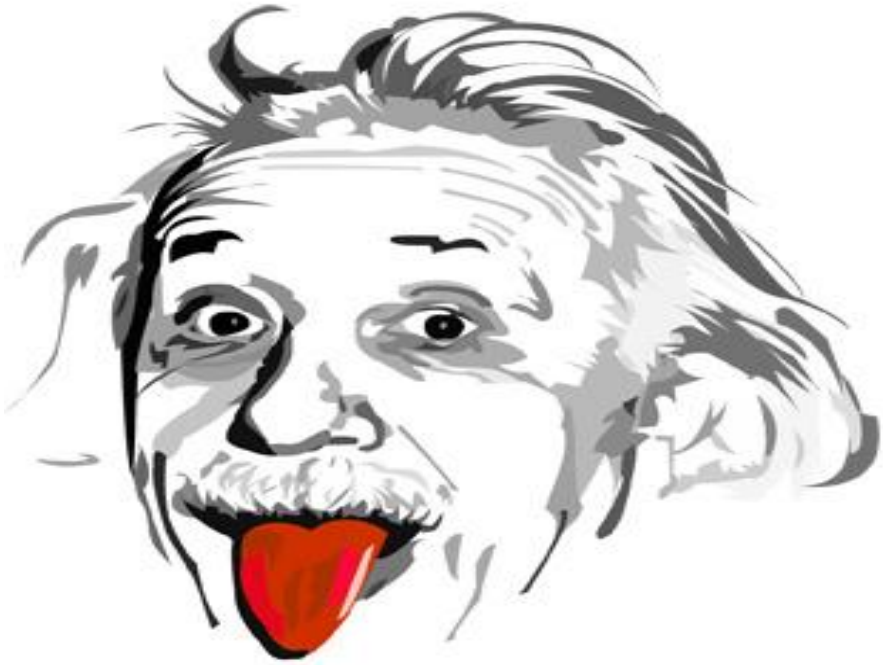
AALBORG UNIVERSITET

# MASTER THESIS

# A Framework for Individual Creative Problem Solving

Based on CPS, TRIZ and Lateral Thinking



*"The Secret to Creativity is Knowing How to Hide Your Sources" (Albert Einstein)*

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# Mike Master Thesis

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## Executive Summary in Danish

De seneste år har innovation stået højt på de fleste virksomheders dagsorden, nu har en ny bølge ramt os nemlig kreativitet. Kreativitet er nærmest blevet et buzz-word og bliver nu betegnet som det der skal styrke og bære den vestlige verdens konkurrence evne. Der er dukket mange koncepter op der skal lære virksomhederne at være kreative, fælles for de fleste er at de skal faciliteres af en facilitator/konsulent og ofte involvere gruppe aktivitet. Disse koncepter er som regel kostelige og ressourcekrævende for en virksomhed og formen kan være grænseoverskridende for mange. Dette speciale stiller spørgsmålet om den kreative problem løsnings proces skal være så avanceret og ressourcekrævende? Problemet er at det praktisk talt vil være umuligt for de fleste danske virksomheder at løse daglige udfordringer i den daglige drift, hvis det indebærer at skulle planlægge og opsætte en gruppekreativitetsproces hver eneste gang. Tesen er at den kreative proces ikke nødvendigvis er avanceret og "flippet", men at man kan arbejde kreativt på en systematisk simpel måde.

Derfor er tre af de mest anvendte og populære tilgange til kreativ problem løsning valgt, CPS (Creative Problem Solving) oprindelig skabt af Osborne, TRIZ (the Theory of Inventive Solving) skabt af Altshuller og lateral thinking kreeret af de Bono. Hver af disse tilgange er opstillet på følgende måde; først deres definition på kreativitet, derefter hvad de anser for at være kreativ tænkning, slutteligt er processen for hver af de pågældende tilgange opstillet. Her skal det bemærkes at TRIZ of Lateral Thinking udmærker sig ved ikke at, fra skaberens side, have en beskrevet proces men mange forskellige værktøjer og historier. Derfor er disse processer opstillet ud fra undertegnedes forståelse for hvordan den kunne se ud.

Disse tre tilgange er så blevet sammenlignet på tre områder: definitionen af kreativitet, kreativ tænkning og den kreative problemløsningsproces.

Ser man på selve processen for de tre tilgange vil man se at de i første omgang virker meget avancerede og komplekse, det er dele af specielt TRIZ da også, men prøver man at se på de enkelte værktøjer ser man at mange er simple i deres form og anvendelse. Et af de vigtige elementer i at arbejde kreativt handler om at fokusere på en ting af gangen, og dette kan gøres med simple virkemidler.

Det interessante ved de tre tilganges syn på kreativ tænkning er at de ikke er én tankegang, men en kombination af to måder at tænke på, den ene er det man kan kalde logisk eller kritisk tankegang, som flest mennesker besidder og mestrer. Den anden måde at tænke på har forskellige navne efter hvilken tilgang vi taler om (CPS: divergent, TRIZ: Imaginary, de Bono: Lateral Thinking) fælles for dem er, at det handler om at tænke anderledes end den logiske/kritiske tankegang. Det vil sige at være kreativ ikke kun handler om at tænke ud af boksen, være flippet men i høj grad også handler om at bruge den "sunde fornuft".

# Contents

# 1. Introduction

The need for creativity and innovation is of the highest importance in companies today. This is especially true in the western world due to the competition from low labor costs in the Asian countries but also due to the increase in the numbers of newly educated engineers including computer engineers (China: 600,000 India: 460,000 a year (Lype 2006)). Many workplaces and functions have moved to these countries and this transition leaves the remaining workforce with the challenge of changing their work habits and/or competences. This change is much like the change that happened when we went from a society based on agriculture to an industrial based society; some have referred to this change as the transition from the information age to the concept age (Pink 2006) what that means is, from having to perform routine work and be specialized in one area the workforce must now be to able to piece parts from different areas together in order to create the *big picture*. One might argue against the idea of calling it a transition from information to concept, but the main point is that in order to be able to stay in the global competition there is a need for stepping up to the challenge and adapting to the changes. The focus on improving the business through efficiency and cost reduction and the *doing what we do better* and *improved customer service* approach are no longer enough (Proctor 2005), today it is imperative to take a creative and entrepreneurial approach to exploit new opportunities (Sloan 2007) and creativity must be positioned as a core business skill (Bilton 2007).

The strong need for building creativity throughout organizations is shown to be widely acknowledged. It is however the presumption of this project, that the thoughts, theories and approaches towards defining creativity and establishing creativity processes within organizations are too numerous, too costly, too unclear, too broadly defined and too exaggerated in their complexity for the majority of organizations to make successful use of these. The following segments will explore and discuss these presumptions through presenting some of the most important aspects and approaches to the subject of creativity.

## 1.1 Problem Background

The "market" is full of concepts influenced by the creativity idea, and the best way to understand the concept of creativity is by looking at it in a holistic view. Creative add-bureaus like IDEO, creative problem solving concepts all have their rightful place in the market; with their thinking tools, work practices, strategy, management techniques etc. each of them supply a distinct component of the operating system for innovation. In Denmark the majority of companies are small or medium sized, and for the most part they do not have the resources to hire consultants or specialists from other trades whenever they want to be creative or innovative. For such companies to use creativity for developing innovation in the daily work as a continuously process they need a more hands on approach which is not costly in resources.

At company level there are several *roadblocks* when trying to implement a systemic approach to innovation. These are: Chaotic and unorganized process, lack of solution search and generation strategy, the knowledge needed may be found outside our knowledge area, lack of cross-functional communication and interaction, difficulties in defining the problem to solve, generating numerous alternatives with trial and error methods, strong mental inertia which prevents us from thinking "out of the box" *(Souchkov 2007).*

One of the problems with most of the processes involving creativity is the fact that they are based on psychological stimulation and involve changing thinking patterns or attitudes that already exist in the individual or within the group and the trick is to generate new ideas which have not been seen by the individual before (which are unknown to the individual). These processes do not bring new knowledge into the innovation process but rather stimulates the knowledge already present in the group (Hipple 2005). Furthermore, most of them are based on the interaction between individuals for creating diversity and thereby on the encounter between different expertise areas. However, there seems to be a whole range of obstacles for an individual to be creative in a setting involving other people or in a company setting in which it may not always be possible, due to the amount of resources, to hire people from different trades or to hire a consultant company every time the need to be creative arises.

## 1.2. What is Creativity?

Just as the different techniques and concepts are best seen in a holistic view, this also applies to the definition of creativity. In literature an abundance of definitions of creativity may be found some of which refer to creativity as: *"the achievement of something remarkable and new, something which transforms and changes a field of endeavor in a significant way"* (Feldman, Cziksentmihalyi & Gardner, 1994). Others add to the sources of creativity, and define creativity as: *"a person's capacity to produce new or original ideas, insights, restructurings, inventions or artistic objects, which are accepted by experts as being of scientific, aesthetic, social, or technological value"* (Vernon, 1984), finally some narrow it down to a simple statement: *"creativity is the ability to produce new knowledge"* (Dacey & Lennon, 2000). Maslow envisaged creativity as a universal aspect of human nature which is found in all human beings. He divides creativity into two levels; primarily, creativity is the source of new discovery, novelty and new ideas coming from what exists at a given point in time. Secondary, creativity is the characteristics possessed by scientists in their collective search for new discoveries alongside other people, based on previous research (Maslow 1970). All these definitions are mainly concerned with creativity as a "product", as something that can be evaluated by someone and identify creativity. A different view of creativity is that of suggesting that creativity is the breaking down and restructuring of our knowledge about something in order to gain new insight into its nature, emphasizing that the understanding of our cognitive model of reality is of highest importance for understanding creativity, that any problem solving may be creative to some degree, that every one of us must to some extent be creative in our daily lives (Haefele 1963). Creativity is "the personal discovery process, partially unconscious, which leads to new and relevant insights" (Rickards 1988) and is very much concerned with how we imagine things, it starts where the language ends (Koestler 1964) and the process of being creative is the escape from assumptions and the discovery of new and meaningful perspectives, in other words, the act of making new connections to things and discovering what has not been considered (Gillian 1993).

However, there seems to be some consensus on the regard that creativity refers to something *novel* (original, unexpected), this may be the ability to come up with new and different viewpoints on a subject and that creativity involves restructuring our knowledge about the subject in order to gain new insight into its nature. For something to be creative it has to be *valuable* (useful, adaptive concerning task constraints) (Sternberg 1988, Borghini 2005, Lubart 1994) this statement also seems to have consensus, but the definition on what is valuable is the big hurdle.

The big dilemma is that any definition is "colored" by the assumptions of the approach or author and creativity, being a concept with many dimensions, any definition may exclude other elements regarded by other approaches as being important.

### 1.2.2 The Creative Problem Solving Process

In order to solve a problem one can use a creative problem solving process, again several approaches as to how this is done may be found in literature. There seems to be some consensus on the regard that a problem or a task needs to exist and it needs to be understood by the recipient (this is especially important for problems of a creative character, thus, these kinds of problems tends to be multi-faceted). Amabile suggests that the overall creative process can be broken down into five steps; problem formulation, preparation, idea generation, idea evaluation and idea selection (Amabile 1984). When the problem is understood or formulated the next step is preparation where knowledge and data about the subject is collected. The method is very different from concept to concept, but the overall idea is to obtain some sort of knowledge related to the subject. It is difficult to find consensus regarding the next step apart from the fact that it deals with getting inspiration for new ideas or getting new ideas. Some concepts focus on using external stimulation for inspiration while others focus on the experience and knowledge residing in the person's brain; however, they all deal with getting new/novel ideas. The ideas are then evaluated with the purpose of selecting the most promising ideas, again the method varies in the different concepts. One of the first creative problem solving processes from 1926 suggests that the process consists of four steps: Preparation, Incubation, Illumination, and Verification (Wallas 1926). What is interesting about this process is the illumination step, which implies that some kind of "revelation" must be involved, not necessarily as in God speaks to you, but a step during which the person steps away from the problem and does something which relaxes or inspires him/her and then suddenly (maybe) new ideas will present themselves.

### 1.2.3 What Makes a Person Creative? What Drives the Creative Act? Blocks to Creativity

There are many different suggestions to which factors make (or hinder) the creative process for the individual. Some claim that it is the way we think, that the brain is caught in pattern thinking and the aim is to break out of this pattern with lateral techniques before the person will become creative (De bono 1977). Others take a more materialistic approach and define the problem as avoiding the trial and error process (which is time consuming and costly) and instead looking at the elements of the problem, separate the problem and then use inspiration from a matrix of patents (in the case of developing products, in other cases the matrix consists of other elements) (Altshuller 1984). Others focus on motivation (extrinsic and intrinsic) being the primary force of the creative process (Amabile 1998).

Another obstacle for being creative is the fact that the human brain is not designed to be creative, humans tend to view problems and situations from one angle and when we are secure with this view, humans have difficulties seeing the problem or task from other angles (Mann 2008). This is, of course, a somewhat subjective statement and the scientific validity might be questioned, but the message is that most people

use their positive experiences as a reference for how to react in a particular situation. Others find comfort in what is already "known" and are to some extent anxious when facing new challenges. The conditions for creative thinking are suggested to be: receptivity, immersion, seeing questions, utilization of errors and detached devotion. (Henle 1962).

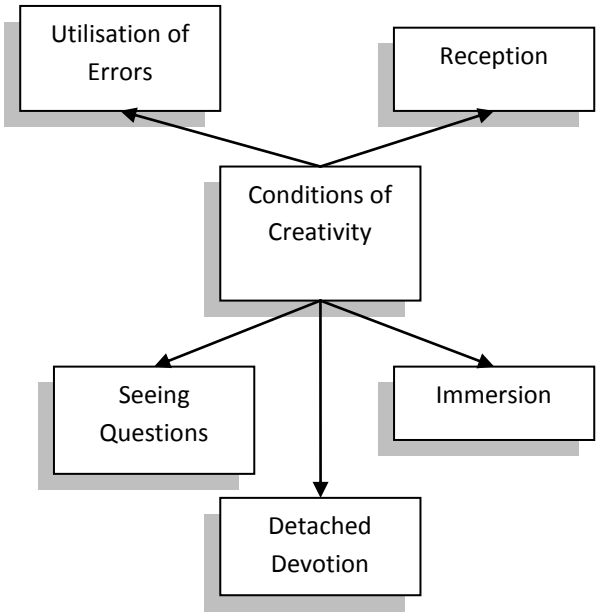



Figure 1 - The Conditions for Creative Thinking

(Source: Henle 1962)

Receptivity involves detaching oneself from current activities and simply paying attention to the ideas that arise. Immersion, our knowledge may work against our creative thinking for we tend not to think about what we know. Existing ideas tend to blind us to new ones, and it seems that creative ideas do not occur to us unless we spend a great deal of time and energy engaged in the exact activity which makes their emergence most difficult. The paradox is not easy to solve. Seeing questions, a question requiring an answer may in fact limit creative thinking since it is unlikely that we, in our thinking, will go beyond the question before us. Utilization of errors, an error may present a new problem and thus stimulate thought. Detached devotion, very intense motivation for solving a problem may well impede the problem solving process. In addition to this condition Arnold suggests that while some barriers limit the individual's creative output residing in people (themselves), others emanate from the environment wherein people operate, he suggests that the barriers may be seen on three levels: Perceptual blocks, the person may not have a "true" relevant picture of the world. Cultural blocks which are influenced by the society in which the person lives and finally emotional blocks which may be fear, anxiety and jealousy.

On the other side we have the well educated who to a large extent are familiar with the concept of creativity and are not afraid to try to come up with new ideas, these "experts" also face some blocks in their ability to be creative. Ford recognized the problematic it in the early 1940s as: "*The moment one gets into the "expert" state of mind a great number of things become impossible".* Some have named this an "expert-trap" while others define it as psychological inertia (Altshuller) and it is essentially an intellectual block, a person who is an expert within a field may have problems seeing ideas or solutions from other areas of expertise.

In *The Theory of Individual Creative Action in Multiple Social Domains* (Ford 1999) the findings on what constrains creativity from the psychological research and the sociologic research are put together and the result is that there seems to be a struggle between habitual behavior and creative behavior in the sense that creative actions are not likely to emerge unless they are expected to present personal consequences that are relatively more desirable than familiar behaviors (Ford & Gioia 1995). This argument is based on what he calls *slices of life* which is what makes up the experiences of the individual and these slices are directed towards some goal(s) or desired outcome(s). Others characterize them as *sense making frames*, as the situation in which an individual is presented with a task and asks the question: "What (is that) is going on here?" (Kahn 1998). These frames or slices of life are the primary generator of individual action (conformist or creative) and the individual forms an intra subjective cause-and-effect reference frame/map of events, actions and consequences and places her/himself in this map and takes actions according to this map (Drazin et al 1999). This frame/map can be described as the joint influence of sense making x motivation x knowledge and ability (Downs and Mohr 1976) (figure 3).

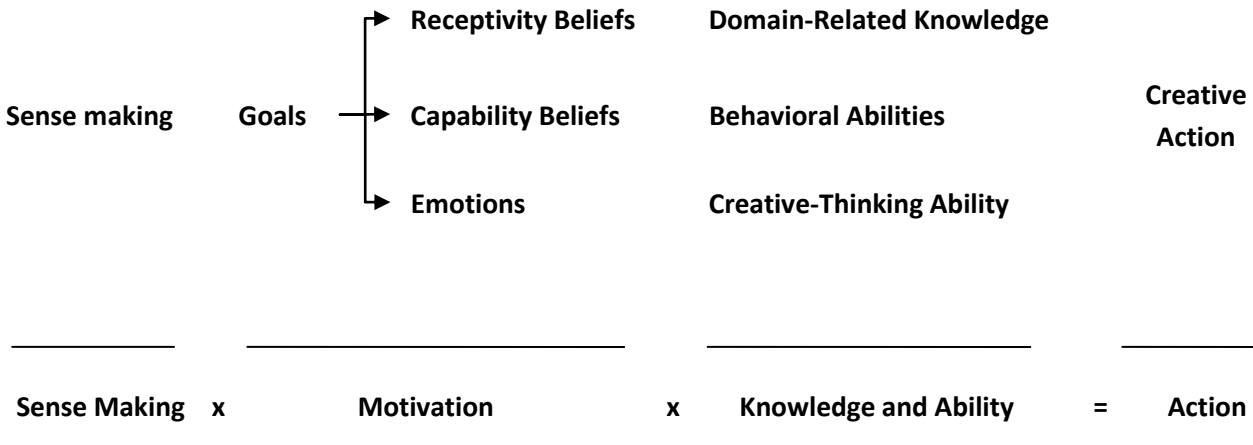



Figure 2 -Sense Making x motivation x Knowledge & Ability = Action

(Source: Downs and Mohr 1976)

In a organizational setting this implies that it must be constructed to enhance a climate and culture that encourages innovation and creative thinking (Jones & MacFadzean 1997) this can done by ensuring the employees safety, in the case a project fails no one's job is in danger (Anderson et al. 1992) and it is the manager's job to ensure that the tasks/problem are well formulated and communicated to the organization (sense making). Managers must encourage creative thinking and ideas need to be implemented effectively in order to success and must give feedback to the employees (motivation).

The definitions and understandings of what blocks or enhances creative thinking are as varied as the definitions of creativity, the consensus seems to be that generating ideas is not a chance process; ideas appear to arise only when people are looking for them. One could call it the x-factor for creative thinking one has to be curious and look for a solution/idea/problem and the problem solving process and creative problem solving skills are useless if the person lacks the desire for solving the problem (Davidson & Sternberg 2003).

## 1.3 Relevance

The relevance of creativity is of highest importance for the competitiveness of companies today, companies face a large number of problems all of equal importance and an increasing number of these problems have few or no precedents. The need for techniques or tools to compliment the traditional logical thinking, which is essentially only an extension of what we already know, is expanding if companies are to cope with the ever growing amount of new possibilities and challenges. Some even claim that building a creative and learning organization is prerequisite for business excellence (Evans & Lindsay 1999).

There seems to be no doubt that creativity and innovation are closely interconnected and some sources view them as symbiotically related phenomena (Academy of Management Review) others define innovation as turning ideas into product, services and processes which comes directly from creative thinking (Couger 1995) . Despite this closeness the research seems to have focused on innovation or creativity and not the interaction. Sociology, economics, engineering and organizational research–focused on innovation and creativity have almost exclusively been examined by psychology. Furthermore, it seems that the researchers studying one topic didn't have any knowledge of the other areas, or at best they only had peripheral knowledge of the results from studies in the other areas. This lack of cooperation or insight has resulted in a failure in capitalizing on the potential synergies.

As mention in the introduction there are a lot of different concepts on the market offering patented creative problem solving solutions for a price. The problem with some of these concepts are that some companies find them hard to use in daily life, thus most of them are build as idea generating sessions are involve a whole range of "craziness". Writing this project it is the author goal that the findings can be use for companies to find inspiration to develop their own process.

## 1.4 Problem Statement/Thesis

The aspects presented in the former segments of the project show the range and numerous different theories, definitions and approaches to the creativity process, which combined illustrates the high level of complexity that is involved in defining and managing this. This high level of complexity is what distorts and encumbers the ability of various organizations to apply and successfully implement and manage the creativity processes, and thereby prohibiting these from producing innovative initiatives and gaining various other advantages that effective creativity processes may produce. Instead the complexity of the creative problem solving process causes organizations to suffer from insufficient and ineffective results due to misplaced resources and time consuming approaches.

Based on these conclusions / findings, the problem statement of this project is as follows;

***"How can creativity processes in organizations be simplified and streamlined to create a systematical, effective individual creative problem solving?"***

Individual is in present project defined as using what is inside your brain but also the interaction with other element, like data, knowledge and other people, what makes it individual is that these element acts as a medium and are not in the actual process, the interaction is lead by the individual. The purpose by naming it individual is the process is aimed to be used by one person to solve problems creatively, but do not exclude interaction with other peoples.

Therefore, the main object of the project is to construct and establish a new framework that, based on the present knowledge and theories on creativity, will seek to simplify and streamline these in order to make the creativity process more manageable (for the individual in the organizations).

In order to construct this new framework, the following two key questions for elaborating and solving the problem formulation need to be examined.

1. Based on a comparative analysis of the three most reputable theoretical approaches to creativity, CPS, TRIZ and lateral thinking, how can the different approaches combined and redefined in order to establish a new and more simplistic framework for managing the creativity process / creativity processes?

2. How can the new framework be constructed to effectively manage and strengthen individual creative problem solving at a low cost and with a minimal amount of resources?

# 2. Scientific Theory and Method

*The following is a introduction to the concept upon which this project is based on, this is intended to provide the reader with an insight into understanding how and what mindset the comparative analysis and the later new framework is founded on. Next part is a description of the data collection for this project and contains an introduction of the three different approaches to creative problem solving. Finally an explanation of the work process for each chapter will be setup and illustrated in a project design.*

## 2.1 Scientific Methodology

Let us begin with a citation, describing the importance of clarifying the methodological approach: "different methodological approaches make different assumptions about their subject area(s)" (Arbnor & Bjerke 1997). This implies that the work process will be affected by the chosen scientific approach. In the present project the system approach will be the best way to describe the view of the author.

The only way to fully understand why a problem occurs and persist in a science system is to understand the parts in relation to the whole (Capra 1996), this argument illustrates the core of the system approach. One can take a more pragmatic approach and claim, that it is practical and appropriate to describe realty as systems, and whether reality really consist of system is not important it is the explanation value that counts.

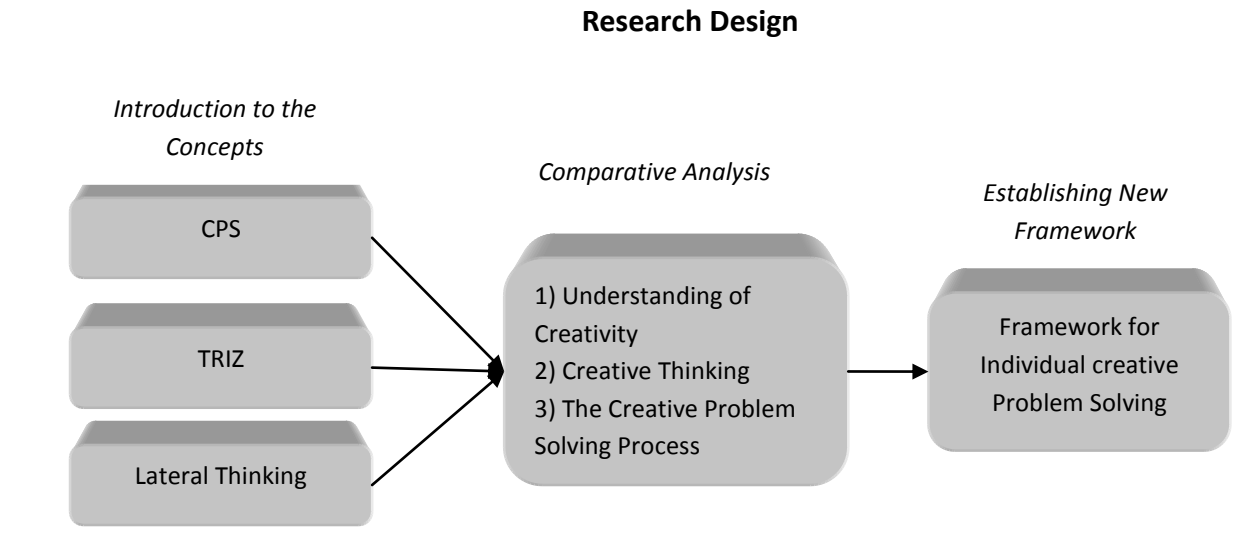



Figure 3 - Research Design

The scientific/knowledge ambitions of the system approach can be expressed in several levels. First step is to determine what type of system is being study, this is done by categorizing the system in different terms. In present project the systems are three approaches to creative problem solving (figure xx) and each of this system are described under the headings: 1) understanding of creativity, 2) Creative thinking and 3) the creative problem solving process. The ambition in the system approach is to describe the system (the three approaches) and determine a relation. In the comparative analysis the relation of the three approaches is determined and the final aim to present a guide to a new framework.

## 2.2 Data Collection

### 2.2.2 The Three Chosen Approaches

By way of introduction, short descriptions of the three concepts or approaches, which have been chosen as the basis for the new and improved individual creative process, will be given. They are different in the way in which they approach creativity; CPS is founded on psychological and sociological scientific findings and work. TRIZ is founded on inventive scientific work and regards creative work as a systemic process of which the result may always be predicted. Lateral thinking is founded on the assumption that the human brain is a pattern making machine and by altering ones perspective, all the knowledge in the brain will assist one in being creative and in coming up with new solutions. The three concepts have one thing in common; there exists not only one handbook but many different books and articles on how to use or understand the concept. This means that in establishing the framework a variety of sources are used, and the development of the framework suggested in this project is based on the above mentioned sources and the subjective understanding of these frameworks.

#### *CPS*

CPS is a systemic framework which suggests that the creative problem solving process happens in the interaction between two different thinking styles, divergent thinking and convergent thinking. The approach has developed a great variety of tools and techniques on how to approach different kinds of creative problems.

#### *TRIZ*

The concept of TRIZ (Russian algorithm for “Theory of Solving Inventive Problems”) suggests that innovation need not necessarily be based on psychological processes, and that innovation is a science that can be served in a practical and useful way like any other form of science. The TRIZ toolbox is a concept of problem solving, analysis and forecasting based on the study of global patent literature and patterns of inventions. This approach presents the individual with the possibility of getting input or inspiration from other areas of expertise in the creative or innovative process.

#### *Lateral Thinking*

Lateral thinking is essentially a thinking attitude; De Bono claims that lateral thinking is creative thinking opposed to logical thinking. This approach suggests a lot of different techniques for using lateral thinking new and novel ideas, but a framework on how and when to use the different techniques seems to be missing. Another tool created by Edward de Bono is the six thinking hats, which is a discussion tool. Each hat represents a color and a thinking attitude and can be characterized as the closest one might get to an actual framework for lateral thinking.

## 2.3 Methodology

*The following contains a description of the work process and the contents of the chapters of the present project.*

**Chapter 1 – Introduction**

The introduction consists of a discussion of the problem background of the subject in the present project as well as a discussion of creativity and the creative process. The Second part of the introduction is the problem statement in which the main purpose of the project is introduced. The purpose of the present project is to establish a framework for individual creativity that includes input/stimulation from other relevant areas (relevant to the task/problem). This is done by selecting elements from the three creative problem solving concepts (CPS, TRIZ and Lateral Thinking) and implementing them in a new concept.

**Chapter 2 – Scientific Theory and Methodology**

Chapter 2 consists of three parts, in the first part the scientific methodology gives the reader an understanding of the concept of reality on which this project is based. The work process of each chapter is then described and finally the work process is illustrated in a project design.

**Chapter 3 – The Three Approaches**

The purpose of this chapter is to introduce the three approaches (CPS, TRIZ and Lateral Thinking) to the reader. The structure of each of the approaches are similar, first a short introduction to the assumptions of the respective approaches. The assumptions are divided into two subtopics; the definition of creativity and creative thinking. The definition of creativity is used to establish how the approach defines creativity and creative thinking in order to identify which thought processes are seen as creative. This is then followed by a presentation of the creative problem solving process; this process will be structured as a systemic individual creative problem solving process. Finally, the chapter will end up in a table comparing the three approaches.

**Chapter 4 – Individual Creative Process**

Based on the findings in chapter 3 the aim is to establish a new framework for the individual creativity. At first the similarities are established in order to create the foundation for the steps of the new framework. Then comparative analysis aimed at establishing the differences between them will follow.

**Chapter 5 – The Framework for Individual Creative Problem Solving**

This chapter consist is a suggestion to how a new process could look like, based on the findings in present project. It begins with the assumptions which it is built on. Then the new framework is presented and discussed.

**Chapter 6 – Conclusions and Perspective**

Chapter 5 consists of a conclusion and the perspective deals with questions arisen in the project and some thoughts on the work process.

**Chapter 7 - Reference**

This chapter contains a list of the literature and publications used in the project.

## 2.4 Project Design

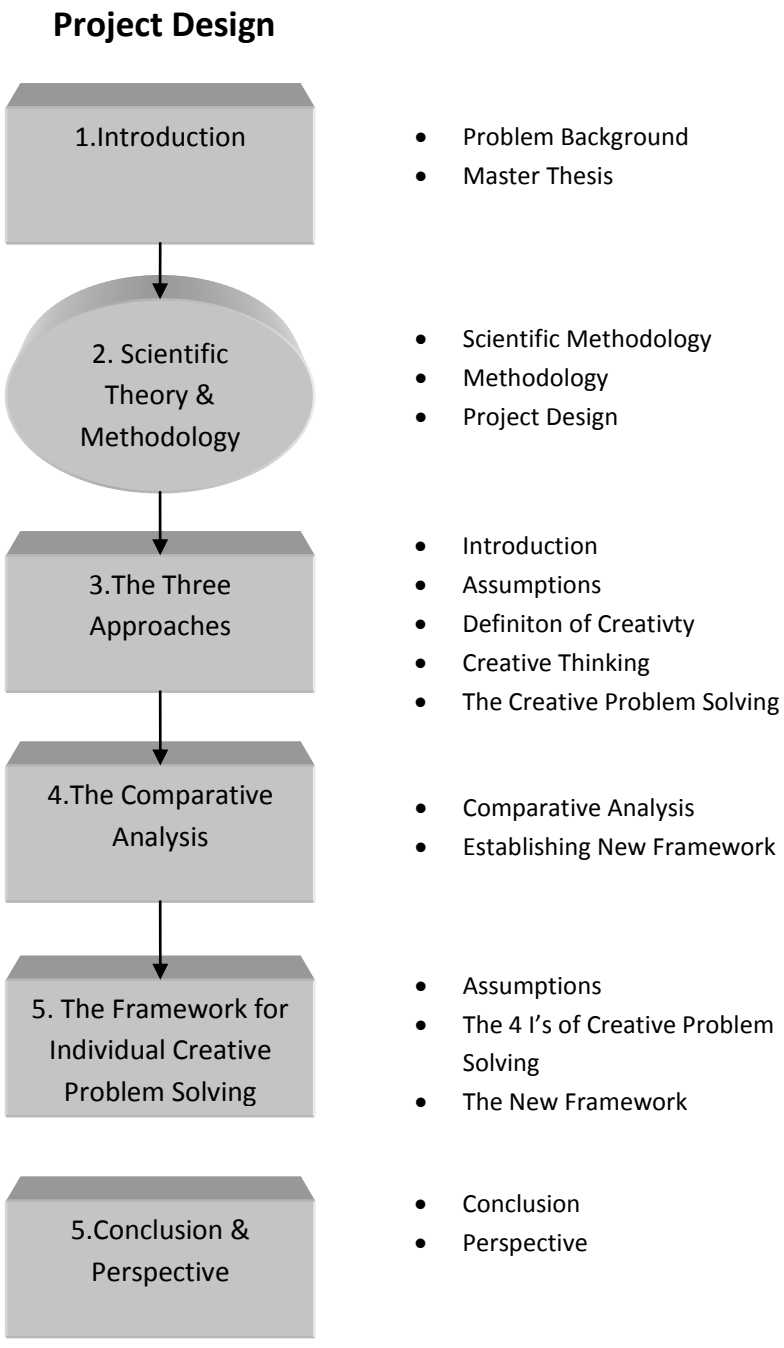
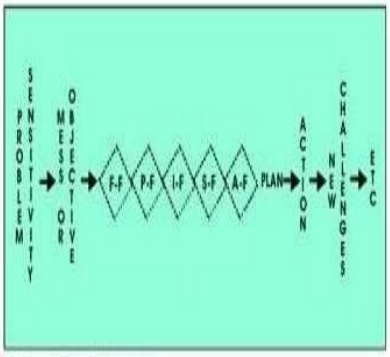


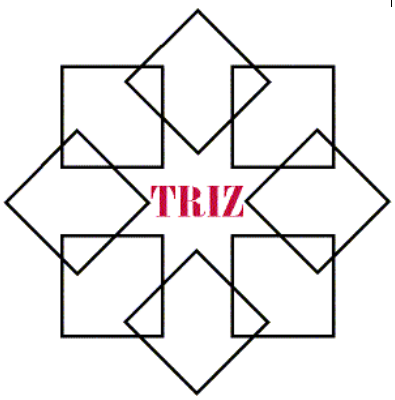

Figure 4 – Project Design

## 3. The Three Approaches

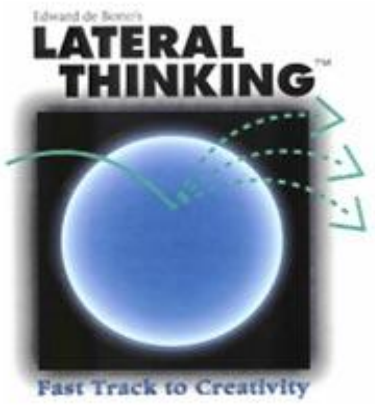
*In the following chapter three different approaches on how to solve a problem or task in a creative manner is introduced, these have been chosen because they are regarded as the three most popular and used approaches in the world. Each of these approaches will begin with a short introduction followed by the assumptions behind the approach, starting with their definition of creativity and what creative thinking is. The creative problem solving process is presented as a step-by-step process for each of the approaches, however, noting that the processes are dynamic and both loop and double loop can be used. The presentation of each of the processes have been constructed in preparation for use in the latter construction of an individual creative problem solving process, note that the construction of the framework for TRIZ and Lateral Thinking are done by the author and the selection of tools and techniques are likewise for all three approaches done by the author.*




*CPS*




*TRIZ*




*Lateral Thinking*

They are different in their way to approach creativity; CPS is founded on psychological and sociologic scientific findings and views all cognitive actions as creative. TRIZ is founded on inventive scientific work, and view creative work as a systemic process and that the result always can be predicted. Lateral thinking is founded on the assumption that the human brain is a pattern making machine and by taking another perspective, all the knowledge in the brain can help to be creative and come up with new solutions. The three concepts have this in common that there is not one handbook in how to use or understand the concept, but many different book and article. This means that in establishing the framework a variety of sources are used, and the framework suggested in this project are developed based on the mentioned sources and the subjective understanding of these framework from the author of present project.

## 3.1 Creative Problem Solving (CPS)

In the following chapter the Osborn-Parnes creative problem solving process (commonly referred to as CPS) will be presented.

**"*It is easier to tone down a wild idea than to think up a new one*."**

### 3.1.1 Introduction

CPS originates from Alex Osborne's (1953) work and was an attempt to improve the simple process of brainstorming (Hipple 2005). He strongly believed that everyone possesses the potential for creative behavior, and he advocated that imagination and judgment are essential to the creative production and that everyone can learn how to make better use of them (Treffinger 1995).

### 3.1.2 Assumptions

***Definition of creativity***

Creativity is a distinguishing characteristic of human excellence in every area and creativity can take many forms; flexibility, independence, high energy, fluency, playfulness, capacity to make order and much more (Treffinger et al. 1992), or in other words: "*the process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficult; searching for solutions, making guesses, or formulating hypotheses and possibly modifying them and retesting them; and finally communicating the results*" (Torrance 1989).. Creativity may be expressed in a broad array of areas or subjects, almost in an infinite number of ways (Torrance & Safter 1990), and it is manifested according to the interests, preferences or styles of the individual (Dunn, Dunn & Treffinger 1992).

***Creative thinking***

The fundamental view on creativity is that the creative potential exists within all of us and through training or instruction individuals may enhance their creative potentials and style, that new and creative ideas emerge from a conscious effort to balance analysis and imagination (Treffinger et al).

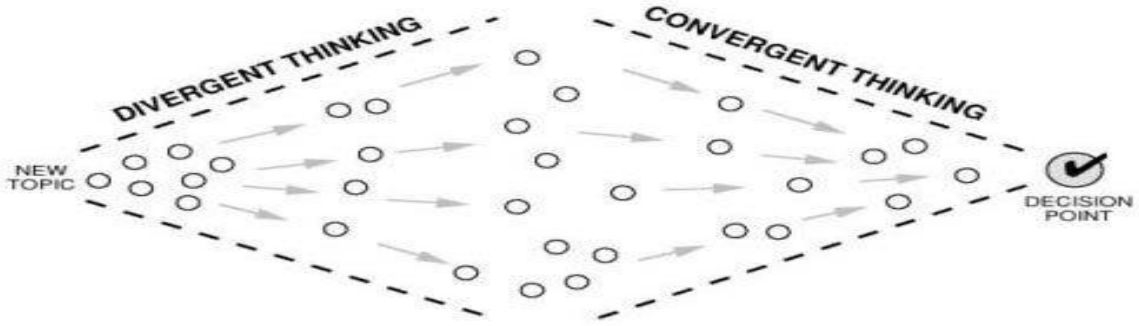



Figure 5 - Divergent Thinking vs. Convergent Thinking

CPS operates with two different thinking styles; divergent and convergent thinking. Within each stage of the creative problem solving processes both divergent and convergent thinking processes are used. The idea is that divergent thinking is used for stepping outside *the box* and convergent thinking is then used for structuring and evaluating the results. During the convergence phase, one looks for material which is either very close to the point of issue or close enough to call for further consideration. Specific items that are identified as important or relevant to a particular stage are known as "hits". Clusters of hits which are related to one another are known as "hotspots" (figure 5)

| Divergent Thinking | Convergent Thinking |
|---|---|
| Generating list of ideas | Sorting ideas into categories |
| Free-flowing open discussion | Summarizing key points |
| Seeking diverse points of view | Coming to agreement |
| Suspending judgment | Exercising judgment |

Table 1 - Divergent vs. Convergent Thinking

*(Source: Kaner 2007)*

*Figure 5 shows the idea behind the two thinking styles, example: when using divergent thinking in a group discussion the individuals express their own point of view, and when switching to convergent thinking the aim is to narrow down the differences and move towards a closure in the group.*

### 3.1.3 The Creative Problem Solving Process

As mentioned in the introduction, the creative problem solving process itself has undergone many changes since Osborne made the first framework. The following framework is structured in a step-by-step framework, however, the idea behind the CPS process is that it is possible to skip steps and, if one gets stuck in one process, to simply start over again.

The process consists of the following steps (Isaksen & Treffinger 1985):

- **O**bjective Finding – define the problem
- **F**act Finding- gather information
- **P**roblem Finding- define the problem correctly
- **I**dea Finding- generate solutions to the problem
- **S**olution Finding- evaluate and choose between possible solutions
- **A**cceptance Finding- implement the chosen ideas correctly

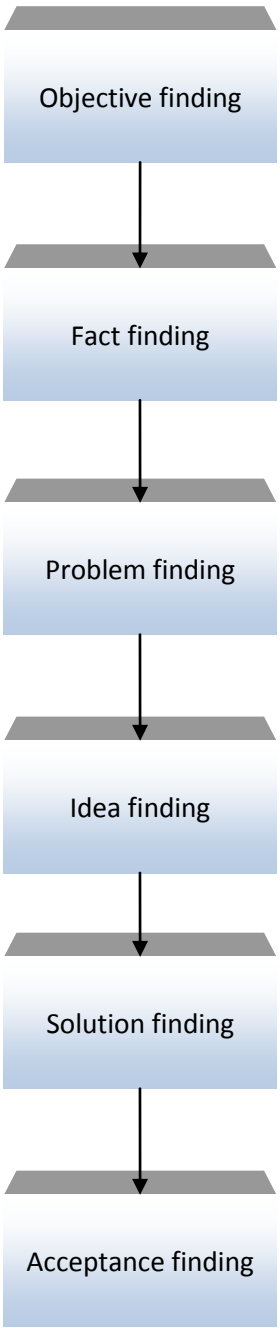



Figure 6 - CPS Framework

### *The objective-finding*

The first step of the process of the objective finding is also known as mess-finding (mess refers to finding the "mess" of interrelated issues, challenges, problems and opportunities to identify an area of focus). First of all, objective-finding is an ongoing process in which the person scans the environment for problems in order to gain attention to changes and new challenges. This may be done by using either past or current experiences or in comparison with what others have achieved and holding that up against one's own level of desirable performance. Establishing and defining the problem is the most important stage of the creative problem solving, for unless the problem is correctly defined, a truly satisfactory solution is unlikely to be found. Furthermore, if the problem is difficult to understand, it might easily be wrongly interpreted, thus resulting in a non-satisfactory solution. The objective-finding stage involves divergent thinking with the aim of generating a list of problems; convergence is then used to identify the most relevant problem areas for further exploration.

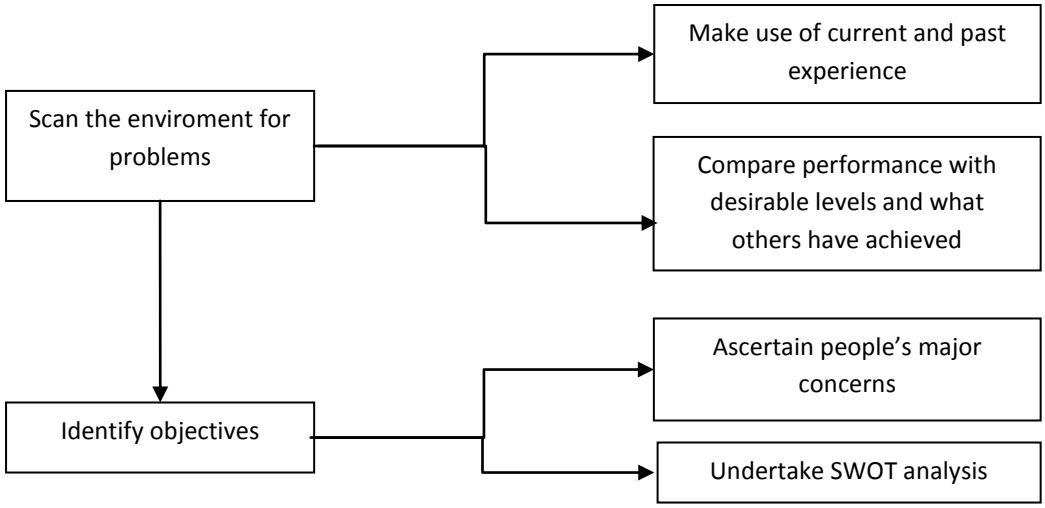



Figure 7 - Objective Finding

One way of identifying objectives is by looking at what people's major concerns are, or in other words what is popular these days, which topics are being discussed. SWOT can be used to identify various strengths, weaknesses, opportunities and threats; these are put in a matrix and hits are identified and when no more hits can be found one should look for clusters that can be combined into hotspots and a more generic or brief objective can now be formulated, this is done by using the ownership-, priority- and critical- criteria. Hits and hotspots are identified by questioning *ownership* (is one motivated to solve it), *priority* (how important is the problem) and *critical nature* (how urgent is it to solve this problem). Upon reviewing the hits and establishing the criteria, the problem statement can be decided upon (this "hits & hotspots" method is used in all the steps of the CPS framework.)

### *Fact-finding Stage*

The next step is Fact-Finding in which knowns, unknowns, issues, challenges and missing information are explored in order to understand the "mess". This is the stage in which the overall comprehension of the problem is increased by collecting relevant information. This is also helpful to the generation of new ideas. At this stage hits and hotspots may assist convergence thinking. The previously identified problem(s) may now be seen from a new perspective. The purpose of this stage is to generate relevant knowledge in order to improve the understanding of the problem, to obtain different perspectives on the problem. One way of doing this is to scan documents (internet) and reports and by attending meetings and talking to those involved in the problem solving (colleges, teachers etc.) and obtaining their knowledge.

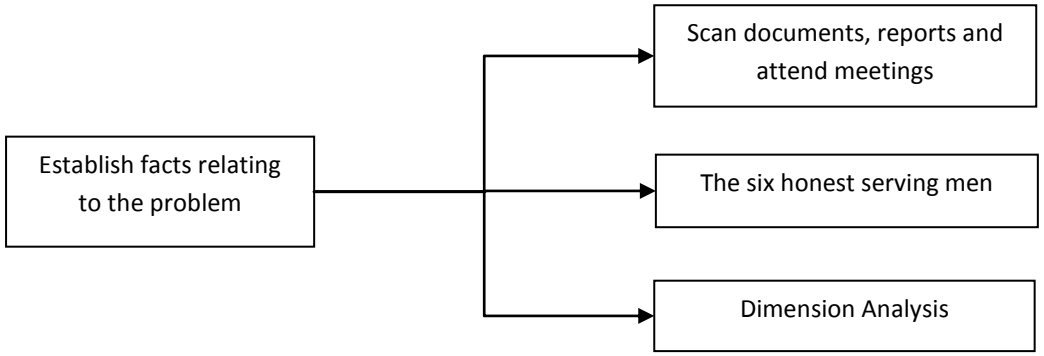



**Figure 8 - Fact Finding**

A tool which may be used for obtaining different perspectives on the problem is "the six honest serving men" (Parnes et al. 1977), a method, which uses as series of Who? What? Where? When? and Why? questions (table 2). The dimensional analysis (Jensen 1978) is a method used for defining the limits or boundaries and dimensions to a problem (table 3). When a satisfactory level of information is obtained, one may move to the next step.

**"The Six Honest serving Men"**

1) State the problem in the format "In what ways might" (who will be? What will they? Where will they? When should it be?)

2) Write down separate lists of Who? What? Where? When? Why? and How? Questions relevant to the problem.

3) Examine the response to each question and use as it a stimulus to generate problem redefinitions.

4) Record problem redefinitions generated in (3) above.

5) Select the best redefinition for ideation purposes.

Table 2 - The Six Honest Serving Men

**The dimensional analysis**

1) State the problem.

2) Write down separate descriptions of the problem in terms of What? Where? When? How much? How serious?

3) Answer questions relating to each of the five dimensions.

4) Asses the answers provided in terms of their significance for solving the problem.

5) Select those areas most pertinent to the problem for further analysis

**The five dimensions:**

- **substantive** (commission/omission, attitude or deed, ends or means, active or threatening, visible or invisible),
- **spatial** (local/distant, isolated or widespread),
- **temporal** (long-standing or recent, isolated or widespread),
- **quantitative** (single or multiple, many or few people, general or specific, simple or complex, affluence or scarcity)
- **qualitative** (deep rooted or surface problem, survival or enrichment, primary or secondary, what values are being violated, to what degree are values being violated, proper or improper values).

Table 3- The Dimensional Analysis

### *Problem finding*

Problem finding essentially uses the hits found in the previous-stage for identifying the most productive problem definition possible. The problem finding stage encourages one to consider different problem perspectives; by restating the problem new viewpoints may arise and lead to many creative solutions. A systemic redefinition technique approach in six steps is used for the purpose of considering all possible angles and information (figure 9).

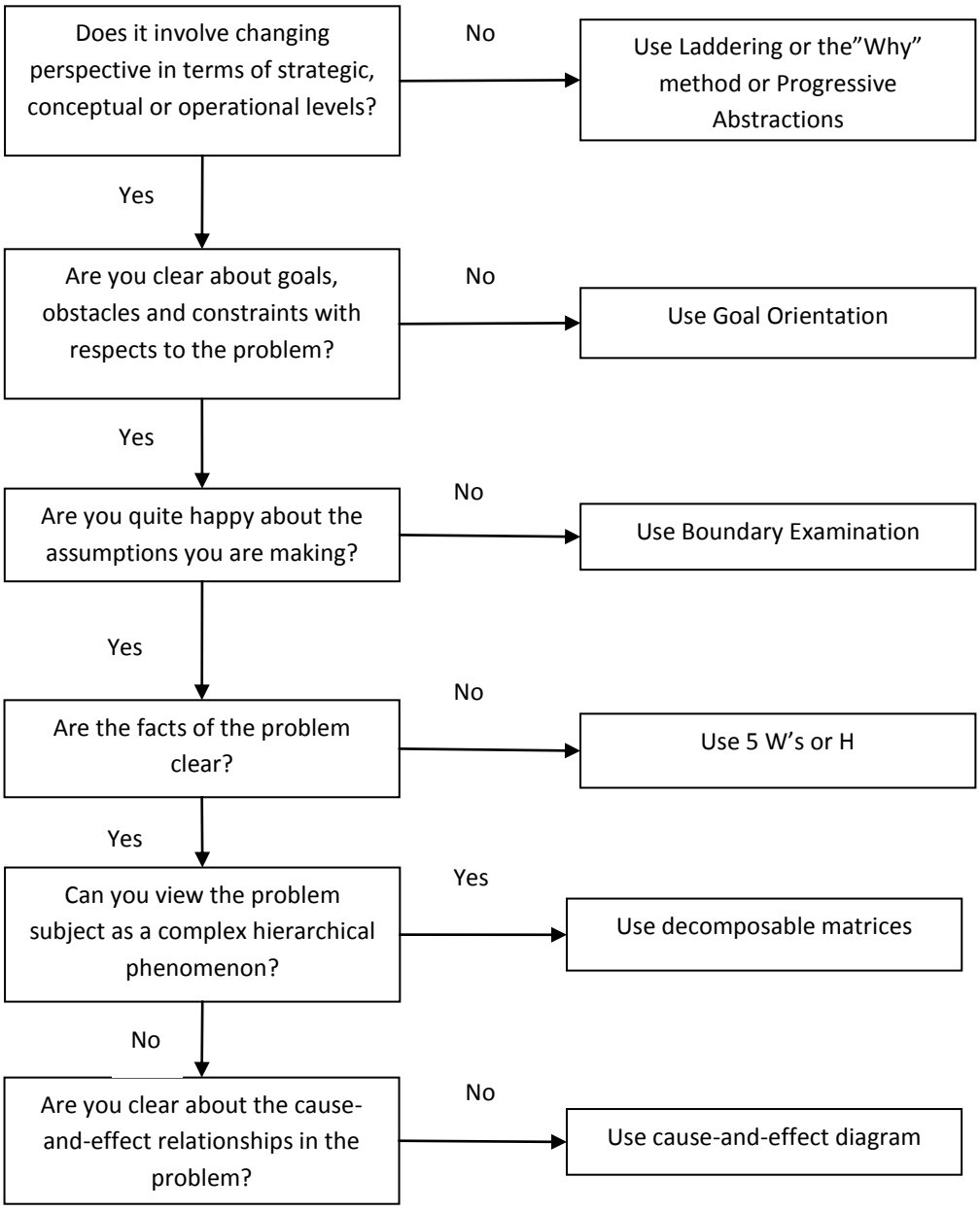



Figure 9 - Problem Finding

If the problem involves changing perspective in terms of strategic, conceptual or operational levels one may move to the next step, if this is not the case, three different techniques may be used. The laddering (table 4) and the why method (table 5)are essentially very similar, the techniques force one to look at the problem while asking questions such as “How to..?” or “Why?” with the purpose of obtaining a high level of problem abstraction. The progressive abstraction (table 6) is a technique which is used to challenge the problem until it exceeds existing skills and technological resources and then forms a new problem definition. If the goals, obstacles or constraints regarding the problem are unclear one may use the goal orientation tool (table 7). This tool is relatively simple, the first task is to state the problem, then find the needs, obstacles and constraints and ultimately redefine the problem. The boundary examination tool is useful for challenging one’s assumptions as it helps identify any important connotations of the key words or phrases in the problem. If the assumptions made are already satisfactory, one may move to the next step and consider whether the facts of the problem are clear. If this is the case, and if the 5 W’s or H techniques cannot be used, one may move to the next step.

If the problem subject can be viewed as a complex hierarchical phenomenon, the decomposable matrices (table 10) can be used. This technique divides the problem into systems and subsystems and the components of these upon which the interrelationship between the elements are rated and the most weighty interaction is selected for further analysis or for idea generation (Simon 1969) .Upon finishing this step or if one assesses that the subject cannot be viewed as a complex hierarchical phenomenon, the next step would be to consider whether the cause-and- effect relationships of the problem are clear. If this is the case one is ready to move on to the next stage, however, if it is unclear, the cause-and-effect diagram (table 10) may be used. This technique searches for causes, effects and associations and places them in a map or diagram upon which the next step is to pick out those causes and effects that seem to be central to the problem

| Laddering |
| --- |
| 1)State the problem in terms of how to.. |
| 2)Use the question why? To move up the ladder and how? To move down the ladder |
| 3)Consider various redefinitions for their usefulness |

Table 4- Laddering

| Why Method |
| --- |
| 1) State the problem |
| 2) Ask why you want to do whatever is stated in the problem |
| 3) Answer the question posed in step 2 |
| 4) Use the answer to redefine a new problem question |
| 5) Repeat stages 2 and 3 until a high level of problem abstraction is achieved |

Table 5 - Why Method

| Progressive Abstraction |
| --- |
| 1) Write down a general statement of the problem |
| 2) Generate possible problem solutions by asking the question: what is the essential problem? |
| 3) New problem definitions are developed from the answer produced at step 2 |
| 4)2 and 3 are repeated until the solutions begin to exceed the existing skills and technological resources and/or until the solution are outside one's sphere of influence |
| 5) Select a satisfactory problem definition for the purpose of generating ideas |

Table 6 - Progressive Abstraction

| Goal Orientation |
| --- |
| 1) General outline of the problem |
| 2) What are the needs, obstacles and constraints? |
| 3) Redefine the original problem |

Table 7 - Goal Orientation

| Boundary Examination |
| --- |
| 1) Write out the problem |
| 2) Highlight key words/phrases |
| 3) Identify important connotations |
| 4) Suggest new definitions |

Table 8 - Boundary Examination

| 5 W's or H |
| --- |
| Asking W or H questions |

Table 9 - 5 W's or H

| Decomposable Matrices |
| --- |
| 1) Establish that the subject of the problem can be viewed as a hierarchical set of sub-system – organizations, groups of people, the human body, many different products, production processes, marketing strategies, etc., can be viewed as such systems.<br>2) List the major sub-systems and their components.<br>3) Enter the sub-systems and their components into a diagonal diagonal matrix in a manner that renders it possible to identify cells representing the interaction of one sub-system with another<br>4) Use the five-point scale to represent the importance of the interaction or strength of the relationship between and within the sub-system<br>5) Select the most weighty interaction for further analysis or generation of ideas |

Table 10 - Decomposable Matrices

| Cause-and-Effect Diagram |
| --- |
| |

Table 11 - Cause-and-Effect Diagram

### *Idea Finding*

The idea finding stage helps to structure the search for potential solutions; this stage mainly uses divergent activity for generating a large amount of ideas using a variety of idea-generation aids. The stage consists of a series of questions posed with the purpose of generating new ideas (figure 10). The first tool is a checklist (table 12) which is used if one only needs to ask a series of questions; the checklist is a simple list of a series of questions. If all aspects of the problem are covered thoroughly then a simple attribute listing (table 13) may be used for the purpose of identifying any connections that may have been overlooked or simply to inspire to new ideas.

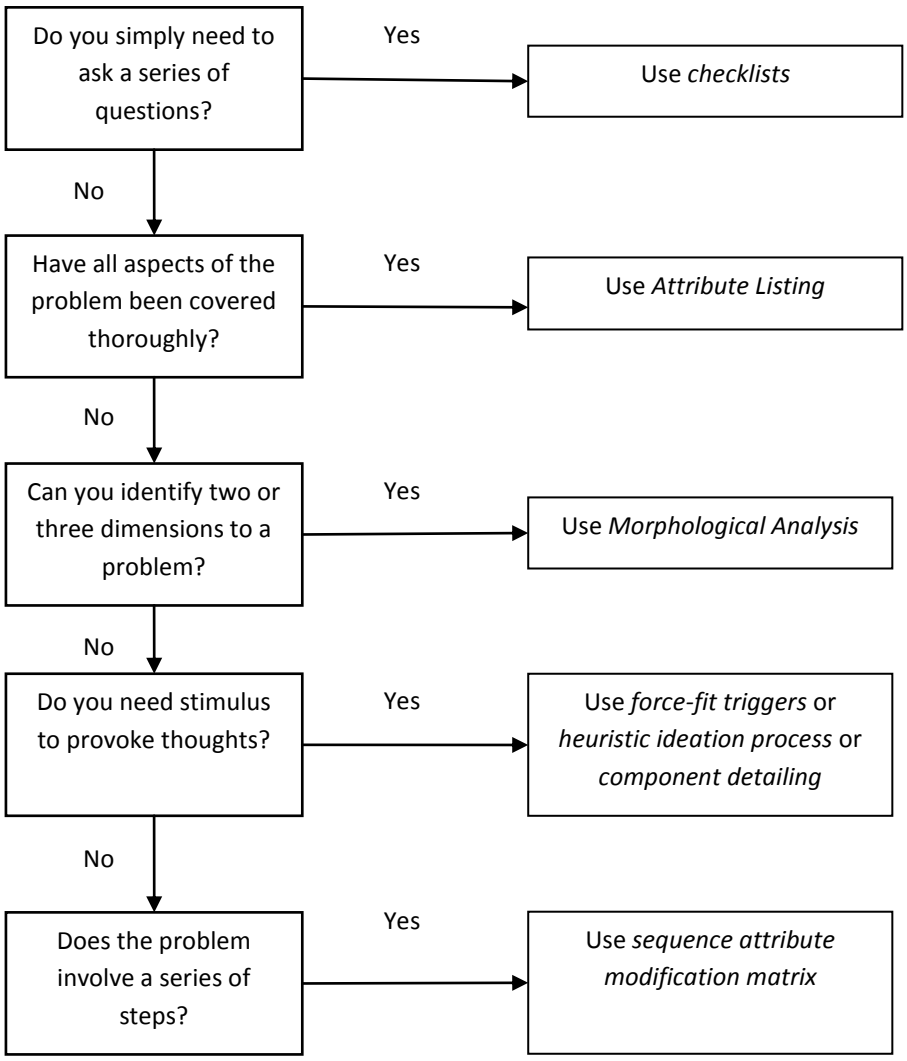



Figure 10 - Idea Finding

If it is possible to identify two or three dimensions to the problem, the Morphological analysis (Zwickly 1948) is used, the elements of each dimension are listed and the attributes are used for stimuli for new combinations (table 14). Another way of obtaining stimuli if two or three dimensions cannot be identified is by using the force-fit triggers, the heuristic ideation process or component detailing. The force-fit triggers technique (table 15) uses images in order to "trigger" new creative solutions. The heuristic ideation (table 16) process is somewhat similar to the force-trigger technique, the difference is that no image is used; instead attributes from other products are used as stimuli for generating new ideas (Tauber 1972). The component detailing technique (table 17) uses a combination of components and attributes listings and then pictures are drawn of these components as stimuli for generating new ideas. Finally, if the problem involves a series of steps the sequence attribute modification matrix (table 18) may be used. The logical steps are listed and a two-dimensional matrix is constructed which is then used as visual stimuli for identifying new ideas.

| **Checklists** |
| --- |
| 1) Why is it necessary? |
| 2) Where should it be done? |
| 3) When should it be done? |
| 4) Who should do it? |
| 5) What should be done? |
| 6) How should it be done? |

Table 12 - Checklists

| **Attribute Listing** |
| --- |
| 1)Feature |
| 2)Attribute |
| 3)Ideas/improvement |

Table 13 - Attribute Listing

| **Morphological Analysis** |
| --- |
| 1) list the dimensions of the product or problem |
| 2) generate a list of attributes under each of the dimensions |
| 3) Combine attributes as stimuli for new ideas |

Table 14 - Morphological Analysis

| **Force-Fit Triggers** |
| --- |
| The cards are images arte pictures or images of well-known objects. |
| 1)choose three different trigger cards showing pictures or images and draw a column for each on a flip chart (three |

columns)

2) Ask the assembled group or individuals to call out in turn the first thing that comes to mind when they think of the item on the trigger card. Fill each column on the flip chart with these ideas

3) Describe the problem to be solved. Ask the groups to find solutions which make use of at least one word from each of the three columns.

4) Move from less sensible to sensible solutions.

Table 15 - Force-Fit Triggers

**Heuristic Ideation Process**

1) List the factors or attributes of two products

2) Take a factor from each list and consider combinations as stimuli for new ideas

3) Generate ideas based upon the stimuli provided

Table 16 - Heuristic Ideation Process

**Component Detailing**

1)The major components of the problem are listed

2)The attributes of each component are identified and listed

3) Different problem component are identified and listed

4) The components and their attributes are studied and noted in detail

5) A picture of each component is drawn, including as many details as possible

6) The drawings are collected and displayed, making the visible to all those involved in the exercise. The pictures should be displayed, while paying attention to their logical order.

7) The collage is reviewed for possible ideas

Table 17 - Component Detailing

**Sequence Attribute Modification Matrix**

1) Enumerate the logical steps involved in the problem under consideration.

2) Indicate ways in which the process may be altered (e.g. eliminate, substitute, rearrange, reverse, combine, increase, decrease, magnify, etc.)

3) Construct a two-dimensional matrix in which the steps appear vertically along the left-hand edge of the matrix and the modifications horizontally along the top of the matrix

4) Examine the matrix cells for instances in which change seems to be promising or in which further studies would be productive

5) Suggest ways of introducing the changes identified

Table 18 - Sequence Attribute Modification Matrix

### *Solution Finding*

The Solution-Finding stage (figure 11) is focused on converging on a subset of ideas, synthesizing and refining them into potentially useful solutions and exploring barriers and approaches to acceptance, it is basically the choice of ideas that can be transformed into workable solutions.

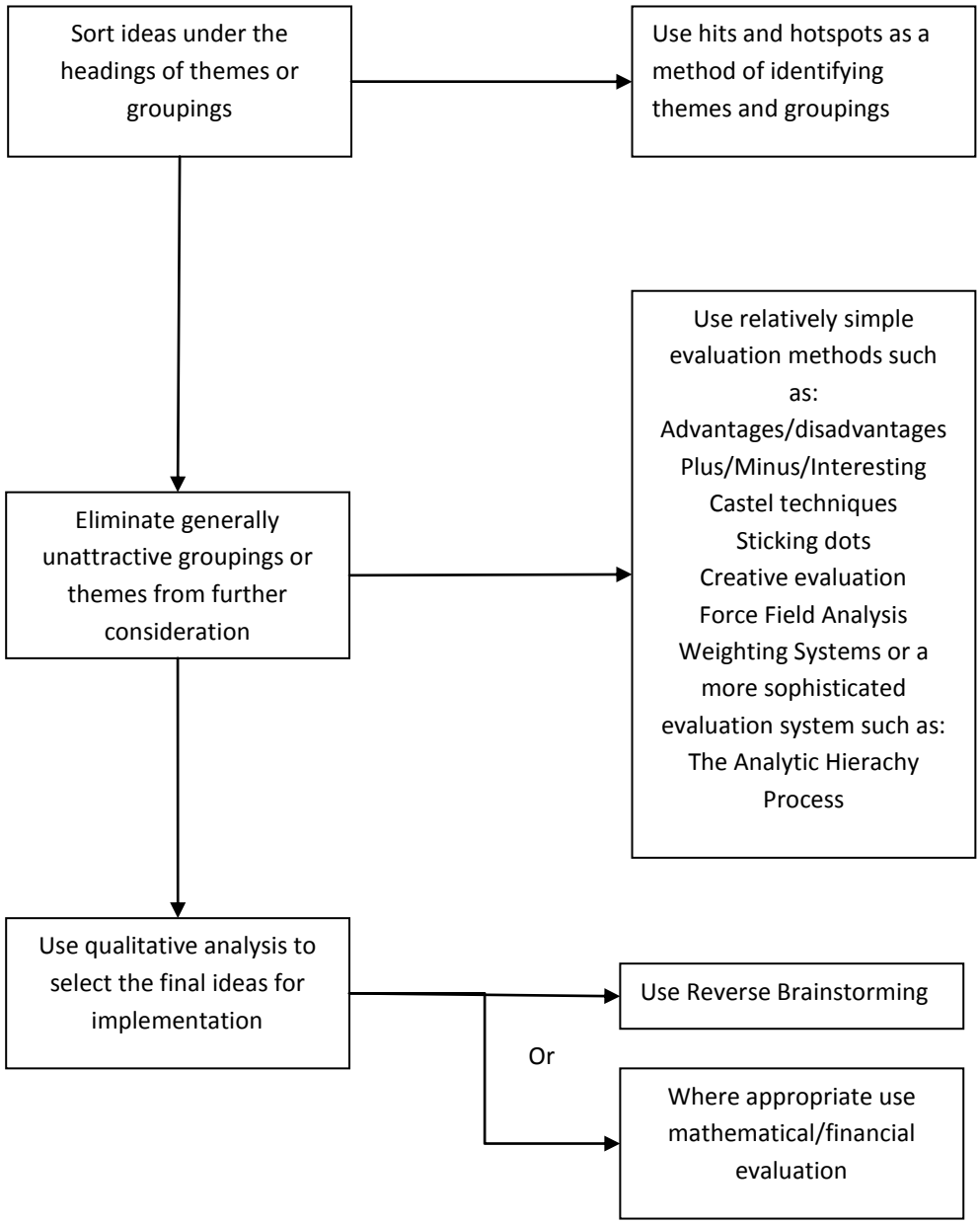



Figure 11 - Solution Finding

First of one must sort the ideas, either under a heading of themes or in groups; this is done by using the hits and hotspots technique. Unattractive groupings or themes are then eliminated from further consideration

by using two sorts of techniques as toolboxes filled with simple evaluation techniques (Advantages/disadvantages, PMI, Castle techniques, Sticking dots (Geschka 1979) etc.) common for all these techniques is the fact that they categorize the ideas into positive and negative groups (and for some an interesting group). On the other side, the analytic hierarchy process (table 19) is a more sophisticated evaluation system, this techniques uses qualitative analysis for ranking the alternative ideas upon which the user is to use his or her intuitions against the analytical results. The final ideas are then chosen and the method of reverse brainstorm (table 20) may be used for discussing the weaknesses of an idea or for identifying what might go wrong when the idea is implemented (Whiting 1958). Finally, financial or mathematical evaluation may be used if the idea is suitable for this kind of evaluation.

| **The Analytic Hierarchy** |
|---|
| 1)Use qualitative analysis objective data |
| 2) Use qualitative analysis with subjective criteria |
| 3) Merge quantitative and qualitative analysis |
| 4) Perform a synthesis of the data generated to rank alternatives |
| 5) Conduct a sensitivity analysis in order to show how sensitive the final priorities for decision alternatives are to possible changes in scores assigned to alternatives and weights assigned to decision criteria |
| 6) Check the analytical results against intuition. Check, in particular, to ascertain that all relevant factors have been included in the decision analysis and that they have appropriate weights/scores |

Table 19 - The analytic Hierarchy

| **Reverse Brainstorm** |
|---|
| 1)People who generated the ideas evaluate them |
| 2)Objective/problem along with a list of ideas generated are displayed |
| 3)All ideas are criticized in turn and criticisms are noted |
| 4) solutions sought for the various criticisms made |
| 5) the idea possessing the fewest unanswered criticisms, and the one that is most likely to solve the problem, is selected |

Table 20 - Reverse Brainstorm

### *Acceptance-Finding*

The final stage of acceptance finding is primarily a divergent activity that helps implement solutions successfully via listing potential implementation obstacles and ways to overcome them and by developing both preventive actions and contingency plans. First step is to identify the main sources of resistance to the solution, when this is identified next step is to decide which technique will be appropriate in persuading people into accepting the solution.

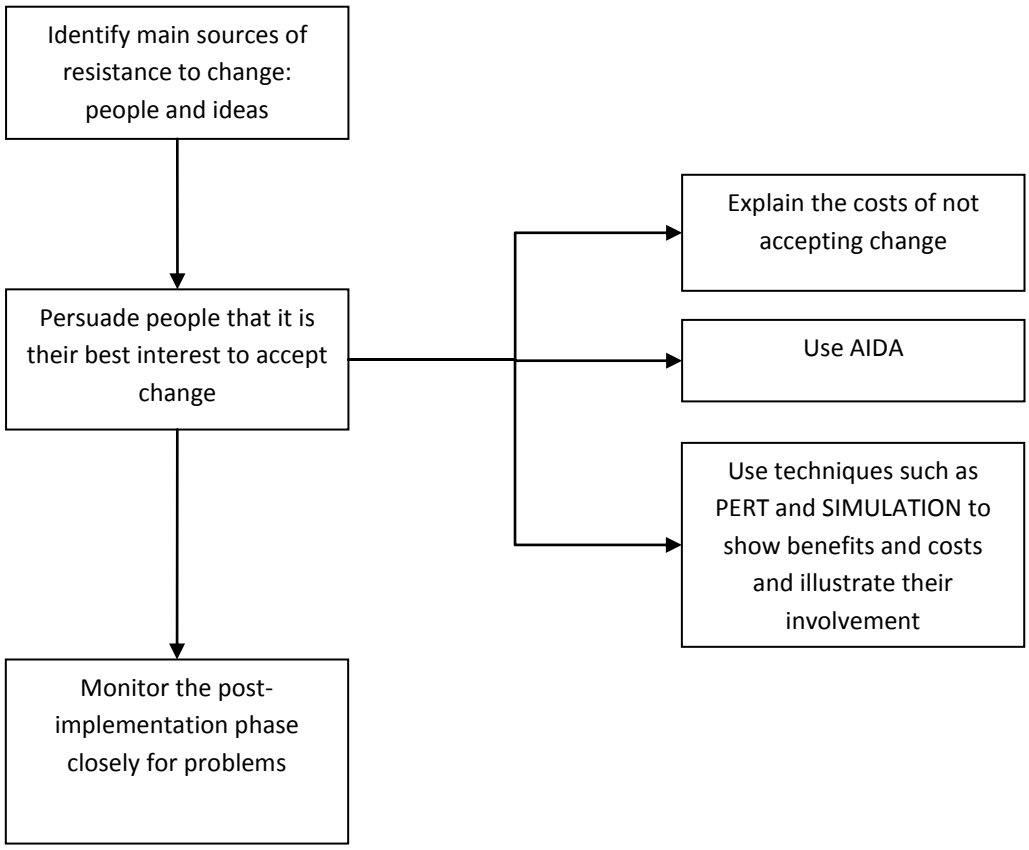



Figure 12 - Acceptance Finding

One way is to explain the costs of not accepting the change or to show the benefits in implementing the change. A more structured form is the AIDA, which is short for Attention, Interest, Desire and Action and is a communication model which can be used to mediate new solution in a structured way. PERT is a method to simplify the scheduling of large and complex projects and can be use to get acceptance in the implementation process. Finally when the solution is implemented the process is to be monitored closely.

## 3.2 Theory of Solving Inventive Problems (TRIZ)

The following is a presentation of *the theory of inventive solving in short* known as TRIZ (in Russia teoriya ressheniya izobreatatelskikh zadatch).

***"Someone somewhere has probably solved a problem similar to yours before"***

### 3.2.1 Introduction

TRIZ is based on objective and repeatable engineering principles and practices, the first studies of TRIZ originate from 1946 when the Russian inventor and engineer Genrich Altshuller started to study patents (Altshuller 2001). He discovered and mapped the patents that lead to breakthroughs and the ones that only added minor change to already existing solutions, and he was able to identify 40 repeatable patterns that lead to his 40 inventive problem solving principles.

The idea behind TRIZ is that the solution to a problem or task can often be found by studying solutions in other subject areas. The solution to a problem in any given subject area can often be found by looking at solutions from other areas of expertise. The solution to any given problem has at one point been solved by someone in the world.

### 3.2.2 Assumptions

TRIZ is a hierarchy and is based on 5 philosophies:

1. **Contradictions**

   The fundamental driving force for innovation and development is directed by a constant identification and creations of solutions to contradictions or conflicts.

2. **Ideality**

   Ideality is defined as: advantage divided with costs and harm/damage.

3. **Resources**

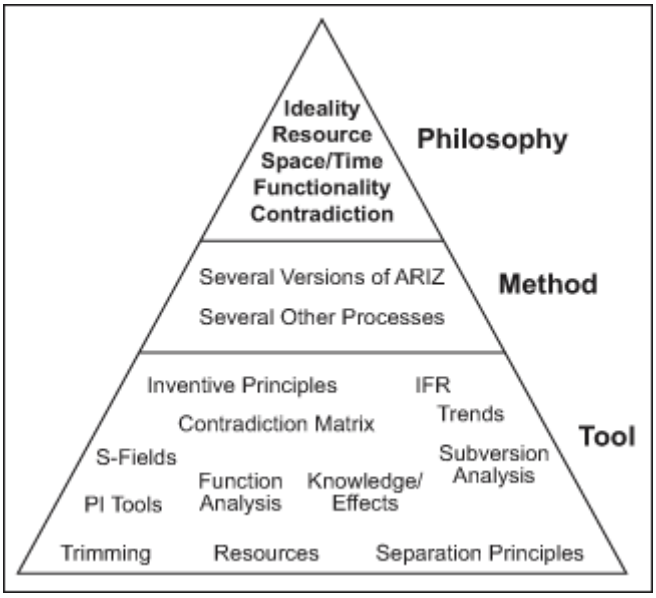
   Intelligent solutions exploit the resources in a more optimal way, even things which are regarded "bad" in a system may be transformed into something good if the right kind of thinking is used.

4. **Space, Time and Interface**

   The way we look at a situation plays a big part in the way we find solutions, it is important to look at the situations from different angles.

5. **Functionality**

   All systems exist with the purpose of carrying out a useful function, and customers buy the product/process for the function and not the product/process in itself.




(Source: Based on Mann 2008)

TRIZ consist of several processes and an extensive toolbox. Like other methods for innovation, TRIZ is based on analogical thinking, but opposed to other methods which are person-centric (based on the experience and skills of the individual) TRIZ is based on hard data (patent database) and not on logic alone (Silverstein et al. 2008).

### *Definition of Creativity*

Creativity is viewed as the continuous search for contradictions and the ability to lift a problem to an abstract level and analyze the problem in parts. Creativity is the ability to split the problem/task into parts, and then, by using TRIZ tools, to solve the problem/task.

### *Creative Thinking*

The basic idea behind TRIZ (figure 13) is that first the problem-solver must analyze the problem in detail and then try to match the specific problem to an abstract problem. Then, on the abstract level, one is to find an abstract solution and then try to transform this into a specific solution (Moehrle 2005).

TRIZ thinking basically consists of looking for contradictions in problems. It takes a systemic approach and aims at finding connections between objects, processes and phenomena that have no apparent connection (Terniko et. Al 1998).

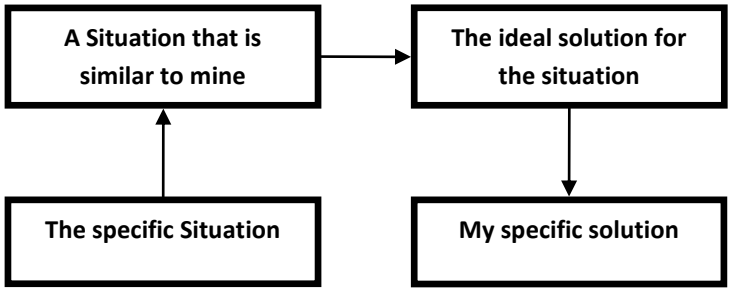



Figure 13- The Basic TRIZ Thinking

### 3.2.3 The Creative Problem Solving Process

The challenge when working with TRIZ lies in the fact that no structured framework has been published by the Altshuller and the frameworks that do exist are copyrighted (Orloff 2003). This chapter tries to establish a framework for using TRIZ in creative problem solving based on various sources. The TRIZ toolbox is very big and most of the tools and techniques are primarily technical directions; in establishing the framework the tools which are only used in a technical context have been deselected.

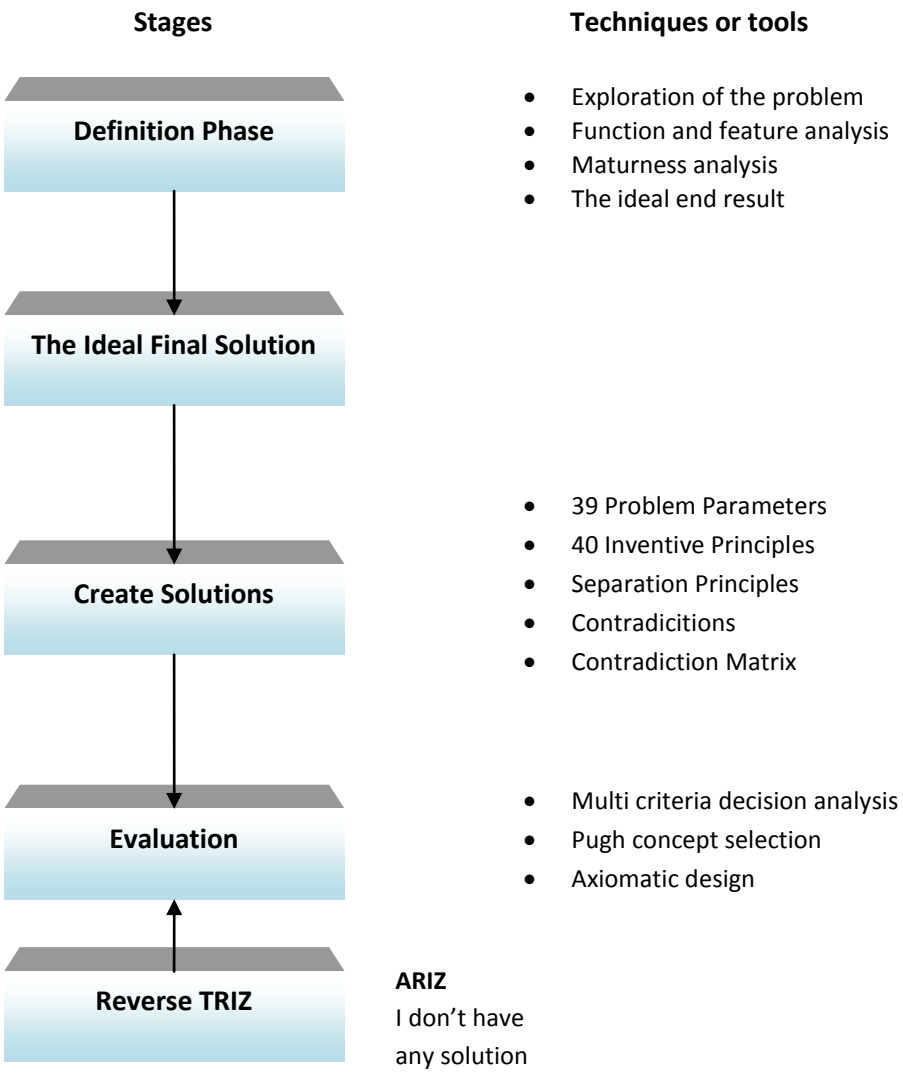
Ideality is defined as the value of something: it recommends that an Ideal Final Result (IFR) be defined at the start of the creative process

1. Define the Ideal Final Result (IFR)
2. List the resources; this includes everything that might be potentially available for solving the problem (including time, space, fields, knowledge, attitudes etc.)

Ideality and resources represent the two extremes of the problem, and once they are known, they form a very strong domain in which the ideal solution must exist. Innovation solutions are frequently discovered merely from conducting an analysis of these two poles.

3. If the direction is still not clear, it is useful to look at the current system in terms of functionality and to pinpoint the exact reason why ideality cannot be increased i.e. a contradiction.

The basic process contains four basic phases: The definition phase chooses tools, create solutions and evaluate.




(Source: based on Moehrle 2005, Souchkov 2007)

### *The Definition Phase*

The first step is the definition stage which consists of four sub stages. The first sub stage is the problem analysis in which one is to elucidate what resources are available and what limitations are present, furthermore, a description of where we want to end up is made (the ideal end result). The next step is the function- and feature analysis which is a detailed description of the situation including the components of the system, the interaction between them and the way this interaction may change over time. Then an analysis is made for establishing the maturity of the present system and the incorporated components. The final stages is a thought process in which one is to imagine the perfect solution to the problem, based on the findings from the three other steps (the difference from the ideal end result from step one is that the solution is now based on the findings and thus one should be able to define a new solution).

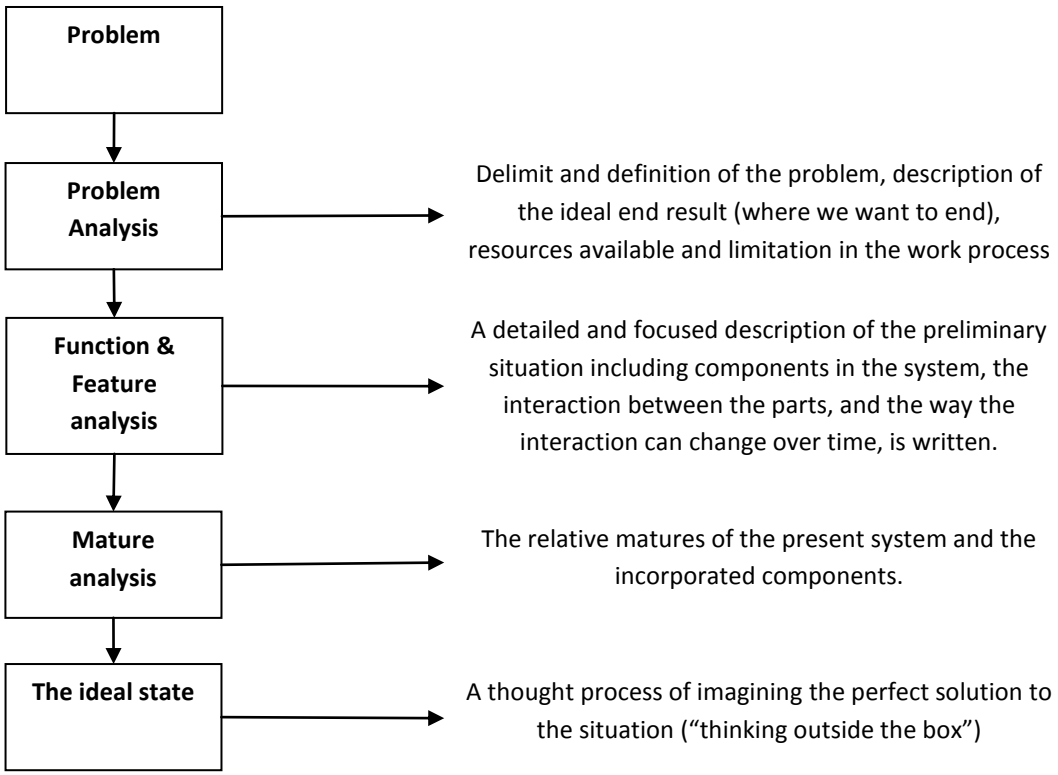



Figure 14 - The Definiton Stage

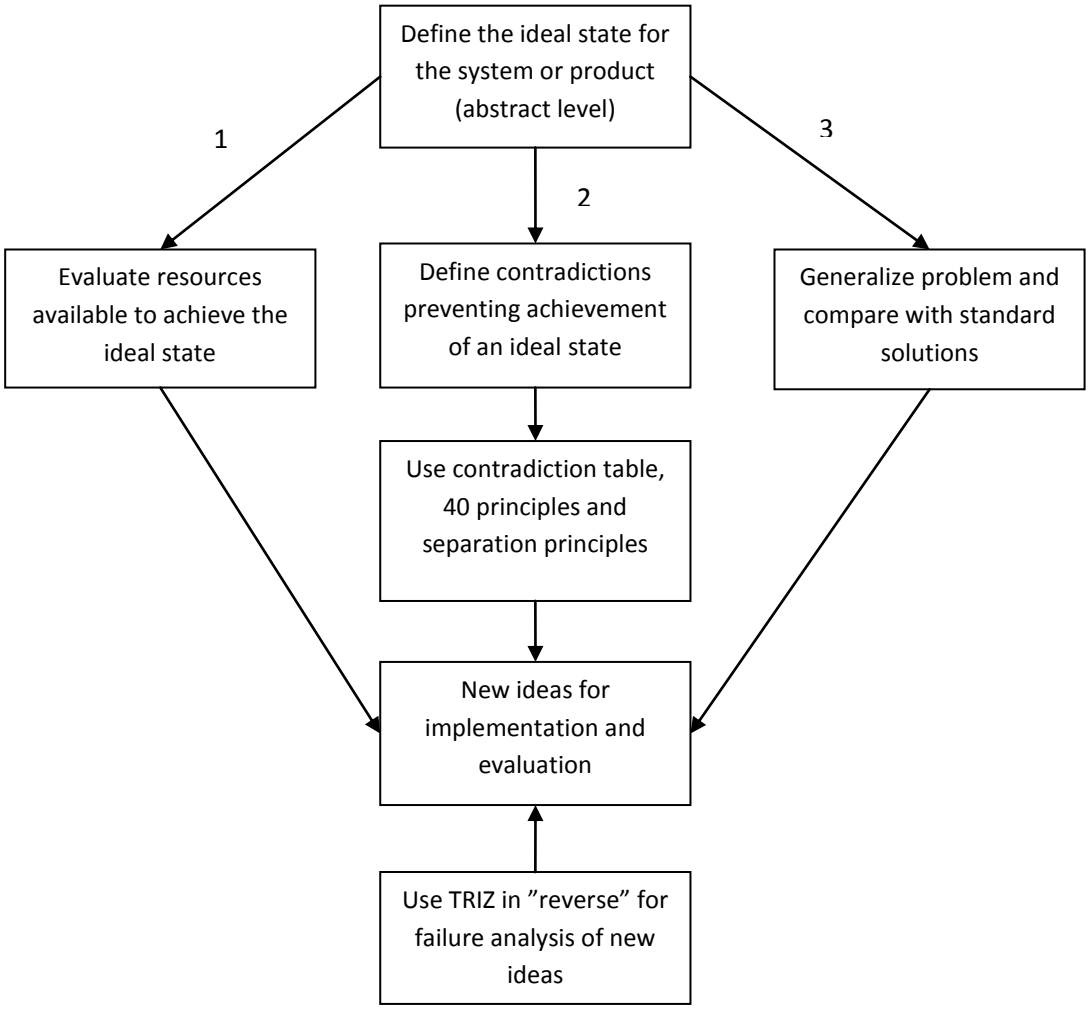
| **Function & Feature Analysis** |
|---|
| 1)Determine the system components |
| 2)determine the key features of these components |
| 3)Find the useful function connections between the components |
| 4)Find the negative (harmful, ineffective, excess) functional conditions |

Table 21- function & Feature Analysis

### *Create Solutions*

The next step is to create solutions, the findings from stage one is to form the basis for this decision.

1)One approach is to evaluate resources available to achieve the ideal state and use that as a way to find new ideas for implementation.




2) Another track is to define the contradictions preventing the achievement of an ideal state, there are basically two different forms of contradictions; the first is a physical contradiction, this is when one element of a system conflicts with itself. The other is a technical contradiction which is when two different elements of a system conflict with each other.

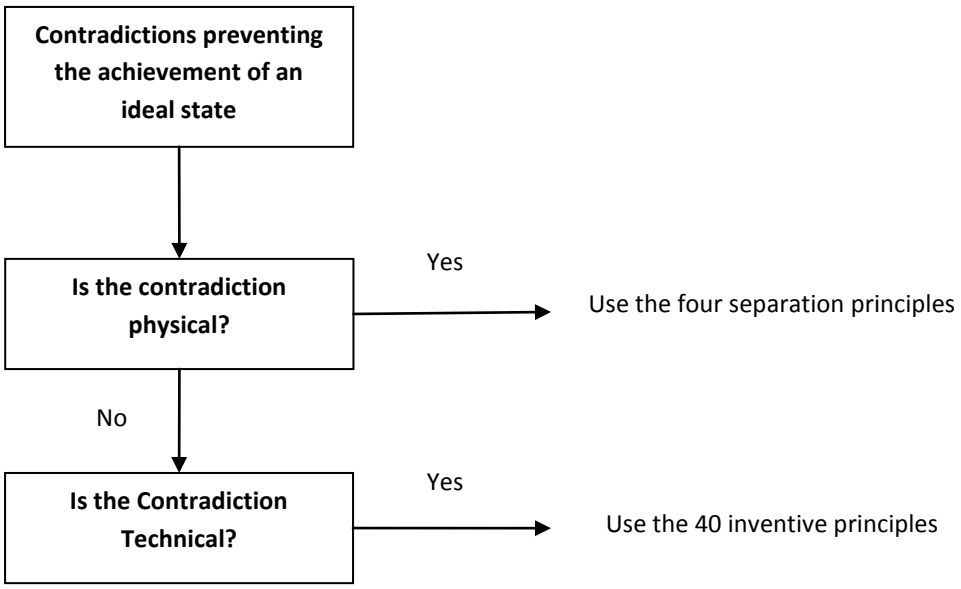



Figure 15- Contradictions Preventing Achievement of an Ideal State

If the findings from step one show that the contradiction is physical then the four separation principles (table 22) can be used. The 40 principles are basic engineering parameters of common objects, such as weight, length, and manufacturing tolerances. TRIZ methodology claims that by studying an individual parameter which is causing a problem, and the other parameters which are in conflict with it, engineering solutions can be created for invention problems. 3) The third possibility is to generalize the problem and then compare to standard solutions. If a solution is not found, one can use the framework in reverse.

| **The four Separation Principles** |
|---|
| 1) Separation in time |
| 2) Separation in Space |
| 3) Separation between parts and the whole |
| 4) Separation upon condition. |

Table 22 - The Four Separation Principles

**The 40 Inventive Principles**

To use the table, go down the left side until you find the property which is to be improved. Then find the parameter that degrade or are worsening (X-axis). At the intersection of these two, you will find a number that indicates the inventive principle that most often is used to resolve this contradiction.

| Worsening Feature → / Improving Feature ↓ | Weight of moving object | Weight of stationary object | Length of moving object | Length of stationary object | Area of moving object | Area of stationary object | Volume of moving object |
|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Weight of moving object | + | - | 15,8, 29,34 | - | 29,17, 38,34 | - | 29,2, 40,28 |
| Weight of stationary object | - | + | - | 10,1, 29,35 | - | 35,30, 13,2 | - |

Table 23- The 40 Inventive Principles

### *Evaluation*

TRIZ is not strong in evaluating solutions, but if there is more than one solution the need for finding the "best" solution will occur. In order to do this the multi criteria decision analysis, axiomatic design and Pugh concept selection (Pugh 1991) tool can be used.

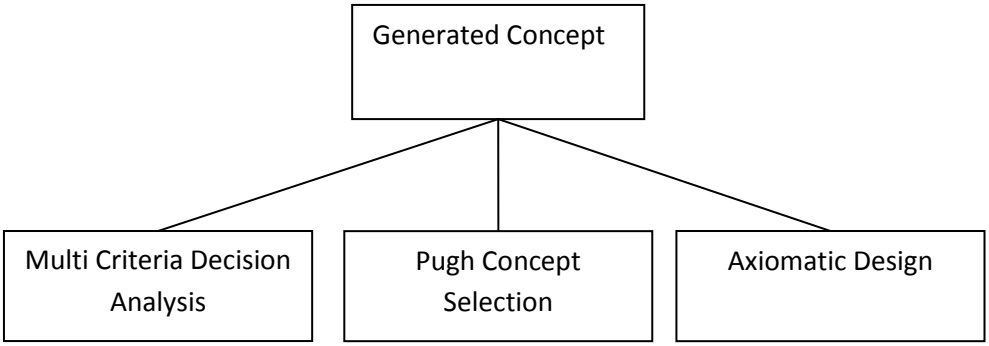



Figure 16- Evaluation Techniques

| **Pugh Concept Selection** |
|---|
| 1)choose criteria |
| 2)form the matrix |
| 3)clarify the concepts |
| 4)Choose the datum concept |
| 5)Run the matrix |
| 6) Evaluate the ratings |
| 7) Attack the negatives and enhance the positive |
| 8) New datum – rerun the matrix |
| 9) Plan further work |
| 10) Iterate to the winning concept |

Table 24 - Pugh Concept Selection

## 3.3 Lateral Thinking

This chapter introduces lateral thinking and some of the tools used in lateral thinking, the six thinking hats are also presented the aim is to combine lateral thinking tools with the six thinking hats to suggest a framework for creative problem solving.

***"Exploring multiple possibilities and approaches instead of pursuing a single approach"***

### 3.3.1 Introduction

Lateral thinking is a term coined by Edward de Bono in the book *New Think: The Use of Lateral Thinking* published in 1967; it refers to solving problems through an indirect and creative approach. Lateral thinking is about reasoning which is not immediately obvious and about ideas that may not be obtainable by using only traditional step-by-step logic.

### 3.3.2 Assumption

The assumption behind Lateral thinking refers to a shift in thinking or perception, a complete break from previous thought (de Bono 1977). Lateral thinking is both an attitude and a wide range of methods. Lateral thinking can be categorized under the headings of: Awareness, Alternatives and Provocative methods (figure 18). **Awareness** concerns the way, in which people look at the problem, **Alternatives** refer to alternative ways of viewing a problem. **Provocative** methods, named "po" by de Bono, usually operate outside the judgment system, he defines provocation as: "*There may not be a reason for saying something until after it has been said*". (de Bono 2006).

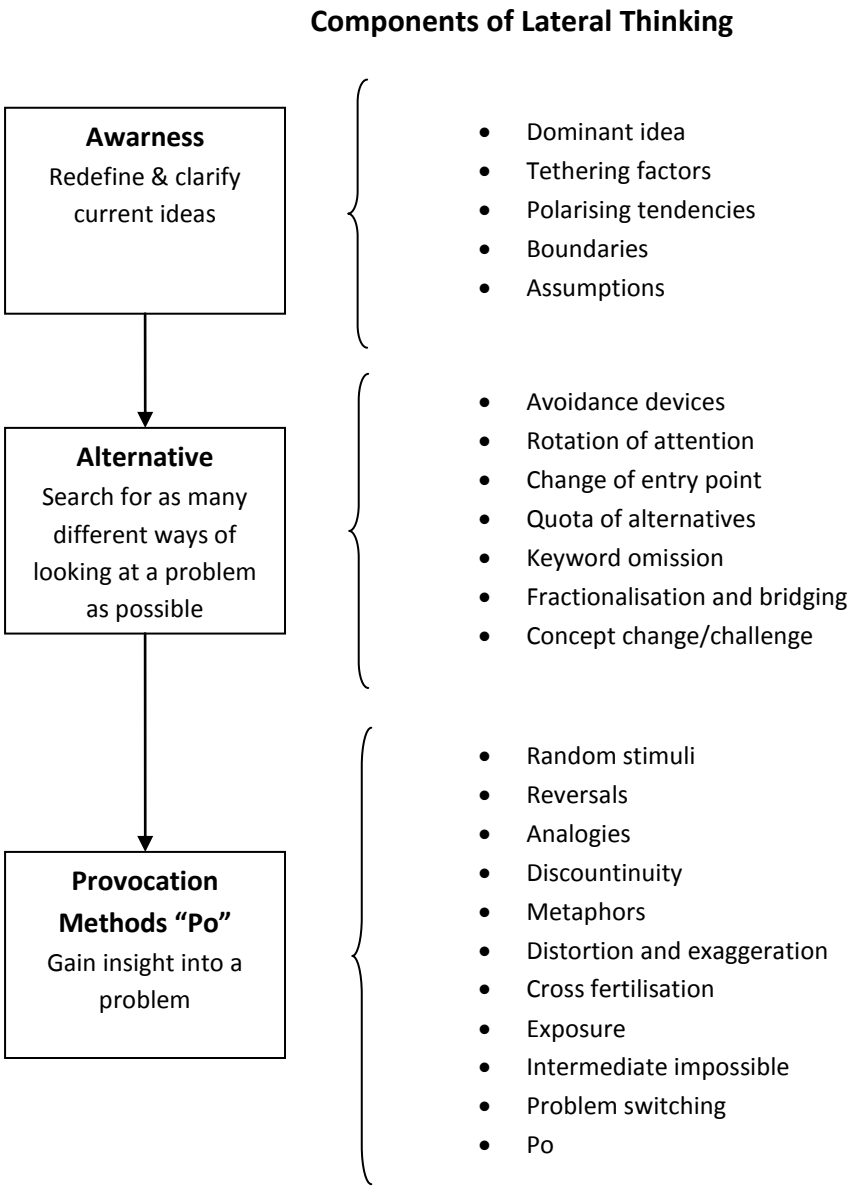



Figure 17 - The Components of Lateral Thinking

### *Definition of creativity*

De Bono states that Lateral thinking is a neutral process and regards any action done by using lateral thinking as being creative (de Bono thinking course). Regarding children he states that they are, what he calls rigid creative, this mean that they are capable of using their imagination to come up with creative ideas, but they lack the ability to "translate" these ideas. Creativity involves breaking out of established patterns in order to look at things in a different way. Being creative is the ability to break out of the pattern thinking to look for new ideas and bring them back to the "pattern".

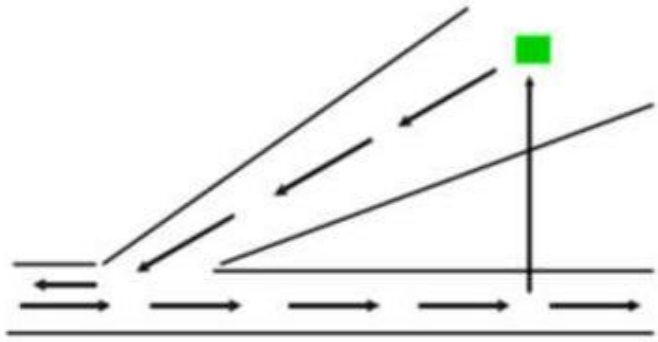


Figure 18 - Creativity According to Lateral Thinking

*Figure 18 illustrates what being creative is all about according to lateral thinking. The bottom arrow shows the "road" (pattern) a person normally uses, the green spot is where you go when using lateral thinking, one is to break out of the pattern thinking in order to find new ideas or perspectives and then bring them back to the "real" world.*

***Creative Thinking***

Vertical thinking is based on a logical thinking approach to a problem. De Bono describes the difference by explaining vertical thinking with the metaphor of digging the same hole deeper and lateral thinking as being focused on digging different holes.

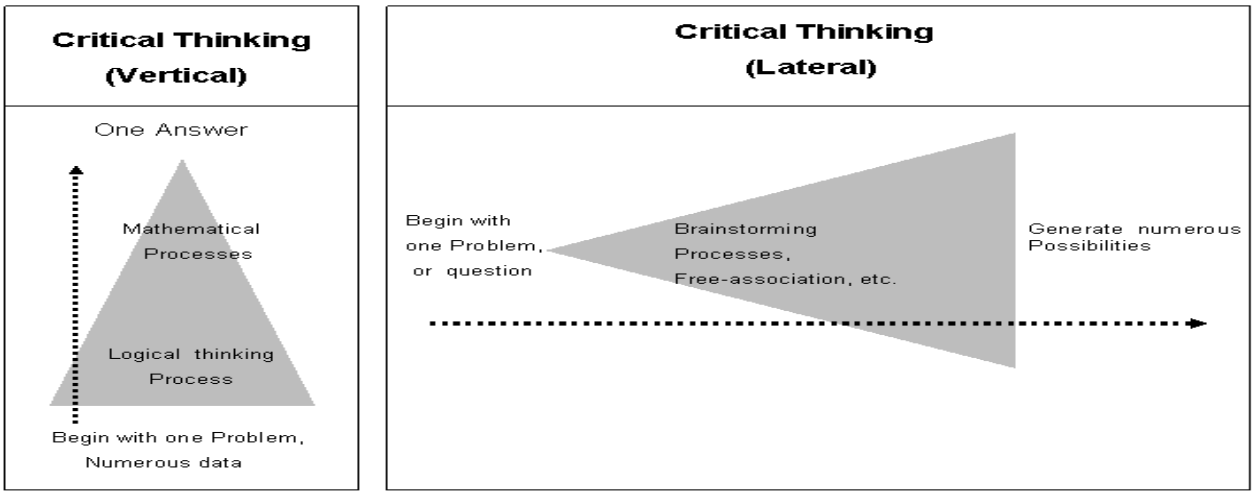



Figure 19 - Critical Thinking vs. Lateral Thinking

### 3.3.3 The Creative Problem Solving Process

One of the characteristic features of de Bono's many books is the fact that he does not present an actual framework in how to use lateral thinking on a task/problem, this is why the following is a presentation of one of his tools called the six thinking hats, this concept will be used as a suggested framework for the creative problem solving process in combination with later techniques.

Lateral thinking is concerned with the movement value of statements and ideas. A person would use lateral thinking when they want to move from one known idea to creating new ideas. Edward de Bono defines four types of thinking tools: **Assessment tools**: checklists and assessment questions that take into consideration corporate alignment, risk, fir, power, etc. **Focus tools** that are designed to broaden the field in which to search for new ideas, planning tools to help prepare for creative and innovative thinking sessions. **Idea generating** tools which are designed to break the current thinking patterns - routine patterns, the status quo. **Harvesting** tools, how to manage your idea output for long term value. **Idea sorting** tools are used to sort out which ideas to use. **Harvest tools** that are designed to ensure that more value is received from the idea generating output – what can be harvested. **Treatment tools** are designed to consider real-world constraints, resources, and support.

### *The Six Thinking Hats*

The Six Thinking Hats is a problem-solving process. During this process the participants are asked to wear different "hats" (thinking styles) allowing only a certain type of thinking and sharing. Each color represents a thinking style, when the **Blue** hat is worn the focus is on how the process should be constructed and carried out and which ideation tools are to be used. The **White** hat relates to the discussion of information needed to define the problem or to evaluate proposed ideas and solutions. The **Green** hat is the idea generation hat, when this hat is being worn the thinking style is outside the famous box and the aim is to break the current thinking patterns, routine patterns and to generate new ideas. The **Red** hat is the emotional hat, here the aim is to forget all about facts and information and instead "look inside" and see what your intuition or gut feeling says about the solution. The **Yellow** hat represents positive thinking; the view is the positive aspects of the ideas and their implementation. Finally the **black** hat represents the critical analysis of the findings.

The six thinking hats is created for the purpose of being used in groups, but in the following it will be used as the framework for the lateral thinking creative problem solving process. This is done by setting up the hats in an order which the author finds most suitable when working with a task/problem (normally when the concept is used in groups the order differs from time to time). On the left side some of the lateral thinking tools is listed for use in the different steps.

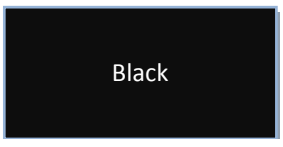

- Facts/Gather Information /Documentation
- Alternatives


- Objectives/Goals
- Focus Tools


- Creative New Ideas Outside Box
- Idea generation tools


- Think Hearth
- Gut Feeling
- Intuition

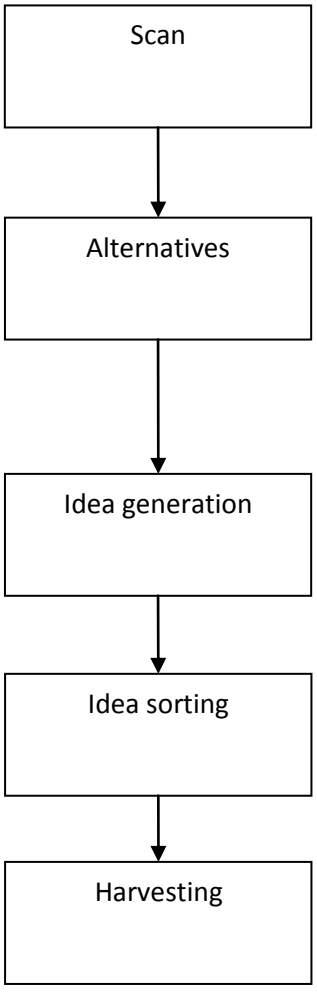

- Cost - benefit Positive Advantage
- Harvest Tools




- Dead Ends Think Black Spot Negative

## Lateral Thinking Framework

The following framework is based on the above mention sources and the subjective understanding of these. The heading for each step is a combination of all the different concepts in lateral thinking, but is also inspired by the frameworks from CPS and TRIZ.




- PMI
- Current Thinking Check List

- APC
- EBS

- Random Entry
- Wishful Thinking
- Escape
- Reversal
- Exaggeration

- TEC
- C&S
- treatment

- Cost benefit
- Harvest

### Scan

De Bono recommends in his thinking course that the first step is to scan the environment for ideas, he suggest this is done by using PMI. **PMI** is a simple attention-directing tool, P stands for plus or the good points, M stands for minus or the bad points and finally I stands for the interesting or the interesting points. One is to look at the problem/task and start with the P and write down all the good aspects, when finished the same is to be done for the next letter and so on. Another approach is to use current thinking check list which is similar simple in form, the idea is by making a list of the things one is thinking about, those will stimulate to getting new ideas.

| PMI |
| --- |
| Look at your current situation and try to find the following: |
| 1) plus – all the positive elements |
| 2)minus – all the negative elements |
| 3)interesting – all the interesting elements |

Table 25- PMI

| Current Thinking Check List |
| --- |
| 1)Make list of all current thought |
| 2)Use current thought for inspiration for new ideas |

Table 26 - Current Thinking Check List

## Alternatives

Next step is to find as many possible alternatives to the problem, one tools is APC which stands for alternative, possibilities and choises, the idea is by looking at one element at the time one identify many different problem definitions to help determine where to focus the ideas. EBS (examine both sides) is also used to create alternatives, this is done by looking at a problem and then try to examine both sides (if the problem is smoking in public places, one is to try to understand the people who are against and the one who are for it).

| APC |
| --- |
| 1)Alternatives |
| 2)Possibilities |
| 3)Choices |

Table 27- APC

| EBS |
| --- |
| Examine both sides |

Table 28 - EBS

### Idea generation

In this phase the idea is to create new ideas by challenging current ideas through provocation, this can be done in a numerous ways. One of the tools is called random entry where objects or word from a dictionary is used as stimulation to new ideas. The provocation or "po" tools which are aimed at creating a list of provocations and then use the most outlandish to move the thinking forward to new idea. The provocation tools (escape, reversal and exaggeration) challenges the concept that the majority always is right, by turning it around and claims that the majority always is wrong and then the aim is to convincingly advocate that viewpoint.

| **Random Entry** |
| --- |
| Choose an object at random, or a word from a dictionary and associate that with what you are thinking |

Table 29 - Random Entry

| **Wishful Thinking** |
| --- |
| 1)Suggest a fantasy that you know occur<br>2)Complete a statement of the form "wouldn't it be if…?" |

Table 30 - Wishful Thinking

| **Escape** |
| --- |
| 1)Negate what you have taken for granted about the topic<br>2)Take a statement, that you take for granted<br>3)The provocation is the negation of the statement |

Table 31 - Escape

| **Reversal** |
| --- |
| 1)Take a statement that you have taken for granted<br>2)Make a statement that is the opposite |

Table 32 - Reversal

| **Exaggeration** |
| --- |
| 1)If there is a numerical or quantitative element in the statement you take for grnated<br>2)Exaggerate the statement (upward or downward) |

Table 33 - Exaggeration

## Evaluation

To evaluate ideas the tool TEC can be used, T stands for target and task, the target is the precise focus of the thinking, the task is the thinking task that is to be performed. E stands for expand and explore. C stands for contrast and concludes. Another tool which can be helpful in the process is C&S which consider the consequences of an action or decision in time and help decide the usefulness of the idea.

| **TEC** |
| --- |
| There are three levels on which the conclusion can be set: |
| 1) A specific answer, idea or opinion |
| 2) A full harvesting of all that has been achieved. Including for example a listing of ideas considered. |
| 3) An objective look at the thinking that has been used. |

Table 34 - TEC

| **C&S** |
| --- |
| Consider the consequences of an action or decision in time: |
| 1) The immediate consequences up to 1 year |
| 2) Short-term from 1 to 5 |
| 3) Medium-term from 5 to 20 years |

Table 35 - C&S

### *Harvesting*

Last step is the harvesting of the ideas the most promising ideas are selected, in this stage a cost benefit analysis can be used. Another tool is harvesting which are a harvesting process in the mind, where in the real world corn are harvested, the idea is to harvest all what have been discovered in the proves of finding the idea(s).

## 3.4Summary

The following is a summary of the previous section; initially a PMI is conducted to illustrate the elements of the three approaches (figure 20).


**CPS**

| Plus | Minus | Interesting |
|---|---|---|
| • Extensive steps for problem solving<br>• Easy to learn and use<br>• Relatively little time needed to prepare a session and to find ideas | • Time consuming<br>• Unclear whether the area of effective solutions will be reached | • Useful for developing quick ideas<br>• Useful for overcoming *negative* thought patterns |

**TRIZ**

| Plus | Minus | Interesting |
|---|---|---|
| • Goal-oriented, time saving search for highly effective solutions<br>• Possible to learn, gain and pass on experience | • Relatively difficult to learn<br>• Insufficiently structured by the author | • The input of "patens"<br>• Very effective when solving "standard problems |

**Lateral Thinking**

| Plus | Minus | Interesting |
|---|---|---|
| • Universal use<br>• Easy to learn and use<br>• Create many new ideas | • Unclear Framework<br>• Source the individuals own experiences<br>• Create many ideas | • Useful for developing quick ideas<br>• Focus on the functions in the brain |

Figure 20 – PMI

First we had the CPS which must be said to have a very extensive “toolbox” and framework; the techniques are easy to learn and are detailed in their description. Finally it would take little time to prepare a creative session due to the comprehensive overview the different tools presents. On the other hand, it seems like the structure of the techniques requires a large amount of time in their execution. Another minus is it is very unclear how focused/effective the solution is related to the problem area, the tools seem to be to general. What is found interesting is that the ranged of tools does it is always possible to “grab a tool a get inspiration, and the tools are constructed in a way that people will find transgressive. TRIZ deliver a concept which are goal oriented and time saving in search of technical solutions and seems very effective and are constructed to learn, gain and pass on experience, that said it is very difficult to learn and is unsuffienciently structured by author (Altshuller) and the big problem is that all the structured processes are patented. The interesting thing about TRI is the input of patents, the idea of not inventing what already is and combining different invention are interesting. Finally TRIZ delivers a effective solution in solving standard solution. Lateral Thinking can be used universal, from dealing with daily challenges to trying to invent new products and the techniques are easy to learn and to use and create many ideas (I can be argued if creating many ideas is a plus, thus it is also a minus). Lateral Thinking is characteristic by a whole range of tales, told in many different ways and books but lack a clear framework, all the book from De Bono suggests techniques and thinking attitude but no framework (beside the six thinking hats, which are intended as a group/meeting tool). Finally it can be argued that due to the source of creativity is the individuals own experience nothing new and ground breaking will come out of lateral thinking. As with the CPS, Lateral Thinking provides tool that can be used to get inspiration to get a different (creative) view on a problem. A interesting element is the focus on the functions of the brain, it is hard to establish whether the brain as a patternmaking organ is scientific valid as De Bono claim, but the idea of focusing of the functions is interesting.

# 4. The Comparative Analysis

*The purpose of the following chapter is to conduct a comparative analysis on three areas, firstly, the definition of creativity according to the three approaches will be examined followed by creative thinking and finally the creative problem solving process represented by each approach will be compared, this is all done with the purpose of identifying any similarities between the three approaches.*

| Approach | Creativity | Creative Thinking | The Creative Process | Definition of a Problem |
|---|---|---|---|---|
| **CPS** | *"The process of becoming sensitive to problems, deficiencies, gaps in knowledge, missing elements, disharmonies, and so on; identifying the difficult; searching for solutions, making guesses, or formulating hypotheses and possibly modifying them and retesting them; and finally communicating the results"* | *Switch between thinking styles* | *New and creative ideas emerge from the conscious effort to balance analysis and imagination* | *Pattern Thinking* |
| **TRIZ** | *"Creativity is the ability to lift the problem to an abstract level and find the ideal solution, and then transform the solution into the specific problem."* | *Systemic/Rational Process* | *Solution are found by using a systemic approach* | *Stem from contradictions or tradeoffs between two or more elements* |
| **Lateral Thinking** | *"One is creative when one use lateral thinking to reasoning what is not immediately obvious and about ideas that may not be obtainable by using only traditional step-by-step logic"* | *Lateral Thinking* | *Challenge every thought and idea and thereby new ideas can arise* | *The difference between what we have and what we want* |

The one thing the three approaches have in common is the swift between thinking styles from critical/logical thinking to an out-of-the-box thinking style, in cps it is called divergent-convergent thinking, in TRIZ it's the swift between logical and "wishful" thinking in the sense that you think up the ideal solution, and in the eyes of de Bono it's the swift between lateral thinking and vertical thinking. It seems to indicate that the "trick" to being creative is to find the balance between imagination and analysis. De Bono uses the lateral techniques as a way of provoking the "normal" (logical) way of thinking; in his opinion this is a way of overcoming the barriers for creative thinking.

In order to compare the three approaches the next step is to find some common denominator. The problem or task is a requisition for using a creative problem solving process, the difference between the approaches is where to start: CPS contains a step for finding objectives, TRIZ focuses on the definition of the problem and Lateral thinking delivers a set of focus tools for broadening the field in which to find new ideas, what they all have in common is the fact that they all begin with some kind of preparation, whether it is searching, defining or by identification. The first comparison parameter is then called **Identification**. The next step is about generating ideas; thinking outside the box, using charts for solving contradictions, this step is all about using the imagination. The word **Ideation** both covers idea generation but also indicates that this step is where the user needs to abandon the logical/critical thinking. The next step is to evaluate or/and select the new ideas, this steps focuses on **Improving** the ideas and will end up in an evaluation. The fourth step is focused on how to get the acceptance or the **Implementation** of the idea.

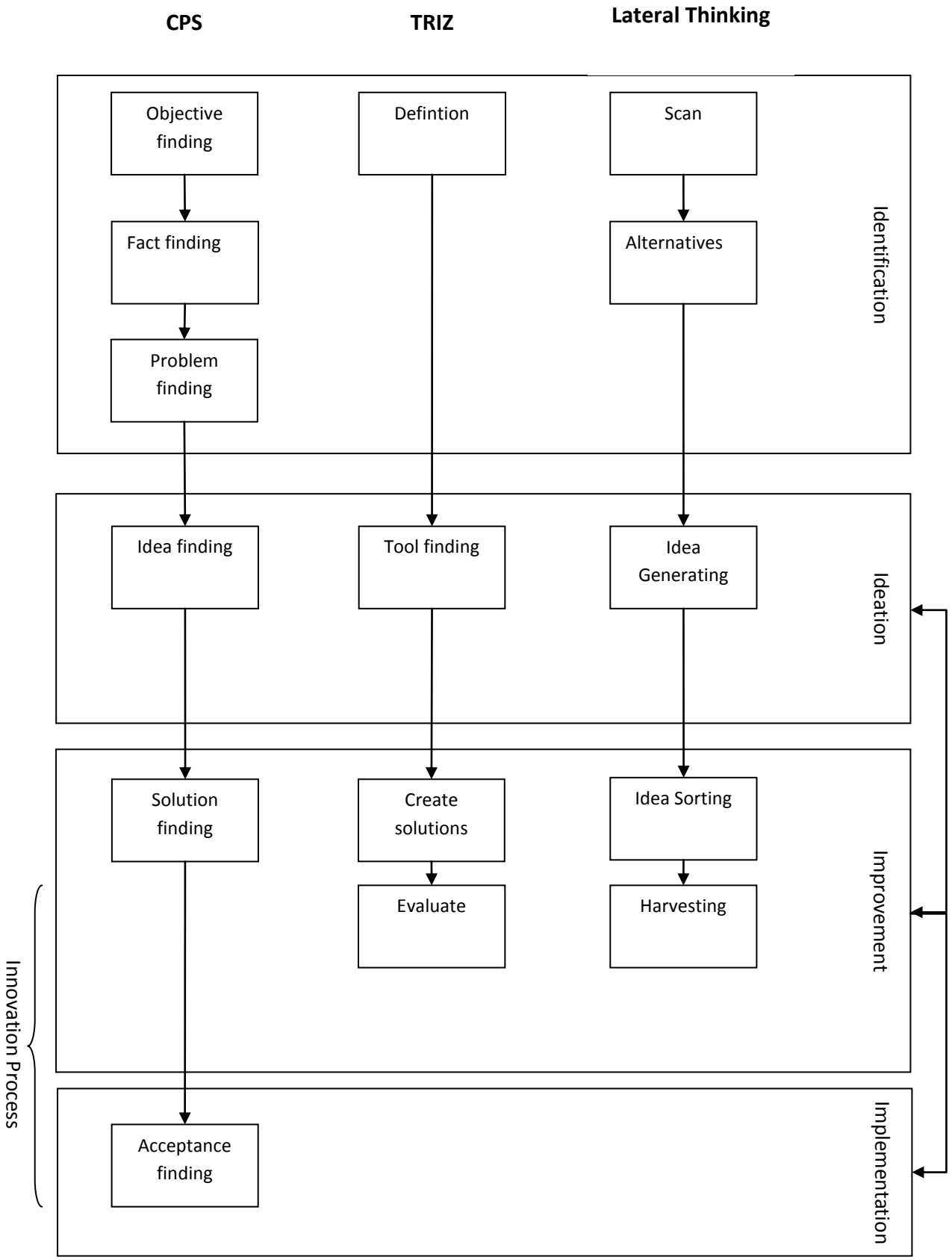



Figure 21- Comparativ Framework

# 5. The Framework for Individual Creative Problem Solving

The following is a suggestion as to how a framework for individual creative problem solving might look based on the CPS, TRIZ and Lateral Thinking.

## 5.1Assumptions

The assumption is that creativity involves critical/logical thinking and imagination (Divergent, Lateral Thinking) and that a problem solving can be defined as creative if one or more of the following conditions are fulfilled (Newell et al. 1962):

1. The problem as initially posed is vague and ill-defined so that part of the task is to formulate the problem itself
2. The thinking is unconventional, in the sense that it requires modification or rejection of previously accepted ideas
3. The thinking requires high motivation and persistence, taking place either over a considerable span of time (continuously or intermittently) or at high intensity
4. The product of thinking has novelty and value (either for the thinker of for his culture)

This implies that the process must have a problem formulation element, and the thinking must be unconventional and it requires high motivation and persistence and finale the outcome must has novelty and value. The first two conditions are implemented in the process, the identification phase deals with the task of formulating the problem and the process suggests tool for modification or rejection of previously accepted ideas. To obtain high motivation and persistence in organizational settings and in order to run an effective creative problem solving session, the climate and culture within the organization must be such that the company encourages innovation and creative thinking (Anderson et al. 1992). Whether the outcome has novelty or value is relatively easy to define (depended on the type of outcome) in a company setting, thus the success of a new product, process can be measured.

## 5.2 The 4 I's of Creative Problem Solving

The following is a suggestion as to how the entire creative problem solving process might look, starting with finding a problem to the implementation of the solution. Figure 22 shows the *eye-candy* version of the new framework, which are called the 4 I's of creative problem solving.

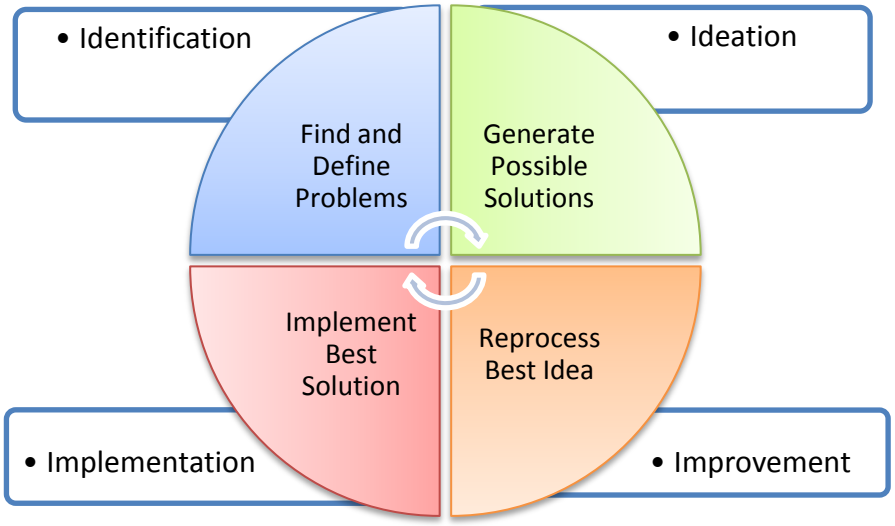



Figure 22 - The 4 I's of Creative Problem Solving

The identification phase involves identifying objectives and formulating problems. Ideation involves generating ideas and how to select the useful ones. Improvement is about how to reprocess and improve the best ideas and finally the last phase concern tools on how to implement the solution.

### 5.2.1 The Whole Process

In the following we will take a further look at, first the whole process, then at the different steps in the process. Looking at the whole process (figure 23) it shows that in each of the four steps/phases there are both actions and end "goals". The starting point is point of departure which covers the present situation (on personal, company and world level), using present situation as background the user is to be observant and look for new objectives (tasks, problems or improvement of existing processes or products) if or when the problem is found, the next step is to define the problem, in this phase several different "creative" tools may be used. This phase is then followed by a fact/data finding phase in which all relevant data regarding the problem is gathered, the end result of this phase is a well defined problem. The next phase, the ideation phase, is about generating new ideas; the aim is by abandoning logical/critical thinking and finding a balance between being creative and being *foolish*. Then an assessment of all of the ideas is carried out and the useful ideas are selected and evaluated.

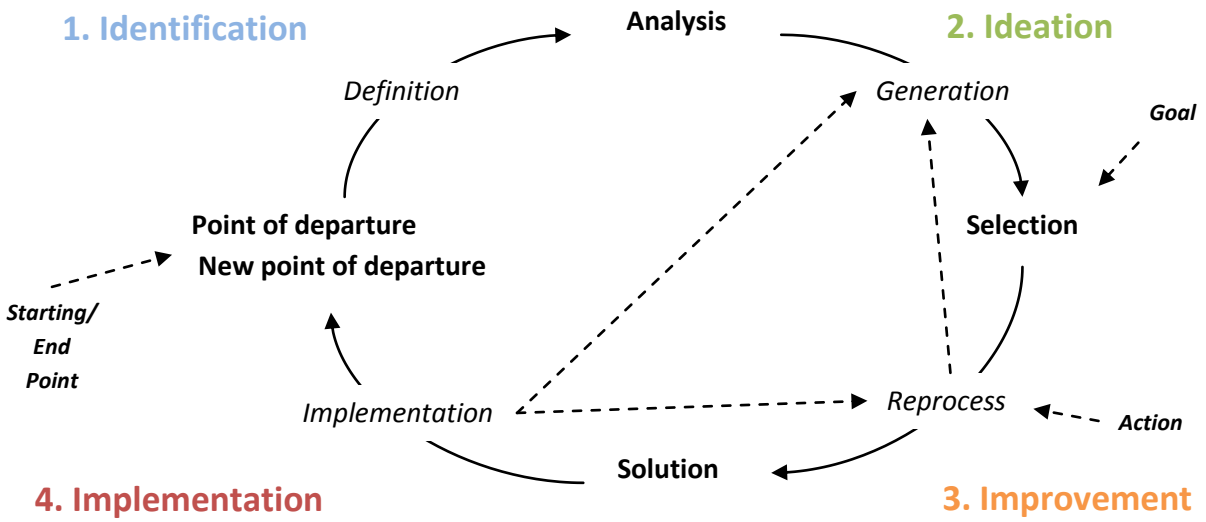



Figure 23 - The Whole Process

The **Improvement** phase is where creativity and innovation theory link together, the objective is to improve and enhance the ideas to end off with a solution (or product, process). The final stage is the implementation phase in which acceptance finding for the solutions to be found and the end goal is to implement the solution in the "present situation" (life, company, and world).

### 5.2.2 The Tools in the New Framework

Next follows a presentation of each step and tools in the new framework. The suggested tools are only guidelines thus the new framework is created as a reaction to the entire patented creative problem solving frameworks and the order in which each step is used is depended on the situation. Each of the four phases are divided in sub-steps, the identification phase consist of: finding problems, data finding and problem definition. The ideation phases is in two phases, first the ideation phase which are divide into three categories according to how paradigm challenging they are (preserving, stretching, breaking) and finally some tools for selecting ideas are presented. Next phase, the improvement phase, presents three different categories of reprocess tools (simple, advanced and technical) according to the sort of ideas which need to be improved. In the final phase some different techniques and tools to how to find acceptance for the solution are presented.

### 5.2.2 The New Framework

The following is a presentation of how a new framework could be constructed. The tools suggested are only guidelines thus the new framework is created as a reaction to the entire patented creative problem solving frameworks.

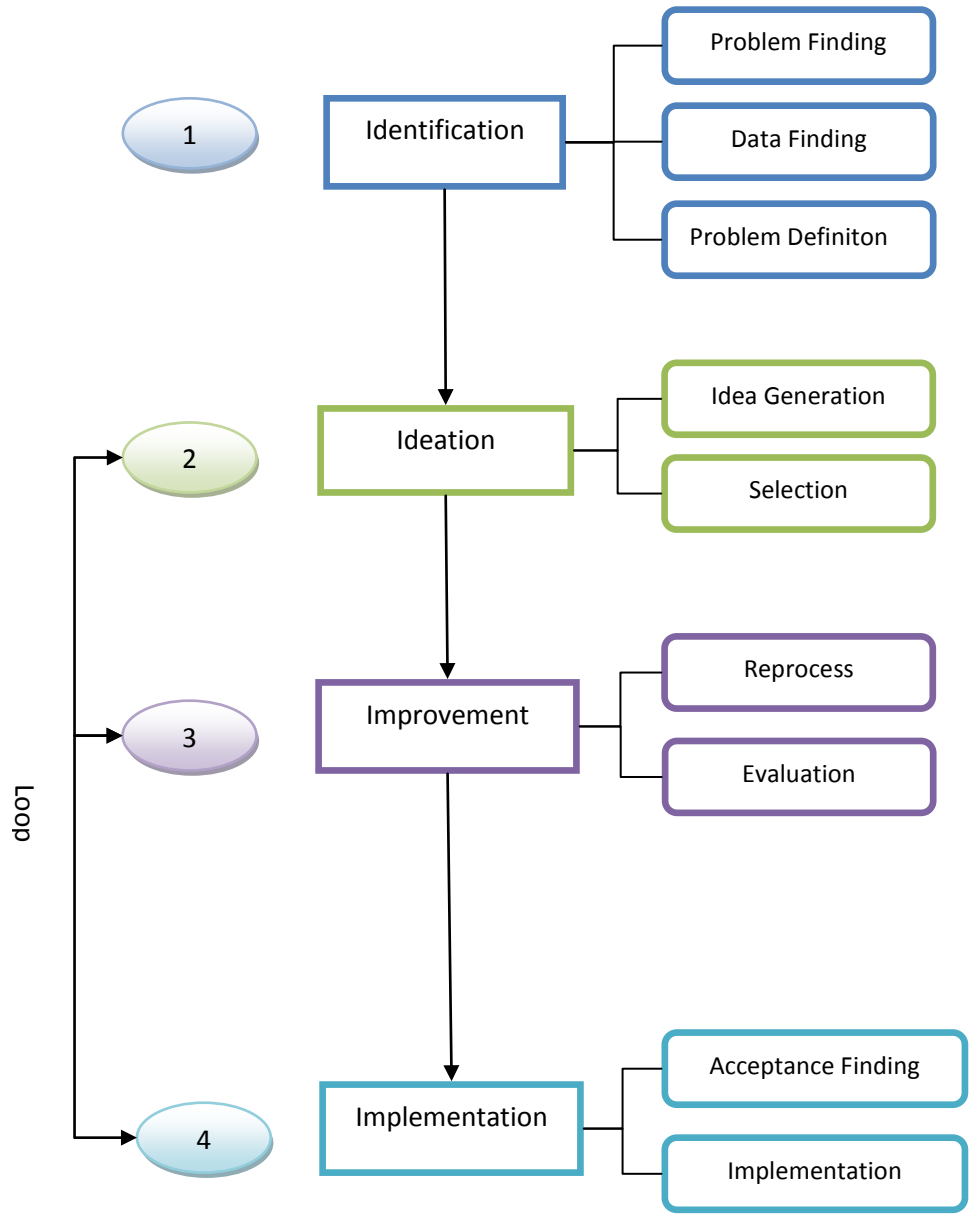
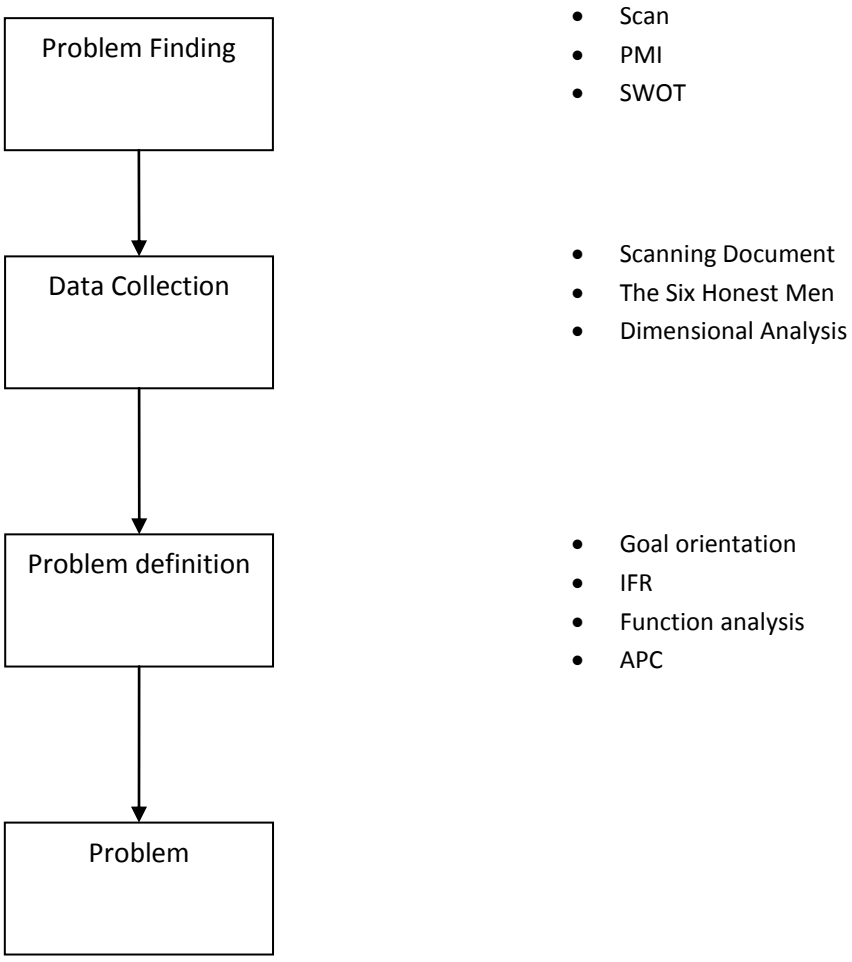



Figure 24 - Framework for Individual Creative Problem Solving

### 5.3.1 Identification

#### *Problem Finding*

The first phase is where a problem is found/identified and analyzed. The first part is to find a objective/problem, this is done by being observant and scan the environment for problems, this can be done by using current and past experience or/and to compare performance with desirable levels of what others are achieving. This stage is an exploration of the broad environment in which there may be opportunities for finding challenges.




The aim is to look at the current world situation or by looking at the present situation for the organization (talk to managers or employees and identify peoples major concerns). A useful tool is the SWOT analysis or PMI which may be used for creating an overview of the present situation and may act as inspiration for finding problems or tasks.

### *Data Finding*

The data finding helps in a better understanding of the problem area and will help in a better definition of the real problem. One way is to gather information; this may be done by scanning documents, by attending meetings or by asking a mentor/teacher. If it not obvious where and what data to look for, the six honest men (table 2) can be used and the dimensional analysis (table 3) have a similar function but are more advanced in its form can be used.

### *Problem Definition*

The aim with the problem definition stage is to challenge the problem and to obtain as many different angles to the problem area. One approach is to define the Ideal Final Result (IFR), what would be the ideal solution to the problem? And then identify what resources are available and what limitation in the process using goal orientation (table 7) If the problem is a technical one the function & feature analysis can be used (table 21). Next step is to obtain a different perspective on the problem; this may be done by using techniques or by presenting the problem to other people, by restating the problem new viewpoints may arise and lead to creative solutions. The important issue in this stage is to define the most productive problem as possible. The APC tool is used for generating alternatives. When formulating the problem there are some guidelines that can be followed, thus the way the problem is defined decides the way the problem solving process will take. The important issue is that the "good" formulation only contains half the solution; it must be an open formulation (Rahbek 2005).

- Check that you are tackling the problem, not the symptoms of the problem. To do this, ask yourself why the problem exists repeatedly until you get the root of it.
- Lay out the bounds of the problem. Work out the objectives that you must achieve and the constraints that you are operating under.
- Where a problem appears to be very large, break it down into smaller parts. Keep on going until each part is achievable in its own right, or needs a precisely defined area of research to be carried out.
- Summarize the problem in a concise a form as possible.

### 5.2.4 Ideation

When using the different ideation (idea generating) tools is it important to make clear how paradigm challenging the different tools is, there are three different classifications (McFadzean 1996): 1) Paradigm preserving (no new elements or relationships are introduced into the problem space). 2) Paradigm stretching (introducing new elements or new relationships). 3) Paradigm breaking (both new elements and new relationships are introduced).

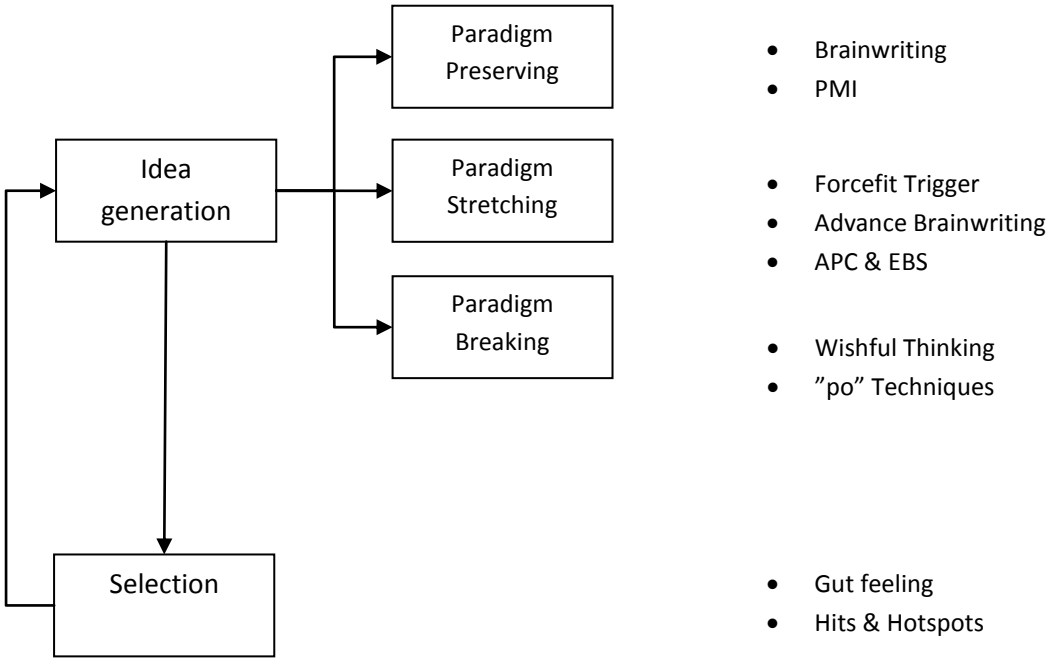



Figure 25 - Ideation

The choice of category is then up to the user, depended on what kind of problem is needed to be solved. The paradigm preserving category contains simple tool as brainwriting and PMI. The paradigm category consists of a stimulation tool called Force-Fit Triggers which can be used to stimulate to new ideas by using card or objects. Advanced brainwriting can also be used; it is brainwriting where the 40 inventive principles can be used as inspiration for the idea generation. To examine both sides of a problem the APC and EBS can use. The paradigm breaking present different tools, first wishful thinking which calls for using the imagination and ask the question: “what if?” Then one can use provocation tools; random entry, escape and reversal they all have the purpose of challenging the perspective of the user to generate new ideas. For evaluating and selecting the productive ideas one can use the gut feeling and select the ideas per intuition, or use hits and hotspots to identify themes and grouping.

### 5.3.4 Improvement

The idea of the improvement phase is to take the ideas and try to reprocess them in order to improve them. There is different way to do that, in the following there is suggested three different sort of improvement categories; simple, which are simple tools that operates by focusing on the different parts of the idea and aim at giving the user new inspiration. The advanced category is analysis or evaluation tools that are constructed to improve the ideas by looking at the parts in a more sophisticated manner and then identify new areas and ideas. The technical category consist of the tools from TRIZ, If the problem have technical characteristic these tools can be used to solved the problem, either by using the matrix or by comparing to standard solutions.

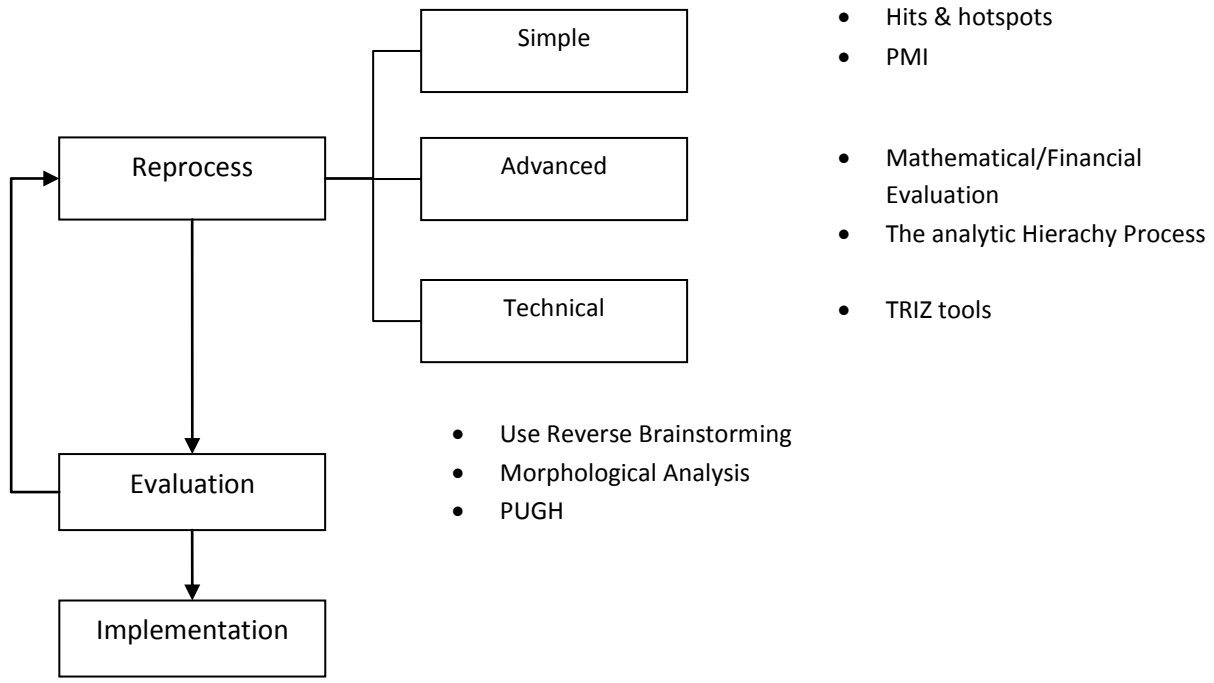



Figure 26 - Improvement

When selecting ideas one possible way of doing so is to start by using your “gut feeling”, what does your intuition say? Then move on to the positive aspects of the ideas and their implementation. The critical analysis might be a combination of identifying contradictions and using CPS matrix. Finally reverse brainstorm may be used as an evaluation tool.

### 5.3.5 Implementation

The final phase implementation is largely dependent on the context in which the user is in. The first step is to identify the potential obstacles and ways to overcome them and this is done by developing both preventive actions and contingency plans. In the following three different approaches are present; attention which is used if the implementation depends on the acceptance of other people. Plan covers some suggestion to different that can be developed to organize the implementation, and the complex part present a tools for implementation of complex project.

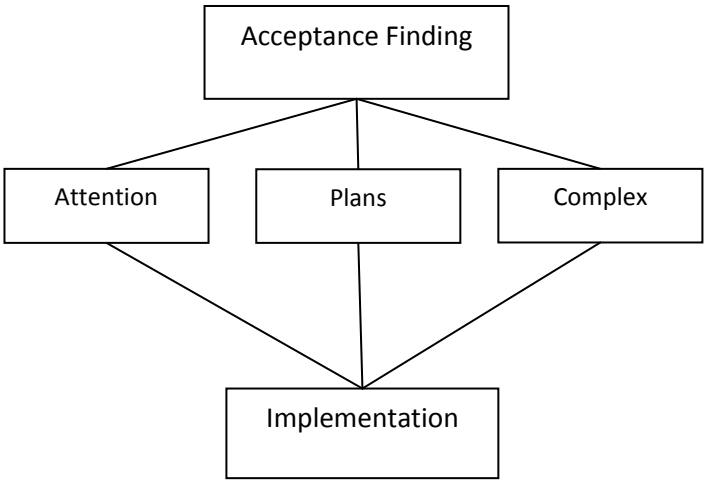



Figure 27 - Implementation

If the implementation requires getting the attention of people one can explain the costs of not accepting the solution, or one can explain the benefits of choosing the solution. There are different plan which can be used when planning for implementation, the escape plan aimed at if the idea does not meet certain milestones the idea is to be terminated. The action plan is a step by step action plan, which will describe every step you will take in the implementation and clarifying what goals are to be met. In this phase the AIDA, which is short for Attention, Interest, Desire and Action and is a communication model can be used to mediate the solution in a structured way. If the implementation of the solution involve a complex process, PERT can be used a method to simplify the scheduling the implementation.

# 6. Conclusion

## 6.1 Conclusion

The aim of the present project was to examine how the creative process in an organization can be simplified and streamlined in order to create a systematical, effective individual creative problem solving framework.

The first phase was to conduct a comparative analysis of the three approaches with the purpose of identifying any similarities and differences. The analysis has shown that the creative process involves purposeful analysis, imaginative idea generation tools and critical evaluation and that the total creative process is a balance between imagination and analysis. The creative (problem-solving) process requires motivation or a drive to action and the implementation of ideas. It is not sufficient merely to imagine new things; work is also required to make the concrete realities.

When looking at the several parts of the process, it shows that some of the tools are simple in form, and their purpose is two sided to make the users creative and to help them keep their focus on the task/problem. Other tools are similar in their form (simple) but have other purposes such as evaluation, inspiration. However, this does not imply that there is no a need for imagination, but rather that the creative process may be done by using simple tools and not magic.

How can creativity processes in organizations be simplified and streamlined to create a systematical effective individual creative problem solving framework?

In the present project this is done by analyzing three of the most popular approaches to creative problem solving, and the findings have been used for constructing a new framework. Whether it is effective is yet to be proven, this of course would have to be tested before any conclusion can be made on that part. The main object of the present project has been to make probable that the creative problem solving process may be simplified and streamlined without losing the ability for being creative, that creativity is not all about being “crazy” and “out there” but rather a process in which imagination and critical thinking are the main ingredients. Furthermore, by simplifying and making the process systematical it may still deliver creative solutions. This of course is only in theory, thus this framework is based on three successful concepts and, in theory, by extracting the common characteristics, this new suggested process should be able to act as a creative problem solving process.

## 6.2 Perspective

An interesting observation is that creative problem solving involves logical/critical thinking and an "out-of-the-box" thinking, together this makes up the creative problem solving act. It indicates that creativity, in the problem solving process, is the product or sum of two different ways of thinking and acting, and that the "out-of-the-box" thinking cannot be defined as the only source to creativity. In creative problem solving processes it is the end-"product" which may be defined as creative and not the idea-generating techniques. Thus, being a creative person is not only about thinking out of the box and generating ideas, but also about being able to think and act in a logical/critical manner, only when these two abilities are combined the act becomes creative. When companies want to be creative they don't have to invest in expensive consultant group concepts, instead working creatively can be done by using simple, not time consuming tools, which the present project has tried to illustrate by comparing three of the most successful creative problem solving concepts and from the findings having constructed a suggestion to a new simple framework for individual creative problem solving.

It is the author's opinion that this project has illustrated that creative work (problem or task solving in business or school/university related context) can be done by using simple focus tools (SWOT, PMI, Alternatives) and by using tools such as the 40 inventive principles the individual can get inspiration from other areas of expertise in solving problems or tasks in a creative manner, that otherwise had to come from group interaction.

Regarding the interaction with other people, the present project has illustrated that part of the individual creative problem solving process involves interaction with other people, this can be an inspiration in finding problems or in gathering information in the problem formulation phase, actually the interaction can take place in every step of the process. However, the main point is that it is dependent on the problem/task, and the interaction with other people is not a prerequisite for creative problem solving.

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## Appendix on CD

- Appendix A – TRIZ 40 Principles
- Appendix B – TRIZ Matrix