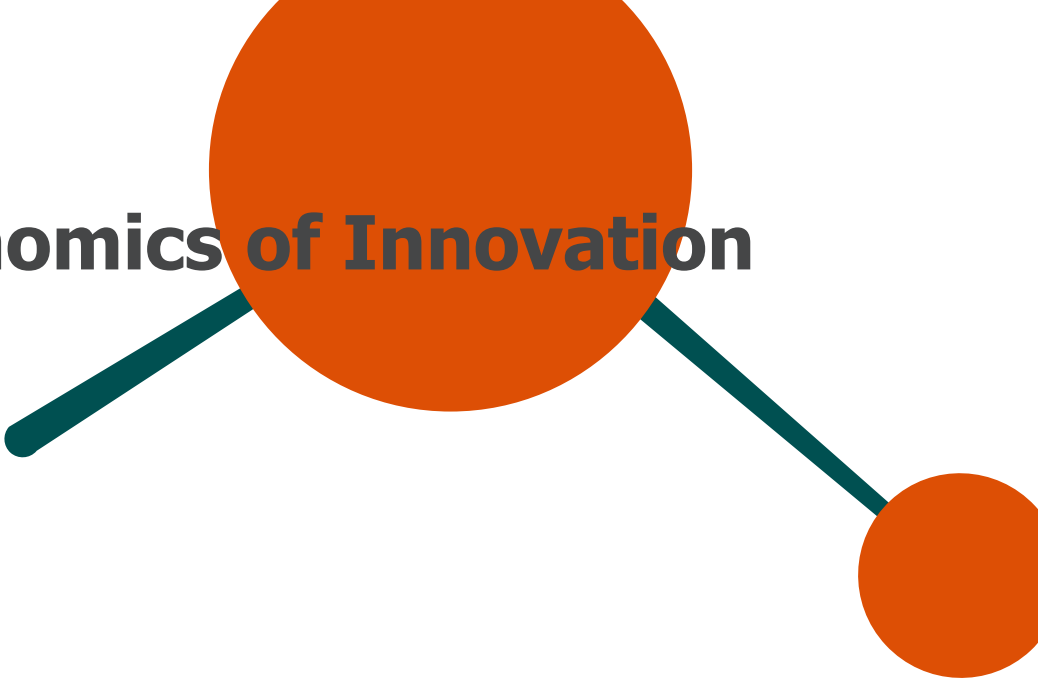
Course: Economics of Innovation



Topic: Linkages, collaborative networks and open innovation

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Innovation and creativity

- creativity is manifested in the production of a creative work (for example, a new work of art or a scientific hypothesis) that is both *original* and *useful*
- innovation begins with creative ideas,
  - creativity by individuals and teams *is a starting point for innovation*; the first is a necessary *but not sufficient* condition for the second

- creativity results:
  - in producing or bringing about something partly or wholly new;
  - in investing an existing object with new properties or characteristics;
  - in imagining new possibilities that were not conceived of before;
  - and in seeing or performing something in a manner different from what was thought possible or normal previously.

- Many creative ideas are generated when somebody discards preconceived assumptions and decides on a new approach or method that might seem to others unthinkable
- Serendipity - effect by which one accidentally discovers something fortunate, especially while looking for something else entirely

BASIC CONCEPTS

- ***Creative thinking represents a combination of logic and intuitive approaches***
- Being creative means dealing with the aspects and possibilities of today and tomorrow
- That requires a person to be open to everything new, do not stick to things that we are all used to, do not adhere to yesterday so much
- Creativity does not mean dreaming, it means productive managing of specific tasks.
- Only a creative approach to the problem solution can be successful.

Creativity in organizations

- **Amabile**: to enhance creativity in business, three components are needed:
  - Expertise (technical, procedural & intellectual knowledge),
  - Creative thinking skills (how flexibly and imaginatively people approach problems),
  - and Motivation (especially intrinsic motivation).
- **Nonaka**: creativity and knowledge creation are important to the success of organizations. In particular, he emphasized the role that tacit knowledge has to play in the creative process.

Creativity and economics

- Joseph Schumpeter: ***creative destruction*** - the way in which old ways of doing things are endogenously destroyed and replaced by the new.
- Paul Romer: the recombination of elements to produce new technologies and products and, consequently, economic growth. Creativity leads to capital, creative products are protected by intellectual property laws.
- The ***creative class*** as important driver of modern economies. Richard Florida in *The Rise of the Creative Class*, 2002 popularized the notion that regions with "3 T's of economic development: Technology, Talent and Tolerance" also have high concentrations of creative professionals and tend to have a higher level of economic development.
- Important aspect to understanding **Entrepreneurship**.

Stages of creative process

- Orientation: Need identification, intention to create
- Preparation: Information collection, problem formulation
- Incubation: seeking solution, evaluation of variants, unconscious thinking
- Illumination (Eureka!): synthesis, creation of ideas
- Realization: transformation of the idea into reality
- Verification: evaluation, learning, improvement

Barriers to creativity - 1

- The value of getting things right time can induce a fear of mistakes and experimentation.
- So can a blame culture where people become afraid of making mistakes.
- Managers who are not as secure as they should be can resist or block ideas that are not their own or which they see as threatening.
- A culture that over emphasizes cost containment, processes, consistency or efficiency.
- A reward system that too exclusively celebrates getting things done fast with no mistakes.
- A general fear of risk taking, wanting to analyze everything to death, to wait and see what others do in the market before acting.

Barriers to creativity - 2

- A lack of explicit funding for experimentation.
- A strict requirement to demonstrate the value of an idea before it has a chance to prove itself.
- A tendency to shoot down novel ideas as a way of scoring points.
- An over allegiance to past successes, proven experience and tried and tested methods.
- A suspicion of novelty, a fear of the unproven.
- A resistance to learning from mistakes or trial and error, a tendency to blame external factors or other people for failures rather than to learn from them.
- Short termism - a drive to meet short term financial goals rather than to invest in the future.

CREATIVITY STIMULATION

- Keep in touch with creative people
- Accommodate the effort to the targets
- Evaluate and appreciate the effort
- Protect creative employees
- Leave them peace and time
- Provide them with security
- Tolerate failures
- Maintain creative atmosphere
- Evaluate the creative ideas quickly
- Be persistent - nothing comes for free

Fostering creativity

- Establishing purpose and intention
- Building basic skills
- Encouraging acquisitions of domain-specific knowledge
- Stimulating and rewarding curiosity and exploration
- Building motivation, especially internal motivation
- Encouraging confidence and a willingness to take risks
- Focusing on mastery and self-competition
- Promoting supportable beliefs about creativity
- Providing opportunities for choice and discovery
- Developing self-management (metacognitive skills)
- Teaching techniques and strategies for facilitating creative performance
- Providing balance

METHODS OF CREATIVE ACTIVITY

- increasing the individual's or team's creative potential
- contributing to the improvement of the creative work conditions
- facilitating the problem solution

Creative Process

- ***Problem Definition*** - including problem analysis, redefinition, and all aspects associated with defining the problem clearly.
- ***Idea Generation*** - The divergent process of coming up with ideas.
- ***Idea Selection*** - The convergent process of reducing all the many ideas into realistic solutions
- ***Idea Implementation*** - Turning the refined ideas in reality.

- Processes - Schemes and techniques which look at the overall process from start to finish (or at least 3 of the above 4 areas)..

- http://www.mycoted.com/Category:Creativity_Techniques

Brain hemispheres

Left brain functions	**Right brain functions**
sequential	simultaneous
analytical	holistic
verbal	imagistic
logical	intuitive
linear algorithmic processing	holistical algorithmic processing
mathematics: perception of counting/measurement	mathematics: perception of shapes/motions
present and past	present and future
language: grammar/words, pattern perception, literal	language: intonation/emphasis, prosody, pragmatic, contextual

Convergent vs. divergent thinking

- Convergent thinking involves aiming for a single, correct solution to a problem
- Divergent thinking involves creative generation of multiple answers to a set problem.

CREATIVITY TECHNIQUES

- trial and error
- brainstorming
- Inspirational questions
- psychological-cognitive, such as:
  - Osborn-Parnes Creative problem solving (CPS)
  - Synectics;
  - Lateral thinking (courtesy of Edward de Bono),
- the highly-structured, such as:
  - TRIZ (the Theory of Inventive Problem-Solving);
  - ARIZ (the Algorithm of Inventive Problem-Solving), both developed by the Russian scientist Genrich Altshuller; and
  - Computer-Aided Morphological analysis.

Trial and error

- select a possible answer, apply it to the problem and, if not successful, select (or generate) another possibility that is subsequently tried. The process ends when a possibility yields a solution.
- more successful with simple problems, often resorted to when no apparent rule applies.
- the approach need not be careless, for an individual can be methodical in manipulating the variables in an attempt to sort through possibilities that may result in success. Nevertheless, this method is often used by people who have little knowledge in the problem area

Trial and error - features

- solution-oriented: trial and error makes no attempt to discover *why* a solution works, merely that it *is* a solution.
- problem-specific: trial and error makes no attempt to generalise a solution to other problems.
- non-optimal: trial and error is an attempt to find *a* solution, not *all* solutions, and not the *best* solution.
- needs little knowledge: trials and error can proceed where there is little or no knowledge of the subject.

Inspirational questions - 1

- What can I substitute to make an improvement?
- What if I swap this for that and see what happens?
- How can I substitute the place, time, materials or people?
- What materials, features, processes, people, products or components can I combine?
- Where can I build synergy?
- What part of the product could I change? And in exchange for what?
- What if I were to change the characteristics of a component?
- What happens if I warp or exaggerate a feature or component?
- What will happen if I modify the process in some way?
- What other market could I use this product in?
- Who or what else might be able to use it?
- What if I did it the other way round?
- What if I reverse the order it is done or the way it is used?
- How would I achieve the opposite effect?

Inspirational questions - 2

- Who else has solved this problem?
- What similar area of expertise might have solved this problem?
- Is there anyone else in the company who knows how to solve this?
- What else could we use to solve the problem?
- Where else might this problem have been solved?
- What other companies might know how to solve this?
- What similar problems have been solved, and how?
- What other industries face the same problem and what do they do about it?

Inspirational questions - 3

- How would they think?
- What objects and items would they be using?
- Where would they be doing it?
- How would they see the problem?
- What action would they take?
- How would they explain the problem?
- How would they solve the problem?
- What does your situation or your problem remind you of?
- What other areas of life/work experience similar situations?
- Who does similar things but not in your area of expertise?

Inspirational questions - 4

- What would my perfect solution be?
- What effect would my ideal solution have?
- What if money/morals/laws did not matter at all?
- What would I do if I had unlimited power and resources?
- What would my ideal solution look like?

Source:Wikipedia

CPS (OFPISA)

- six stage process, each with a divergent and a convergent phase.
  1. Objective Finding (or Mess Finding): Sensitise yourself for issues that need to be tackled.
  2. Fact Finding: Gather information about the problem.
  3. Problem Finding: convert a fuzzy statement of the problem into a broad statement more suitable for idea finding.
  4. Idea Finding: generate as many ideas as possible
  5. Solution finding: Generate and select obvious evaluation criteria and develop the short-listed ideas from Idea Finding as much as possible in the light of these criteria. Then choose the best of these improved ideas for further development
  6. Acceptance finding: How can the suggestion you have just selected be made up to standard and put into practice?

Synectics

- problem solving approach that stimulates thought processes of which the subject is generally unaware.
- developed by William Gordon,
- central principle: "Trust things that are alien, and alienate things that are trusted."
- Encourages
- fundamental problem-analysis and, on the other hand,
- the alienation of the original problem through the creation of analogies
- It is thus possible for new and surprising solutions to emerge.
- Synectics is more demanding of the subject than brainstorming, as the many steps involved mean that the process is more complicated and requires more time and effort.

Synectics - steps

- Analysis and definition of the problem
- Spontaneous solutions
- Reformulation of the problem
- Creation of direct analogies
- Personal analogies (identification)
- Symbolic analogies (contradictions)
- Direct analogies
- Analysis of the direct analogies
- Application to the problem
- Development of possible solutions

Lateral thinking

- de Bono
- methods of thinking concerned with changing concepts and perception; reasoning that is not immediately obvious, ideas that may not be obtainable by using only traditional step-by-step logic
- shifting of thinking patterns, away from entrenched or predictable thinking to new or unexpected ideas.
- A new idea that is the result of lateral thinking is not always a helpful one, but when a good idea is discovered in this way it is usually obvious in hindsight, which is a feature lateral thinking shares with a joke
- We may need to solve some problems not by removing the cause but by designing the way forward even if the cause remains in place
- http://en.wikipedia.org/wiki/Lateral_thinking

Lateral thinking vs. critical thinking

- Critical thinking is primarily concerned with judging the truth value of statements and seeking errors.
- Lateral thinking is more 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.
- Critical thinking is like a post-mortem while lateral thinking is like diagnosis.

Lateral thinking - inspiration

- **Random Entry**: Choose an object at random, or a noun from a dictionary, and associate that with the area you are thinking about.
- **Provocation**: Declare the usual perception out of bounds, or provide some provocative alternative to the usual situation under consideration. Prefix the provocation with the term 'Po" to signal that the provocation is not a valid idea put up for judgement but a stimulus for new perception.
- **Challenge**: Simply challenge the way things have always been done or seen, or the way they are. This is done not to show there is anything wrong with the existing situation but simply to direct your perceptions to exploring outside the current area.

Six de Bono hats

- **White hat** (Blank sheet): Information & reports, facts and figures (*objective*)
- **Red hat** (Fire): Intuition, opinion & emotion, feelings (*subjective*)
- **Yellow hat** (Sun): Praise, positive aspects, why it will work (*objective*)
- **Black hat** (Judge's robe): Criticism, judgment, negative aspects, modus tollens (*objective*)
- **Green hat** (Plant): Creativeness, Alternatives, new approaches & 'everything goes', idea generation & provocations (*speculative/creative*)
- **Blue hat** (Sky): "Big Picture," "Conductor hat," "Meta hat," "thinking about thinking", overall process (*overview*)

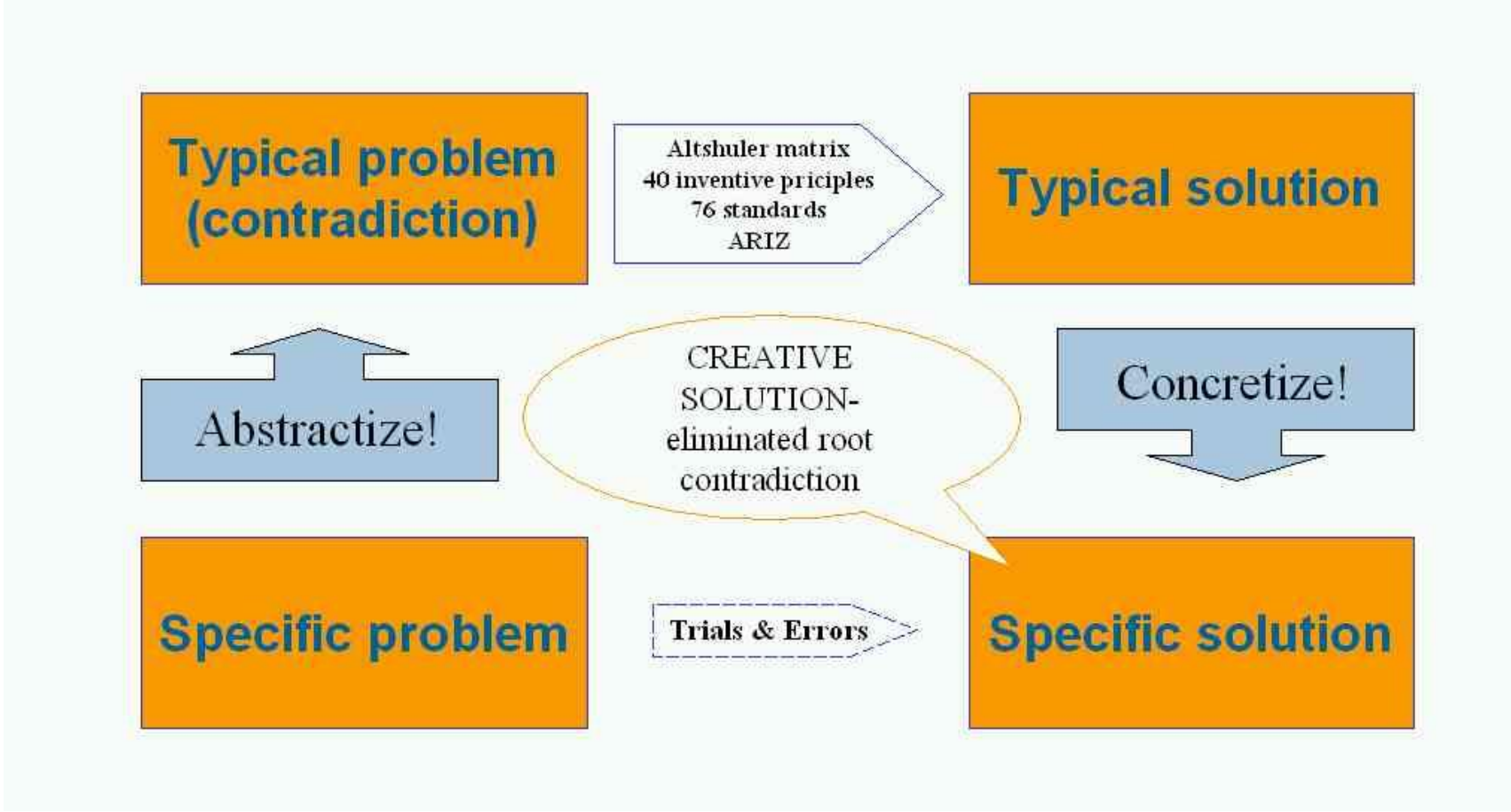
Example - meeting

- The meeting may start with everyone assuming the **Blue** hat to discuss how the meeting will be conducted and to develop the goals and objectives.
- The discussion may then move to **Red** hat thinking in order to collect opinions and reactions to the problem. This phase may also be used to develop constraints for the actual solution such as who will be affected by the problem and/or solutions.
- Next the discussion may move to the (**Yellow** then) **Green** hat in order to generate ideas and possible solutions.
- Next the discussion may move between **White** hat thinking as part of developing information and
- **Black** hat thinking to develop criticisms of the solution set.

TRIZ, ARIZ

- Теория решения изобретательских задач" (***T****eoriya* ***R****esheniya* ***I****zobretatelskikh* ***Z****adatch*) = Theory of inventive problem solving
- *Inventing is the removal of a technical contradiction with the help of certain principles*

TRIZ process for creative problem solving

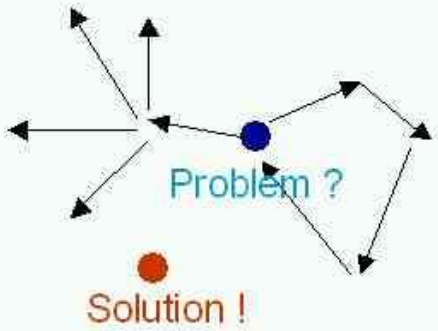


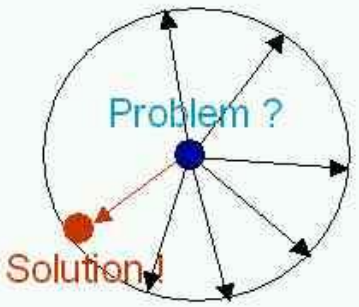
Contradictions

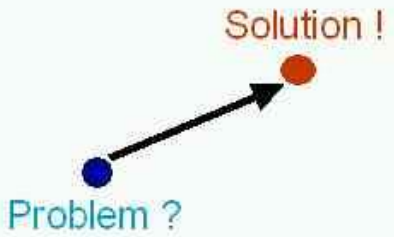
- Inventive problems stem from contradictions (one of the basic TRIZ concepts) between two or more elements, such as, "If we want more acceleration, we need a larger engine; but that will increase the cost of the car," that is, more of something desirable also brings more of something less desirable, or less of something else also desirable. These are called Technical Contradictions.
- Physical or inherent contradictions: More of one thing and less of another may be needed. For instance, a higher temperature may be needed to melt a compound more rapidly, but a lower temperature may be needed to achieve a homogeneous mixture.

Matrix of Contradictions

- 40 inventive principles
- rows: 39 system features that one typically wants to improve, such as speed, weight, accuracy of measurement and so on.
- columns: typical undesired results.
- matrix cell: points to principles that have been most frequently used in patents in order to resolve the contradiction.







Chaos: “Let’s just try!”

“Let’s try everything!”

“Let’s go forward!”

Brainstorming, Synectics, etc.

Morfological analysis, Osborn questionary, etc.

TRIZ, ARIZ

Morphological analysis

- designed for multi-dimensional, non-quantifiable problems where causal modeling and simulation do not function well or at all
- Fritz Zwicky (1967, 1969) - exploring all the possible solutions to a multi-dimensional, non-quantified problem complex

Morphological analysis - steps

1. The problem to be solved must be very concisely formulated.
2. All of the parameters that might be of importance for the solution of the given problem must be localized and analyzed.
3. The morphological box or multidimensional matrix, which contains all of the potential solutions of the given problem, is constructed
4. All the solutions contained in the morphological box are closely scrutinized and evaluated with respect to the purposes that are to be achieved.
5. The optimally suitable solutions are selected and are practically applied, provided the necessary means are available.

Example 1 - energy conversion

initial	**transmission**	**final storage**
kinetic – K	kinetic – K	kinetic – K
electrical – E	electrical – E	electrical – E
chemical – C	chemical – C	chemical – C
thermal – T	thermal – T	thermal – T
nuclear - N	nuclear - N	nuclear - N

Example 1 - continued

- K->E->C: hydroelectric generation which is then stored in a battery.
- C->T->K: internal combustion engine (chemical energy transformed into thermal energy) leading to energy being stored in a flywheel.
- E->C->T: common refrigerator

Example 2 – cardboard packaging

Parameter	**Parameter values**					
separated media	solid / solid	solid / fluid	solid / gas	fluid / fluid	fluid / gas	gas / gas
level of separation	total	partial				
protection against	gravitation	mechanical forces	heat	radiation	sound	
combination with	paper	plastic	wood	paint	nothing	

solution: throwaway beverage packaging

Reference and source

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