an innovation manager and be very careful to change their policies.

The motto of these companies: "Cheap and decent".

6. *Commutants* *("Focus strategy" by M. Porter)* are small, non-specialized companies. They are very flexible and use any possibilities for business, but usually don't possess extended manufacturing or Research and Advanced Development capacities. Commutants cover the remaining parts of the market. These companies tend to replicate the competitors' commercial secrets rather than create themselves. They take everything that does not cause interest at Violent, Patient and Explerent. Their unification role is connecting; therefore, they were called "communicator". They actively contribute to the promotion of new products and technologies on a massive scale creating new services on their basis. It accelerates the process of diffusion of innovations. Innovative management companies should be well versed in the specifics of buyer of the goods, the situation on the market, and also precisely, quickly and reliably anticipate potential crises.

Characteristic	**Commutant (*mousses*)**	**Patient (*foxes*)**	**Violent (*lions, elephants, hippos*)**	**Explerent (*swallows*)**
Type of business	Standard	Specialized	Standard	Specialized
Production profile	Universal small	Specialized	Mass	Experimental
Companies size	Small	Large, medium, small	Large	Medium, small
Sustainability of companies	Low	High	High	Low
R&D costs	Low	Medium	High	High
Power factors in competition	Flexibility, multiplicity	Adaptation to a particular market	High performance	Lead in innovation

Another way to market is the creation and development of the pioneering Explerent companies. The founders of the company, breaking consumer's stereotypes and business traditions are forced over a long period of time to overcome the inertia of the market. Further development of the company takes place within the *Violents strategy*. Thus, the numbers of cases with positive developments dynamics of firms are limited as follows:

1. *Commutant → Violent → Patient*;
2. *Explerent → Violent → Patient*;
3. *Explerent → Violent*.

Based on this scheme, the management of any company for developing the strategy should be defined depending on answers to the following questions:

1. What type of strategy is mainly used for the firm's current business?
2. What are the possible scenarios for its further development in the desirable and undesirable directions?
3. What should be done for the development of the company in the required direction?

7. *Spin-off and Spin-out companies*.

Spin-offs are divisions of companies or organizations that then become independent businesses with assets, employees, intellectual property, technology, or existing products that are taken from the parent company. Shareholders of the parent company receive equivalent shares in the new company in order to compensate for the loss of equity in the original stocks. However, shareholders may then buy and sell stocks from either company independently; this potentially makes investment in the companies more attractive, as potential share purchasers can invest narrowly in the portion of the business they think will have the most growth.

Some examples of spin-offs:

- Guidant was spun off from Eli Lilly and Company in 1994, formed from Lilly's Medical Devices and Diagnostics Division.
- Cenovus Energy was spun off from Encana Corporation in 2009.
- DreamWorks Animation was spun off from DreamWorks Studios in 2004.
- Nuage Networks was spun off from Alcatel Lucent in 2012.
- News Corporation's publishing operations (and its broadcasting operations in Australia) were spun off as News Corp in 2013. The previous News Corporation's remaining media properties were retained under the name 21st Century Fox.

Spin-out is a firm formed when an employee or group of employees leaves an existing entity to form an independent start-up firm. The prior employer can be a firm, a university, or another organization. Spin-outs typically operate at arm's length from the previous organizations and have independent sources of financing, products, services, customers, and other assets. In some cases, the spin-out may license technology from the parent or supply the

parent with products or services; conversely, they may become competitors. Such spin-outs are important sources of technological diffusion in high-tech industries.

Examples of spin-outs:

– Shugart Associates was a spin-out of IBM.

– Fairchild Semiconductor was a spin-out of Shockley Transistor; the founders were Shockley's "traitorous eight".

– Intel was in turn a spin-out of Fairchild, as were a large number of firms in the semiconductor industry.

8. International trade is especially appropriate for the rapidly growing number of "hollow corporations". A ***hollow corporation*** is a business without a factory and with a minimum number of employees in which manufacturing is performed by outside suppliers. A hollow corporation might depend on outside suppliers for virtually all of its products, such as an American toy company importing product from China. Or, it might depend on outside suppliers for selected components in its overall product line, such as The Boeing Company.

It's also a template for the modern business model of the 21st century. The result is that companies, both large and small, are performing ever fewer of their traditional functions and becoming 'hollow'.

9. Current trends are the forming of ***small firms' networks*** (strategic partnership). The main feature of network companies is that organizational relationships are built between legally autonomous but interdependent entities.

6.3. THE ADVANTAGES AND IMPORTANCE OF SMEs

The experience of most developed countries bears witness to the fact that small and medium-sized businesses are sufficiently effective and represent the most dynamically developing sector. Major corporations, which have unquestionable priority in the opportunities for attracting financial, material and labour resources to carry out large innovation projects have undisputed advantages in a whole number of sectors and spheres of activity. At the same time for many spheres the optimum and most productive are small forms of organization of economic activity. The development and introduction of innovations are, to a significant extent, part of this group.

The main *advantages* of small and medium-sized enterprises are confirmed by the practice of economic activity of all market economy countries and include the following:

– flexibility, a sense of initiative, dynamism and maneuverability in taking managerial decisions;

– absence of inertia inherent in the adaptation to constantly changing technological and market operating conditions;

– increased receptibility to new, original innovations and technologies;

– absence of manifestations of bureaucracy and formalism in the organization of a firm's activities;

– a high level of capability in providing diversification of goods and services in accordance with the momentum of demand, and accelerated reaction to changes in economic circumstances;

– relatively low capital intensity;

– a quicker return on investments (as much as twofold);

– the production of SMEs largely corresponds to modern trends for the individualization of demand.

To a significant extent, the advantages of small enterprises relate also to the innovation sphere, as shown by the following:

– in small enterprises the most beneficial conditions are established for creation which, by its very nature, is individual;

– creative activities are, by their very nature, alien to superfluous organization, hierarchical concerns, and are characteristic of major firms, and at the same time they are characterized by the striving for freedom which is an important condition for achieving anticipated results;

– in small firms, an inventor, owner and manager often act as a single individual, which in a significant sense virtually removes the basic contradiction of corporate management;

– new information technologies create favourable conditions for the operation of small enterprises, which were previously possible only within major firms.

Importance of SMEs is governed by a number of factors, including social and macroeconomic elements:

– SMEs help to reduce unemployment, thereby swallowing up a significant number of employed people, which has a beneficial effect not only on the social development of society, but also on the pace of economic growth;

– SMEs help to form the middle class which consolidates the stability of social systems, based on marketeconomy principles;

– they also help to diversify the economy and create healthy competition;

– SMEs are usually responsible partners and disciplined budgetary payers;

– the financial difficulties of individual SMEs are, as a rule, not reflected in macroeconomic processes;

– SMEs are much less involved in the processes of capital flows overseas;

– SMEs usually benefit from the loyal nature of public opinion.

During the past few years the importance of small enterprises has increased everywhere and in all spheres, including that of innovation. This is not by chance. Western experience of entrepreneurial activities clearly confirms the advantages of SMEs in innovation development. Thus, according to specialists' observations, 46 out of 58 leading inventions in America and Western Europe in the twentieth century belong to individuals and small firms. In accordance with the data of the National Scientific Fund of the United States of America, firms with up to 500 employees, calculated for each dollar invested in scientific research activities, gave 24 times more new inventions than large corporations (with more than 10,000 employees).

6.4. FORMS OF SUPPORT FOR INNOVATION COMPANIES

In general, support programs for innovation companies include the following forms:

A **university research park**, **science park**, or **science and technology park** is an area managed in a manner designed to promote innovation. It is a physical place that supports university-industry and government collaboration with the intent of creating high technology economic development and advancing knowledge. There are many approximate synonyms for "university research park", "science park", technology park, technopolis and biopark. The appropriate term typically depends on the type of affiliation the parks has with an institution of higher learning and research, and also perhaps the sort of science and research in which the park's entities engage.

Science and technology parks are supported by universities in order to bring in industry with which they can collaborate, and by local government in order to improve the prosperity of the community.

The world's first university research park started in the early 1950s near Stanford

University, and foreshadowed the community known today as Silicon Valley. Another early university research park was, and is, Research Triangle Park.

Science parks are sources of entrepreneurship, talent, and economic competitiveness, and are key elements of the infrastructure supporting the growth of today's global knowledge economy. By providing a location in which government, universities and private companies cooperate and collaborate, science parks create environments that foster collaboration and innovation. They enhance the development, transfer, and commercialization of technology.

According to the management paradigm, a science park must:

1. Have access to qualified research and development personnel in the areas of knowledge in which the park has its identity.
2. Be able to market its high valued products and services.
3. Have the capability to provide marketing expertise and managerial skills to firms, particularly Small and Medium-sized Enterprises, lacking such a resource.
4. Be inserted in a society that allows for the protection of product or process secrets, via patents, security or any other means.
5. Be able to select or reject which firms enter the park. The firm's business plan is expected to be coherent with the science park identity.
6. Have a clear identity, quite often expressed symbolically, as the park's name choice, its logo or the management discourse.
7. Have a management with established or recognized expertise in financial matters, and which has presented long term economic development plans.
8. Have the backing of powerful, dynamic and stable economic actors, such as a funding agency, political institution or local university.
9. Include in its management an active person of vision, with power of decision and with high and visible profile, who is perceived by relevant actors in society as embodying the interface between academia and industry, long-term plans and good management.
10. Include a prominent percentage of consultancy firms, as well as technical service firms, including laboratories and quality control firms.

A **business incubator** in business speak is a company that helps new and startup companies to develop by providing services such as management training or office space.

Business incubators differ from research and technology parks in their dedication to startup and early-stage companies. Research and technology parks, on the other hand, tend to be large-scale projects that house everything from corporate, government or university labs to very small companies. Most research and technology parks do not offer business assistance services, which are the hallmark of a business incubation program.

Among the most common incubator services are:

- Help with business basics
- Networking activities
- Marketing assistance
- High-speed Internet access
- Help with accounting/financial management
- Access to bank loans, loan funds and guarantee programs
- Help with presentation skills
- Links to higher education resources
- Links to strategic partners
- Access to angel investors or venture capital
- Comprehensive business training programs
- Advisory boards and mentors

- Management team identification
- Help with business etiquette
- Technology commercialization assistance
- Help with regulatory compliance
- Intellectual property management

Entrepreneurs who wish to enter a business incubation program must apply for admission. Acceptance criteria vary from program to program, but in general only those with feasible business ideas and a workable business plan are admitted. It is this factor that makes it difficult to compare the success rates of incubated companies against general business survival statistics.

Although most incubators offer their clients office space and shared administrative services, the heart of a true business incubation program is the services it provides to startup companies.

About one-third of business incubation programs are sponsored by economic development organizations. Government entities (such as cities or counties) account for 21% of program sponsors. Another 20% are sponsored by academic institutions, including two- and four-year colleges, universities, and technical colleges.

In many countries, incubation programs are funded by regional or national governments as part of an overall economic development strategy. Rents and/or client fees account for 59% of incubator revenues, followed by service contracts or grants (18%) and cash operating subsidies (15%).

Incubators often aggregate themselves into networks which are used to share good practices and new methodologies.

A **business cluster** is a geographic concentration of interconnected businesses, suppliers, and associated institutions in a particular field. Clusters are considered to increase the productivity with which companies can compete, nationally and globally.

The term business cluster, also known as an **industry cluster**, **competitive cluster**, or **Porterian cluster**, was introduced and popularized by Michael Porter in *The Competitive Advantage of Nations* (1990).

Several types of business clusters, based on different kinds of knowledge, are recognized:

- *High-tech clusters* – These clusters are high technology-oriented, well adapted to the knowledge economy, and typically have as a core renowned universities and research centers like Silicon Valley, the East London Tech City or Paris-Saclay.
- *Historic know-how-based clusters* – These are based on more traditional activities that maintain their advantage in know-how over the years, and for some of them, over the centuries. They are often industry specific. For example: London as financial center.
- *Factor endowment clusters* – They are created because a comparative advantage they might have linked to a geographical position. For example, wine production clusters because of sunny regions surrounded by mountains, where good grapes can grow. This is like certain areas in France such as Burgundy and Champagne, as well as Lombardy, Spain, Chile and California.
- *Low-cost manufacturing clusters* – These clusters have typically emerged in developing countries within particular industries, such as automotive production, electronics, or textiles. Examples include electronics clusters in Mexico (e.g. Guadalajara) and Argentina (e.g. Córdoba). Cluster firms typically serve clients in developed countries. Drivers of cluster emergence include availability of low-cost labor, geographical proximity to clients (e.g. in the case of Mexico for U.S. clients; Eastern Europe for Western European clients).

– *Knowledge services clusters* – Like low-cost manufacturing clusters, these clusters have emerged typically in developing countries. They have been characterized by the availability of lower-cost skills and expertise serving a growing global demand for increasingly commoditized (i.e. standardized, less firm-specific) knowledge services, e.g. software development, engineering support, analytical services. Examples include Bangalore, India; Recife, Brazil; Shanghai, China. Multinational corporations have played an important role in "customizing" business conditions in these clusters. One example for this is the establishment of collaborative linkages with local universities to secure the supply of qualified, yet lower-cost engineers.

6.5. FINANCIAL FORMS OF STIMULATION FOR INNOVATION ACTIVITIES OF SMEs

The main effective direct and indirect forms of support and stimulation for innovation activities of SMEs, used in developed countries, in the most general sense include the following:

1) Direct financing of scientific research and development work to create and use innovations in the form of subsidies for devising and promoting new technologies, goods and services which usually constitute about 50 per cent of overall expenditure of firms for these purposes (United States of America, France etc.). A significant portion of this expenditure is commonly used to stimulate the innovation activities of SMEs. For example, within the general scope of State subsidies in Germany, aimed at financing inventions in industry, the share of SMEs is about 30 per cent. In the United Kingdom, a special State program has been set up, by means of which expenses of small innovation enterprises for new inventions are subsidized. The most widespread form of subsidies during the past few years are grants, which are given both by the State and also by different international and public organizations, as well as by special funds, by means of financing of innovation projects on a competitive basis.

2) Special loans for innovation activities, granted as a rule on specific conditions and which envisage full or partial compensation of bank interest from special funds, or the State budget. This stimulation measure has been most widespread in Western Europe. So, in Germany SMEs which invest resources in the modernization of production facilities, control of the launch of new types of products or measures for rationalizing the use of energy, receive special loans up to 50 per cent of the resources spent for these purposes by an enterprise itself, while bank loans for acquiring new equipment are insured from the State budget. In Italy, special loans for technological innovations are granted up to 80 per cent of the cost of an innovation project for a period of up to 15 years.

3) The grant of tax privileges and holidays relates to measures for indirect stimulation of the activities of small and medium-sized innovation enterprises. Based on the fact that an enterprise's profit is the foundation for financing innovation activities, and increasing it leads to growth in companies' innovation opportunities, and also on the stimulating and regulating functions of taxes, many developed countries, beginning from the 1960s, actively use the tax system for the purposes of stimulating innovation development.

In practical reality in different countries various approaches are used to tax privileges: specific or single purpose grant, establishment of temporary frameworks etc.

The most widespread and effective forms of tax privileges are:

– a reduction in tax rates on profits, used to finance research and development, acquisition of high-technology equipment and other purposes linked with innovation activities;

– a reduction in the taxable base for the size of expenditure aimed at conducting scientific research and developments, which in some countries significantly exceed actual

expenditure on research (in separate periods they constituted in Singapore up to 200 per cent, Australia – 175 per cent, United Kingdom 125 per cent, and for SMEs – 150 per cent);

– a so-called research (investment) tax credit, granting in essential terms a postponement of tax payments on profit, used for innovation purposes and promoting the reduction of the overall tax burden (USA, Japan, France, Spain, Ireland, Canada, Netherlands);

– the inclusion of expenditure on research and development in the self-costing of products;

– tax holidays on profit obtained from the introduction of innovation projects, granted for a number of years;

– the establishment of privileges for taxation on profit obtained as a result of the use of patented inventions, utility models, know-how and other intellectual property subject matter;

– a reduction in the taxable profit on sums of contributions to funds used for innovation activities, the acquisition of tools and equipment, transferred to the scientific research and innovation spheres, etc.

4) The establishment of systems of privileges for depreciation charges is a fiscal measure and, essentially, leads to the establishment of accelerated terms for redemption of equipment and, especially, its high-technology component. For these purposes, the service periods for equipment are usually set at up to three years, while for other basic funds they are up to five years. Transferring the depreciation charges to the cost price of production allows the taxable portion of profit to be reduced. This is widely used in the United Kingdom, Germany, France and other countries. In a number of countries, special systems are used for the redemption of scientific equipment, which in addition to stimulating effects enhance the competitiveness of scientific and innovation activities.

5) Privileges or full exemption from the payment of customs duties for imports of scientific and high technology equipment. Support for venture capital activities, designed to assist special financing for innovation activities. So called venture investing is one of the most effective mechanisms of an active innovation policy, which to a significant extent removes or, at least, significantly mitigates the eternal contradiction between an investor and an entrepreneur regarding the periods for the return of and reward on funds invested. Foreign experience of the operation of venture capital shows that it is usually generated through the funds of private corporations, pension and insurance companies, banks, investment funds and other sources.

In a number of countries, the State is an active participant in venture financing, especially at the initial stage of development of this financial institution. In this regard, it may act through the State venture fund, which invests directly in innovation enterprises (United Kingdom, India), or by creating a “fund of funds”, which invests in private venture funds (Israel, Finland, Singapore), or a mixture of the two (Canada, Finland, Japan). Another form of direct participation by the State in venture financing is the provision of State guarantees to compensate for possible losses from the financing of innovation activities (Western Europe, Singapore, United States of America, Japan). With no relation to direct participation by the State in the formation of venture capital, as a rule it provides significant tax and other privileges for its functioning.

6) The formation of an innovation infrastructure, the main elements of which are consulting, financing, information and other components, and also special organizational structures designed to assist innovation activities, above all SMEs: science-technology parks, innovation incubators, technology transfer centres, technopolises, clusters and other innovation networks, as well as spin-off and start-up companies.

7) Assistance with patenting, privileges and postponements for payment of

patent fees, granted to SMEs, and also to individual inventors by national patent offices or from budget funds. In a number of countries for the different categories of applicants, including for SMEs and natural persons, a special level of patent fees is set (Austria, Germany, United States of America). Thus, in the United States of America in order to stimulate patent activities by SMEs up to 50 per cent of expenses, associated with obtaining protection documents, is paid from budgetary funds. About 25 per cent of patents are granted on the above conditions. In Austria, postponement or exemption from payment of fees is applied, if an invention is designed to save energy.

In most developed western countries, complex systems have been developed for the stimulation of innovations by SMEs. The existence of different forms of stimulation makes it possible to choose from their wide variety those which to the greatest extent meet the specifications for activities and the corresponding stage of the life cycle of a specific innovation project. The combination of the above complex systems with the effect of mature market mechanisms, which have effectively attracted private capital to finance the development and use of innovations, has led to the formation of a highly effective mechanism aimed at accelerated technological modernization.

TOPIC 7. STATE REGULATION OF INNOVATION ACTIVITIES

1. *The role of state regulation of innovation processes.*
2. *Types of government incentives.*

7.1. THE ROLE OF STATE REGULATION OF INNOVATION PROCESSES

The need for state regulation of innovation processes is caused by objective circumstances of all countries' economic development. Innovations in modern society are becoming a factor of economic growth stabilizing and national security strengthening. Therefore, the state must exercise its regulatory impact on innovation processes.

Government regulations can have both positive and negative effects on the innovation process. Among other goals, regulatory reform is intended to enhance the positive regulatory effects on innovation.

Regulation can be said to generally refer to policies where the government acts as a referee to oversee market activity and the behaviour of private actors in the economy. Such government intervention in the marketplace is usually justified on the basis of market failures and the need to ensure societal wellbeing.

- ***Economic regulation*** is generally intended to improve the efficiency of markets in delivering goods and services. It can include government-imposed restrictions on firm decisions over prices, quantity, service and entry and exit.
- ***Social regulation*** is intended to protect the well-being and rights of society at large. It can include protection of the environment, health and safety in the workplace, protection of the rights of workers, and protection of buyers from fraudulent or incompetent behaviour by sellers.
- ***Administrative regulation*** relates to general government management of the operation of the public and private sectors. It can include regulations relating to taxes, business operations, distribution systems, health care administration and intellectual property rights.

Regulatory reform is directed to making sure that these regulations remain fully responsive to changes in the economic, social and technical conditions surrounding them. Regulatory reform can take many forms. With regard to *economic regulation*, reform can mean deregulation, privatisation or opening up a market to increased competition. In the case of *social regulation*, reform generally means improving the flexibility and cost-effectiveness of regulations. With regard to *administrative regulation*, reform is usually directed to streamlining and improving the efficiency of regulations. In some cases, regulatory reform can mean increased rather than decreased levels of regulation or government surveillance.

Some specific features of state regulation of innovation processes at the national and regional levels are shown in table 7.1.

Table 7.1. Features of state regulation of innovation processes

Stages of the innovation process	The level of government regulation	
	state	regional
Fundamental research	Almost completely organized and funded by the state	There is indirect interference in economic activities of relevant scientific (research) institutions as the organizations that operate on the certain territory; coordination of activities in some areas
Applied research		
Development and design	The government can stimulate innovative activities through tax remissions, direct financial assistance from centralized funds, etc.	Subjects of state regulation of innovative activities at the regional level can assist in accessing technology, cancellation (reduction) of some local taxes, carry out direct financial assistance from regional budgets, etc.
Trial Introduction		
Industrial production	Intervention of state or municipal enterprises in economic activities	
Marketing	Public authorities provide access to relevant statistics and background information	
Sales	The state takes measures (legislative and administrative) to protect domestic producers, to lobby theirs interests in foreign markets, to organize public and international exhibitions, presentations, fairs, PR-campaigns, etc.	Majority of innovative products procurement is organized through a system of government orders; assistance provided through the provision of equal and transparent access to the competition and the organization of regional and interregional exhibitions, fairs, presentations, PR-campaigns, etc.

In different countries, the process of state regulation of innovation processes can occur in different ways, which is reflected in the state legislative acts.

Japan has a minimum of own natural resources at its disposal, therefore the government considers the scientific and innovative policy as a most important means of stimulating overall economic growth and enhance the international competitiveness of the country. The Japanese government does not manage industrial development as the decision-making authority, a mutual partnership probably exists between the elements of the state apparatus and the industry sector based on pragmatic solutions, mutual respect, coordinated activities aimed at achieving common goals.

In *France* the level of centralized regulation of innovation is the highest, research are recognized as national program and presented in the form of five-year strategic research plans.

In *England* there is no system for innovation's centralized control, but well designed interaction mechanism exists, enabling the coordination of innovations development at the state level.

In the *U.S.*, economists and sociologists see in the venture business a deliberate entry of the U.S. economy in a phase of growth of the new "Kondratiev cycle".

State regulation of innovative activities should be done by:

- identification and support of innovative activities priorities directions on state, sectoral, regional and local levels;
- formulation and implementation of national, sectoral, regional and local innovation programs;
- creation of the legal framework and economic mechanisms to support and stimulate

innovative activities;

- protection of the rights and interests of the subjects of innovative activity;
- financial support of the innovation process implementation;
- introduction of preferential taxation of innovative activities;
- support of the operation and development of modern innovation infrastructure.

International experience on influence on the innovative processes indicates a lack of formal criteria which would ensure effective scientific, technological and innovative development. Each state creates its own national innovation system through which exercises in particular government regulation. This regulation includes measures of state support for innovative activities and aimed at ensuring economic growth of the state and improvement of its competitiveness.

7.2. TYPES OF GOVERNMENT INCENTIVES

When in comes to providing incentives to encourage innovation, governments step up in two ways:

Direct subsidies often target certain industries, either because they are seen as strategically important (as for defence purposes) or because the government believes it can foster growth in a particular sector. Direct subsidies are best suited to encourage high-risk projects and to meet specific policy goals, and are usually allocated based on a competition among firms. This ensures that resources from the state budget are invested in the best projects within the topics defined by the political authorities. Such allocation mechanisms might be relatively costly to administer, but make it possible to target financing according to what the government has chosen as vital goals for R&D.

The other major subsidy comes *indirectly*, through the tax system. Generally speaking, countries that have been successful at fostering innovation build a tax platform that includes a number of elements for corporations: low taxes (through a tax holiday, an overall low tax rate, or industry-specific low tax rates); an R&D tax regime; an IP tax regime; and a holding company regime.

I. Tax system: In general, businesses prefer general tax relief or lower corporate tax rates, rather than targeted incentives to certain types of investments. In addition to lower taxes, corporations also like predictability in a tax regime.

1) *Tax Incentives*

A wealth of evidence has shown that even private sector R&D has broad effects that benefit society, such as higher productivity, faster communications, safer vehicles, improvements in health, and so on. As the world recovers from the severe economic crisis, governments continue to evaluate their support for R&D activities and the tax incentives and the overall trend continues to be more R&D support over time.

Tax incentives reduce the marginal cost of R&D and thus stimulate more of it. They're usually available for a wide range of firms, and the firms themselves decide what kind of R&D to pursue. Tax incentives take the form of tax credits, tax deferrals, or allowances for related expenditures.

Most of the developed countries offer R&D tax credits, with the largest subsidies in countries such as Spain and France. In addition, Brazil, India, South Africa and China also offer attractive R&D tax credits. Targeted credits also vary by sector: Singapore is the world's most specialized country in the area of nanotechnology, while biotechnology leaders include Ireland, Belgium, Canada, and the U.S.

The size of the credit or deduction varies considerably, from a modest percentage of

the allowable expense to more than 100% of the expense incurred. Some countries cap the total credit/deduction, others do not; some countries only credit expenses incurred inside the country and inside the taxable enterprise; others qualify expenses regardless of where the expense occurs.

Among various countries, some use tax incentives only for fostering the market introduction and uptake of new products and processes, such as Israel and Romania. Others such as Greece, Latvia, and Malta include R&D as one of many possible items for a general investment incentive scheme. There is no strong pattern concerning which countries do not use tax incentives for R&D at all: some are countries with high R&D intensity such as Germany, Sweden, Finland, and Switzerland; others are countries with low R&D intensity such as Cyprus and Slovakia.

2) *Tax Holidays*

Tax holidays are popular with emerging countries seeking to attract new foreign and other investment in innovation. They generally offer tax-free periods for new investments by innovation- or tech-intensive companies (which are defined in various ways), often followed by reduced tax periods. These can be focused on a high-tech industry or a targeted geographic area.

Tax holidays vary significantly from country to country. China, for instance, offers two to five years complete exemption from the first income-generating year, followed by three to five years at 50%. Israel offers seven years from the year of first taxable income, but up to ten years for companies in a special economic zone. India, meanwhile, offers ten years commencing the first year of manufacture in a designated software, hardware, or export-oriented zone. The country offers 15 years (100% for the first five years and 50% for the next ten years) for companies located in special economic zones.

3) *Venture Capital Incentives*

Tax incentives to encourage venture capital (VC) investments are offered by many countries to accelerate investment in technology and other priority sectors. China, Malaysia and Singapore offer direct incentives to VC firms. In China, VCs investing in new high-tech business may offset 70% of their investment against future VC income. In Malaysia, start-up or seed capital investors receive deductions equivalent to the value of their investment (alternatively a 10-year exemption of certain income) and in Singapore, realized investment losses on qualifying company may be offset against other taxable income. Investors themselves, including VC firms, consider the capital gains tax and the tax treatment of dividends to be very important factors in creating an advantageous investment environment.

4) *Intellectual Property Tax Relief*

More countries are considering tax relief on capital expenditures incurred in the acquisition of IP.

Laws or enforcement practices that restrict the deductibility of arm's-length royalty payments stifle innovation in that country. These restrictions, which ignore the value of intellectual property created outside of the country, are particularly acute in high-tech industries and impede the licensing of foreign intellectual property into the country. Such restrictions also impair the licensing of intellectual property created inside the country, which further slows the spread of innovations.

5) *Indirect Taxation*

There are two primary forms of indirect taxation in force around the world today – value-added taxes (VAT) and customs and excise duties. Within these two major tax types exist thousands of rates, rules, and regulations that allow authorities to collect tax at most stages in the product or service life cycle. Both sales tax and VAT are primarily designed to tax the final consumer with businesses acting as the collection agent for the state on the value

added by them at each stage in the supply chain.

II. Legal Environment: A robust and predictable legal environment encourages innovation by convincing foreign investors and multinational companies that a country has laws and regulations in place to protect their interests – and that the government and its courts are willing to enforce those laws.

1) *Protection of Intellectual Property Rights*

Enforcement and protection of intellectual property rights forms a crucial component in innovation, especially for technological innovation. While all markets face similar issues, countries with weaker institutions supporting patent protections and copyright laws tend to lag in innovation on the global competitive stage. Without such legal protection and effective legal institutions for enforcement and judicial review, innovators have no recourse but to take their business elsewhere.

The main types of IPR include patents, copyrights, trademarks, and trade secrets. Many emerging markets have weak records in protecting IPR, particularly for intellectual property held by foreign-owned companies.

The debate surrounding strong IPR protection sometimes divides mature markets and emerging markets. From the perspective of mature economies, without the ability to protect investments in new ideas, proprietary processes, new technology, and R&D, there is little incentive for private actors to spend resources on innovation.

2) *Patent System*

Patenting trends provide a unique and detailed source of information about the state of innovation and technology within a country. There is a strong correlation between the number of triadic patent families (Triadic patent families refer to patents filed at the European Patent Office, the US Patent and Trademark Office, and the Japan Patent Office that protect the same invention) and industry-financed expenditures on R&D. The more a country spends on R&D, the higher the propensity to patent.

A robust patent system thus has several benefits: It discourages copycats who steal ideas without appropriate compensation, it disseminates leading-edge knowledge, and for companies owning significant patent portfolios, it delivers a "seat at the table" when new technology designs are being negotiated in standards groups.

In short, patents are an absolute requirement for enterprises seeking to compete and collaborate in the global innovation marketplace; they are an entry ticket to commercial and technological advancement.

III. Fiscal Environment: The investments a government makes to strengthen its innovation infrastructure can have a dramatic impact on the ability to attract domestic and foreign investment. In some cases, focusing on grants for higher education and R&D can spur domestic innovation that has a longer-lasting effect on the local economy. These and other types of fiscal incentives are explored in this section:

1) *Higher Education*

Research universities have long been hotbeds of innovation. Fiscal investment in innovation thus can include the indirect investments to educate and train scientists and researchers, build world-class institutions and facilities, facilitate interactions with global communities to generate fresh ideas and new perspectives, and build structures to commercialize innovations.

It's not just the university institutions themselves that carry out research and drive innovation. With the transition from industrial to knowledge-based economies, a highly educated workforce is critical to support innovation in the private sector. Without skilled

employees, companies cannot grow and maintain competitiveness; there is a strong relationship between the strength of a country's higher education system and its overall ability to innovate.

2) *Grants for Basic Research*

Fiscal support for R&D is critical for any government hoping to encourage the formation and success of local companies that focus on creating new technologies. Typically, this support is provided through grants, loans, or contracts, or through investment in infrastructure. The infrastructure investment can take a physical form such as universities, buildings, labs, logistics, and transportation, or an intangible form such as university graduates.

3) *Foreign direct investment (FDI)*, by bringing new technology, knowledge, or innovative processes to a country, can be one of the most significant channels for international technology transfer and developing the infrastructure necessary for innovation. FDI can benefit innovation activity in the host country in several ways, such as through reverse engineering or the import of skilled labor. FDI flows also indicate the degree of a country's integration into the global economy. In India, for example, FDI plays a pivotal role not just in importing innovations developed elsewhere, but also in improving domestic R&D through foreign companies' creation of R&D centers.

Many countries limit the level of foreign ownership, often to a 50% stake, in certain industries deemed vital to national security or other national interests. Such limitations apply to defense contractors, media outlets, telecommunications carriers, and other industries, depending on the country.

4) *Grants and Loans for Capital Investment*

For most high-tech multinational corporations considering whether to build a facility in a particular country, the most compelling type of public incentives are government grants that subsidize plant, equipment, and other physical investments.

Countries looking to attract foreign high-tech firms thus often use grants. Ireland did so when wooing Intel and Dell to open major facilities, and Israel and Singapore have high grant rates currently. The governments of these countries decided that it was worth the subsidy, since attracting a few well-known multinational brands sends a powerful signal to other foreign companies that they too can confidently invest in the country. A core of multinationals then can encourage growth of an indigenous supplier network and, eventually, could lead to the rise of several homegrown multinationals.

5) *Venture Capital and Private Equity Support*

Entrepreneurs play a pivotal role in innovation. New companies are often at the forefront of introducing new ideas, business practices, and technologies into the mainstream. Although many factors play a role in the level of entrepreneurship, availability of capital is critical for survival for these new companies. Venture capital is an important source of financing where risk is too high for banks and other secured lending and capital markets are inaccessible.

Some countries are responding by offering incentives directly to venture capital firms. In China, for example, venture capitalists investing in new high-tech business may offset 70% of their investment against future income. In Malaysia, start-up or seed capital investors receive deductions equivalent to the value of investment (alternatively, a ten-year exemption of certain income). In Singapore, realized investment losses on qualifying company may be offset against other taxable income.

TOPIC 8. MANAGING INTELLECTUAL PROPERTY

8.1. INTELLECTUAL PROPERTY OBJECTS.

At introduction of objects of intellectual property in a civil turn the solution of a question on a form of use of this object always is necessary to the owner: to do it in own production or to choose one of forms of commercial use. According to recommendations of the World Intellectual Property Organization commercial transfer of OIP can be carried out as follows:

- sale of all exclusive rights on OIP by the owner;
- licensing;
- know-how transfers.

In addition, there are another forms of OIP commercialization such as paying in authorized capital of the enterprise, getting a credit against security of OIP, franchising. To choose an optimum decision of commercial OIP use the following should be done:

- patent research aimed at determining a technological level and trends of development of objects of innovative activity, their patentability, patent purity, competitiveness on the basis of patent and other information;
- the market research including study and analysis of developed new goods competitiveness factors using inventions and other OIP, and also research of tactical forming factors of the market and prospects of its development during life cycle of goods inventions.

Choosing a form for OIP use is carried out on the basis of possible options comparison. Use of intellectual property objects (for the industrial enterprises first of all, of industrial property objects (IP)) in the own production is the most effective option. After all in this case all profit on use of given object remains at the industrial enterprise possessing exclusive rights on it.

However there is a variety of reasons making the use of industrial property objects owned by industrial enterprise, in own production complicated:

- there is no possibility on industrial enterprise to finance production using objects of industrial property owned by the given enterprise;
- the cost of production made using industrial property objects owned by the enterprise will be obviously too high to provide the necessary volume of realization and profit;
- manufacture of products mentioned above doesn't correspond to a profile of primary activity of the enterprise;
- legislation doesn't allow to organize manufacturing and sales of products using the given industrial property object.

If it is impossible to organize own production using given OIP it may be possible to sell

the license for the right to use object of industrial property. The profit from such form of commercial use of industrial property object, as experts estimated, will be for 70-90% less than from application of the previous option. However trading licenses can make sometimes much more profit than the organization of own production.

Very often the best option will be combined form of commercial use of industrial property object at the industrial enterprise i.e. both own production and sale of licenses.

Sale of all exclusive patent rights by the owner is a full assignment of industrial property object from one subject to another without time limitation (certainly, within period of this right validity according to the legislation) and without limiting the territory (within the territory of action of a transferred exclusive right).

Licensing is granting by the patent owner to other physical or corporate body of the permission to commit one or more actions in a certain country during the limited period of time. The owner of the patent issued in the given country has an exclusive right to commit actions mentioned above. License agreement (contract) that secures such a deal is the most common means of transmitting rights for use of the industrial property objects protected owing to the state registration. License trade is the main form of technology transfer.

The license contract is characterized by the following main indicators:

- conditions of the license usage;
- the volume of the rights transferred under license;
- mode of license object legal protection (patent law object, means of an individualization, copyright object);
- nature of license object usage (industrial or commercial);
- degree of industrial development of license object (at a stage of idea, technical solution, industrial development, etc.).

Cash award as a payment for the license acts as a payments under a licensing agreement of three types:

- royalty;
- lump-sum payment;
- the combined payment.

The royalty is a license remuneration in the form of periodic assignments (a share from profit or amount of sales of products made on licensed technology). In pure form or in combination with other types of payment these assignments are the part of the majority (up to 90%) of license agreements. Royalty are usually paid at the end of every year of the agreement action, starting from the moment of finished goods release. In the presence of a condition on payments in the form of a royalty in the contract, the condition about the minimum guaranteed payments can be there as well. In long-term relations the differentiated rates that vary by years are applied. Specific rates cuts when sales grow are used for stimulation of the licensee to expansion of volume of output. Such form of payments is connected first of all with desire to share risk. In case of failure with license product manufacturing losses will be sustained both by the licensee and the licensor.

Lump-sum payment represents payment of firmly fixed sum of license remuneration at once or by 2-3 portions i.e. doesn't depend (formally) on the volume of realization of products made under licenses. In this case all risk is taken by the licensee that is good for the licensor. But, on the other hand, licensee will lose a chance to get super-profits in case of unexpected success of a license product.

In practice the combined payments including the initial sum in the form of lump-sum payment (10-13% of the total price of the license) and the subsequent periodic assignments (royalty) are used most often.

The problems connected with commercial use of IP can be divided into the following main groups:

1) problems of regulation of the relations at creation of IP objects at the enterprise;
2) problems of acquisition and payment of property rights on use of IP objects created outside the enterprise;
3) problems of ensuring protection (safety) and legal protection of IP objects;
4) problems of commercial use of IP as property (intangible assets) of the enterprise;
5) financial and economic problems of use of IP and the organization of its accounting.

8.2 INTELLECTUAL PROPERTY RIGHTS.

8.2.1 INTELLECTUAL PROPERTY RIGHTS.

The World Intellectual Property Organization (WIPO) defines intellectual property (IP) as "creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce." More specifically, intellectual property refers to a broad collection of rights relating to such matters as works of authorship, which are protected under copyright law; inventions, which are protected under patent law; marks, which are protected by trademark law; as well as trade secrets, designs and other related rights.

It is important to note that these forms of intellectual property are very different and the protections afforded under them serve different purposes. Intellectual property relates to the results of created and RR work, new solutions, inventions, new technology or technological development, software, new design of industrial and other products and others. A part of aforementioned categories could be protected through copyright laws, patents, trademarks and industrial design. Any know-how involved in the product could of course also be kept secret within the company, through internal agreements, to others.

The needs for copyright and related laws have become more and more evident especially through the opening up of the Information Society. Music and software are examples on this.

The intellectual property rights have changed over time but the main objectives have always been the same to encourage the inventing of new products and services to the benefit of the end-users. The word copyright is mainly used to protect the rights of writings or production by an author but nowadays also includes the software development. Copyright only protects the "expression" from the author and not the idea behind it. More and more products even in the mechanical industry nowadays have software included directly to the product or in the production of it which might be interesting for the company to protect.

Borders for marketing of goods and services are disappearing in a European and global market. Copyright based services and goods should be and are available and marketed especially within the European Community.

Intellectual property rights (IPRs) give the owners of ideas, inventions, and creative expression the right to exclude others from access to or use of their property for a certain period of time. International treaties and the laws of the various countries differ significantly in terms of the degree of protection and enforcement available.

The need for intellectual property rights and related laws is to protect innovative products and services and also to secure companies and persons on the investment they have made to be able to marketing and distributing them to end users not to be copied by others. The intellectual property rights are becoming increasingly important as they often cover huge economical values.

On the other hand not everything can be protected as it should prevent the free competition on the market and the laws for intellectual property are in that sense very

complicated and differ from country to country. Certain type of inventions, for instance results from academic research, can not be protected. Inventions that have not been protected could be copied and reproduced Intellectual property and related rights are, as mentioned, based on national laws and legislations. Within Europe there is a tendency now to adjust the national laws and legislations through a common European legislation.

A typical example on the needs of intellectual property rights is when a company wants to market a new product based on some technical invention. The company wants the product to be exclusive and easy to separate from other similar products and also be protected as far as possible from reproduction by competitors. In that case the company could think of patenting the technical solution behind the new product combined with some protection of the design (based on artistic rights) as well as a trademark of the product. In addition some protection for the marketing of products, similar in form and design, could be secured through the marketing legislations available. It is for instance not allowed to market a product which is very similar in its design as another well known product to benefit from the good will that product might have.

Intellectual property rights have a growing economic importance and will in many companies be the most valuable asset. Most important issues of the intellectual property rights seem to be patent and trademarks, especially within hi-tech production like electronics, biotechnology and medicine production, but it becomes increasingly important in mechanical industry.

8.2.2 PATENT.

A patent is an exclusive right granted for a product or a process that provides a new way of doing something or offers a new technical solution to a problem.

A patent is regarded as a property right which can be issued nationally and/or in other countries where the company wants to protect its solution. The patent gives the company exclusive right to manufacture, to use and to sell the product within a limited time period (20 years; can vary from country to country). As it is a property it could be sold or licensed to others or be subject to contracts and/or other agreements. Once a patent is issued it is possible to make profit on it especially for the person(s) who is the inventor. The patent can not be global so it must be protected in the countries where you want to market and to sell the product. If there are many countries where the patent is needed, it might be a costly and administrative procedure. International Patent Application (PCT Application) exists, but it is more a matter of an application system which will not give a global patent but a number of national patents.

8.2.2.1 PRECONDITIONS FOR PATENTING.

It is not possible to reward a patent to every invention. An invention must, in general, fulfil the following conditions to be protected by a patent. It must be of practical use; it must show an element of novelty, that is, some new characteristic which is not known in the body of existing knowledge in its technical field.

This body of existing knowledge, called "prior art", could be checked using e.g. patent databases or general and technology-specific search engines. The invention must show an inventive step which could not be deduced by a person with average knowledge of the technical field. Finally, its subject matter must be accepted as "patentable" under law. In many countries, scientific theories, mathematical methods, plant or animal varieties, discoveries of natural substances, commercial methods, or methods for medical treatment (as opposed to medical products) are generally not patentable (WIPO, 2006).

*The term "**patent**" usually refers to an exclusive right granted to anyone who invents any new, useful, and non-obvious process, machine, article of manufacture, or composition of matter, or any new and useful improvement thereof, and claims that right in a formal patent application. The patent is a government license that gives the holder exclusive rights to a process, design or new invention for a designated period of time. Applications for patents are usually handled by a government agency.*

8.2.2.2 APPLYING FOR A PATENT.

You have to apply for the patent through a special application procedure given by the national authorities responsible for patents and patenting. It must be written in a manner that a technical person in the field should be able to understand and to use the invention in research and development or in industrial production. In most countries it is possible to make a pre-application and after that has been judged and looked upon from the possibility to be rewarded, a final application will be made.

A normal patent application could in Europe be done in three possible ways:

- National patent application which can be rewarded by the national organization
- International patent application (according to the international patent application-PCTsystem) which are sent to international organizations that have been given the right to handle these applications. At the end the national organizations in the country/ countries involved will be given the final reward.
- European patent application, where the European organization for patents, European Patent Office-EPO, could reward a patent.

The procedures are costly and take long time, often some years, and less than one year is very rare. Consulting organizations are the main actors on behalf of the company or individual that wants a patent. The more countries you want your patent rewarded in, the more costs you will have for consulting, translation and different fees.

Especially being a researcher it might be interesting to publish what you have discovered. Be careful here, a patent is in itself a publication describing the invention and in return you will be given a protection to non authorized use. If you publish it on your own first in a scientific journal or similar it will prohibit having it patented in most countries in the world. However it is possible to publicize the results if the publication does not give sufficient information so that it could be duplicated or manufactured from the information given in the article. Consult your national regulations in advance.

One important source for more information about patent is the IPR-Helpdesk funded by the European Commission which is a service free of charge with the aim of supporting creativity and innovation in Europe (www.ipr-helpdesk.org).

8.2.2.3 PATENT PROTECTION ABROAD.

As already mentioned it is possible to protect a product also internationally even if always coming back to national patent protection. The international patent protection (Patent Cooperation Treaty – PCT) or the European patent protection (European Patent Convention – EPC) represent an opportunity for an international protection.

PCT application

The Patent Cooperation Treaty (PCT) is an international patent law treaty, concluded in 1970.

It provides a unified procedure for filing patent applications to protect inventions in

each of its contracting states. A patent application filed under the PCT is called an international application, or PCT application**.** PCT is based on agreements between more than 100 countries. The main idea is that the application could partly be made through a single application and you need to define the countries where the patent should be issued.

The application could be done through the national patent registration office or, which often is the case, through the World Intellectual Property Organization (WIPO – www.wipo.int) in Geneva or the European Patent Office (EPO – www.epo.org). Application forms are available.

The PCT application process starts with an international search and gives the applicant a possibility to see what option there is to receive a patent. After that an examination is made by an expert who gives his opinion of the possibility to receive the patent. The international phase is then being followed by national phases in the countries where the patent is sought.

The WIPO website gives more details about the PCT-application and the different time framesand phases.

Application for European Patent – EPC

The European patent is based on the European Patent Convention, EPC, which came into force in 1977. So far 36 states have become parties to the Convention and four states have made a separate agreement (the so-called extension states) to the effect that the European patents are extended to cover them too According to a European agreement it is possible to receive a patent covering 40 European member states of European Patent Convention as well as some other countries by filing a single application for a European patent. The application must include a list of countries where it should be designated and if being approved it will be validated in those countries. It is done through a translated version of the patent to all national offices. The European Patent will result in national patents in designated countries.

The application could be sent directly to the European Patent Offices in English, German or French languages. Application forms are available from the European Patent Office.

As in the PCT-application the process starts with a search to find out any obstacles to the patent. If the applicant wants to continue, then the assessment of the application will be done. When it is ready for approval translation is needed in the three languages; English, French and German. It will also be published in the European Patent Bulletin.

The European Patent is actually not a true European patent but a number of national patents.

For that reason it still has to be validated in all countries which also will include translation to national languages.

8.2.3. UTILITY MODEL.

It happens quite often that someone has made some kind of simpler technical invention, but getting a patent is not possible (lower innovation level) or it would be too costly and timeconsuming to make a patent application, especially this might be the case for SMEs or for individuals.

One alternative for making a patent application is to have it classified as a “Utility model”. The utility model protects a technical invention that fulfils the criteria of novelty, invention and application, but the invention is more broadly defined than what is needed for a patent. The requirements regarding novelty differ from country to country.

A utility model is an exclusive right granted for an invention, which allows the right

holder to prevent others from commercially using the protected invention, without his authorization, for a limited period of time. In its basic definition, which may vary from one country (where such protection is available) to another, a utility model is similar to a patent. In fact, utility models are sometimes referred to as "petty patents" or "innovation patents.

To receive a utility model protection is much easier and means more or less a registration procedure. A national body examines the requirements of the application and if fulfilling the requirements it will be granted as a utility model.

The time compared to an application for a patent is considerably shortened, and the process might take half a year or even less. The protection of the rights to the utility model is shorter than for patents, in most nations it is about 10 years or less.

The utility model protection is valid only at a national level and so far not adopted in Europe, but the European Commission is working on the possibility of introducing it also at a European level.

8.2.4 TRADEMARK.

*A **trademark**, **trade mark**, or **trade-mark** is a distinctive sign or indicator, used by an individual, business organization, or other legal entity, to identify that the products or services with which the trademark appears originate from a unique source, and to distinguish its products or services from those of other entities.*

A trademark is different from copyrights and patents as it is a symbol or name or combination of name and symbol regarding a special product or service to make it well known and to differ from other similar products and services. A trademark can be registered or it can also be protected through the use of it so that a big part of the target group knows about it.

No one will then be able to use the trademark or a trademark which is very close in its design. The trademark does not include a time limit even though it should be registered again every ten year. But it could be repeated as many times as feasible.

All types of trademarks, of a product or others, should be possible to produce in graphical form. A question which has been much discussed is whether a sound could be registered as atrademark, and a decision has now been made meaning it can if following some basic rules. Trademarks could be registered in more than one country.

The use of trademarks is very important to all types of products and services, even if it not registered. Most companies but also organizations, associations and schools etc. use their trademarks at all time in their communication. The application of a European wide trademark covering all European countries could be made through the Office of Harmonization for the Internal Market (OHIM) located in Alicante.

8.2.5 INDUSTRIAL DESIGN.

Industrial design is the use of a combination of applied art and applied science to improve the aesthetics, ergonomics, and usability of a product, but it may also be used to improve the product's marketability and production. The role of an industrial designer is to create and execute design solutions for problems of form, usability, physical ergonomics, marketing, brand development, and sales.

An industrial design is the ornamental or aesthetic aspect of an article. The design may consist of three-dimensional features, such as the shape or surface of an article, or of two dimensional features, such as patterns, lines or color. Industrial designs are applied to a wide variety of products of industry and handicraft: from technical and medical instruments to

watches, jewelry, and other luxury items; from house wares and electrical appliances to vehicles and architectural structures; from textile designs to leisure goods.

New products and processes – innovations – are often results of R&D – Research and Development activities. These inventions are, as mentioned, protected through patenting.

The development of new products could also be build upon the invention of new forms often mentioned as "design". It could be on an esthetical basis but also on the usability of the product depending on a certain design. The legislation concerning design is to protect the design of a product. As in the case of copyright this will be given to the designer and it will not be allowed for others to use the new design in their products.

Industrial design rights in the European Union are provided at both the Community level by virtue of the Community design and at the national level under individual national laws.

Registered Community design (RCD) is valid in all EU Member States, and the registration procedure of such a design is carried out by the Office for Harmonisation in the Internal Market (OHIM) with headquarters in Alicante, Spain. An RCD is valid in the European Union as a whole and it is not possible to limit the geographical scope of protection only to certain Member States.

The protection could be done at a national level or at European level through the Office of Harmonization for the Internal Market (OHIM).

TOPIC 9. SUSTAINABLE INNOVATION

9.1. SUSTAINABILITY.

One of the most long-term challenges that the world faces is sustainable development.

However, sustainable development is a difficult concept to define, which is continually evolving. One of the most used definitions referred to sustainable development can be found below.

Sustainability *refers to* ***(a)*** *use of the biosphere by present generations while maintaining its potential yield (benefit) for future generations and* ***(b)*** *non declining trends of economic growth and development that might be impaired by natural resource depletion and enviromental degradation.*

United Nations, 1997

Therefore, sustainable development and sustainability involves the conservation of natural resources for future growth and development. The main aim of sustainable development is to improve the quality of life of the people (at local and global level), while ensuring the feasibility of the environment and natural systems upon which all life is based.

But in general terms, we can consider that sustainable development has three key components. In the *World Summit on Sustainable Development in Johannesbourg* in 2002, these three aspects were named as the three pillars of sustainable development: **environment**, **society** and **economy**. Welfare is interdependent on these three categories, which are strongly linked among them. The viability and long-term economic growth depends on a rational and sustainable use of natural resources, as well as on the preservation of the environment. Furthermore, social welfare needs long term sustainability at economic and environmental level.

Figure 9.1. Components of sustainability

9.1.1. THE SUSTAINABLE ENTERPRISE.

The sustainable enterprise supports sustainable development by providing at the same time economic, social, and environmental benefits. The company's responsibility should be focused to both stakeholders and shareholders. "Stakeholders" are defined as anyone who is influenced, either directly or indirectly, by the actions of the firm.

According to this point of view, the business entity should be used as a vehicle for coordinating stakeholder interests, and not only maximizing owner profit. At the end the organisation should be able to ensure financial benefits for the company, conservation of natural resources and respect to the environment, and social advantages for employees and local community.

9.1.2. THE RIO DECLARATION.

The Rio Declaration on Environment and Development (United Nations, 1992), enhanced the definition of sustainable development with the establishment of 18 principles of sustainability.

As is stated in the Human Development approach, and the main international organizations in the field of the development recognize (United Nations, World Bank...), development is more than economic growth. Regarding to this, to be sustainable, economic development:

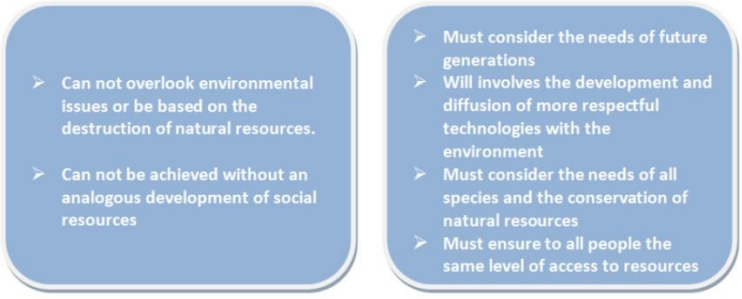


Figure 9.2. *Rio Declaration - Economic development*

9.2. INNOVATION AND SUSTAINABILITY.

There is a strong connection between the sustainability of the companies and the sustainability of the system where they develop their activity. A more sustainable model of development depends on the contributions and doings of the enterprises. Moreover, the viability of the companies in the long term is significantly related to the incorporation of sustainability criteria to their management, strategy and business model.

Besides this, the future of the companies is also strongly linked with their ability and capability to innovate. Innovation represents an effective way to achieve strategic goals (as i.e. to develop competitive vantages).

Both innovation and sustainability suppose a new way to manage and carry out the activity and the philosophy of companies. Innovation demands more competences than those oriented to improve products and processes. Innovation involves creativity and initiative, experimentation, knowledge dissemination, collaboration among co-workers, etc.

Sustainability involves the development of strategies and business models able to obtain results on the economic, environmental and social fields. Sustainability is not an obligation or legal requirement, but a challenge that offers several opportunities to the organisations.

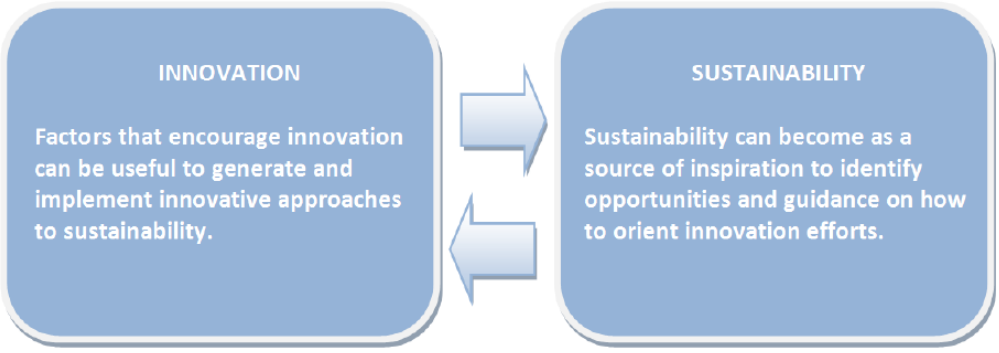


Figure 9.3. *Connection between Innovation and Sustainability*

9.2.1. GOALS AND CHALLENGES FOR SUSTAINABLE INNOVATION.

The main goals and challenges of sustainable innovation are the following:

- To fill market gaps, through the development of technologies, processes, products or services which take in account the need of the future generations and which are oriented to sustainable development.
- To carry out a transition in the technological and managing fields, focused on the incorporation of competitive sustainable approaches to the organisation activity, objectives and strategy.
- To improve resource efficiency and low consumption, as well as to extend the use of lean technologies.
- To promote a culture of innovation based on sustainability and develop the necessary skills and competences to adapt the activity of the organisation to sustainable criteria.
- Give solutions to global challenges such as renewable energy sources, health and an aging population or how to increase the participation of youth in the labour market and society.
- To promote the digital society in the development of enterprises and citizens.

9.2.2. SUSTAINABLE VALUE.

Sustainability adds a new framework to guide innovation efforts in order to create "sustainable value". Organizations needs to combine the present and the future as well as internal and external aspects related to the company. In this sense, companies must manage the current business for short term results and, in turn, create the technologies and tomorrow's markets to generate expectations of future growth. Additionally, they must be able to address domestic issues, for example, process improvement or development of certain skills while addressing external issues such as the satisfaction of stakeholders and identifying new business opportunities.

In this context success means to differentiate from competitors through developing a business model that will create value, and to appropriate a portion of it in a way accepted by the markets and the "business" environment. That success is based on the ownership, management and development of some resources and capabilities complying with basically three premises:

- They must be valuable,
- difficult to imitate and
- hard to replace.

Development of resources and capacities based on the establishment of new relationships with stakeholders will be an important asset to take in account. Internalize implications of sustainable development does not necessary lead to develop valuable resources and capabilities. But it is unquestionable that society is moving in the direction of requiring to the companies more sustainable behavior. All the technologies, capabilities and products (or services) are likely to be imitated or acquired before or after by our competitors. However this will be more difficult when these resources or capabilities are difficult to formalize, or when their development depends on the know-how and learning of the company, or when their construction were socially complex by involving many people inside and outside the company.

Sustainable value framework

As Hart & Milstein defines, there are 4thkey dimensions for the creation of sustainable value, with associated business strategies, challenges and opportunities. They represents this framework as follows:

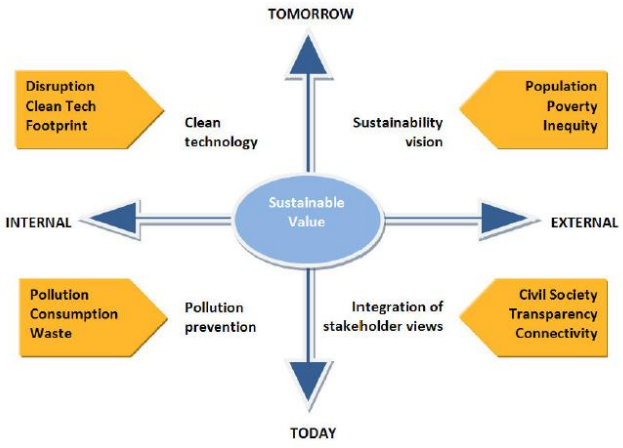


Figure 9.4. *Creating sustainable value*

Source: Hart, L.S. & Milstein, M.B. (2003): "Creating sustainable value", *Academie of Management Executive,* 2003 Vol.17 No.2.

Companies should be able to address domestic issues, for example, process improvement or development of certain skills while addressing external issues such as the satisfaction of stakeholders and identifying new business opportunities.

9.3. ECO-INNOVATION.

The idea of environmental innovation or eco-innovation is relatively recent, and it is referred to those innovations, products or processes that contributes to sustainable development.

Although there is no generally accepted definition of eco-innovation it can be defined as:

Eco-innovative products, techniques, services or processes which aim at the prevention or the reduction of environmental impacts or which contribute to the optimal use of resources *relevant alternatives.*

European Commision

However it should be noted that the scope of eco-innovation may go beyond the conventionalorganisational boundaries of the innovating organisation and involve broader social arrangements that trigger changes in existing socio-cultural norms and institutional structures (OECD, 2009)

Some companies and other private and public organisations have started to use environmental (eco-) innovation referred to the contributions of business to sustainable development, as well as complementary way to improve competitiveness. In this context ecoinnovation could be defined as those innovative processes that produce a reduction of environmental impact and optimising the use of resources, indepently of the intentionality or not of that effect. When a new process is more efficient in the use of resources than other can be considered as an eco-innovation.

At the end, eco-innovation aims to promote the introduction of advanced technologies and sustainable approaches (including the non-technological ones). Besides this, the concept of environmental innovation entails new opportunities in the organisations, involving new stakeholders, activities and business and increasing the competitiveness. Thus, ecoinnovation will be the key component to carry out the structural change that it will be demanded in economic, social and environmental field in the next years.

9.3.1. ECO-INNOVATIVE ORGANISATIONS.

As the same way we can define the concept of eco-innovation, it is possible to characterize the companies or organizations that develop and apply this approach in their daily activity.

The European Commission, Eurostat and OECD defines Eco-industries as follows:

Eco industries *are those which produce goods and services to measure, prevent, limit, minimize or correct environmental damage to water, air and soil, as well as problems related to waste, noise and eco-systems. This includes technologies, products and services that reduce environmental risk and minimize pollution and resources.*

European Commission (2006)

Eco-innovators are those organizations or companies able to adopt processes, technologies, management systems, products or services which produce environmental benefits. Furthermore, we can divide these organizations in different categories, attending to how they introduce the environmental or sustainable innovations:

- **Strategic eco-innovators**: *active in eco-equipment & services sectors, develop ecoinnovations for sale to other firms.*
- **Strategic eco-adopters**: *intentionally implement eco-innovations, either developed inhouse, acquired from other firms, or both.*
- **Passive eco-innovators:** process, organizational, product innovations etc that result in environmental benefits, but where is no specific strategy to eco-innovate.
- **Non eco-innovators:** no activities for either intentional or unintended innovations with environmental benefits.

Source: MEI (Measuring eco-Innovation) project financed by the European Commission in under the 6th R&D Framework program Thematic Priority: Call FP6-2005-SSP-5A

Nokia, Eco-innovation in the last 10 years:
http://www.youtube.com/watch?v=ylAr03ePuIc

9.3.2. TYPOLOGY OF ECO-INNOVATIONS.

It should be noted than in an eco-innovation approach is especially important to be focused not only in a single product, process or solution, but in the whole value chain of the organisation, from the original conception of the innovation to the overall result and the appraisal of the final customer.

We can distinguish three main types of eco-innovation:

Products and processes

A **product innovation** is the implementation of a product or service with improved performance characteristics such as to deliver objectively new or improved services to the consumer.

OECD, Oslo Manual (2005)

Product eco-innovation refers to those products or services which their impact on the environment it is optimised during their production process. Products refers to both goods (with a different nature) and services such as new public mobility schemes or environmental services (i.e. waste management).

A **process innovation** is the implementation/adoption of new or significantly improved production or delivery methods. It may involve changes in equipment, human resources, working methods or a combination of these.

OECD, Oslo Manual (2005)

One of the main eco-innovation processes is the development and implementation of clean technologies (or environmental technologies as well). Some examples of these technologies are waste water treatment technologies, water supply, noise and vibration control, green energy technologies, etc.

Innovative eco products in Japan: http://www.youtube.com/watch?v=gGp540bIUuc&feature=related

Organisational

An **organizational innovation** includes the introduction of significantly changed organizational structures, the implementation of advanced management techniques, the implementation of new or substantially changed corporate strategic orientations.

OECD, Oslo Manual (2005)

From an organizational view, eco-innovations involves the development of formal environmental management systems (EMS) and audit systems, chain management and chain management cooperation between organizations, pollution prevention schemes, etc. Some examples management and audit tools or solutions are EMAS and ISO 1400 family standards.

Marketing

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.

OECD, Oslo Manual (2005)

Marketing innovation may include preliminary market research, market tests and launch advertising. The activities of market innovation must include an environmental approach, taking in account green aspects in the product promotion, packaging, placement or pricing (i.e. eco-labelling).

9.3.3. ECO-INNOVATION MECHANISMS

Eco-innovation mechanisms are the way on how the organizations make changes to achieve innovations in product and processes, organizational and marketing areas through different alternatives:

Figure 9.5. *Sustainable Manufacturing and Eco-innovation: Towards a Green Economy*
Source: OECD (2009): "Sustainable Manufacturing and Eco-innovation: Towards a Green Economy", *Policy Brief*, June 2009.

9.3.4. ECO-INNOVATION BENEFITS.

Introduction of eco-innovation approaches can provide several benefits to the organizations and companies that have carried out their implementation. These benefits can be defined in terms of the three pillars of the sustainable development: social, economic and environmental.

Economic benefits

• Optimization of production costs through a more efficient use of resources and inputs.

• Reduction in the costs of waste management.

• Minimization of process and organizational costs.

• Development of a green image.

• New products and market gaps.

• Competitiveness benefits.

Environmental

• More efficient use of resources.

• Minimize the use of non renewable resources.

• Reduction of pollutant emissions.

• Reduction of waste production.

• Contribute to the sustainable development of your city/area.

Social

• Generation of green employments.

• Cleaner, healthier and natural working environment.

• Supporting sustainable social development.

TOPIC 10.
EVALUATION METHOD OF THE INNOVATION PROJECT EFFICIENCY

10.1. A NEED FOR A COMPLETE SYSTEM OF INDEXES TO EVALUATE THE EFFICIENCY OF A NEW PRODUCT DEVELOPMENT PROJECT.

The financial evaluation of innovation project efficiency is a very useful tool for the manager's decisions referring to selecting and continuing a project. But only this criterion is not sufficient to take an optimum decision because a large majority of these projects are influenced by qualitative criteria.

The evaluation criteria used for the innovation projects are very diverse depending on some factors: the project's essential characteristics, the evaluation's goal, the moment when the evaluation takes place and the main features of the enterprise and of the industrial area of activity.

There were many attempts of configuring an evaluation criteria system that suit a large number of innovation projects. Certainly, the evaluation has to include both *quantitative* and *qualitative criteria*, and the number of criteria must be sufficiently great to allow an objective appreciation upon the project's viability.

Due to the fact that the evaluation process of the innovation projects is very dynamic, the nature and the importance of the evaluation criteria are very diverse depending on the stage of the project.

For a pertinent evaluation of innovation project efficiency it is very important to elaborate a **complex system of indexes**. That system must have an optimum number of indexes because a large number of indexes determine increased difficulties in the decision process. Some of those indexes are based on a quantitative evaluation, but others imply a qualitative evaluation, so that, for a comprehensive evaluation of an innovation project, it must be assured the compatibility between all those indexes.

An objective evaluation of efficiency for an innovation project must be based on a complete system of indexes, consisting of indexes for the performance of the elaboration phase and also for performance of the running phase of the project. Also, it must be considered that the different stages activities of the project's economic lifetime contribute in different ways to the final project success. Thus, in the elaboration stage, the critical success factors depends on research & development activities while in the exploitation stage the performances mostly depends on integration degree between research & development activities and other activities of the enterprise.

In this context, a complete system of indexes for evaluating the efficiency of an

innovation project must approach at least the following *perspectives*:

1) *The financial performances of the project* – reflects the capacity of future incomes to cover the investment and exploitation costs of the project;

2) *The project's value*;

3) *The technical performances of the project* – influences the consumer's satisfaction degree and, consequently, the volume of the project future incomes;

4) *The efficiency of research and development activities of the project* – determines the amount of cash outflows in the project elaboration stage;

5) *The capacity of fitting in the estimated cost and duration of activities* – influences the amount of the project future incomes;

6) *The degree of integration between the research & development and production activities* – determines the production cost level of the new products;

7) *The degree of integration between the research & development and marketing activities* – influences the amount of the project future incomes.

The *first two approaching perspectives* offer a global vision about the project, referring to efficiency of all activities, starting with elaboration stage and finishing with the exploitation stage of the innovation project. The *next three perspectives* refer especially to the efficiency of the elaboration stage activities and the *last two perspectives* reflect the integration degree between research & development activities and other activities of the enterprise.

10.2. THE EVALUATION OF THE FINANCIAL PERFORMANCE OF THE INNOVATIVE PROJECT AND IT'S VALUE

The evaluation of the **financial performance of the project** must consider the following economic figures:

1) Method of Net Present Value, *NPV*.

Present Value (*PV*) is a formula used in Finance that calculates the present day value of an amount that is received at a future date.

$$\mathrm{PV} = \frac{C_1}{(1+r)^{\mathrm{n}}}, \tag{10.1}$$

Where:

C_1 – Cash Flow at period 1;

r – Discount Rate;

n – number of periods.

Time value of money is the concept that receiving something today is worth more than receiving the same item at a future date. The presumption is that it is preferable to receive $100 today than it is to receive the same amount one year from today, but what if the choice is between $100 present day or $106 a year from today? A formula is needed to provide a quantifiable comparison between an amount today and an amount at a future time, in terms of its present day value.

Net Present Value (*NPV*) is a formula used to determine the present value of an investment by the discounted sum of all cash flows received from the project.

$$\mathrm{NPV} = \sum_{i=1}^{\mathrm{T}} \frac{C_i}{(1+r)^n} - \sum_{i=1}^{\mathrm{T}} \frac{IC_i}{(1+r)^n}, \tag{10.2}$$

Where:

C_i – Cash Flow by years;

r – Discount Rate;

IC_i – Initial Investments over the years;

n – the consecutive years of financial resources investment;

T – the number of years of getting a profit from investments.

Or, if the output investments are one-time:

$$\text{NPV} = -IC + \sum_{i=1}^{\text{T}} \frac{C_i}{(1+r)^n} \tag{10.3}$$

When a company or investor takes on a project or investment, it is important to calculate an estimate of how profitable the project or investment will be. In the formula, the – *IC* is the initial investment, which is a negative cash flow showing that money is going out as opposed to coming in.

The formula for the discounted sum of all cash flows can be rewritten as

$$\text{NPV} = -IC + \frac{C_1}{(1+r)^1} + \frac{C_2}{(1+r)^2} + \ldots + \frac{C_{\text{T}}}{(1+r)^{\text{n}}} \tag{10.4}$$

If *NPV*> 0, then the project should be accepted. The owner receives profit.

If *NPV* <0, then the project should be rejected. The owner will have losses.

If *NPV* = 0, then the project is neither profitable nor unprofitable.

Cash flow for the project comes not only at the end or beginning of the year, but may be distributed by month, decades, days and other sub-periods. To determine the *NPV* of the project suggest that payments on the project are received at the end of each sub-period equal amounts. Then, *NPV* during the accounting period *i* years will be:

$$NPV = C \cdot \frac{\left(1+\frac{r}{t}\right)^{tn} - 1}{r \cdot \left(1+\frac{r}{t}\right)^{tn}} - IC \tag{10.5}$$

2) Method of Profitability Index, *PI*.

This index is an addition to *NPV*.

$$\text{PI} = \frac{\sum_{i=1}^{\text{T}} \frac{C_i}{(1+r)^n}}{\text{IC}} \tag{10.6}$$

If *PI*>1, then the project should be accepted.

If *PI*<1, then the project should be rejected.

If *PI*=1, then the project is neither profitable nor unprofitable.

Project profitability index shows the amount of income (asset growth) of the project on monetary unit of investments and the amount of net profit.

3) Method of Internal Rate of Return, *IRR*.

This index is the discount rate when the amount of revenue resulted from the project equal to the initial investment (spending). Assessment of projects with *IRR* is based on determining the maximum amount of the discount rate (*IRR* = *r*), at which the project will be breakeven (*NPV*=0).

$$\sum_{i=1}^{T} \frac{C_i}{(1+IRR)^n} - IC = 0 \qquad (10.7)$$

If the project will be financed entirely by loans of commercial banks, then value of ***IRR*** indicates the upper limit of the allowable level of bank interest rate above which the project becomes unprofitable.

4) Methods of Payback Period, *PP* and Discounted Payback period, *DPP*

The method is aimed at defining the period of investment return. Algorithm for calculating the payback period depends on the uniformity of the distribution of predicted income from investments:

a) if the income is distributed evenly by year

$$PP = \frac{IC}{PC'}, \qquad (10.8)$$

Where:

PC' is average annual profit margins;

b) if the income is distributed unevenly: Index of discounted return period takes into account time factor and it is needed the discounting.

Always *DPP* > *PP*, because the process of discounting is used.

The **project's value** may be expressed by a performance index which is based on qualitative criteria of evaluation. The performance index is a useful tool that can be applied for innovation project's evaluation while other complex methods imply increased costs and longer project duration. A major advantage is that this index allows including both economic and extra-economic criteria. More than that, the performance index considers the different importance of the criteria depending on the nature of the project and specific conditions.

10.3. THE EVALUATION OF THE TECHNICAL PERFORMANCE OF THE INNOVATIVE PROJECT.

The technical performance index reflects the technical progress level, measured like difference between the current and the previous technical performances of a product, process or technology. If the project is technically a success, the current technical performances of the new product or process represents an improve comparing to the previous products or processes. This improvement is due to the innovation process.

The technical progress level of the innovation project can be compared with the competitor's technical performances, with the forecasted technical performances of the

project, or with the technical performances of a similar previous project.

The technical performances of the innovation project can be expressed by the key technical parameters of the new product, process or technology. The technical performance objectives reflect, usually, the consumer's perception about the success of product technical performance level.

The technical performance level of an innovation project is given by the relation:

$$P_{tec} = \frac{P_{tec}^{e} - P_{tec}^{i}}{P_{tec}^{p} - P_{tec}^{i}}, \tag{10.9}$$

Where:

P_{tec} is the technical performance level of the innovation project;

P_{tec}^{e} is the effective (current) level of the innovation project technical performance;

P_{tec}^{i} is the initial (previous) level of the innovation project technical performance;

P_{tec}^{p} is the forecasted (planned) level of the innovation project technical performance.

10.4. THE EFFICIENCY OF RESEARCH AND DEVELOPMENT ACTIVITIES OF THE PROJECT.

The efficiency of research and development activities of the project measures the intensity of technical success obtained by the consumed resources (cost or time). It can be quantified with two indexes:

1) the *research & development productivity* calculated based on the consummated resources cost (p_{CD}^{C}), with the relation:

$$p_{RD}^{C} = \frac{P_{tec}}{C}, \tag{10.10}$$

where C is the consummated resources cost to obtain the required technical performances.

2) the *research & development productivity* calculated based on the effective duration of activities (p_{RD}^{T}), with the relation:

$$p_{RD}^{T} = \frac{P_{tec}}{T}, \tag{10.11}$$

in which T is the effective duration to obtain the required technical performances.

10.5. THE CAPACITY OF FITTING IN THE ESTIMATED COST AND DURATION OF ACTIVITIES.

The capacity of fitting in the estimated cost and duration of activities will be expressed by two indexes:

1) the cost index will show the difference between the current cost and the estimated cost of the developed activities, given by the relation:

$$\Delta C = C^p - C^e, \tag{10.12}$$

Where:

ΔC is the deviation of effective cost from the estimated cost;

C^p is the estimated (planned) amount of cumulated cost for all activities;

C^e is the effective amount of cumulated cost for all activities.

2) the time index will show the difference between the effective duration and the planned duration of the developed activities, calculated by the relation:

$$\Delta D = D^p - D^e, \tag{10.13}$$

Where:

ΔD is the deviation of effective duration of activities from the estimated duration;

D^p is the estimated (planned) duration for all activities;

D^e is the effective duration for all activities.

10.6. THE DEGREE OF INTEGRATION BETWEEN THE RESEARCH & DEVELOPMENT AND PRODUCTION ACTIVITIES.

The degree of integration between the research & development and production activities relieves the efficiency of information exchange between research & development department and production department. It can be expressed by indexes like: the time to market, the number of redesigns or the average time of redesigns.

The time to market index represents the total time needed for elaboration of a new product, service or technology from the initial project stage to the launch on the market.

The total duration is given by the sum of the duration of each stage, according with the relation:

$$d_e = d_c + d_{pr} + d_{s0} + d_l, \tag{10.14}$$

In which:

d_e is the total elaboration time of the new product, service or technology (time to market);

d_c represents the duration of concept elaboration;

d_{pr} is the projecting duration of the new product, service or technology;

d_{s0} represents the duration of zero series production;

d_l is the duration of the launch on the market of the new product, service or technology.

The redesigns number of the new product, service or technology denoted N_{rp} is another index of integration degree between the research & development and production activities.

A large number of redesigns relieve a low integration degree. Optimum situation is given by a small number of redesigns with a short time to market. This index is linked with another one, the medium duration of a redesign ($\overline{d_{pr}}$). If that duration is large, the time to market is longer than estimated duration and the innovation project takes too much time.

The last index of integration degree between the research & development and production activities is the design efficiency based on production cost of the new product, service or technology (C_p) and manufacturing and testing possibilities of the enterprise referring to the new product, service or technology. For that purposes could be used method of Break-Even Point Analysis.

The method essence consists in determining the critical volume of sales at which revenues from sales is equal to costs, that is, the sales volume, after which the company will begin to make a profit.

$$X_{bep} = \frac{A}{V - VC}, \quad (10.15)$$

Where:

A – the fixed costs, the value of which does not depend on changes in the volume of sales in the relevant period;

V – the unit price;

VC – the variable cost per product unit.

In this method it is necessary to compare the predicted sales of goods (services) with critical sales. It enables to develop measures to expand the markets.

10.7. THE DEGREE OF INTEGRATION BETWEEN THE RESEARCH & DEVELOPMENT AND MARKETING ACTIVITIES.

The degree of integration between the research & development and marketing activities reflects the efficiency of relationship between those two departments and can be expressed with the following indexes:

1) the contribution of the new product, service or technology to the turnover growth ($P_{\Delta CA}$), given by the relation:

$$P_{\Delta CA} = \frac{CA_p}{\Delta CA}, \quad (10.16)$$

Where:

CA_p is the turnover obtained based on the new product, service or technology;

ΔCA is the growth of the enterprise's total turnover after the launch of the new product, service or technology;

2) the relative contribution of the new product, service or technology to the turnover growth of the portfolio of products (P_{CAg}), calculated with the relation:

$$P_{CAg} = \frac{CA_p}{CA_g}, \quad (10.17)$$

Where:

CA_p is the turnover obtained based on the new product, service or technology;

CA_g is the portfolio turnover after the launch of the new product, service or technology;

3) the contribution of the new product, service or technology to the profit growth ($P_{\Delta p}$), given by the relation:

$$P_{\Delta p} = \frac{PE_p}{\Delta PE}, \quad (10.18)$$

Where:

PE_p is the exploitation profit bring by the new product, service or technology;

ΔPE is the growth of the total exploitation profit after the launch of the new product, service or technology;

4) the relative contribution of the new product, service or technology to the profit growth of the portfolio of products (P_{Pg}), calculated with the relation:

$$P_{Pg} = \frac{PE_p}{PE_g}, \quad (10.19)$$

Where:

PE_p is the exploitation profit bring by the new product, service or technology;

PE_g is the portfolio exploitation profit after the launch of the new product, service or technology;

5) the accomplish degree with the consumer's needs of the new product, service or technology is determined by product quality features.

Each of the presented indexes is an evaluation criterion of the innovation project global efficiency. The indexes number in the evaluation system can vary in each particular case. In certain situations, can be introduced some specific indexes needed by the innovation project features. In another situation, if the concrete conditions and known data require, some indexes can be removed from the evaluation system.

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