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Training handbook for SMEs and Start-ups/Entrepreneurs

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Innovation management & Transnational partnership

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INTRODUCTION

The training handbook you are holding in your hands is one of the out outputs of the Coordination & Support Action project *FP7-INCO-2013-9 R2I-ENP, project no. 609531 – "Knowledge Transfer Community to bridge the gap between research, innovation and business creation" - acronym NoGAP*, coordinated by Steinbeis-Europa-Zentrum of Steinbeis Innovation gGmbH, Germany, in which 13 partners from 6 European countries are cooperating to help foster innovation and technology transfer throughout the European Union and the Eastern Partnership.

The Technical University of Cluj-Napoca, through the Danube Innovation and Technology Transfer Centre, together with the National Technical University of Ukraine, Kyiv Polytechnic Institute, the Union of Slovak Clusters and Steinbeis-Europa-Zentrum have cooperated within this project to develop 3 training handbooks aimed at the three main target groups involved in the process of knowledge creation and valuation: the researchers, the companies (mostly SMEs, start-ups and entrepreneurs) and the information multiplicators. Based on these handbooks, trainings will be delivered in each of the countries of the Eastern Partnership to help in spreading a culture of cooperation among these entities in order to better serve the social and economic development, especially related to the societal challenge "secure, clean and efficient energy".

The training handbook aimed at SMEs, start-ups and entrepreneurs presents the most important issues related to Innovation management and Transnational partnership, which are considered as keys in "bridging the gap" that currently exists between the scientific contributions and business opportunities connected to the field of renewable energy. The handbook has strong interactive and practical features that will make it more impactful upon delivery to the participants. Its structure includes 5 chapters, as well as an Introduction, a Glossary and the References section.

Chapter 1 includes a short overview of the main motivations and trends that exist related to innovation in companies, as well as an introduction to the basic concepts of the field. A large portion of the chapter is dedicated to an interactive questionnaire that will be used in the actual trainings for assessing the organizational innovation potential and creativity level within a company. Based on the participant's feedback, a discussion and debated concerning innovation management will help the trainees gain their own perspective on the topic.

Chapter 2 discusses some of the current models that the specialty literature presents related to actually stimulating, managing and valuating innovation management in firms. Besides presenting the way these models are structured and work, the chapter brings some important clarifications in understanding the relationship between improvements and innovations. Moreover, a sub-chapter is dedicated to implementing innovation management in companies through projects.

Chapter 3 is a very practical one and presents a package of the most important tools used in the field of innovation and new product development for conducting successful deployments. These includes methods for discovering and understanding requirements (e.g. brainstorming, voice of the customer, Kano analysis), methods for processing requirements and establishing product or service characteristics (Quality Function

Deployment), as well as methods for deciding upon implementation solutions (Pugh's New concept selection method). A complete example, going through all the stages of an innovation project, is presented with focus on the renewable energy sector.

Chapter 4 presents and introduction to the topic of Transnational partnership, that will help (the small) companies in tackling the challenges in starting to "think big" in terms of scope, impact and collaboration networks.

The authors and trainers wish to express their thanks to all the project partners and to everybody that has contributed to this training handbook. It is our hope that, in a small part, all of our actions here will contribute to a better future.

The authors and the trainers

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Chapter 1

Basics of innovation

In this new economic context in which we find ourselves during this period of the 21st century, a period in which economy is already global, the practice of innovation has become critical in achieving success in any endeavor. In this new stage of the world economy, the evolution of society is impacted by great advances in ownership and distribution of information and knowledge, as well as by continuous need for the management of change.

The need for innovation

Innovation has an important role because it can restructure, refocus and harmonize companies and countries with the new requirements of the economy, by enabling them to achieve durable competitive advantages. Innovation represents the means through which creativity is valorized on the market. The development and deployment of innovative products and services has to constitute the main objective of any company, because through them the company will increase its level of competitiveness.

It can be asserted that in a globalized market, innovation is the engine of economic growth and development of kind of entity. By harnessing creativity and development and incorporating these two into existing products and services, consumer demands are satisfied, and new market segments are created.

In terms of tools of innovation and economic cycles, characterized by technical-scientific developments, (Christensen 2003) makes a differentiation between the adoptions of innovations related to customer requirements: "disruptive innovation" and "support innovation". Support innovation is correlated with consumer demands, having as objective the improvement of existing products and services. Disruptive innovation generates improvements far above expectations, thus creating new markets instead of seizing existing ones.

A series of management models were created in the course of time, oriented towards innovation, which attempted to develop principles, stages and processes by which ideas become innovation within an organization. Also, a series of authors have proposed

models for catalyzing and monitoring this type of activity so that its yield can become more impactful. A careful management process involves identifying innovational preceding stages, as well as factors influencing the planning stages, implementation, monitoring and analysis (see Figure 1.1 for such an example).

FIGURE 1.1 Innovation process

(Carpenter, Model for Employee Innovation: Amazon Prime Case Study 2010)

New economic and social realities require the development of products and services to fully satisfy consumer demands, which have become more complex and more numerous over time. Innovation is one of the possibilities to redefine everything that currently exists both as a principle or concept, or model, form and structure. The innovation process constitutes a method to harness and put to use human creativity. As such, it can veer of target sometimes and uncertainty about its results should be considered intrinsic (Figure 1.2).

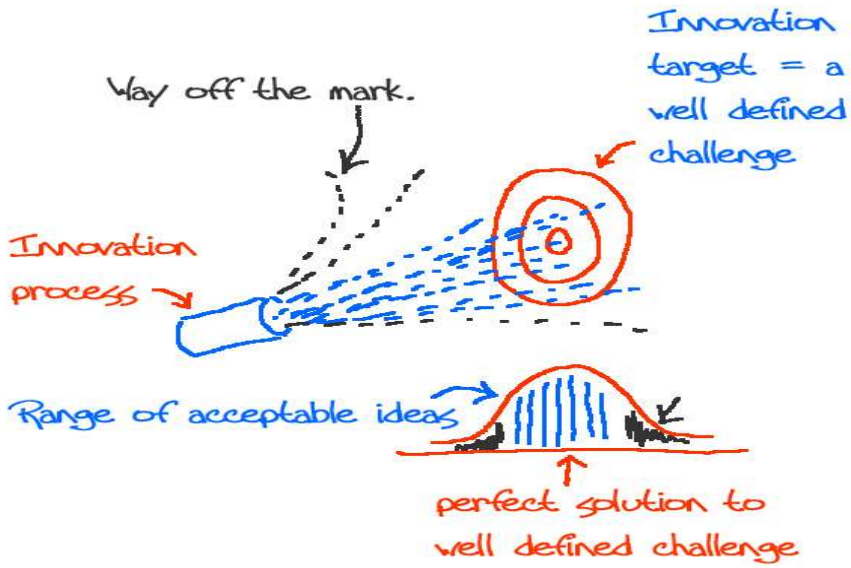


FIGURE 1.2 Need for innovation

(Abott 2009)

Creative ideas have to be put into practice, as this type of resource is inexhaustible and it is inside any organization, but it must be harnessed in order to obtain beneficial results on the long term. Each economic actor, company, institution, organization or state has the ability to innovate, however to enjoy the benefits of innovation a series of investments have to be made. The importance of the proper working environment must not be overlooked, which is conducive and stimulative to employee creativity.

Innovation has become a key for survival and development at the same time for institutions, companies and states since the rules of the market are changing according to the customer's needs. The new markets, with a strong tendency towards globalization, change the rules at an accelerating rate, so for obtaining the ownership of competitive advantage serious investments into research must be made just to be able to supply innovation results towards the market.

Another important aspect is the fact that the process of innovation, regardless if it is a physical product or service, must become a continuous, iterative one. No company will be able to resist over time without continuously innovating its market offer. As for any innovator in any market sector, it will not take long before competitors figure out how to integrate innovation themselves into their own products and the innovative company in question loses its competitive advantage.

The substitution of resources, whether human, financial, material or informational can contribute for maintaining the organizations success in the economic markets as an important actor. This highlights once again the need for innovation.

Concepts and definitions, characteristics

In a broad sense, innovation is seen as the process by which value is achieved through creativity. In this sense, the specialized literature presents several definitions, all of which can be summarized to a central idea, that innovation is something "new", that does not have a history or a previous version. Defining the theoretical knowledge and the information, products, services and processes, which can be used practically, constitute the essence of innovation.

According to the Austrian scientist J. Schumpeter, in his work "Theory of economic development" innovation is:

> "The totality of changes aimed at implementation and use of new types of products, means of production and transport, markets and forms of organization of production process".

Another definition which accentuates the importance of innovation in the framework of economic activities, is given by Peter Drucker; he relates to innovation as "a tool of an enterprising manager, he explores the means by which the change as an opportunity for the various different services or businesses" (Brad 2006).

> "Successful innovation is the creation and implementation of new processes, products, services and methods of delivery which result in significant improvements in outcomes, efficiency, effectiveness or quality" (Eveleens 2010).

Relative to the above definitions, we can say that innovation is how a company can achieve growth, adjust and increase the level of competitiveness through specific mechanisms and processes. Innovation is the transformation of an idea into a concept, which serves as a tool to achieve the company's goals, making it more effective and efficient. Figure 1.3 depicts the most important conceptual linkages that can be established when researching the scope and content of this concept.

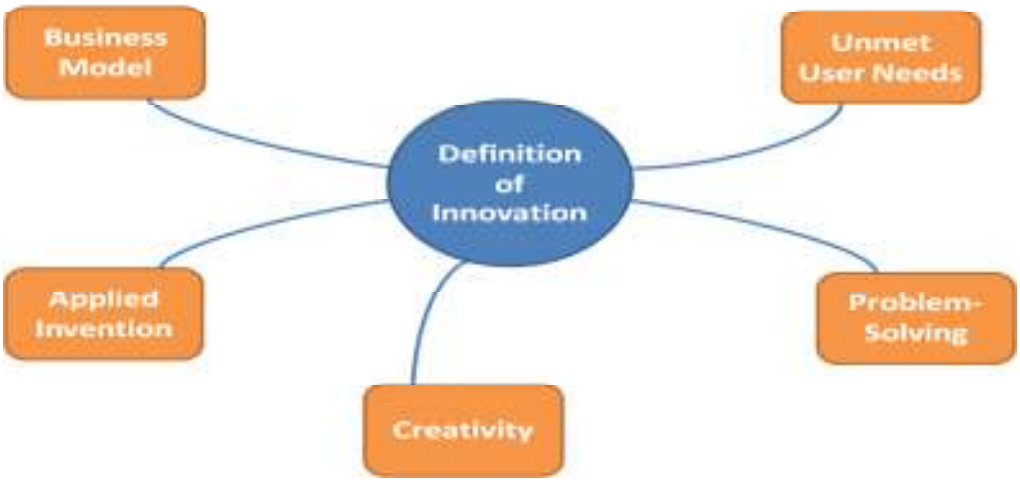


FIGURE 1.3 Definitions of innovation

(Carpenter 2010)

Out of the previous definitions according to the above cited authors we can extract a number of issues and concerns relating to innovation:

- ✓ the innovation is knowledge transformation into end products and services designed to meet consumer demands;
- ✓ innovation has the ability to create new markets;
- ✓ innovation is the result of a creative process;

- ✓ research and development activities may result in innovation.

The creational process represents one of the fundamental processes of innovation, because creativity is the trigger factor of an idea. Through this process, ideas are generated and can be implemented in various forms or strategies in a range of activities and areas. With the help of creativity most, if not all, of the problems which the organizations face can be solved. For this reason, the use of creative techniques as well as the maintenance of a favorable environment must constitute one of the basic priorities of organizations.

There are a multitude of definitions relating to creativity, but in essence it can be defined as follows:

> "creativity is a par human mental excellence process, which consists of combining an original form of knowledge gained through study, observation, experience (percepting existing elements) leading to a product, useful for society, in a certain amount of time" (Răbonţu 2010).

The verb "to create" means the capacity of each of us has to think about new things, that nobody has ever thought of before. In this sense, creativity is the engine of progress, improvement and innovation in all aspect of society and economy.

Essentially, in order to distill creativity into innovation, one must go through a sequence of cascading steps, increasingly taking into account the balance between potential benefits and existing constraints (see Figure 1.4).

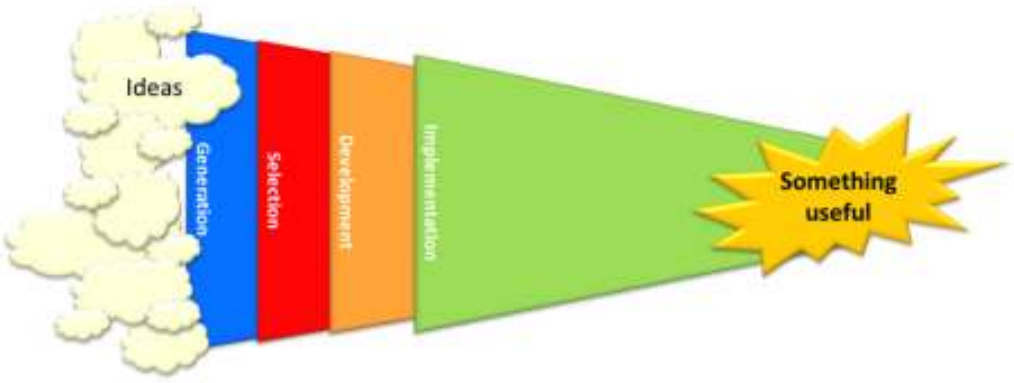


FIGURE 1.4 Creativity process

(FutureSME 2012)

Creativity can be utilized to obtain a new product for a company, if the proper environment is set. The creative act can take place spontaneously, however only a part

of the creative ideas come to be matured and put into practice, which can truly be used for taking advantage of new opportunities for growth and development.

Innovation types and trends

Specialized literature provides a number of classifications for innovation types; they vary depending on criteria such as purpose, achievement, impact on society/economy and the measurable progress. In the following, these types of innovations are presented, which are considered at as being the most important ones:

- ✓ product innovation;
- ✓ process innovation;
- ✓ system innovation.

Product innovation is one of the most widely used forms of innovation. It is preferred by most companies because it can be achieved based on either an idea, a product already on the market, or it is based on a radically new idea, a revolutionary concept, that changes the existing products on the market.

In terms of process innovation, this type of innovation refers to the internal components of an organization. Innovation on processes increases the yield and improves the efficiency of the organization by changes made to the production processes and the used management models. In this type of innovation, the processes undergo a number of changes, which can be total or partial, but the product remains the same or is subject only to some small changes, related to price, reliability, quality or presentation on the market.

Product innovation is preferred because it brings visible changes, immediately felt by businesses on the market. In contrast, process innovation is felt in time, and it brings a number of advantages in terms of market share, price and increased efficiency for the organization in question.

A system innovation includes activities that require significant resources (including information) from different fields and it also requires the involvement of governmental entities, academic environment, and other businesses and can stretch over long periods of time. In such a demarche, the entire business model can undergo major changes, leading to a different behavior towards many or all of the internal and external stakeholders (customers, employees, suppliers, etc.). This type of innovation has the obligation to comply with a number of regulations coming from governmental institutions, either cultural or social, because it faces considerable interface problems.

Assessing the organizational innovation potential and creativity level. Exercise.

Assessing the innovation potential and creativity level of the organizational climate (for small and medium-sized enterprises) in this case it is done through the eyes of the employees. These questions serve as a useful framework for top level management in establishing how important is innovation and creativity to employees, making them more self-conscious about these key concepts and which are the areas that could be improved by raising the awareness and cooperation.

I. GENERAL INFORMATION

1. Position of employee within the organization:

- ✓ ...
- ✓ ...
- ✓ ...
- ✓ ...

All types of positions, specific to the organization should be listed here, by the responsible, who conducts this assessment.

Department / Team in which the employee works:

- ✓ Management
- ✓ Human resources
- ✓ Acquisition and sales
- ✓ Production

Age:

- ✓ 18-25
- ✓ 26-35
- ✓ 36-43
- ✓ More than 44 years

Gender

- ✓ Male
- ✓ Female

II. INDIVIDUAL ASPECTS OF EMPLOYEES

	Very poor (-3)	Poorly (-1)	Fairly well (0)	Well (1)	Very well (3)
How do you handle challenges at work?					
How would you rate your completion of activities you were charged with at work?					
How committed are you to your work?					
How would you rate your enthusiast level regarding your work activities?					
How well do you integrate your previous experience into your activities at work?					
How do you rate your understanding about the importance of innovation and creativity?					
How well do you understand the importance of using creativity techniques?					
How do you consider that you include creativity in your day to day activities at work?					
At what level do you consider that you seize opportunities that include innovation at your workplace?					
How easily do you come up with innovative solutions for your workplace related problems?					
How motivated are you in finding the best creative and innovative solution to your problems?					
How well are you influenced by your colleagues' innovative solutions?					
How does time pressure influence your creativity at your workplace?					

How engaged are you in problems emerged at your workplace?					
How familiar are to you your organizations objectives and goals?					
How familiar is to you your organizations policy and procedures?					
How are you satisfied with your working environment (quiet, clean, friendly, safe, non-toxic)?					
How well are the procedures set by top management followed by you?					

III. GROUP DYNAMIC

	Very poor (-3)	Poorly (-1)	Fairly well (0)	Well (1)	Very well (3)
How do your colleagues think you integrate creativity in your activities at work?					
How well do your colleagues motivate you in coming up with creative solutions?					
How are your creative solutions rated by your colleagues?					
How well does your team support your creative or innovative endeavors?					
How would you rank your freedom to express ideas within the organization?					
How well does your organization tolerate diversity?					
How are you motivated to share your solutions with other team members?					
How are your creative and innovative ideas received by your team members?					
How would you rate your team members openness regarding communication?					

How well do you communicate and share ideas with colleagues outside your team/department?					
How well do your team members take into account suggestions/ ideas coming new members?					
How does your team react to external, but temporary individuals assigned to the team?					
How well are the procedures set by top management followed by your team?					
How is your team involved in solving problems on its own?					

IV. MANAGEMENT / LEADERSHIP

	Very poor (-3)	Poorly (-1)	Fairly well (0)	Well (1)	Very well (3)
How involved are you in your organizations decision making process?					
How motivated are you by your organization in including creativity in your work related activities?					
How does your organization reward your efforts for your innovative solutions given to solve persistent problems?					
How satisfied are you with your organization's management system?					
How does your organization support the implementation of your innovative solutions?					
How does your organization's management listen to employee ideas?					
How well do your personal work objectives support the organization's goals?					

How does your organization's management inspire enthusiasm?					
How well is your organization's management familiar with employee problems at work?					
How would you rate your organization's management openness to employees?					
How is your organization's management/ leadership respected?					

Chapter 2

Innovation process & innovation management

Developing a successful innovation model

There have been many studies targeting the field of innovation, with all its implications: from the requirements of an innovative organization to the specific management models that encourage innovative practices, all aspects have been tackled with more or less successful outcomes.

According to (Gaynor 2002) the basic requirements for an innovative endeavor are the following "four complementary elements":

- ✓ *Competent people* – people with sufficient know-how and work experience that can enable them to make the necessary mind connections in order to generate innovation (be it inside a process, product or system). These people also need to be constantly motivated and supported in their initiatives (by providing resources, time or know-how necessary for the advancement of the process);
- ✓ *Sound management practice* – it is surely obvious that competent management practice is the foundation of every successful economical endeavor. As a success enabler, management needs to assume the role of generator of innovation opportunity, sustain the potential and aid into maturity promising new innovative solutions. It can be a difficult task for the managerial function because, as we know, innovation is not a structured process; therefore management must both create structure and accountability and, at the same time offer the necessary "relaxation" of system and policy in order to encourage innovation "sprouts";
- ✓ *Good innovation design* – satisfies the equation "innovation = invention + implementation/commercialization";
- ✓ *An environment that provides freedom to exercise personal initiative* – a type of organizational structure that has the flexibility and the dynamics necessary to interlink the structures and functions of an organization in order to support innovation.

A successful exponent of rapid and prolific innovative behavior is the IT industry.

The road to successful innovation is not easy and not structured as, for example, a project management approach. As (Gaynor 2009) highlights, in our current business practice "innovation is generally ad hoc because organizations fail to recognize that innovation requires a focus, a design, and development of an environment where innovation and innovators can flourish". This bears the consequences of putting pressure on employees to innovate without offering a supportive organizational system to help them. It entails that the process is not well understood and that the step sequence, even if not formalized into a structure, needs to lead from idea generation all the way to market dissemination. As follows, the afore mentioned author propose a generic innovation process model which consists of the following steps:

- ✓ Idea
- ✓ Concept
- ✓ Invention
- ✓ Innovation
- ✓ Pre-project
- ✓ Project
- ✓ Market

The graphic form of the model is presented in the figure below:

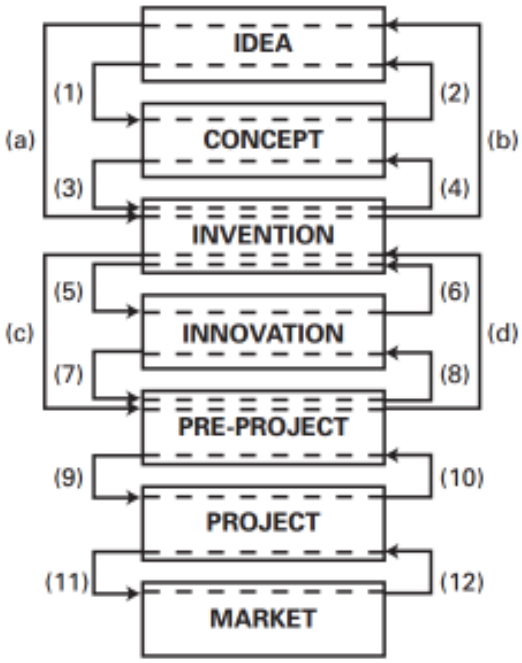


FIGURE 2.1 Generic innovation process model

(Gaynor 2009)

The model identifies the general innovation process steps and the feedback loops that adjust the process.

The *Idea* process step is according to (Gaynor 2009) the most difficult to go through. It cannot be planned and it requires a certain amount of dedication and creativity. There is not much light shed on the idea generation process and it is highly dependent on the individual and the organizational structure. The outcome of this step needs to be a "plausible and workable" idea, which fits inside the organizational profile. Of course, ideas are of no value to an organization if a decision is not taken to pursue that certain idea. According to the author, "managers have a responsibility to listen to those ideas and find those gems that need to be explored.". Therefore, a key element inside the idea generation process is the management decision. It is not only fruitless but also highly demotivating for employees to spend their and the company's valuable time generating ideas which will be neither heard nor decided on by their managers.

The idea generation process needs to fit inside an organizational innovation design framework. It is of course fruitless for an organization who acts in the field of wind mills production to generate ideas related to solar panels. Therefore, an organization needs to establish its innovation design framework and communicate it to all its employees. This needs to be based on a thorough analysis of the organizational environment which needs to be based on:

- ✓ Organization mission an vision;
- ✓ Organizational values;
- ✓ Organizational strategy and policy;
- ✓ Organizational development plans;
- ✓ Internal, organizational and industry standards;
- ✓ Technological capabilities;
- ✓ Financial capabilities and perspectives;
- ✓ Human resource capabilities;
- ✓ Know-how;
- ✓ Market analysis and positioning.

A very good generator of ideas is the problem solving process. If approached correctly, it can yield valuable idea generation opportunities. According to (Gaynor 2009), "resolving a problem usually creates an opportunity".

The requirements for identifying and solving a problem in order to generate valuable ideas are identified by (Gaynor 2009) as follows: knowledge, adequate level of experience, communication, teamwork, imagination, interest, initiative, insight, observation and "breadth of vision with the ability to live with uncertainties and resolve conflicts".

For the *Concept* stage, the author gives a complete and thorough description which we will adapt in the following paragraphs. The purpose of this stage is to create a structure

that gives logical continuity to the idea generation process and the subsequent decision to pursue certain ideas. It treats issues such as:

- ✓ Strategy alignment;
- ✓ Directing or personalizing the idea in such a way that it receives a market value and it addresses a specific target group or industrial purpose;
- ✓ Capabilities investigation, in order to asses and calibrate the resource and infrastructure needs in order to bring the concept to the final stage of the innovation process;
- ✓ Market analysis;
- ✓ Target group feedback;
- ✓ Planning process which identifies development steps and finally also deliverables for each step for tracking, traceability and monitoring purposes;
- ✓ Documentation process.

When necessary, the concept stage is followed by an *Invention* stage. Its purpose is to formalize the previously developed concept and to achieve a structure where it can be protected through intellectual property rights (IPR).

As the concept matures, it is necessary for it to enter the *Innovation* stage. In this stage the main target is to demonstrate the feasibility of the proposal. More actors will be brought into action such as engineering specialists, marketing and sales, support functions such as environmental, health and safety, legal issues. A team must be formalized and all the concerns of all party not previously consulted must be reconciled. The deliverable for this stage must be a feasibility study which attests to the viability of the idea on several levels:

- ✓ Organization wide;
- ✓ Market;
- ✓ Strategic development;
- ✓ Industry.

The Pre-project stage needs to set into place the final coordinates of the innovation endeavor to be tackled. It needs to set the baseline of the project through the development of a business and project plan. It may also encompass the prototype development where such are needed.

The Project stage needs to go through all the formalized project management steps and principles. Its final purpose is to implement the innovation and when needed bring it to the Market stage with all that it entails.

In order to have a complete description of the model we also need to take into consideration the feedback loops. These loops have the purpose to regulate the process

and to adjust the information and the outputs according to the subsequent process' needs and requirements. Such feedback loops can be found throughout the model which means that the innovation process is cyclical and a certain stage is not complete until it receives all the feedback necessary from the "client" stages. It can be the case that, given a certain feedback, the process can even be restarted given a trigger from the market.

The authors chose to give an extensive description Gaynor's model because it was evaluated as the most complete and comprehensive one found in the specialized literature. Apart from the detailed description in the innovation process steps, the model also includes the feedback loops which aid in correcting the innovation process. Further we considered useful to briefly present other models which generally go in the same direction, with small variations. All of these should offer a complete overview of the innovation models possibilities and approaches. It is, of course, useful to know and understand as many approaches as possible to further identify an appropriate one (one suitable for the specificity of the organization – taking into consideration management style, management systems, organizational culture, organizational structure and scope and human resources structure) or even to develop a personalized model.

In the innovation field there are a number of academic endeavors that give a structure for a successful innovation model. For the purpose of this handbook we will describe the following models, as identified in (Gaynor 2002):

ROBERTS AND FROHMAN'S MODEL

It consists of six stages:

- ✓ Recognition of the opportunity
- ✓ Idea formulation
- ✓ Problem solving
- ✓ Prototype solution
- ✓ Commercial development
- ✓ Technology utilization and / or diffusion

THE COOPER MODEL

The model deals with a more rapid movement of the product innovation towards the market. This model is designed in such a way that at the end of each stage, a decision must be made to continue or not with the product innovation.

- ✓ Problem identification;
- ✓ Ideation – the stage where ideas are generated in order to solve the previously identified problem;

- ✓ Conceptualization – developing a complete product proposition by defining market issues, resources scouting, financial steams, technologies and organizational fit;
- ✓ Development – all the design and development activities fit into this stage (parts, manufacturing, prototypes, management etc.);
- ✓ Testing – running all the necessary tests in order to validate requirements, functions, capabilities, quality and market fit;
- ✓ Product launch – commercialization and implementation into production and on the market.

VAN DE VEN'S MODEL

This model identifies three periods in the innovation process:

- ✓ Initiation – is characterized by an abundance of ideas which need to be developed into workable plans. There is an iterative process involved in the concept definition and solution creation and because of that, the initiation phase can last up to years. A lot of research, learning and discovery is involved;
- ✓ Development – presents some commonalities such as:
  - The idea may proceed into development through different paths which may result in different outcomes;
  - The success criteria are dynamic and they change as the concept progresses;
  - The staff is seldom paid just for developing the concept, therefore there isn't a full commitment to the job;
  - There is a constant negotiation regarding resources; many times the resources are not specifically described and the resource need is not fully understood;
- ✓ Implementation / termination – this involves reconciling the new with the old. Now is when success is determined.

The challenges of innovation

There are several challenges to be overcome when dealing with the innovation process. As presented in (Berkun 2010) they are:

- ✓ *Finding an idea* – ideas are ubiquitous. They occur to anyone and in any filed imaginable. Some sources of ideas might be: problems, coincidences, human interactions, observation or studying. Good ideas are hard to come by; that is why a pool of ideas is always better than striving for that one perfect idea;

- ✓ *Developing a solution* – an idea is just that: an idea. It has no form or structure, it only exist in the mind and understanding of its developer. For it to gain momentum and increase in value it needs to be developed into a solution. This requires an increasingly more amount of effort and concentration. It requires skill and competency in the specific field of application. Here is where the winners are separated from the others: many ideas don't get past the point of solution generation from a number of reasons: no market, unfitting technologies, not enough know-how in the field, not feasible etc.;
- ✓ *Sponsorship and funding* – solutions, as good as they may be, need testing validation and possibly even more research. A solution is generally not mature enough for the market and needs constant financial infusions for survival and evolution. Depending on the position that the solution generator has in the economic environment (established company, start-up, individual innovator etc.), funding and sponsorship solutions need to be found for the innovation to reach its next level of maturity. These may take the form of internal company founding, venture capital or angel investment, banking system support, country or regional innovation founds or many others depending on the industrial sector and the regional specificities. Sponsorship must also be understood in the form of political or managerial support, lobbying, decisional influence and other non-financial but essential inputs;
- ✓ *Reproduction* – it is not enough to just create a prototype and to validate it. Mass production is necessary to get the innovative idea to the market in order for it to start generating economic, social or environmental benefits. This involves adapting the innovative idea to fit current mass production technologies in order to be cost effective and feasible on the market. Reproduction involves a different type of design that was utilized to develop the prototype and utilizes a different set of paradigms. As an example, hybrid cars may be a reality in today's society, but the constraints generated by high manufacturing cost, difficulties with hybrid fuels infrastructure and the low maturity of technologies in the field keep this kind of product in the low end market penetration level;
- ✓ *Reaching potential customers* – the innovation status is truly achieved by an idea when it reaches its final beneficiaries or customers. Many innovations lose their value in today's economy simply by not being able to reach their customers and to prove their value in use. Thus, marketing and communication are an absolute must;
- ✓ *Beating competitors* – the opportunity of a valuable innovative idea is easily understood by competitors. Even if we are not taking into account imitators, whose presence is increasing in probability as the value on the market is greater (see the iPhone case in US and China) , there are still competitors on the same market niche with similar products or services. Therefore, an innovation needs to be presented and sold in a right way as to demonstrate unique characteristics and benefits. Differentiation on the market is an absolute must in today's fast paced economy;

- ✓ *Timing* – an innovative idea might be an excellent one but unless it is planted in the right "soil" it will be useless. The time factor is essential in bringing an innovation to the market. It has to be complementary with the culture, the concerns, the interests and the understanding potential of the targeted society or population. A revolutionary idea, as valuable as it may seem, takes a lot of explaining and of consumer education to achieve market penetration;
- ✓ *Keeping the lights on* – of course, innovation is a big effort. It involves a greater risk than day-to-day business. This is why we need to be paying an extra amount of attention to the operational part of the business: bills have to be paid, processes and teams need to be managed and, at the end of the day, the company needs to have tomorrow assured.

Innovation planning and development

First and foremost in the innovation planning and development endeavor is an adequate organizational design that encourages innovative actions.

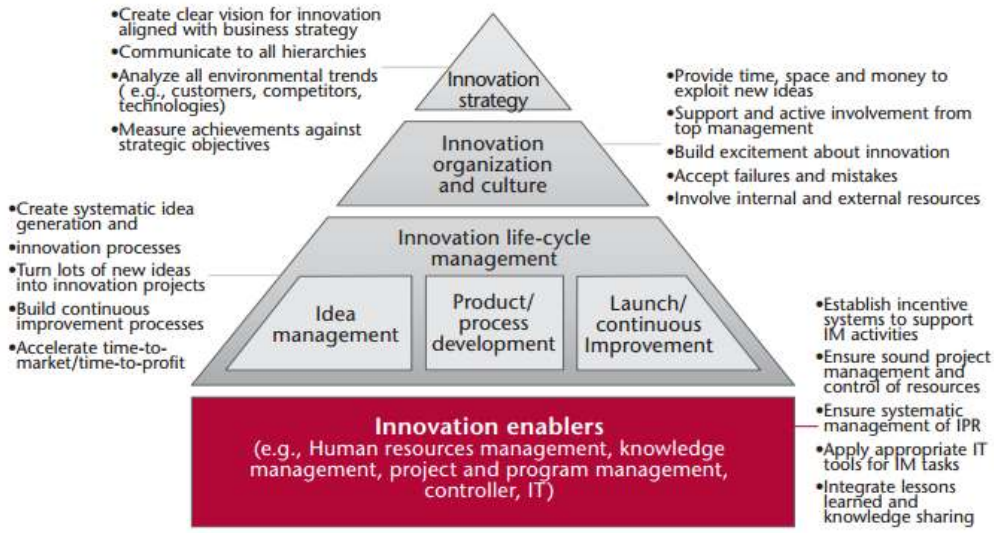


FIGURE 2.2 Success factors in each dimension of A.T. Kearney's "House of Innovation"

(IMP3rove European Coordination Team 2006)

The idea that the figure above suggests is that innovation planning and development can be stimulated and encouraged with a proper organizational design, such as the house of innovation.

The baseline for the house –its foundation – are the so called "enablers", the basic processes of any organization that streamline throughout all its functions and support all the primary value adding processes. All these processes if conducted in a certain manner have the property to stimulate and even sprout innovation. Their function, above all is to manage the organization in such a way that it stimulates creativity and new ideas and offers support for innovative practices.

The next process is more related to the innovation process itself and proposes an approach based on innovation lifecycle management which deals with idea management processes, new product and process development and continuous improvement processes. It is set in place to define a system in which innovation is at the center and which operationalizes creativity and innovation.

The two are being "crowned" by an innovation organizational culture. All organizations have an organizational culture – it can be formal (intentional) or informal (unintentional). The key is to stimulate such a culture where innovation and new ideas are valued, respected and recognized, both individually and institutionally. This is, of

course the next logical and natural step after the setting into place of an innovation lifecycle management system. Its purpose: to maintain and continue the system.

The "roof" of the innovation house is the innovation strategy. As in all the organizational design models, the upper most important element in organizational sustainability and continuity is a sound strategy. It can be directed towards any business facet, thus, the innovation house proposes as a "closed" and functional model the innovation strategy. There is common sense to understand that there cannot be long lasting performance and sustained outcomes in innovation without a strategy that will direct and manage the organization accordingly.

An example of a fully functional and performant innovation management process could be considered the one developed by Microsoft and presented in (Microsoft Corporation 2013). It consists of five stages:

- ✓ *Envision* – is the part of the process where the company ensures uniformity throughout the process. This involves developing the vision, the strategy, establishing the agreements and the managerial support and the alignment with all the organizational processes and strategies. These are disseminated and communicated in order to ensure the penetration and understanding and solving the "getting people onboard" issue. In its second stage it ensures the creation of a collaborative environment through social approaches such as brainstorming. It therefore sets the ground for a successful unfolding of the program;
- ✓ *Engage* – the general purpose of this stage is to generate ideas. As the model in the figure below shows, it starts to generate a funnel effect for the idea selection process. In the idea collection step there is a big emphasis on engaging people. The focus is on the people because they are the source of ideas. Once a structure frame of idea collection is set into place, formalized and supported there is a credible environment in which ideas are shared and captured. This step also allows focusing the idea generation system onto value creation for the business. An idea that does not fit into the organizational strategy has very little chance of succeeding, and even so with a lot of effort. But thinking inside the box yields not innovative results. Therefore, the idea development can proceed. There is a natural filter in between the two stages, meaning that ideas are naturally excluded. They may be combined into something better or may not just be feasible for the current state of things;
- ✓ *Evolve* – as the cycle continues, ideas are considered more carefully. They must gain real value and increase in quality in order to actually be considered for next steps. In order to define a viable proposal multiple inputs are needed. People with different expertise need to come together and share their know-how in order to bring the idea to maturity. As more effort is put into the innovation process less ideas remain to be considered. It is therefore a good idea to always keep the know-how gathered in the management process, even if the ideas are eventually discarded; know-how is always valuable and can lead to better ideas or even better innovation management processes;

- ✓ *Evaluate* – discussions may be relevant up to a certain point. . Objective criteria for evaluation must be considered and implemented in order to ultimately choose the best idea for implementation. As depicted, this process consists of two stages: the team evaluation where a final tem decision is attempted on objective criteria. Further, the management approval is always needed because, after all, an implementation is first and foremost the management's responsibility and they have to stay behind it. The process can very well be iterative, meaning that the ideas batch can go through the evaluation process multiple times before a final decision is made;
- ✓ *Execute* – marks the start of the idea implementation. This is generally done in a form of a project, therefore the execute phase actually means the project phase. Innovation project management will be detailed further in this chapter.

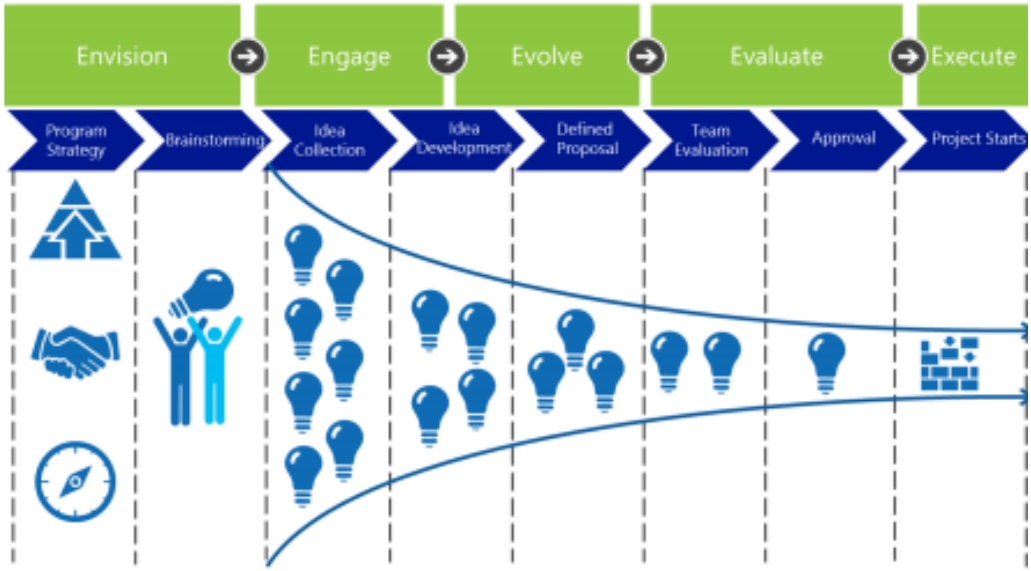


FIGURE 2.3 Microsoft's innovation management process

(Microsoft Corporation 2013)

Innovation and continuous improvement

As we previously highlighted, innovation in today's economy is a prerequisite for the organizations existence and long term success. You need to be one step ahead of the competition with both internal and external processes and outputs. But, as we previously stated, innovation doesn't always mean to be disruptive. Inventions may be a significant part of the innovation practices but they are not the whole story. Incremental improvements are sometimes more successful and most often more accessible.

As such, the continuous improvement methodology is as important to the innovation management process as other successful models driving innovation.

Continuous improvement

The continuous improvement framework constitutes a baseline for most standardized management systems. It postulates that the organizations needs to create an internal culture where all processes and employees are directed towards constant improvement of processes, products, services and systems. The basis of this approach is that none of the established processes or products present at a given time in an organizations structure or portfolio is at their best; they can always be improved and taken to a higher level.

At the center of the continuous improvement framework lays the now ubiquitous feedback loop. In simple terms, it means that an existing process or product must benefit from a feedback process which allows the beneficiaries to present their inputs. It further needs to implement those elements which result from the gathered feedback, with the condition that they make sense inside the philosophy of the product or process or within the organizational strategy. It is a constant process centered on the beneficiaries or clients which enable the organization to achieve higher customer satisfaction.

The continuous improvement process is specific to the entire organization and can be put into practice by all of the employees, regardless of their know-how or position inside the organizational structure. It enables all employees to have an input and to improve their work which, in turn, can have a significant effect on the organizational overall performance. An involved and motivated employee, which is aware of his significance inside the organization may be sometimes more valuable than a very well structured and supported RDI process.

There are a number of principles and philosophies which are of value to understand the continuous improvement process.

The *Deming cycle*, also known as the Deming – Shewhart cycle or PDCA is a well-known management approach for continuous improvement. It is widely recognized, especially through its usage in underlying international standards structure such as ISO

9001, ISO 14001 and others. As the figure below shows, it is an iterating process that consists of four stages:

- ✓ Plan: as its name reflects, this step establishes the definition of the action or project, the objectives, the success criteria, the planning itself (what to do, where to do it, who is going to do it, how, with what means, when) and a data collection plan;
- ✓ Do: involves the actual depletion of the planned steps, as described in the plan stage. It involves documenting the events (problems, unexpected events) and collecting data;
- ✓ Check: represents the stage of the process where the evolution of the project or activity is evaluated. This highlights the importance of constantly checking the evolution of the project. Many times, the success or failure is determined at the end stage. This can be extremely costly and time consuming. By integrating a feedback loop of constant results monitoring, these high expenses can be significantly diminished. The check activity evaluates the current stage of implementation and allows for corrective measures to be taken;
- ✓ Act: this is the stage where the corrective actions are put into place, after being analyzed and planned in the check stage. The iterative character of the cycle comes from closing the loop between act and plan. This involves constantly adjusting the plan according to the corrective measures that were taken.

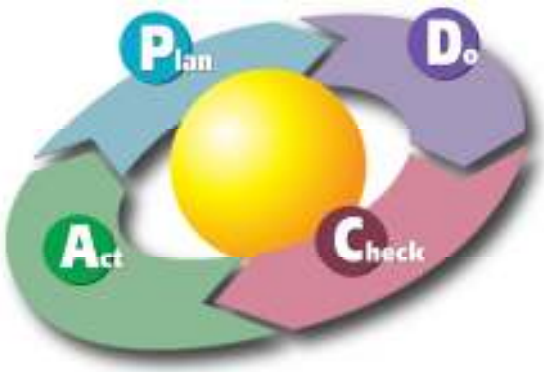


FIGURE 2.4 Deming cycle (PDCA cycle)

(Wikipedia 2006)

The cycle is adaptable to any kind of activity or project and is very successful because it has built in itself an improvement cycle.

Kaizen is a well-established terminology which comes from the Japanese language. It promotes the continuous improvement processes inside an organization while at the same time keeping the organizational equilibrium.

Implementation of continuous improvement

The *ISO 9001:2008* international standard for quality management promotes a series of principles which constitute the fundamentals for quality management. The 6th principle deals with Continuous improvement and requires that organizations commit to continuous improvement of their global performances. This is a part of the internal view of the quality management principles. The standard clarifies that:

- ✓ The continuous improvement of products, processes and systems must be viewed as an individual objective for each member of the organization;
- ✓ Periodic evaluations and results need to be compared against excellence criteria previously established in order to identify gaps and consequently improvement opportunities;
- ✓ The organization needs to formulate its objectives and measures in such a way as to encourage and promote improvement.

An implementation model, typical to the PDCA cycle, is presented in the figure below:

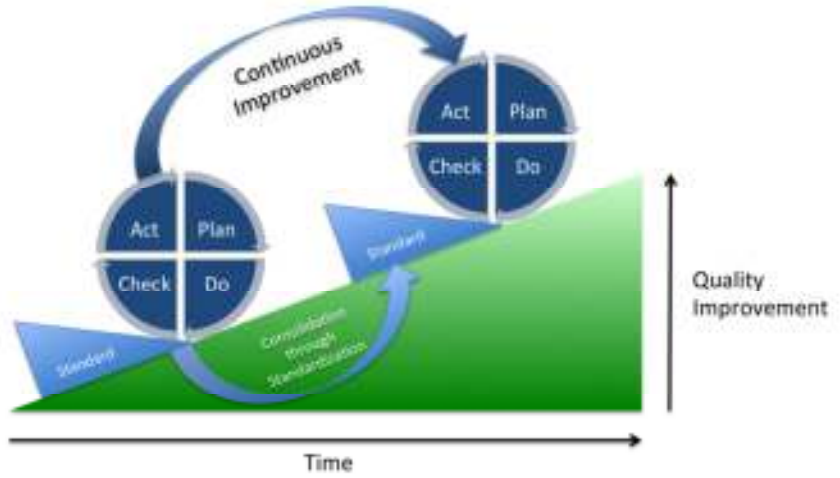


FIGURE 2.5 PDCA process

(Wikipedia 2006)

The figure shows the way continuous improvement can be consolidated through standardization. This means that whenever an improvement process is undertaken (the PDCA wheel rolls up the slope towards higher quality levels) it needs to be subsequently stabilized through standardization. This implies defining the current state achieved as the new way of doing business. After standardizing and settling with the new status-quo, a new continuous improvement process can be started.

According to the literature in the field, there is a debate whether improvement can be seen as an innovation activity. Arguably, improvement does not create sufficient

differentiation and can be seen as just a form of catching up with competition and with market demand.

However, for the purpose of this handbook, the authors consider necessary taking into consideration improvement as an innovative factor for the following reasons:

- ✓ Improvement (be it of system, process or product) is not only a way of doing business: it must place itself inside the company culture as an operational philosophy. Continuous improvement is the basis of a successful organization and the continuous improvement process approach consists the minimum baseline for a competitive innovation management system;
- ✓ Continuous improvement sets the base for a company culture where problems are discussed and not avoided. As we previously mentioned, one of the most important sources of ideas, thus innovation, are problems and malfunctions. It is absolutely necessary for an organization to set in place the mechanisms for detecting, analyzing and correcting them and the continuous improvement approach is the best and simplest way to do so;
- ✓ Many of the innovations constantly appearing on the market are not the disruptive kind. They may just be seen as improvements of established models. An iterative approach as presented in the figure above can be used as a model in approaching this type of innovation. With incremental improvements on a certain flawed or not good enough characteristic, improvements can be achieved.

Innovation project management

Just like any project, innovation also needs to be managed. In order to do so, we must understand that innovation is a process. For this, Alexander Hiam proposes an innovation cycle, a nonlinear process which "captures the main management stages of almost every innovation process" (Hiam 2010).

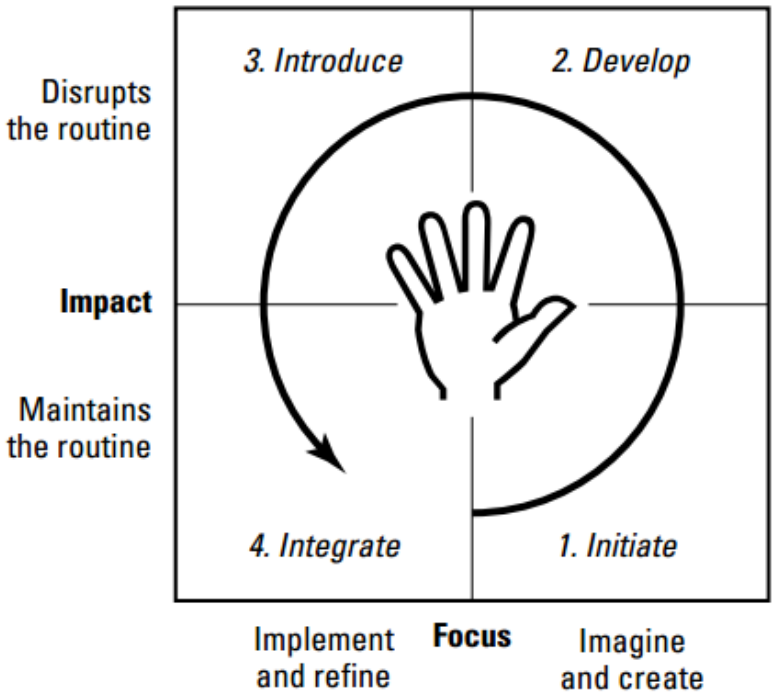


FIGURE 2.6 Hiam's Innovation Cycle

(Hiam 2010)

The main idea of the cycle is that the end of one process is the beginning of a new one. At any given point of the process, chances are that something needs to be changed or adjusted. As opposed to a normal project management approach (which also contains some level of adjustment as the process unfolds), an innovation management approach must be more flexible throughout its entire lifecycle. It may be the case that the innovation planned for implementation may not be working at the correct parameters or may not fit to the purpose. It is therefore always a good idea to reassess every step of the project and to adjust where needed. This cycle is meant to be applied to every stage of the implementation process.

The model is divided into four stages each having different characteristics related to focus and impact.

- ✓ The initiation implies a relatively low impact of the innovation inside the organizational structure with a high focus on creativity. It encourages thegeneration of ideas and design of innovations without the risks that are involved by a high impact on the organization.
- ✓ The development stage involves a transition towards a higher impact and a gradual increase of creative input. It should stabilize the project stage, to standardize it for preparing an introduction into the organization structure. It is usually a highly disruptive stage that involves conflict management skills due to the high resistance of the organization.
- ✓ Introduction is the stage where the organization is faced with the innovation and must commit to it. There is also a high resistance of the organization present in this stage but, by now, the innovation process has reached a certain maturity due to the high disruption from the previous stage. By dramatically decreasing the creativity inputs, it allows a more structured and standardized approach which eases understanding and penetration throughout the organization.
- ✓ The integration stage is meant to allow the organization to integrate the innovation, to make it "its own". This is the stage when innovation transits towards normal business practice: it is no longer an innovation, a novel process or element but an integrative part of the organization.

There are also some approaches identified in (Hiam 2010) to help organizations manage the innovation process as described above:

- ✓ Design flexibility – the "learning as you go" approach which works especially well in the innovation management field. It postulates that, no matter how final it may seem, the innovation design is a never ending process. There is, of course the matter of "knowing when and where to stop" but the paradigm still stands: there are always improvements to be made and the best mindset for innovation management is that continual assessment and adjustment is a must. Just don't overdo it.
- ✓ Clear goal – as in every project management endeavor, all starts with a goal. A goal means knowing what you want to do and if that is not clear and specific enough, chances are the project will likely fail. A clear set of goals are half of the way towards a clear structure of the innovation management process and are the main ingredient in a successful communication and understanding inside the project team. All the team needs to be pulling in the same direction and goal setting is the way to do it.
- ✓ Communication – needs to happen as often and as widespread as possible. Inside an innovation management process probably the most difficult to achieve is the total understanding and agreement on the project results. Most probably every member of the team has his own viewpoint on results, motivation and other key elements of the project. The only way to get them all on board is to constantly communicate on project issues and as wide as

possible. Sometimes it is even not enough to communicate inside project teams. There might be other relevant stakeholders outside the project team which can "make or break". They must also not be forgotten.

- ✓ Long term benefits – one of the characteristics of innovation is that it is disruptive. It changes status-quos and this makes people especially uncomfortable. Forcing changes on organizations is known to have disastrous effects in the short term, by eventually killing the project, and in the long term, by immobilizing the organization. The best way to help people cope with changes is to give them a positive outlook on the situation: what will the benefits of this innovation project be for them specifically, how will they be more productive, what will the benefits be for the company, what is the impact of this on their own life and work? After all, it's all a matter of acquiring a new habit.
- ✓ Constant monitoring – success doesn't just happen. A successful project is constantly being monitored and adjusted in order to achieve the desired results. Work standards must be maintained, deadlines have to be met and problems always occur. It is also a good source for a decision of Go/NoGo. Not all projects are successful but if so, we do not need to waste valuable resources to get to the end of one.

A successful model for new product launches was developed by Procter & Gamble. It consists of six stages (Hiam 2010):

- ✓ *Discovery* – is related to the research activity. An idea is formulated and basic guidelines are given in order to differentiate the product;
- ✓ *Design* – the prototyping stage where the product is described in detail and a commercial model is developed to assess the feasibility of the idea. Also the production technology needs to be described, as well as the resources implied by the process;
- ✓ *Qualify* – the product needs to be validated on the market through analyses of potential and risk. The feasibility of the product needs to be determined and a decision needs to arise whether to launch or not;
- ✓ *Ready* – after the market validation a final optimization needs to be made according to market feedback. The product is being prepared for launching with all the connecting processes such as production setup, logistics. The planning of the launch;
- ✓ *Launch* – is the so called "zero series", a pilot series that is meant to be a test for all the product lifecycle. The series needs to be produced, distributed, sold and customer feedback needs to be received. This stage should give a final calibration feedback in order to bring the product to full market maturity;
- ✓ *Leverage* – the final product is being unrolled as a fully marketable product and it is consequently studied for optimizations such as product management, cost cutting, efficiency, etc.

The project management structure

For the scope of this section we need to first clarify the project concept.

Project – "a temporary endeavor undertaken to create a unique product, service or result" (Project Management Institute 2008).

The definition therefore describes a structured sequence of events which is conducted in order yield a unique (which means that it does not exist in this form or structure up to the project moment) result which can take the form of "a product that can be either a component of another item or an end item in itself; a capability to perform a service; a result such as an outcome or a document" (Project Management Institute 2008). It is defined in time meaning that it has a specific beginning and end. "The end is reached when the project's objectives have been achieved or when the project is terminated because its objectives will not or cannot be met, or when the need for the project no longer exists."

Considering the previous description, we can conclude that,in what concerns process structure, innovation and project management overlap. Therefore, an adoption of project management structure and principles can only be of great value to the innovation process.

Firstly, some lessons that need to be learned from project management practice when implementing innovation projects (Business 2 Community n.d.):

- ✓ *Knowing the scope* – understanding what is the purpose of the innovation project, what are the specific needs addressed and what are the objectives;
- ✓ *Clarify success criteria* – every project needs a scale by which success should be measured. Innovation projects are no different. They either succeed or fail and a measurement for this needs to be put in place;
- ✓ *Communication* – as we previously discussed, communication is an important component of an innovation project. It is well established inside the project management best practices repertoire and it surely needs to pass into the innovation project management area both as an iterative and fundamental practice but also as a skill;
- ✓ *Be open to change* – change is a constant in today's dynamic business world. The innovation area is most susceptible to these and it thrives from it and the project management discipline has excellent tools and techniques to handle and channel changes towards positive outcomes.

Inside the project management scope there are 5 process groups which typically encompass all the project management activities (Project Management Institute 2008):

- ✓ *Initiating* – deal with the definition phase of the project. Here the project objectives are defined, processes are identified and the proper communication is being conducted (authorizations, internal and external information activities,

popularization of the project), the project team structure is defined and potential risks and constraints are identified;

- ✓ *Planning* – are those groups of activities that have a purpose to refine the scope and the objectives, to set in place the plan and the course of action, to correlate the outcomes with the activities and available resources and to identify the success criteria;
- ✓ *Executing* – all the activities groups that deal with the actual implementation of the project;
- ✓ *Monitoring and Controlling* – necessary activities that take place throughout the lifecycle of the project that ensure the successful completion of the project – by accomplishing all the objectives inside the defined constraints;
- ✓ *Closing* – activities which are required to finalize the project such as reporting, documenting for further replication and use, administrative work, handover of the results and know-how.

Managing a project includes the following activities described in (Project Management Institute 2008):

IDENTIFYING REQUIREMENTS;

The requirements can be grouped into two categories:

- ✓ Project requirements:
  - Quality requirements;
  - Business needs;
  - Legal requirements;
  - Know-how / training requirements;
  - Financial requirements;
  - Time requirements;
  - Resources requirements;
- ✓ Product requirements:
  - Subjective requirements;
  - Technology status – technological requirements
  - Technical requirements;
  - Functional requirements;

- Quality requirements;
- Legal requirements;
- Market demands'
- Customer needs / requests;
- Validation requirements.

STAKEHOLDER MANAGEMENT

Stakeholder management is a very important part of the project management activities which, unfortunately, gets overlooked many times. Stakeholders are those individuals or groups that have an interest in a certain activity (in this case, in the innovation process). The interest can be related to the final outcome, to the process or to tangential implications. The stakeholders (interested parties) can be both internal and external. When analyzing project stakeholders, two dimensions must be considered:

- ✓ *The project dimension* – meaning that the internal stakeholders pertain to the project team and scope and the external ones are external to the project but limited to the organization's dimension;
- ✓ *The organization dimension* – is mostly important when we need to consider the whole range of stakeholders, which are not visible from the first perspective: it highlights the stakeholders from the environment external to the organization, which, even if are farther in interaction and communication are still immensely important to the project outcome.

Stakeholders, in all of their different forms, are important to the project's unfolding and outcomes on two dimensions: interest and power of influence. Each stakeholder analysis is unique and reflects the specificity of the project. A general identification of categories of stakeholders can be considered the following (all of which, according to project scope and needs, can be further decomposed):

- ✓ Project team;
- ✓ Project manager;
- ✓ Employees;
- ✓ Management of the company;
- ✓ Customers (both internal and external);
- ✓ Business partners;
- ✓ Employees' families;
- ✓ Public authorities (local, regional, national, European, international);
- ✓ Civil society;

- ✓ NGOs;
- ✓ Universities, research bodies and knowledge intensive organizations;
- ✓ Intellectual rights bodies;
- ✓ National, international and industry specific norms, standards and best practices.

A stakeholder analysis is performed in order to have a wide viewpoint of all the interested parties and to understand what their interests are, how the project or company can cope with them, which is the degree of influence of each stakeholder and the possibilities to mitigate the risks derived from them.

MANAGING CONSTRAINTS GENERALLY DERIVED FROM:

- ✓ Scope;
- ✓ Quality;
- ✓ Schedule – the schedule imposes a limited timeframe to achieve desired results;
- ✓ Budget;
- ✓ Resources
- ✓ Risk.

In order to better understand the project constraints we could consider the project triangle, depicted below:

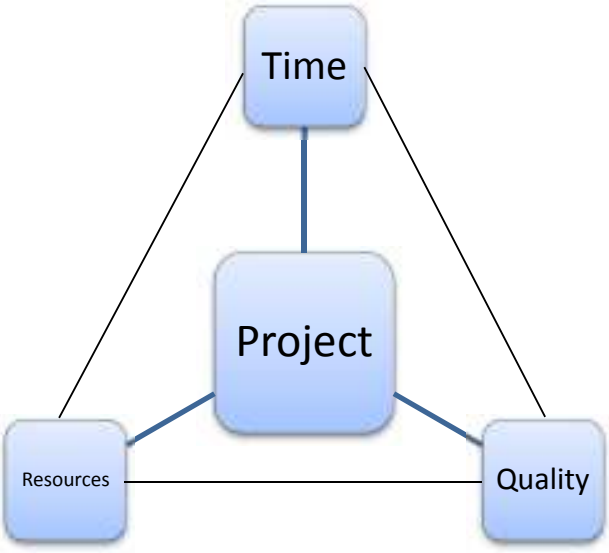


FIGURE 2.7 Project triangle

As observed, there are three main components of a project: time, quality and resources, that encompass all the project dimensions. In an ideal situation these are perfectly

balanced and the triangle appears to be equilateral. As the project unfolds and compromises are made, the triangle changes its shape. This visualization method is best utilized to suggest that all the compromises done during the project on any of the dimensions are done at the expense of another. So, as we economize on resources, chances are that the quality or the time dimensions will be affected. Also, an overzealous quality management can have serious time and resources costs.

The challenges of managing innovation

Of course, a project management structure needs to be applied with every innovation management project, which comes with its own specific set of challenges and constraints, as described in the previous section. Apart from those, managing innovation has its own challenges to overcome. As described in (Berkun 2010), these are:

I. ENVIRONMENT

A good innovation manager knows that he is in full control of the environment where his people are active. He needs to take responsibility of it in any way possible. It may be the case that financial investments are not possible (which, reportedly, happens most of the time). But one of the most important components is the psychological and social environment which is completely under the manager's control and needs no budget allocations.

An idea can be compared to a seed: if it has proper environmental conditions (appropriate soil, good weather and humidity, enough light and space to develop) it can spawn into a mature plant. As important is the organizational environment for the maturing of ideas: it can nurture or suffocate them.

The manger is responsible for creating and encouraging such a "fertile" environment. It needs to be first of all collaborative. Good ideas come from good people; great ideas come from great teams. An open communication environment is known to be highly effective in developing innovative ideas. Moreover, people who don to feel they are competing with each other are more inclined to share ideas and contribute. a supportive atmosphere is also a great encouragement: judging early stage ideas may not only be counterproductive but also highly demotivating. Making fun of, laughing at or disparaging ideas or their creators need to be discouraged by managers. Team structures are also an important factor to consider.

A creative environment can be also supported by office architecture, which is also a decision that a manager can take in this direction. Open space workplaces, the way the buildings are designed and decorated. Visual and other physical and intellectual stimuli must not be underrated when shooting for that innovative environment.

A flexible workplace may be a good solution in some cases: physical arrangements can be changed for people to constantly find themselves in new surroundings, thus eliminating routine; the work schedule can be many times negotiated, especially with

the people who are subject to innovation systems: some people are more creative early in the morning whilst others are real night owls; allowing for people to have a more relaxed schedule at work can lead to time on their hands which can be used for generating innovative ideas: a more mature delegation system, not crowding key personnel with operational tasks, allowing flexibility in task execution (where it is fitted) or even designating specific work hours for focusing on innovation activities and ideas (brainstorming sessions, open space technology sessions, ad hoc teams, research time etc.).

II. PROTECTION

The feeling of security is an important component of the manager's activity. A manger needs to take his role as an enabler of people's ideas. He needs to protect his people and their ideas. Excellent ideas most often threaten the status-quo. This, in turn, generates hostility and opposition which, most likely, the idea generator cannot withstand. It is the manager's duty to protect the idea, promote it and support it in order for it to reach maturity.

When discussing protection, legal aspects must also be considered. There are several ways in which national and international law protect innovations and inventions in their different stages of life.

Another very important component of the protection issue which resides in the hands of the manager is the financing. In this case, protection is more related to the continuity of the idea and ensuring its future. Therefore, if an idea requires more time, capital or other types of resources the manager must step in in order to ensure the survival of the idea or innovative project.

III. EXECUTION

Ideas are just abstract concepts. In order for them to gain any value they need to be translated into economical applications. This can be done through a project, by making a prototype or by taking it all the way to mass production or market penetration. It is the manager's role to achieve the state of execution of an idea. This of course requires a specific set of skills and resources which typically are in the manager's power: planning, team development, resource allocation, involving personnel with different sets of skills.

There are also the challenges of balancing the requirements of the team's members in order to reach the final form of the innovation. Negotiation skills are needed as well as market knowledge in order to configure the innovation to its final form.

IV. PERSUASION

Persuasion is important in every level of the innovation process lifecycle. A successful completion of an innovation project is directly related to the level of perseverance involved. This is the direct attribute of the manager: recruit valuable personnel, convince, retain talent, get investors aboard, create momentum around the project, get people to believe in the project.

Chapter 3

Tools and techniques for applying innovation

Methods for generating ideas / Tools for stimulating creativity

6-3-5 Method

The 6-3-5 method is one of the most used tools for finding solutions to various problems. It is part of a series of techniques through which employees are encouraged to find solutions. Thus, it can be used in any type of organization, because it is considered to solve problems as easily and quickly as possible. (Brad 2004)

This tool has been developed by Bernd Rohrbach in 1960, and consists in organizing teams of 6 people, each and every one of them must develop 3 ideas or offer 3 solutions to various problems exposed in a period of 5 minutes. The number of sessions of this method shall be equal to the number of persons in the team, so that each of the participants expresses his ideas or solutions.

The format recommended for this method includes a team formed by 6 person, which should generate a number of 3 solutions or ideas in 5 minutes. However there have been tested a series of combinations as well, such as 6-3-10 or 5-3-6, so that the method can be adjusted in the light of the specific nature of the problems that have to be solved in each organization. (Brad 2004)

Below is a table that represents a possible worksheet for idea generation:

TABEL 3.1 Idea generation matrix (Brad 2004)

	Idea *1*	**...**	**Idea *n***
Team member *1*			
...			
Team member *j*			
...			
Team member *m*			

The progress of the method is both simple and efficient. According to (Brad 2004) deployment of this method should follow these steps:

1. In the first step the person who manages the session will form teams and will inform their members about the problem upon which to focus and find solutions.

2. In step two, after receiving a table similar to above one, each team member, will generate a number of ideas (according to the above table n ideas), in a predetermined time interval, and they will be written in each section.

3. In the third step, after the table is completed by each team member, it will be handed over to the left side, so that it will be received by each member's left neighbor.

4. In step four, the participants will complete the table again, received from their colleagues, with a new solution or idea, but based on the existing notes. This process will go on until the table is completely filled.

By the end of session, the table will be completed and finally the multitude of ideas generated can be processed and analyzed. The number of ideas generated will be equal to the number of ideas (n) multiplied by the number of participants (m), resulting in $n*m^2$ ideas.

It should be noted that this method can be practiced in a variety of forms, either in a written form on paper, or through the use of a computer, the process is the same as participants are prohibited to communicate between them during the course of this session.

As stated before, this method is one of the easiest, most cost-effective methods, by means of which they are able to resolve a number of issues, with different levels of complexity, and is also a good opportunity for employees to interact between each other for idea exchange, each of them helping to solve the problem as the method itself involves cooperation between participants.

Mind-Map Method

Mind mapping is a cognitive method by means of which people are able to resolve a number of issues of varying degrees of difficulty, in many ways. This method was invented by Tony Buzan in the 1970's and involves problem solving in a both logic and creative way, by outsourcing ideas and interconnecting them.

This method can be used successfully by both brain hemispheres through graphic means and it is simple, but effective in the same time, since it combines creativity and imagination with logic (Aimee 2012). It consists of organizing thoughts, and it gives an all-at-once overview of the topics, issues or ideas in question.

Making a map of the mind is also a good opportunity to shed light on a series of ideas, of various parts of the brain, which typically remain on the inside and are not fully explored. For carrying out of such maps various images shall be used, as well as pens and pencils of different colors, words written in capital letters, lines and dashes derived from main ideas and other symbols aimed to create the map's contour.

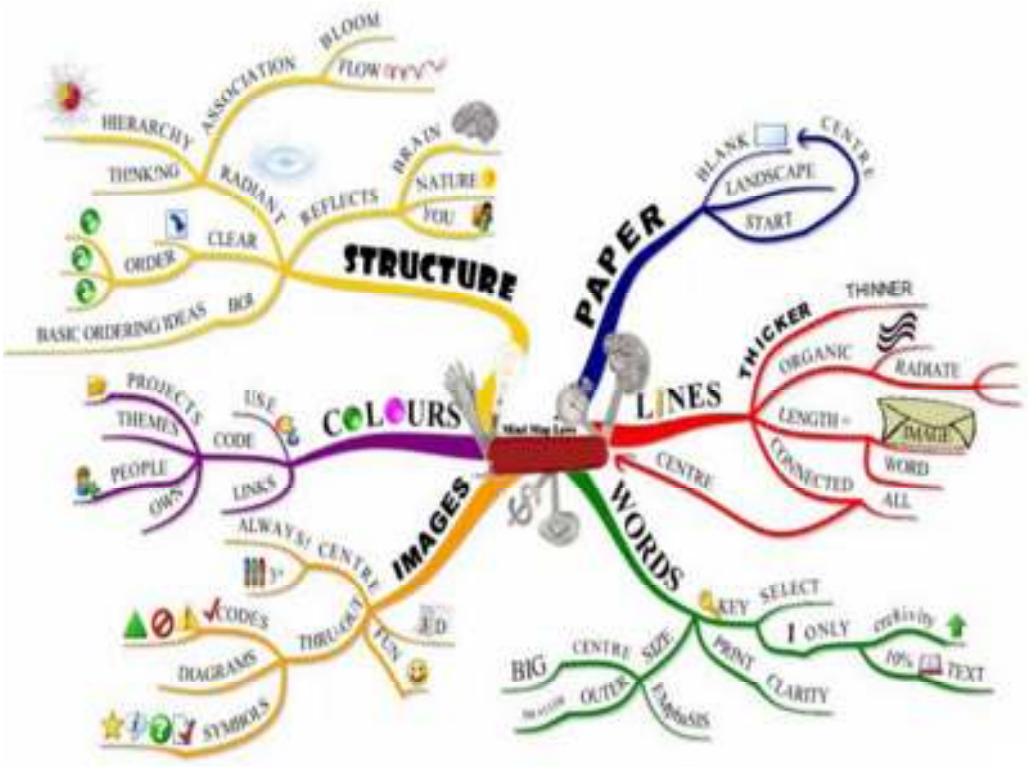


FIGURE 3.1 Mind map example

(Astutiamin 2009)

For the purposes of this map of the mind a series of steps must be followed:

1. In the first place there is need for a sheet, on which will be drawn upon, written or noted any form of distraction. It is better to start in the center of the page, so that the brain has a greater freedom of expression, thus it gathers ideas naturally without any constraints or inhibitions

2. In the center of the page it is possible to write words, draw pictures or symbols and it is advisable to draw such images that are more expressive and most of the times they suggest a series of messages in a much more expressive manner than words.

3. Use colors, because they have the power to stimulate human brains, so that connections are formed much faster and easier.

4. Implementation and demonstration of connections, the links between words and pictures are recommended to be represented by curved lines, because they have a positive impact on brain, straight lines should be avoided.

5. For each connection or branch made, use expressive words to highlight them and give a better brain mobility at the same time.

Voice of customer table (VOCT I & VOCT II)

Voice of customer table, or shortly VOCT is a simple and unique tool used specifically for better understanding the customer needs and what he meant when stating his requirements.

The method can be used in conjunction with the QFD method. All results obtained with the help of this method will constitute inputs for the QFD relationship matrix.

The graphical support for this method is a simple table, which is completed by answering questions in each section. The method is divided into two steps. Firstly the VOCT I table helps understand the actual requirements by deploying a 5W1H analysis. The sections in the table refer to What? (doeshereallymean), Who?(isthecustomer), When? (isthe product beingused), Where? (isthe product beingused), Why? (doesthecustomerwantthis), How? (can it bedone).

TABEL 3.2 VOCT I table example

Voice of customer	What?	Who?	When?	Where?	Why?	How?
Requirement 1						
...						
Requirement n						

Secondly, based on the previous table, in the VOCT II table there are established the CTQs (critical to quality requirements), functional requirements and potential faults identified at this stage. In the "CTQs" section the needs will be transposed into technical characteristics, it should also be identified the target values for each characteristic, which, in the eyes of the customer are considered satisfactory. (e.g. the autonomy of a laptop is measured in hours – the satisfactory CTQ for this requirement is 5-6 hours)

Furthermore each requirement, as stated by the customer, will be rephrased and shortened so it could be used more easily in the QFD "house of quality".

TABEL 3.3 VOCT II table example

Voice of customer	CTQs	Functional requirements	Reliability	Rephrased needs
Requirement 1				
...				
Requirement n				

Both tables provide a "simple-to-use" tool specific for understanding what the customer needs and what does he means when he formulates his requirements. It is suggested that the VOCT should to be deployed in the early stages of product development.

Kano model

Basic notions

The Kano model, developed by Noriaki Kano in 1984, divides the sum of the customer requirements in three categories: basic-needs, performance needs and delighters.

When only the basic needs of a customer are met it can't be said that the customer will be satisfied. It will only create a state of state of "not dissatisfied". In the case of some customers the basic needs are not even stated, as they must be understood implicitly by the manufacturer. In the case of QFD method the basic requirements tend to be omitted, because the QFD only analyzes if the requirement is met or not. The Kano model, by making a distinction between the requirements, helps them to be taken into account more accurately.

The performance attributes are those which are formulated explicitly by the customer and for a product to be stated as being of a high quality it must contain as many performance attributes as possible. The number of how many is up to the customer, as for one customer could be less and for another one could be more. When buying a product, these are the attributes that the customers look for and if present, they are willing to pay extra for them.

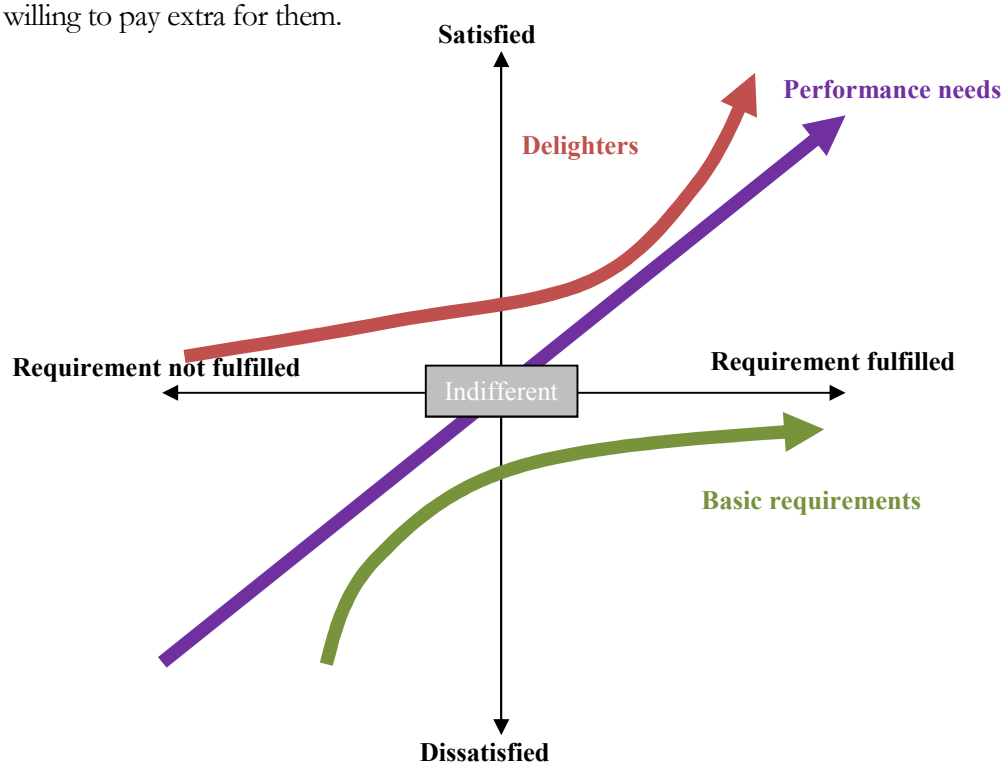


FIGURE 3.2 Kano model example

(Wikipedia 2005)

The third category of attributes contains the so called delighters. This category, like the first one, contains needs that are not stated by the customer. The difference is that in this case the attributes of the product are not expected. The delighters satisfy needs of the customer that he wasn't aware of. Doing so can lead to a high level of satisfaction. Products that incorporate delighter type of attributes are innovative because they have a competitive advantage over products from the same market segment.

Applying the Kano model

According to (Sauerwein 1996) the Kano model can be applied with the use of a questionnaire in four steps:

STEP I: IDENTIFYING CUSTOMER NEEDS

This step can be done using individual or focus group interviews. The latter have a greater dynamic and they help identify needs and requirements much faster than individual interviews. On the other hand, individual sessions help understand the needs better and the customer can state his problems clearer.

STEP II: DEVELOPING THE KANO QUESTIONNAIRE

For each attribute of the product a pair of multiple choice questions is formulated. Each question has five answers, increasing gradually. Firstly it is established how the customer feels like if the product has the feature incorporated or not (functional form of the question) and secondly what is the customer's reaction if the product does not have that feature (dysfunctional form).

TABLE 3.4 Kano question pair example

How do you feel if your furniture edges are rounded?	I like it that way It must be that way I am neutral I can live with it that way I dislike it that way
How do you feel if your furniture edges are not rouded?	I like it that way It must be that way I am neutral I can live with it that way I dislike it that way

Based on the answers given the following evaluation table is completed:

TABLE 3.5 Kano evaluation table example

Customer requirements →		Dysfunctional (negative question)				
		Like	Must be	Neutral	Live with	Dislike
Functional (positive question) ↓	Like	Q	A	A	A	O
	Must-be	R	I	I	I	M
	Neutral	R	I	I	I	M
	Live with	R	I	I	I	M
	Dislike	R	R	R	R	Q

A – Attractive; M – Must-be; R – Reverse; O – One-dimensional; Q – Questionable; I – Indifferent.

"A" is used if the feature is Attractive to the customer: the answer to the first question is "Like it" and to the second question is: "Neutral" or "Can live with". "I" means that the customer is Indifferent to this feature and is not willing to pay extra, if present.

"Q" stands for "Questionable" and if the question was phrased correctly it should not appear in the evaluation table. However it may appear with a low frequency, if the question was not understood correctly by the customer. "R" means that the customer doesn't want that specific feature and he also aspects that it would be reversed in such way that the product will contain the opposite of it.

It would also be helpful, if besides the questionnaire a ranking scale for each feature will be given to the customer. This will rate every feature, thus obtaining valuable information that could be used in prioritizing needs and focus on a certain aspect in product development.

STEP III. DEPLOYING THE KANO QUESTIONNAIRE

The questionnaire should be applied to a preset sample of customers and the method through which they are conducted it is up to the user of the method. It could also be

done with the help of online services, but in this case it must be chose a broader sample because of the low return rate.

STEP IV. DATA PROCESSING AND RESULT INTERPRETATION

The results are collected into one single table, thus obtaining the frequency with which the customers find a feature "attractive", "must-be", "reverse", "one-dimensional", "questionable" or they are "indifferent" to it.

TABLE 3.6 Result interpretation table example

Product requirement	A	O	M	I	R	Q	Total
Feature 1							100%
Feature 2							100%
...							100%
Feature n							100%

If there are several category features in one product and in the phase of product development are several constrains to deal with, then the features that create the highest dissatisfaction for the customer should be dealt with priority. To prioritize it could be used the M>O>A>I rule. This means that the "Must-be" features are more important that the "One-dimensional" ones and so on. Furthermore, the importance of features from each category is settled by their frequency rate or higher percentage in the result interpretation table.

The Kano model can be usefully intersected with activities such as:

- ✓ Identifying customer needs and requirements;
- ✓ Establishing customer satisfaction level;
- ✓ Product development;
- ✓ Quality Function Deployment;
- ✓ Competitive and technical benchmarking;

Analytic hierarchy process (AHP)

Analytic hierarchy process, like the name says, it is a method used for prioritizing customer's requirements through systematic comparison. Each requirement is evaluated with every other one from the list except with itself. Thus, a matrix is created and for each comparison a value is assigned from 1 to 9 and filled in the matrix.

Since the matrix is square each element intersects with one another twice. The comparison doesn't need to be done the second time, because the upper domain from the diagonal is the mirrored extent of the lower domain and vice versa. Due to this reason only the lower or upper domain will be completed, with respect to the user's choice.

It is recommended that the extent of the AHP matrix should not be more that 15 rows and columns. Otherwise the percentages of the requirements will be closer to one another and a clear distinguishment between them will not be possible.

When completing the matrix and assigning values to each comparison the scale of relative importance (proposed by Thomas L. Saaty – AHP theoretician) has to be taken into consideration:

TABLE 3.7 Scale of relative importance (Saaty 1980)

Intensity of importance	**Definition**	**Explanation**
1	Equal importance	Two activities contribute equally to the objective
3	Weak importance of one over another	Experience and judgment slightly favor one activity over other
5	Essential or strong importance	Experience and judgment slightly favor one activity over other
7	Demonstrated importance	An activity is strongly favored and its dominance is demonstrated in practice
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order
2,4,6,8	Intermediate values	When a compromise needed

The calculus can be done automatically or manual. However, a software solution is highly recommended, because the mathematic formulas are complex and can be

difficult to follow for the average user. There are many free versions which can be downloaded from the internet, also available in the classic Microsoft Excel format.

The final percentages should reflect the Pareto rule, in this case 20% of requirements should have a total importance of at least 80 %.

The result of this method is a prioritized list of requirements which constitute as inputs for the QFD method. It is imperative that the requirements are prioritized before the QFD method is deployed, otherwise prioritization of the technical characteristics can't be done.

Quality function deployment (QFD)

Basic notions

In any competitive economy, quality, price and the reaction time to the market requirements are essential for the company success. Recently, innovation became the fourth and maybe the most important determinant of competitiveness. Out of all them, quality is a long-term success factor (Crişan, şi alţii 1999).

The QFD method is a system for planning the activities of all the departments in a company or organization offering products or services, with the purpose of maximizing customer satisfaction. QFD translates the customers' requirements into technical characteristics of the product/service with the goal of developing market oriented products/services. For applying this client orientation principle, it is necessary to determine the clients' requirements, using various methods of investigation for collecting data.

Yoji Akao, developer of the QFD method (Akao 1997), defined QFD as being „a method for developing a design quality aimed at satisfying the consumer and then translating the consumer's demands into design targets and major quality assurance points to be used throughout the production stage". (Mazur 1993)

If we are referring to a service, than the QFD could be defined as: „a system and procedures to aid the plan and development of services and assure that they will meet or exceed customer expectations." (Mazur 1993)

Researchers H. Makabe (Japan) and D. Clausing (United States) developed a simplified method called „House of Quality" containing six matrixes. This method is adaptable to various needs, with the possibility to use all the matrixes or only some of them depending on the desired results. In this research the authors used the following matrixes: Client Requirements matrix, Technical Characteristics matrix, Relationship matrix, Technical Evaluation matrix, Customer Satisfaction matrix.(Figure 3.3)

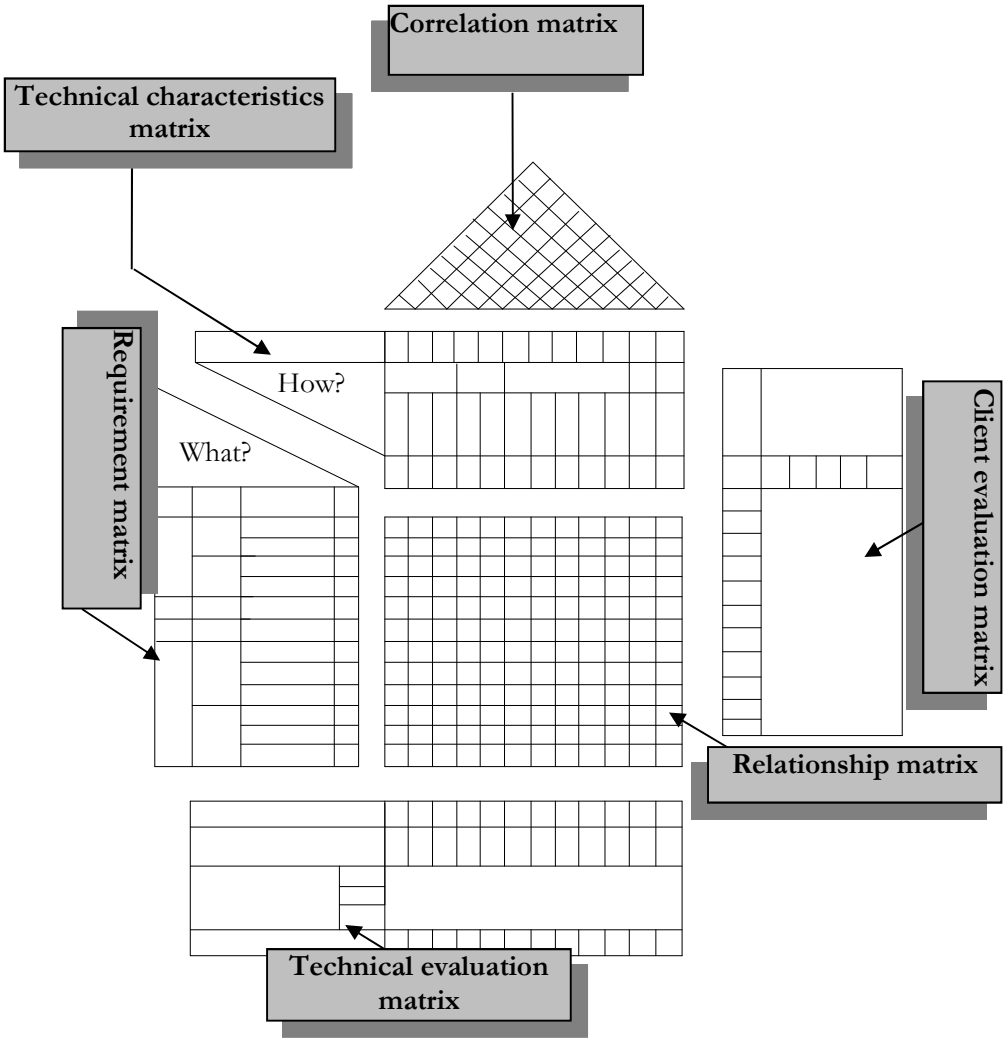


FIGURE 3.3 Basic components of the House of Quality

Adapted after (Crişan, şi alţii 1999, 58)

The client requirements matrix contains the customers' requirements regarding the product/service being analyzed and the importance factor assigned to each individual requirement. The steps necessary for filling out this matrix are: determining these requirements through different investigation methods; hierarchizing these requirements and assigning the importance factors for each requirement.

The technical characteristics matrix contains the characteristics of the product or service offered by the producer/supplier. The relationship matrix points out the correlation between the customer requirements and expectations and the technical characteristics of the product/service being analyzed.

Customer requirements are being translated into technical characteristics in this matrix. The structure of this matrix is that of a table with two inputs: customer requirements

and expectations on the rows and producer/supplier technical characteristics on the columns. At the intersection between rows and columns there is the correspondence between customer requirements and technical characteristics of the product/service. This correspondence is a numeric one (needed for the matrix calculus) but it is usually represented trough symbols. This research uses the following symbols for expressing the correlation degree: strong=⊙; medium=O; weak=Δ. For filling out the correlation matrix the following steps are needed:

- The customers requirements are selected starting with the first one up and ending with the last one down
- The technical characteristics are selected starting left and ending right
- Each row is filled out at the intersection with each line with the correlation between the requirement of the customer and the technical characteristic of the product/service
- If there is no correlation than the intersection is left empty

The evaluation matrix is filled out with the difficulty degree for each technical characteristic. Specific matrix calculus is performed either manually, or using specialized software.

The next stage would be the interpretation of the results based on the prior identified correlation degree. If there is more than one QFD analysis that refers to the same product/service, it is possible to do a concatenated analysis of all the QFD's using statistical calculation programs.

Applying the QFD method

There are several ways for applying the QFD method. The simplest option is to use a single matrix, in which correlations are verified between inputs. Customer requirements serve as entries and as outputs a prioritization of the technical characteristics of the product (CTQ - critical to quality) will be obtained. The weight of each feature will be established (calculated – manually or by computer) based on the correlations completed matrix (Brad 2004):

$$i_k = \sum_{i=1}^{n} r_i \cdot a_{ik}; k = \overline{1,m}$$

where:
n – is the number of stakeholder requirements;
m – is the number of technical characteristics;
i_k – is the calculated importance degree of each technical characteristic;
r_i – is the weight of the i-th customer requirement;

a_{ik} – is the relationship coefficient established between the *i*-th customer requirement and the *k*-th technical characteristic.

The results are displayed primarily in percentages according to the importance of each CTQ. The method does not require major material resources, but for a proper application several teams are required to work individually, just so objective results will be obtained.

The first step to take is to get the support of management for applying the method. Management must allocate the necessary time for each member of each team, so their performance in the method will not be superficial and will not be overlapped with other activities. This ensures that each member is dedicated to the application of the method and the participants are aware of its importance and will carry out the preset tasks. Also, the purpose of applying the method has to be made known to members before starting the meetings to avoid blurs and thus allotted time will be used to the maximum. No time will be you will not waste time with explanations during working hours.

The next step involves collecting customer needs. Furthermore they must be understood correctly to avoid loss of quality of the final product. Clearly the customer can't be satisfied at 100 % for two reasons. The concept of customer itself incorporates not just one individual, but many, and it would be ideal that all people should be fully satisfied. This is not possible, each individual having their own set of preferences. The second reason is that there are so-called intrinsic characteristics of the product that the customer did not specify, but expects the product to contain them. Similarly, the intrinsic characteristics of an individual can be specified requirements of another individual, it depends on each culture and education of each one. From this point of view we can say that quality is subjective and to eliminate this aspect, while applying the QFD method, more than one team will work with numerical data for providing objective results.

The amount of individuals can be grouped into several categories to divide all the requirements and to better understand what the customer wants. A distinction between intermediate and end user customers or principal beneficiaries has to be made. For example, when designing a car it must be kept in mind the intermediary customer requirements, who in this case are: the driver, the mechanic or in a broader sense the person or legal entity who owns the car, but more importantly there must be understood the requirements of the end user, in this case the passenger that uses this means of transportation. Each of these individuals interacts differently with the product and each has its own set of requirements, the product does not necessarily perceived in the same way. Often final beneficiaries and intermediary customers coincide, but if a distinction is made between the requirements of several categories the term "client" satisfies the needs of a greater number of individuals. Thus, by increasing the proportion of satisfaction for more individuals, a product with higher quality is obtained.

What makes QFD method unique is that the main concern are the customer needs. The process is driven by what the customer wants. Therefore more effort has to be involved in determining exactly the customer requirements. This makes the time for designing the product to grow, but it will reduce the time required for launching the product on the market.

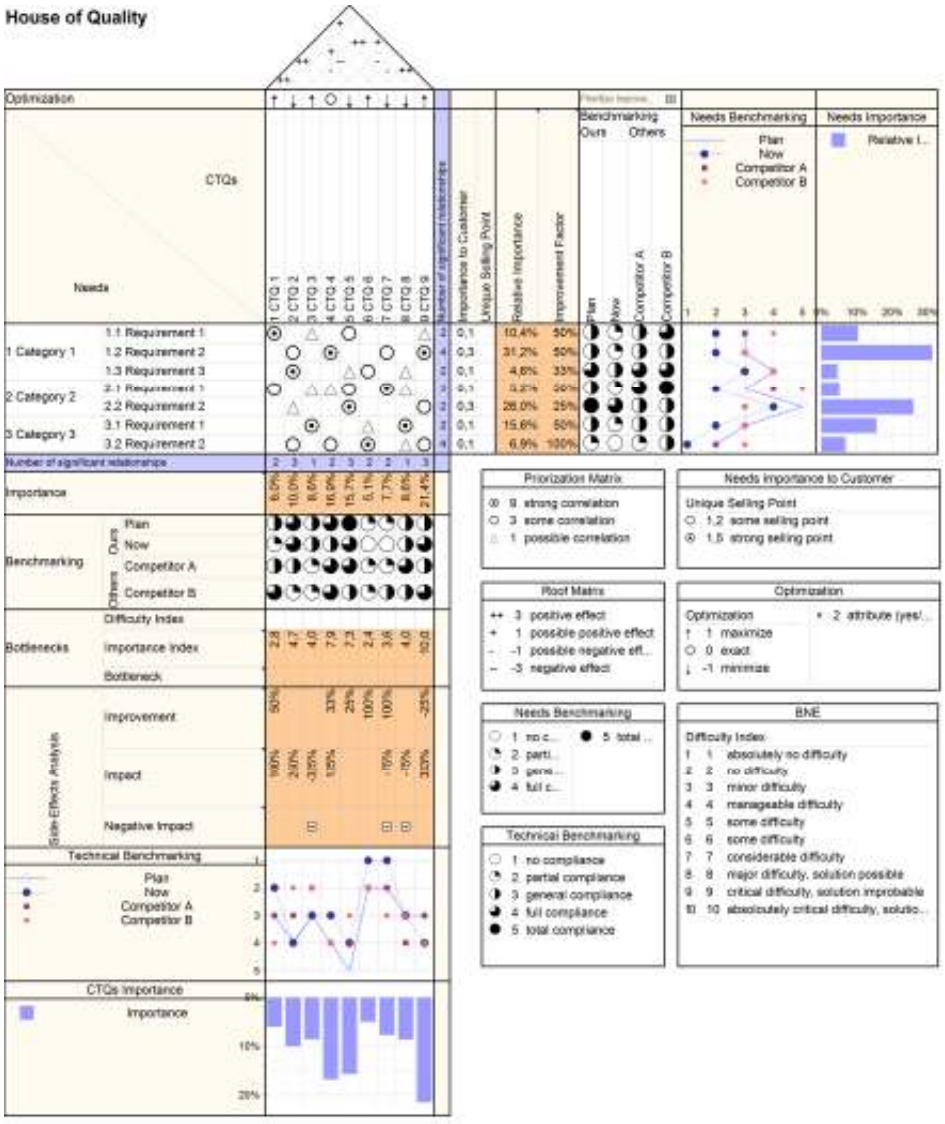


FIGURE 3.4 House of Quality example

To maximize the impact of QFD method it may be combined with other quality tools such as the brainstorming method, affinity diagram, Pugh, VOCT I, VOCT II, AHP. Also, for improved impact through more deployment stages, QFD can be used in a cascading approach, with the outputs becoming inputs for the next stage (also named Clausing's model).

Pugh Method

By advancing through the product development phase and product design process a point is reached where there are multiple solutions available for one problem and the best solution is yet to be chosen. In the case of product design there could be more design variants or alternative embodiments for one product. A suitable method which comes in aid of selecting the right solution is the Pugh matrix. The creator of this method is Stuart Pugh, also inventor of the Total Design methodology. The main idea of this tool is that the variants are compared with a reference element with respect to a set of predefined criteria.

The Pugh matrix has a lot of versions which can be applied to different scenarios and situations. For example the input set of criteria can be pre-prioritized or not, the evaluation scale can include 3, 5 or more values (based on the Saaty scale), different symbols can be used representing different compliances with the set of criteria and so on.

In the case of innovation and product development it is proposed a version that is more commonly used: the set of criteria constitute as customer requirements, which have to be prioritized before serving as input for the matrix, and the scale of -3 (strong negative effect), -1 (some negative effect), 0 (neutral), +1 (some positive effect), +3 (strong positive effect) should be used. The comparison can be done without a reference concept, in this case, it is analyzed, the impact of the requirements on each concept. Each square of the matrix is completed and in the end the concept having the highest score (above 0) is selected.

TABEL 3.8 Pugh table example

			Proposed concepts		
			Concept 1	Concept 2	Concept 3
Item	Requirements	Importance	Concept scores		
1	Requirement 1	15.6 %	0	-1	-1
2	Requirement 2	22.9 %	+1	+1	-1
3	Requirement 3	33.7 %	-1	+3	+3
4	Requirement 4	14.1 %	+3	-1	-1
5	Requirement 5	7.6 %	+1	0	+3
6	Requirement 6	6.1 %	+3	+1	0
Positive effects			4	3	2
Negative effects			1	2	3
Neutral effects			1	2	1
Net effect			0.574	1.004	0.713

The values are multiplied with the importance factor of each requirement. The multiplied values are then summed up and the "Net Effect" is obtained representing the proportional rating of each concept, i.e. the rating of Concept 1 is calculated using the following formula:

$$\sum_{i=1}^{n} = \frac{Importance\ of\ Requirement\ n}{100} * Concept\ score\ n$$

According to (Brad 2004, 186-191) there are 7 steps in elaborating the Pugh method:

STEP 1 – IDENTIFYING THE CRITERIA

In this case customer needs are translated to CTQ requirements. As stated in the previous chapters CTQs should have attached exact values, thus enabling them to be quantifiable.

STEP 2– PRIORITIZATION OF INPUT DATA

If the Pugh method is used after deploying QFD method the CTQs are already hierarchized as a result of the matrix and their importance could be used as input data. Otherwise the ranking can be done using AHP method or similar prioritization methods.

STEP 3–DETERMINING THE UTILITY CURVE FOR EACH CTQ

During this step graphs are created for representing the customer level of satisfaction. The Y axis of these graphs represents the theoretical customer satisfaction measured in percentage. The X axis represents the value of the CTQ attribute in question. For each pair of customer satisfaction % and CTQ value a point is created on the graph. After connecting each point the utility curve is obtained,which represents the customer level of satisfaction. This is somewhat subjective proceeding because the graphical representation of the customer satisfaction is done through the eyes of the engineer(s) applying the method. He or they are the ones that agree upon the customer satisfaction for each value.

Graphic representation of utility curves

STEP 4 – CONCEPT RATING

Each concept is compared with the criteria and a score is given based on the decision of how each requirement influences the concept. The scale of rating is: -3, -1, 0, +1, +3 (it can be changed according to user preference).

STEP 5 – CONCEPT EVALUATION

The rating of each variant is calculated, using the above mentioned formula.

STEP 6 – SELECTING THE BEST ALTERNATIVE

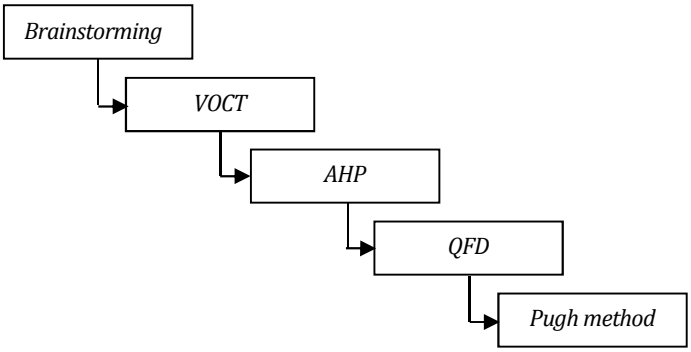
The proposed concept having the highest possible score above 0 will be selected

STEP 7 – FINAL EVALUATION

This step comprises of a supplementary and final analysis after which one out of several alternatives is selected. As practice shows, a judgment based solely on numbers could be the wrong one. Experience also plays a key factor, thus the final evaluation will be done with the help of an experienced engineer and it will result in the selection of the final and best variant.

Structured deployment of VOCT, AHP, QFD and Pugh method. Example

Example. *Using Qualica, a specialized software tool, a renewable energy solution is selected for the needs of a small tourist business by deploying several methods and linking them in a cascaded way:*



The first step was the constitution of a team within the Design Engineering and Robotics Department from the Technical University of Cluj-Napoca.

A responsible was selected out of the team members, who will introduce into the software all the data upon which the members agreed. In this way it is assured that errors due to software misuse are avoided and the information is not redundant.

OK	Voice of Customer	What?	Who?	When?	Where?	Why?
	Need as stated by the customer	What is really meant? Rephrased customer ...	Who is requesting this?	When is the product being used?	Where is the product being used?	Why is this being requested?
	1 It should be cheap	Cost efficient	Customer	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	2 It should require little capital	Small initial investment	Customer	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	3 It should have low noise	Silent	Customer End-user Local authorities	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	4 It should be easy to use and maintain	User-friendly and low maintenance	Customer End-user	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	5 It should not require additional accesories and parts	Minimal resource consumption	Customer	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	6 It should be possible to use in all types of weather	Weather independent	Customer	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	7 It should be possible to be installed immediately	Easy to install	Customer	Almost non-stop use	Indoor use	For powering household appliances independently from the grid
	8 The energy source should be used in more ways	Output versatility	Customer End-user	Almost non-stop use	Indoor use	For powering household appliances independently from the grid

	Technical University of Cluj-Napoca		
Department	Design Engineering and Robotics	Status	draft
Product	Renewable energy solution	Date Created	25 Jan 2014
Responsible	Dragomir Mihai	Date Release	14 Feb 2014
Prepared by	Bodi Stefan	Date Changed	
Team			

FIGURE 3.5 VOCT I analysis

After conducting the Brainstorming, a total of 8 requirements were found to be most significant and they served as input for the VOCT I method. The requirements were

further analyzed in such way that they were understood completely by each team member, they were rephrased and prepared for QFD use. (Figure 3.20)

OK	Voice of Customer Need as stated by the customer	Needs Rephrased customer need for use in QFD	CTQs Related Critical to Quality Characteristics	
	1 It should be cheap	Cost efficient		
	2 It should require little capital	Small initial investment		
	3 It should have low noise	Silent	Noise coefficient	20 dB
	4 It should be easy to use and maintain	User-friendly and low maintenance	Reliability (MTBF) Maintenance complexity	5000 h 3 man hours
	5 It should not require additional accesories and parts	Minimal resource consumption	Reliability (MTBF)	5000 h
	6 It should be possible to use in all types of weather	Weather independent	Up-time	24 h
	7 It should be possible to be installed immediately	Easy to install	Maintenance complexity	3 man hours
	8 The energy source should be used in more ways	Output versatility	Energy output level	300 kWh

Technical University of Cluj-Napoca

Department	Design Engineering and Robotics	Status	draft
Product	Renewable energy solution	Date Created	26 Jan 2014
Responsible	Dragomir Mihai	Date Released	14 Feb 2014
Prepared by	Bodi Stefan	Date Changed	
Team			

FIGURE 3.6 VOCT II analysis

The next step was the VOCT II table. This helped indentifying the CTQs and the target values for them (Figure 3.6).

After the preliminary VOCT methods were completed, the ranking of needs followed. This was done by the use of the AHP inbuilt function of the program.

Group:	Top Level Needs	Output								Completed
	AHP Toplevel Matrix	Cost efficient	Small initial investment	Silent	User-friendly and low maintenance	Minimal intervention for running	Weather independent	Easy to install	Output versatility	Importance in group
	9 9,00 an orde... ⅛ 0,25 essenti... 8 8,00 absolut... ⅛ 0,20 essenti... 7 7,00 demons... ⅛ 0,17 demons... 6 6,00 demons... ⅛ 0,14 demons... 5 5,00 essenti... ⅛ 0,13 absolut... 4 4,00 essenti... ⅛ 0,11 an orde... 3 3,00 conside... 2 2,00 twice as... 1 1,50 somew... 1,00 Equally ... 0,67 somew... ½ 0,50 half as i... ⅓ 0,33 clearly i...									
Input	Cost efficient		2	5	3	3	2	2	2	24,2%
	Small initial investment			3	¼	⅛	⅛	3	⅛	8,5%
	Silent				⅓	¼	¼	2	⅛	4,5%
	User-friendly and low maintenance					⅓	¼	2	⅛	9,3%
	Minimal intervention for running						½	2	1	14,4%
	Weather independent							2	1	19,8%
	Easy to install								½	5,6%
	Output versatility									14,0%

FIGURE 3.7 AHP prioritization matrix

As previously shown, the AHP is completed by comparing pairs of requirements between them. Each time the following question was asked: "How important is the need from the right column compared to the one above?" If it is more important an integer number is written signifying how many times is more important. If it is less important a fractional number is written and the denominator represents how many times is less important.

The final, prioritized list is shown in the figure below:

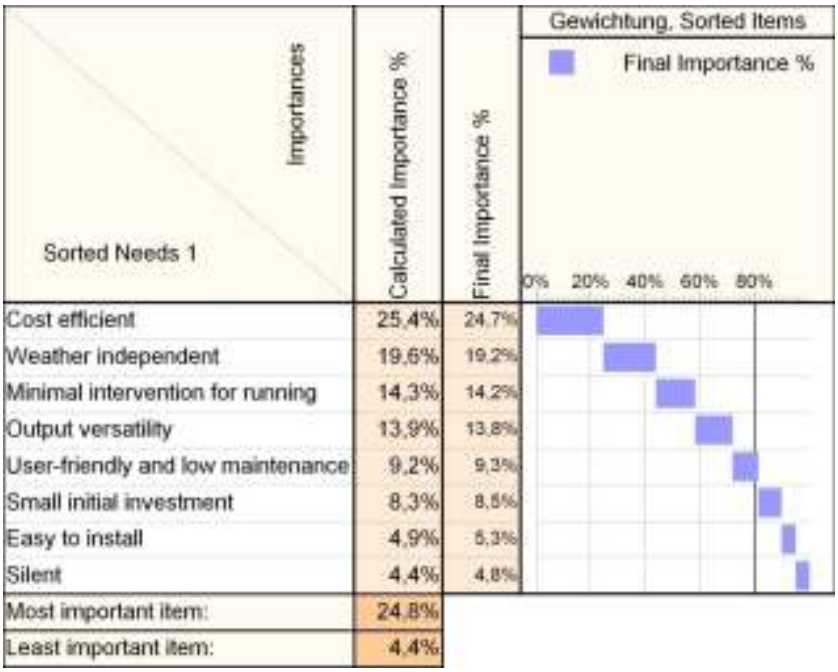


FIGURE 3.8 Prioritized needs in order of importance

The software recommends that the most important item should be at least 5 times more important than the last item. In this case the condition is fulfilled as the most important item is 5.77 times more important than the last one. The results are automatically normalized and the Final importance of each item is obtained and displayed graphically.

The prioritized needs then served as input data for the House of Quality and the QFD matrix, showed in Figure 3.8.

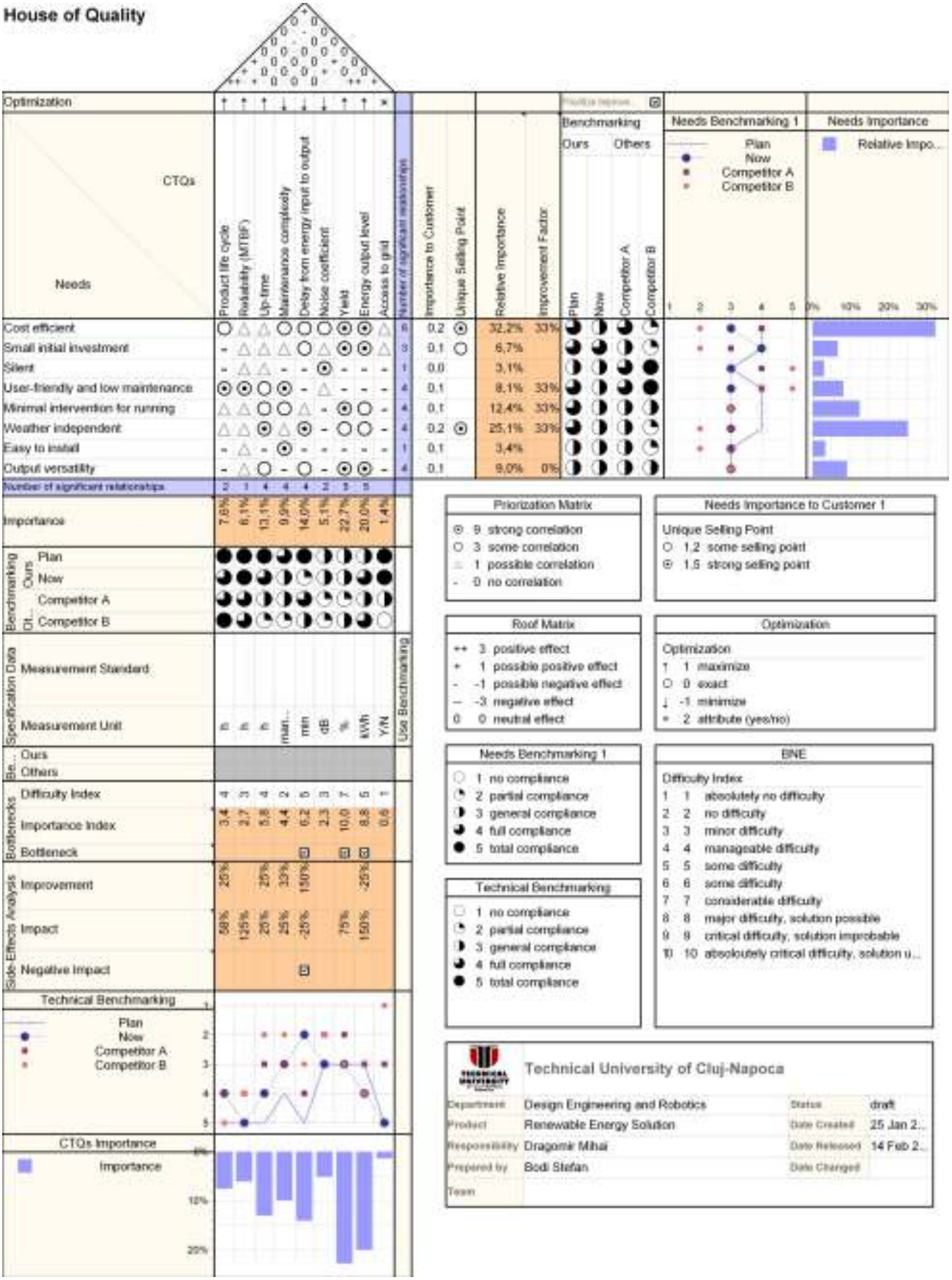


FIGURE 3.9 House of quality

At this stage the CTQs were analyzed firstly: it had to be decided in which way should they be optimized and then they were compared to each other to see what influences exist between them. It can be seen that mostly there are positive influences (+, ++) and a couple of negative ones (-, --), the rest have no influence on each other (0). Where negative influence is present true optimization cannot take place, because as we increase the performance of one CTQ the other ones performance will drop. In this scenario much more complex problem solving tools have to be deployed in other to solve this issue and to harmoniously combine the CTQs. Through this analysis performance-related problems are identified at an early stage and it is assured that the product will be used safely with maximum performance.

The next step consists in completing the actual QFD matrix. The correlation between needs and CTQs is analyzed and decided what type of correlation exists. The legend for the symbols used can be seen in Figure 3.9. In this analysis needs with unique selling point are also taken into account: their importance degree was boosted by attributing strong selling point (1.5) or some selling point (1.2) values.

IMPORTANT!!! On each row there must be at least a strong correlation, otherwise the need of the customer which is not strongly correlated with a CTQ won't be mirrored in the product's performance indicators. Thus, that particular need of the customer won't be satisfied.

After obtaining the importance of each CTQ two types of benchmarking were done: needs and technical benchmarking. Both of them were displayed graphically in Figure 3.9.

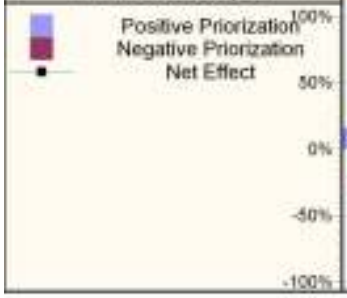
Furthermore, bottlenecks in obtaining specific CTQ targets can be identified. By attributing a difficulty index for the CTQs the software calculates possible bottlenecks and displays them with the ☑symbol.

The Pugh method is the final tool used for selecting the appropriate solution of renewable energy. The four possible solutions are compared to the specific needs of the customer and the best one is chosen. The Pugh method will be deployed as described in the above chapter, using the same scale.

The results are then calculated, automatically in this case, and the solution having the highest score is displayed graphically in comparison with the other ones. The final results can be observed in Figure 3.10.

Needs \ New Concepts	Aeolian solution	Solar solution	Biogas solution	Geothermal solution	Importance
Cost efficient	+	++	-	-	32,2%
Small initial investment	--	++	-	-	6,7%
Silent	+	++	+	+	3,1%
User-friendly and low maintenance	-	++	+	+	8,1%
Minimal intervention for running	+	++	++	+	12,4%
Weather independent	-	-	++	+	25,1%
Easy to install	--	++	-	○	3,4%
Output versatility	-	-	+	+	9,0%
Positive Effects	3	6	5	5	
Negative Effects	5	2	3	2	
Neutral Effects	0	0	0	1	
Net Effect	-2	4	2	3	
Positive Priorization	15,9%	65,8%	44,2%	19,2%	
Negative Priorization	-24,2%	-11,4%	-14,1%	-13,0%	
Net Effect	-8,3%	54,6%	30,1%	6,3%	

Multicriteria Analysis



Needs-Concepts-Matrix

++	3 strong positive ef...	--	-3 strong negative ef...
+	1 some positive eff...		
○	0 neutral		
-	-1 some negative ef...		

FIGURE 3.10 Concept selection using Pugh's method

Chapter 4

Transnational partnerships

Creating the transnational partnership

According to the (UN Global Compact 2013) there are seven main steps that have to be respected when building a successful partnership, capable of achieving preset goals and objectives. It can be argued that all partnerships are unique, however, the following steps constitute as common elements regarding all partnerships. In essence, a successful model can't be obtained, if one of these steps is omitted or skipped.

STEP I – IDENTIFYING AND SELECTING POSSIBLE PARTNERS

Basically any type of entity can associate itself with another, if the partnering is found to be opportune for all involved parties. Namely, these entities can include any type of companies, official institutions, non-governmental organizations, or even research or academic institutions. There are no restrictions regarding potential cooperation, however there are some factors that limit this aspect including the following:

- ✓ end scope of the partnership;
- ✓ resources involved (material or human);
- ✓ matching competences and experience of partners;
- ✓ timetable;
- ✓ political and legal aspects.

The risks and rewards have to be carefully analyzed in order to select a compatible partner which can assure the completion of the project and reduce the risks by deploying its connections or infrastructure. Thus, from the early stages of a partnership the goal and objectives have to be clearly defined. Additionally, an estimate about involved resources has to be made in order to identify the scale of the project.

Competences and experience of potential partners have to be described and it has to be formulated the contribution of each one. The more heterogeneous the skill set is of involved partners, the higher the success rate of the project and the better the chance for finding innovative solutions to problems occurred during the time stretch of project (Leonardo UK National Agency 2003).

Timetables also have to be synced, this way assuring that no other external activities will influence projects tasks. The contribution and timetable analysis at this stage does not have to be done in-depth, as these will be reviewed and detailed at a later phase, after the potential partners have been compared and the best are selected. Finally, all the necessary authorizations have to be obtained (in the case of governmental institutions or civil society organizations) and legal aspects have to be identified and taken into account.

STEP II – INDIVIDUAL CONTRIBUTION OF PARTNERS

After the selection process is complete, the definition of roles and individual undertakings can begin. All involved partners have to know what they are responsible for. If one or more partner is capable of completing a certain task, it has to be delegated the most competent one in that area. Overlapping competences can lead to disputes, if the responsible(s) is (are) not clearly named.

Mapping the core competencies of all partners helps when deciding who is responsible for what. This way it is also assured that each partner will have its mark on the outcomes and that it is included in the decision making process.

The management of the partnership can be done by selecting a lead representative, preferably who has the most experience, but not necessarily because all members can express their vote regarding this issue. The lead partner will have to mobilize all the resources involved in such a way that at least the primary goals are achieved. The temptation is however to enforce its own interests upon the rest of the partners, but deflecting from the previously set objectives can lead to partnership failure.

The partnership should be designed to be inclusive, meaning, that all the involved entities (regardless of their country of origin) should have their own separate role and the budget allocation should be made according to this principle (Leonardo UK National Agency 2003). If the project activities are shared only by partners from the same country the transnational nature of the project is jeopardized.

STEP III – SETTING UP THE TIMETABLE

The partners have been chosen, the competences have been described, roles and contributions have been distributed, now it's time for putting them all together in a timeframe. Due to the vastness of a multi-national partnership it is carefully divided into distinct implementation stages, each with its own objectives and preset outcomes that are reviewed and evaluated at the end of each phase.

Activities are created corresponding to each stage and they are designed to lead to the achievement of pursued results. Activities, which does not depend on the outcomes of another, or standalone activities can be completed simultaneously, thus shortening the implementation time and saving resources. There are cases, however when it is desired for a partnership to last as long as possible, because the longer it carries out activities the greater the impact. Such partnerships address, for example, environmental challenges.

Additionally to designing the activities performance indicators have to be defined, which will reflect the degree of implementation or the failure or success at the end of each phase. These results must be communicated to all partners and to external stakeholders (UN Global Compact 2013).

When creating the timetable it also has to be kept in mind, that there are cases in which a partner decides to exit the partnership prior to contracting. The completion of the activities set in each phase must not be influenced by this factor and the remaining partners have to be capable to overtake the activities left uncovered (Leonardo UK National Agency 2003), quickly, such that the success of the project will not be put to the risk.

STEP IV – DEFINING THE PARTNERSHIPS SCOPE

The definition of the scope also defines the magnitude or scale of the partnership. The results and objectives set the scope to be local, regional or global, each with its own advantages and drawbacks.

Local partnerships are easier and much faster to implement, than at a global level. They involve local resources deployed by local companies serving local beneficiaries with local needs (UN Global Compact 2013). The time-span of these types of partnerships are usually short, however this can be influenced by the amount of resources involved, number of partners and bureaucracy of local authorities.

Global level partnerships are much visible and serve the needs of millions. The risks are greater, they involve considerably more resources and stretch over long periods of time.

STEP V – CREATING THE GOVERNANCE STRUCTURE

The governance structure is the backbone of the partnership. It sets the rules about how the partnership functions and who is responsible for which stage of the project, how resources are allocated and who is involved in the decision-making process. Designing this structure can prove to be difficult, if multiple partners are involved and the magnitude of the partnership is significant.

The governance structure is constituted by three key factors:

> "the underlying agreement, the chosen degree of autonomy and the established management bodies" (UN Global Compact 2013).

The underlying agreement can be looked as the core element of the partnership. When a consensus is reached and interest is expressed between the partners, that is, the moment when the partnership starts to exist effective immediately. This agreement can be in the form of an oral expression of cooperation or it can take a written, more official form. In both cases there are advantages and disadvantages, and when choosing

an agreement form all of them have to be weighed and considered, in the context of that particular situation. The oral agreement offers flexibility, it is non-bureaucratic, avoids complex legal procedures and it can be terminated at once without any other supplementary actions. On the other hand the legal risks are higher, the degree of uncertainty for success increases, partners are not motivated for respecting deadlines and the security level of investments is very low. Opposed to this type of agreement, the written partnership contract builds trust between partners, clearly stating all the necessary information and conditions agreed upon and signed by all involved members (UN Global Compact 2013).

The degree of autonomy is set by how the partnership is administrated and how does it function: if it is managed as a project it has a low autonomy degree, if it was constituted to be a newly formed entity it has a high level of autonomy. Again, this depends on the scale of the partnership. When the partnership is managed as a project by an administrator who dealt with similar projects in the past his experience can be valuable, thus saving resources and time. The disadvantage of this is that by speeding up the administrative actions the potential of expanding activities are also limited. (UN Global Compact 2013). Newly formed partnerships require not only large financial resources, but also time and know-how needed for it to be operational. In contrast, the positive thing is that the expansion potential is much bigger and it can serve the needs of more stakeholders.

Management bodies are those who represent and help steer the partnership. When chosen, the scale of the partnership has to be taken into account: simpler partnerships require single practitioners, more complex ones need the governance of management teams. These teams can be comprised of chosen experts of the relevant partners (steering bodies) and other management support bodies. The latter ones are addressing strategic issues (their intervention in the partnership is periodical – once or twice a year), while the steering bodies are concerned with tactical and operational aspects of the partnerships (constantly adjusting activities to achieve desired outcomes) (UN Global Compact 2013).

STEP VI – FINANCING THE PARTNERSHIP

Depending on the needs of the organizations for development, self-improvement and growth the E.U. offers several opportunities, with financing through newly created programmes specific for research and innovation field.

The biggest one is the Horizon 2020 (also known as FP8 – Framework Programme 8). It contains numerous sections and hundreds of calls, covering a wide range of participants, from research organizations to SMEs. The first calls were released last year in mid-December. The main pillars of this programme are: excellent science, industrial leadership, societal challenges, spreading excellence and widening participation, science with and for society, European Institute for Innovation and Technology, Euratom.

Another important programme, is the Competitiveness of Enterprises and SMEs or COSME. This programme focuses specifically on developing SMEs. It has a six year

lifespan and a generous budget of 2.3 billion €. The main objective of this programme is to support and help SMEs to access financing, thus improving their access to markets. The first calls for this programme started last year in mid-December (only 9 were released), like in the case of Horizon 2020, but there are many more to come.

Additional information regarding these projects and other possible sources for financing can be found at the following webpage:
http://ec.europa.eu/research/participants/portal/desktop/en/home.html

STEP VII – MONITORING AND EVALUATING THE PARTNERSHIP

This process assures all the necessary information, needed to determine if the goals and objectives set at the beginning of the partnership are achieved or not. Monitoring activities gather key piece of information during the course of the partnership. This information is then compared to already established performance indicators, thus analyzing the extent to which they were reached.

While monitoring activities are conducted throughout the whole partnership, evaluation is done only at regulated time intervals or when an implementation phase is completed and the continuing of the partnership depends on the previous phase' success.

Because monitoring activities are a crucial part of partnership functioning and because they are done on an ongoing basis, the partners are usually responsible for their deployment. On the other hand evaluation can be outsourced to external institutions: consultancy firms, NGOs or academic institutions, in the case in which partners are incapable, or don't have the necessary resources, excluding financial, to do it themselves. (UN Global Compact 2013)

External evaluations are generally more expensive, than those conducted internally, however they assure a higher level of impartiality and they are done more objectively. Additionally, when needed, they can be presented as credentials to external stakeholders, proving performance level (UN Global Compact 2013).

Communication and conflict resolution

Team management and communication

Although we, as humans, physically have the same constitution we are very much different and defined by the environment we live in. Our behavior is very much influenced by certain factors, including: political, economic and religious beliefs, which shape our individual thinking.

The above mentioned notions constitute our culture, which is synonymous with the nation-state: German culture, Chinese culture, Russian culture, etc. However, even at a national level, within a sovereign state there can be distinguished significant cultural differences between factions, named cultural groups. For example, Milanese and Sicilians, both live within the borders of Italy, thus both are part of the Italian culture. However significant differences can be observed between these factions, so they are categorized as cultural groups. (Lewis 2012, 9-11)

Each cultural group has its customs and specific behavior and they follow their own set of rules, written or unwritten. The ones that have the greater impact are the unwritten ones, which in the eyes of an individual belonging to a separate cultural group can be found strange and hard to accept or comply. This is the reason why cultural differences are so difficult to resolve and individuals belonging to one group are hardly accepted by other culture groups.

The concept of globalization is slowly changing all these paradigms, due to ever increasing international interactions in almost every field, people from different cultures, working together to achieve the same objectives, are becoming more and more aware of the importance of accepting, respecting and understanding other cultural groups' customs, communication styles and ways of thinking. (Lewis 2012, 9-11)

Regarding international teams, members that have a significant background in this field tend to label their experiences with colleagues from certain cultures: they might find that they get along better with some than with others. Nevertheless, the correct and moral attitude when in a multi-cultural international team is to adapt to the team members preferences in such a way that no one will feel disconsidered. This could be very difficult to achieve, since one individual could be very reluctant to change his behavior for another, but all this comes with experience.

Thus, it can be said that a multi-cultural team could be difficult to manage. All these differences between members are conflict sources, which divert from punctual activities and could lead to failure in achieving the objectives. What is the reason that despite these disadvantages the best team, regarding its structure is considered to be the multi-national one? The answer to this question can be summed up in just a few words: excellence through versatility out of diversity.

The key word here is diversity. Even if there are some disadvantages when constituting a multi-national team they pale in comparison with the pros. As discussed in the previous chapters the "spark" that ignites innovation is creativity. Within a team built employing members with the same way of thinking (from the same cultural or cultural group) creativity is very low. New ideas or unconventional ones are a bit difficult to obtain as the problem is viewed through a narrow perspective.

On the other hand within intercultural teams creativity is stimulated between team members by broadening the thinking spectrum. Ideas stimulate ideas, thus radical solutions are proposed and innovation is born.

Figure 4.1 illustrates a comparison between different types of teams with different levels of performance corresponding to each one.

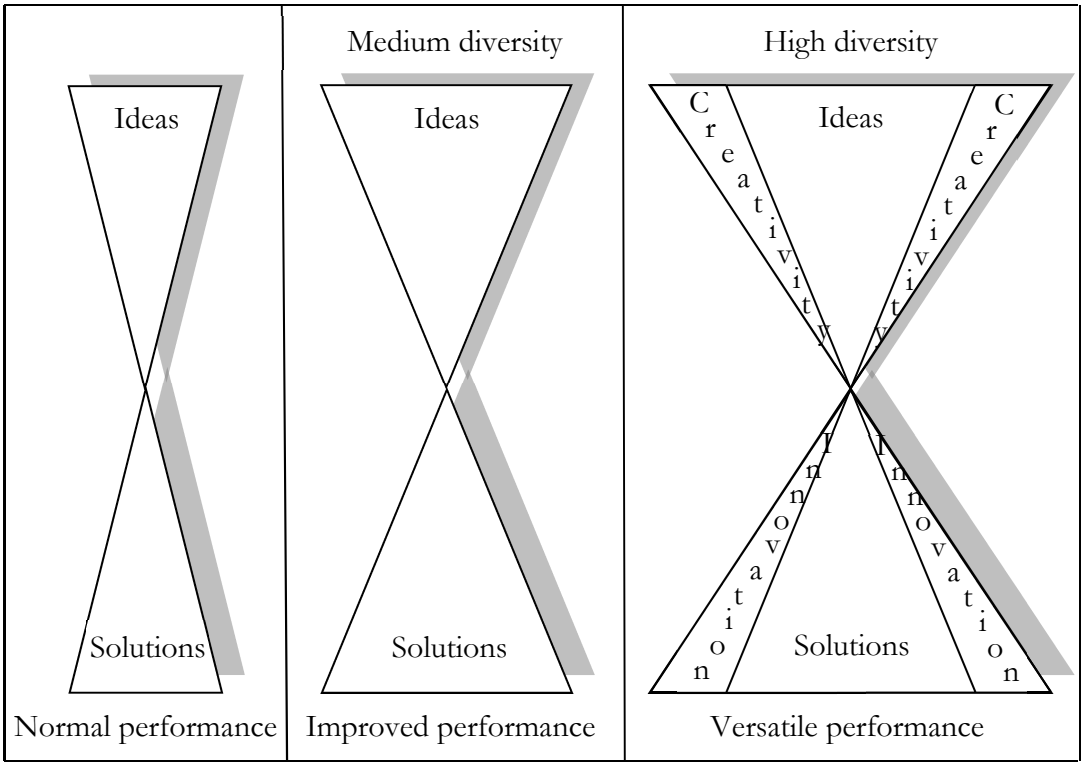


FIGURE 4.1 Correlation between team diversity and performance

Adapted from (Lewis 2012)

Considering all the above, the manager of the intercultural team is supposed to bring all the team members to common ground. The first step in this direction is to establish a "universal" communication style, accepted by all members. Secondly, rules have to be set up right from the beginning and made known by all members regarding identified divergent values such as: "directness vs. diplomacy; punctuality vs. flexible attitude to time; scientific vs. contextual truth, etc." (Lewis 2012, 26)

Conflict resolution

The most common factors due to which conflict situations occur are miscommunication and misunderstanding the coworker or team colleague. Adding the international element to the team we obtain a very prone to conflict scenario. Within a multi-cultural team, things tend to get lost in translation, preset goals are misunderstood and ideas expressed incorrectly. These conflict sources have to be avoided and/or corrected by making everything clear to everyone. If the team members know what to do, they will be busy completing their assignments on their agenda and they "won't have time" to get involved in conflicts.

Supporting the above hypotheses managers intersected in the real world with the following situations, speaking out of experience:

> "The main source of virtual conflict occurs when people don't have the same expectations about outcomes or goals. Confusion occurs around who is doing what, who is allocated how many hours, and personality differences" – Virtual Leader, Investor Relation (Yael 2012)
>
> "The biggest virtual conflict involves communication or lack thereof: How come I wasn't told? How come no one communicated with me? Other conflicts between virtual team members happen when people don't pull their weight. Generally, they don't talk to each other. They go to the project manager, and the project manager has to deal with it." – Project Manager, Pharmaceutical Company (Yael 2012)
>
> "Since you don't have body language and eye contact, which are so much a part of how we communicate, verbal or e-mail message scan be easily misinterpreted. There are many more misunderstandings in the virtual environment. For example, e-mail blasts across the organization can be more risky than yelling down the hall way. Conflict can arise from misinterpreting an e-mail sent out of emotion or not fully thought through." – Field Operations Manager, Gourmet Food Company (Yael 2012)

Although in a virtual environment actions leading to conflict can be overlooked or remain hidden because physical interactions don't actually happen, they are still present. However, this virtual barrier has both its negative and positive aspects. The negative aspect is that tension can build up over a long period of time and then suddenly explode, unlike in the case of physical interactions, where tensions are released immediately and gradually. Of course, this issue is also related to the type of the individual's personality. Introverted personalities tend to build up anger and when they can't take it no more, they unleash it all. Amongst the positive aspects it can be mentioned that the virtual barrier provides a "thinking time buffer". This means that individuals can analyze their perceived tension scenarios and see if they were wrong or

not in that situation. If they realize that they made a mistake the tensions will not build up anymore. Again this is also in close relation to the type of the individual's personality and if they are capable to admit that they were wrong. It is up to the virtual team manager to foresee all these situations and scenarios and diffuse them before a breakdown in communications happens.

According to (Yael 2012) there are four typical types of virtual conflicts: performance conflict, identity conflict, data conflict, and social conflict, which are presented below:

I. PERFORMANCE CONFLICT

This type of conflict is constituted by all the work-related factors. Differences regarding schedule in completing a certain task, resources needed or even the manner in which a problem is dealt with can bear potential conflict sources.

These differences have to be resolved in such a way that all the involved parties are satisfied as possible with the decision or they convene upon a solution themselves. It is recommended that smaller conflicts are deal with the latter approach, thus stimulating the bondage between members. However, it has to be noted that in both cases a mediator is needed, otherwise the so called small conflict can escalate and more people could become involved in it. Unresolved and persistent issues lead, mostly, to low performance, however in some cases certain conflict scenarios can energize team members, thus increasing overall performance.

II. IDENTITY CONFLICT

This sort of conflict, like the name suggests, happens mostly when team member(s) report to more than one manager or supervisor. In a big organization, with numerous employees, teams and departments it is difficult complete all the assignments given by multiple superiors, especially when the organizational chart is arranged vertically. This means that the employee can receive multiple tasks to complete simultaneously. Figuring out priorities can be found difficult, thus conflict situations can emerge.

The conflict can escalate when superiors of the same employee have different views and objectives. Even if these incompatibilities are minor, the employee won't know what he actually has to do and who to follow.

III. DATA CONFLICT

Since our modern times dictate the use of information technology, even when communicating, this also constitutes as a potential source for conflict. Online communication is starting to overthrown the traditional ways, especially in a work environment, where everyone does their daily activities with the help of a computer. It seems to be easier to send e-mails and memos to colleagues rather than speaking with them directly. What we don't realize is that everyone is bombarded with information and it's hard to take it all in, analyze it and prioritize it. The so called data conflict

situation appears when team members aren't aware of key piece of information exactly because it was lost in the pile.

This conflict source tends to be underestimated as, seemingly, it has no impact for team members' in carrying out their activities. Practice shown that this is not the case: it must be noted that when a conflict source has the potential to lower performance it has to be very much taken into account and dealt with right from the beginning.

IV. SOCIAL CONFLICT

Finally, social conflict occurs when team members are not able to create a bond because their views upon certain aspects differ very much, thus tension situations and arguments are prone to take place. This can be avoided if teammates are introduced properly and if they take time to try to know each other and start up face-to-face communication. If this doesn't happen, small conflicts occurring sporadically can build up over time between team members and suddenly erupt having negative consequences.

Glossary

Innovation process – The process through which customer requirements are met by incorporating into a newly developed product solutions that have not been employed before

Support innovation – Innovation that focuses on improving existing products, correlated with customer requirements

Disruptive innovation – Innovation through which a new market is created, by improving or totally replacing an older technology

Product innovation – The development/creation of new products or the improvement of existing ones resulting in a more competitive product on the market

Process innovation – The development/creation of new processes or the significant improvement of existing ones that provide advantages regarding productivity, delivery method, service capability or efficiency

System innovation – The development/creation of a new system or the improvement of an existing one, requiring major resources from different fields and stretching over long periods of time

Innovation model – Management model that includes innovation into the governance of an organization

Continuous improvement – The ongoing effort of an organization for improving their processes and products

Deming cycle (or PDCA) – 4 step management tool used for deploying continuous improvement within and organization

Kaizen – Japanese philosophy based on continuous improvement for every aspect of an organization

6-3-5 Method – Stimulative creativity tool for finding (innovative) solution

Mind map – Stimulative cognitive method used for problem solving or for exploring alternative solutions

VOCT (Voice of customer table) – Tool used for describing and understanding customer needs

Kano model – Tool used for identifying and categorizing customer needs as well as for establishing a customer satisfaction level

AHP (Analytical hierarchy process) – Method used for prioritizing customer requirements through successive comparison

QFD (Quality Function Deployment) – Method that boosts customer driven design and planning of quality through all stages of product development

The house of quality – Graphical support for the QFD method

CTQ (Critical to quality) – "Must-have" technical characteristics through which a product performance can be measured

Cascaded QFD – Subsequent, 4 step use of QFD method

Affinity diagram – Method used for categorizing and organizing ideas resulted from brainstorming or from other creativity stimulating tools

Pugh matrix – Instrument that helps select the most advantageous variant compared to several others

Transnational partnership – Agreement between organizations from various fields of activity and different countries

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NoGAP project partners:

Beneficiary name	Logo	Country
Steinbeis Innovation gGmbH, Steinbeis-Europa-Zentrum		Germany
Technical University of Cluj-Napoca		Romania
SC IPA SA		Romania
Slovak University of Agriculture in Nitra		Slovakia
Union of Slovak Clusters		Slovakia
Belarusian State Agrarian Technical University		Belarus
Republican Centre for Technology Transfer		Belarus
International Centre for Advancement of Research, Technology and Innovation		Georgia
Georgian Technical University		Georgia
National Technical University of Ukraine, Kyiv Polytechnic Institute		Ukraine
Centre for Science and Technical Information and Innovation Promotion of Ukraine		Ukraine
E.O. Paton Electric Welding Institute of NAS of Ukraine		Ukraine
German Aerospace Center		Germany