Use of TRIZ for Prediction of the Future of Technological Systems

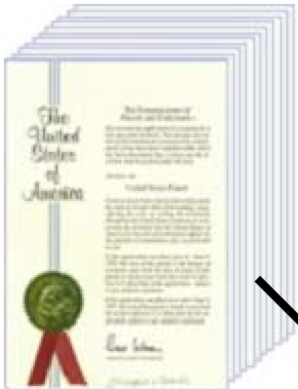
Boris Zlotin, TRIZ Master

Ideation International Inc

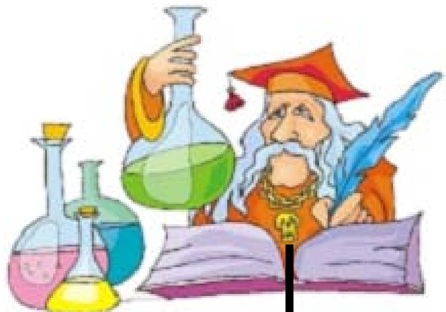
The Fifth TRIZ Symposium in Japan, 2009

Over 60 Years of Development

initiated and led by G. Altshuller and involving hundreds of scientists and inventors



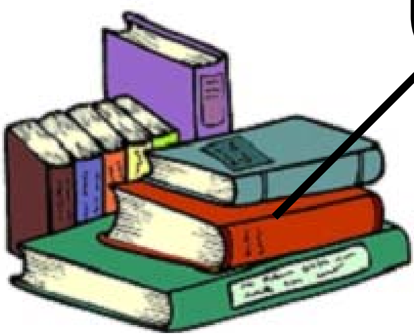
More than 2.000.000 worldwide patents



Practical experience of thousands of scientists, inventors, engineers, managers, businessmen, etc.

Theory of Inventive Problem Solving

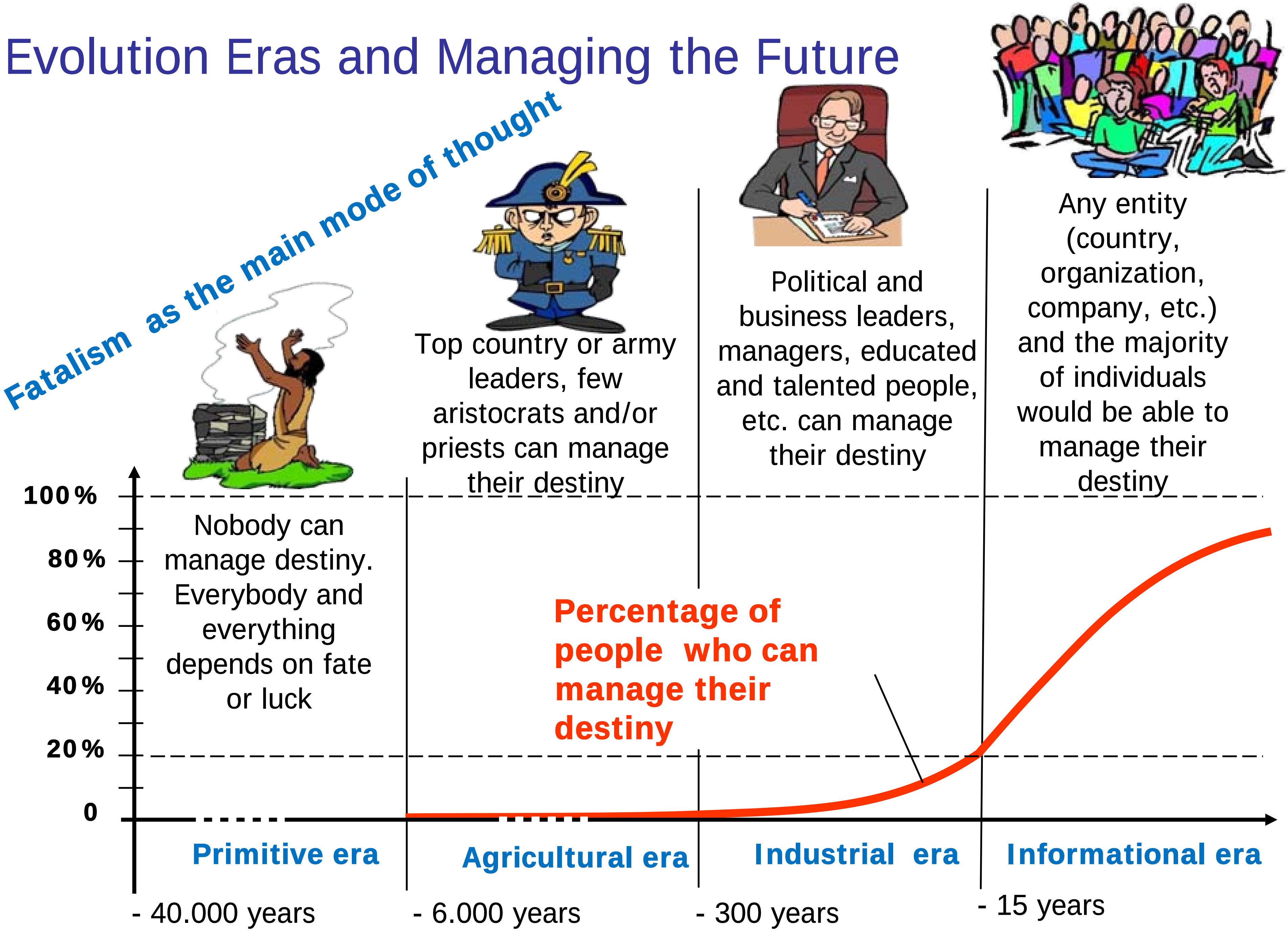
TRIZ



History of evolution in different areas of technology and science, social systems, business, management, art, languages, etc.

Feedback from solving with TRIZ thousands of problems

Evolution Eras and Managing the Future



Ideation Operating System for Innovation

Directed Evolution®
A systematic procedure for strategically evolving future generations of technological systems

DE

AFD I-TRIZ IPS

CIP

Anticipatory Failure Determination

Failure Analysis
A systematic procedure for identifying the root causes of a failure or other undesired phenomenon in a system, and for making corrections in a timely manner.

Failure Prediction
A systematic procedure for identifying beforehand, and then preventing, all dangerous or harmful events that might be associated with a system.

Management of Intellectual Property
A systematic procedure for increasing IP value and providing protection from infringement and circumvention.

Inventive Problem Solving
A systematic procedure for resolving tough technological problems, enhancing system parameters, improving quality, reducing cost, etc. for current generations of products and technologies.

Problem Solving versus Directed Evolution

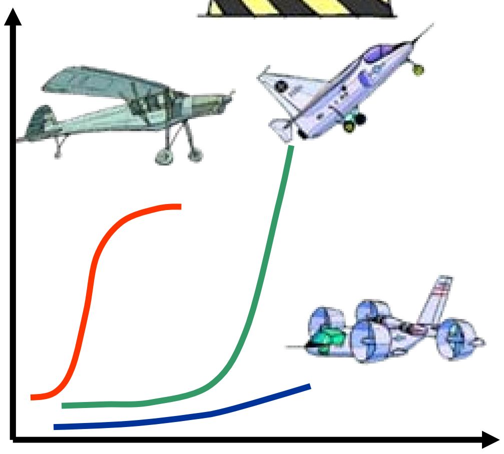
- Inventive Problem Solving (IPS) = reactive way of evolution

- DE = Directed Evolution = pro-active way of evolution involving timely transition to the next evolutionary step avoiding the majority of problems inherent to the existing system

The Purpose of Directed Evolution: Building Sustainable Competitive Advantage by developing a comprehensive set of logically sequenced scenarios that enables the planning and on-going development of technological and business systems.

Directed Evolution®

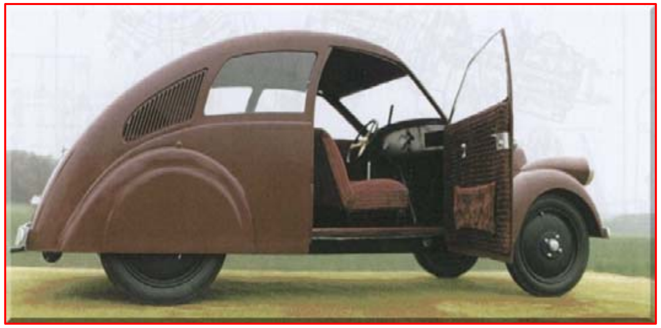
- A systematic process to predict the future generations of a system by inventing them, and
- A systematic approach targeting the identification of a comprehensive set of potential evolutionary scenarios for:
  - Products/Services/Processes
  - Technologies
  - Organizational structures
  - Industries
  - Markets



Perfect Systems – Desired Result of Directed Evolution

Throughout history, only a limited number of technological systems have possessed the outstanding qualities that allowed them to enjoy enormous success over an unusually long life. We name this kind of systems “***Perfect***” or “***Consummate systems***”.

Singer sewing machine



Volkswagen Beetle

DC-3 in service June 2006

Kalashnikov Machinegun

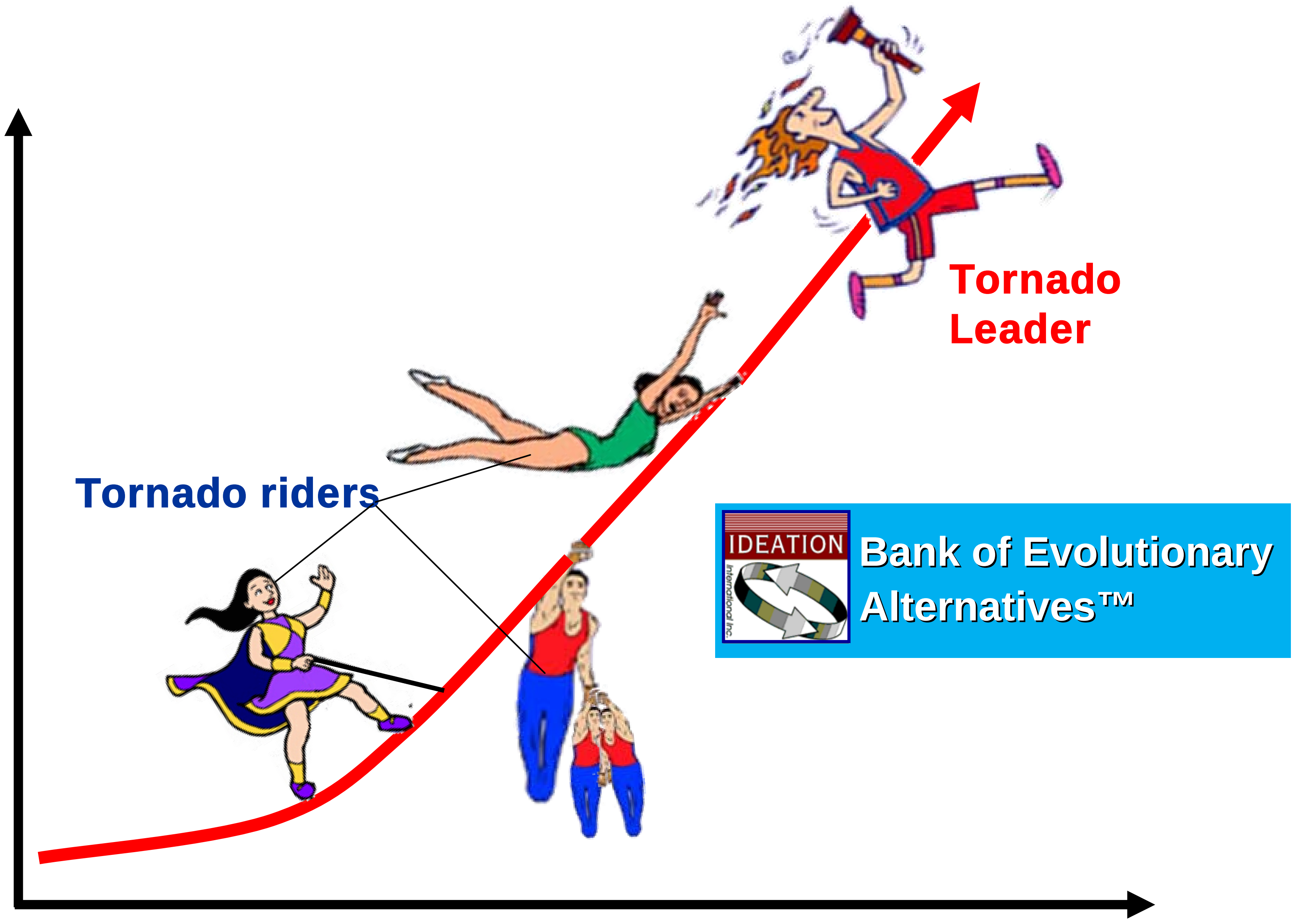
Marketing Tornado – Desired Result of Directed Evolution

- Oil lamp invented   1840
- Kerosene invented   1855
- First oil well drilled   1859

Kerosene lamp
increased bright time

equal to increasing of man power by 25-30%

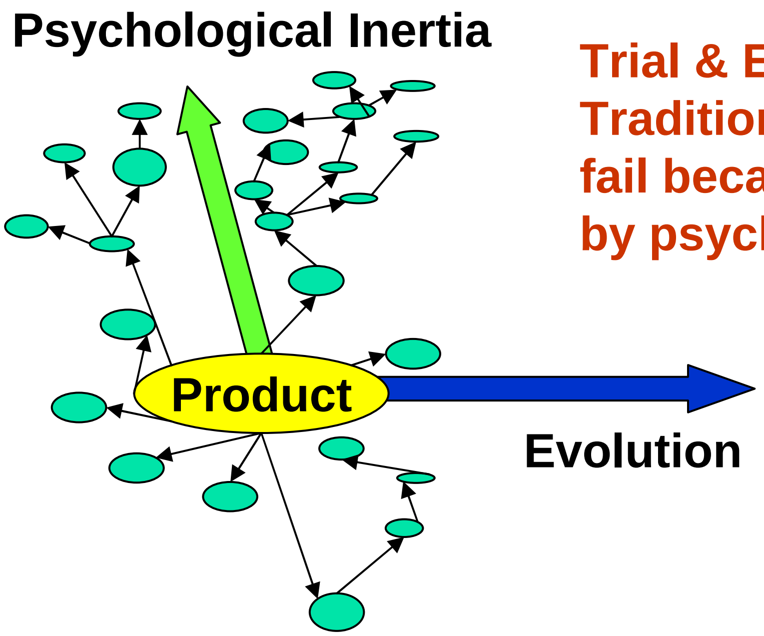
Riding Marketing Tornado - Way to Success



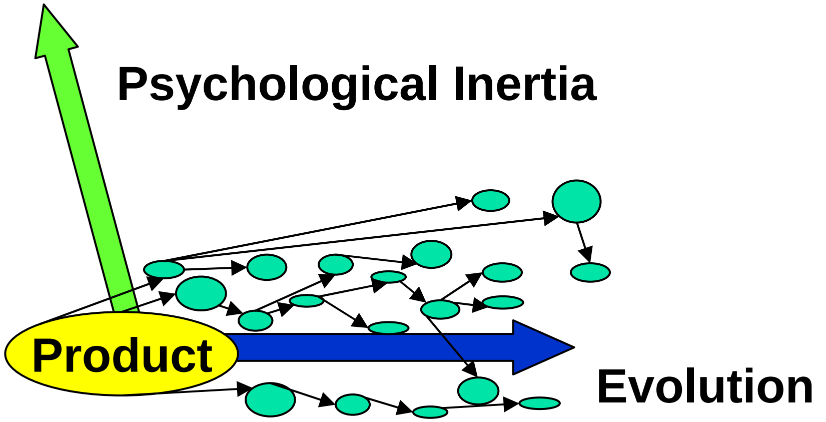
The History

- Technological Forecasting (1950's)
  - Utilizes probabilistic modeling of future characteristics of various systems
- TRIZ Forecasting (1970's)
  - Utilizes selected TRIZ-based tools to generate an idea(s) helpful for the next product or process generation
- I-TRIZ Anticipatory Failure Determination (1980's)
  - Utilizes selected TRIZ-based tools to predict and prevent possible undesired events emerging in the process or a as a result of evolution
- Directed Evolution (1990's)
  - Utilizes extended set of Patterns/Lines of Evolution to generate an exhaustive set of potential scenarios of system positive evolution

Evolutionary Approach versus Traditional Trial & Error Method

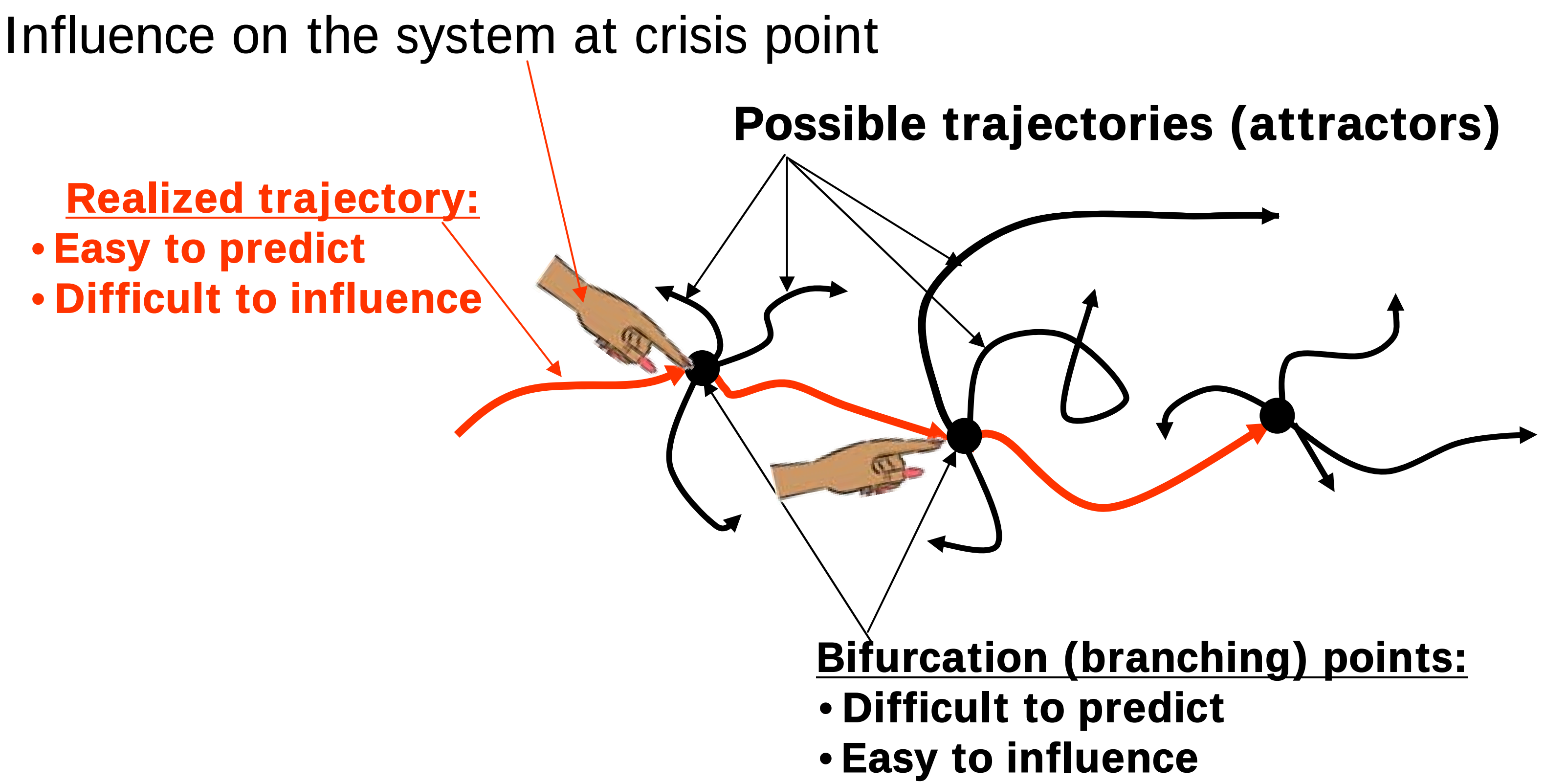


Trial & Error in evolution: Traditionally, majority of trials fail because they are influenced by psychological inertia.



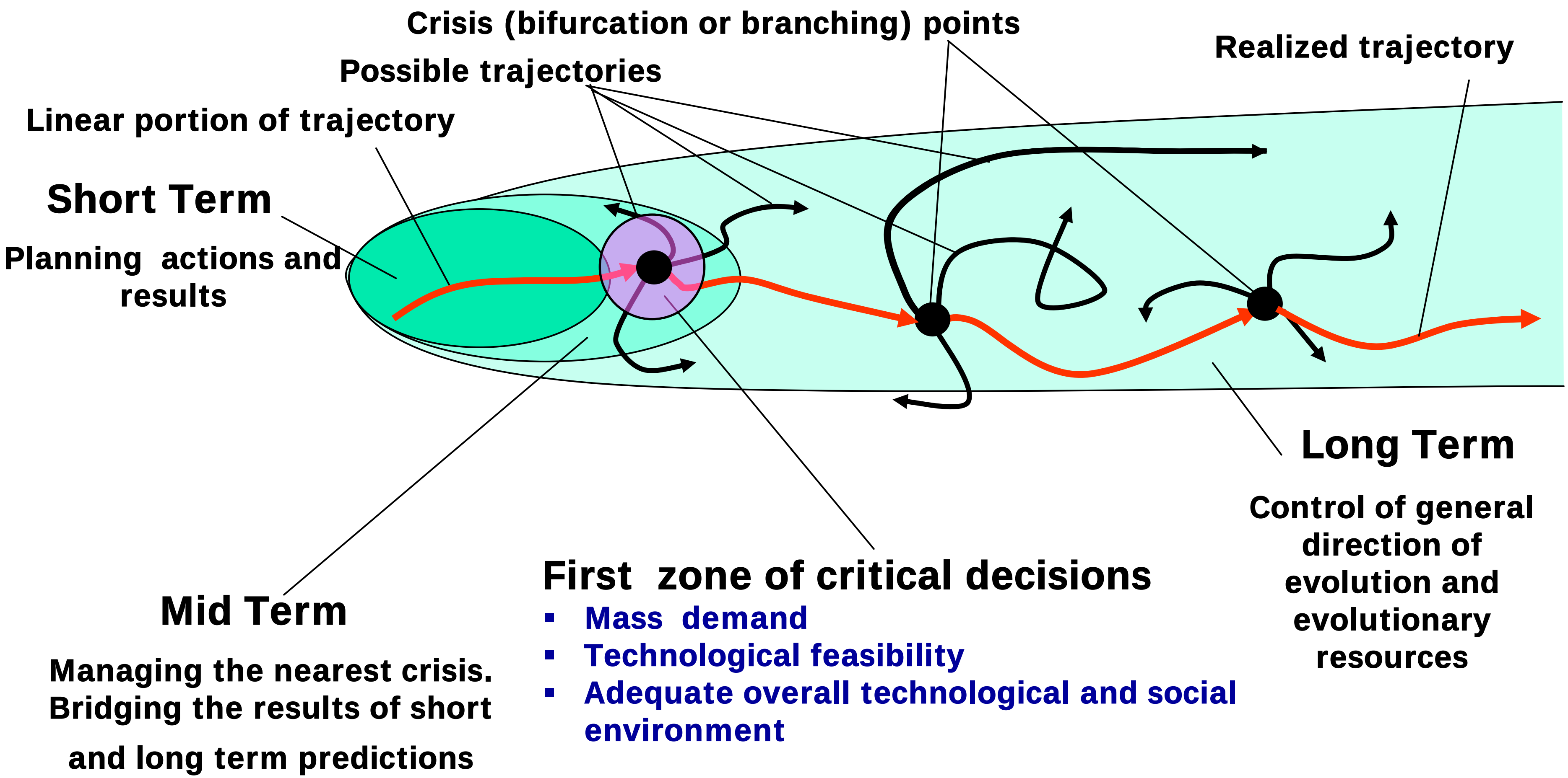
Evolutionary Approach: Majority of trials are productive because they follow defined Patterns of Evolution.

How Can One Control Evolution?



Caesar and Napoleon, Bismarck and Churchill, Lincoln and Roosevelt – all shrewd and successful politicians used controlling evolution through influencing the system at crisis points

Non-Linear Evolution and Forecasting



DE is Based on Patterns of Evolution

- Systems evolve not randomly, but according to objective patterns
- Patterns can be identified based on the analysis of historical development of technology, markets and social trends
- Identified patterns can be purposefully used for system development, avoiding numerous blind trials

Patterns of Evolution:
Common threads between
evolving systems.

Patterns of Evolution: The History

- 1960s – strongest principles from the 40 Innovation Principles set by Genrich Altshuller (Dynamization, Self-service, etc.)
- 1975, spring – the first set of Patterns of Technological Evolution by Genrich Altshuller (Static-Kinematics-Dynamics)
- 1975, fall – Boris Zlotin started teaching Patterns of Technological Evolution in St. Petersburg
- 1981 – first hierarchical structure (sub-patterns or lines of evolution) by Boris Zlotin
- 1989 – new system of patterns of evolution published in the book *Searching for new ideas* by Altshuller, Zlotin, Zusman and Filatov
- 2009 – updated system of patterns of evolution utilized in the Directed Evolution software

Evolution Toward Increased Dynamism

Line: Transition to Multifunctional Performance

Non-Dynamic System → System with Changeable Elements → System with Variable Components

Increasing system dynamism allows functions to be performed with greater flexibility or variety

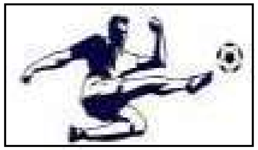
Line: Increasing Degrees of Freedom

Non-Dynamic System → System Changeable at the Mechanical Level: with a Hinge, Hinge Mechanism, Flexible Materials, etc. → System Changeable at the Micro-Level: Phase Transformations, Chemical Transformations, etc.

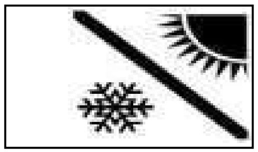
Field (action, influences) evolution

Changes of fields

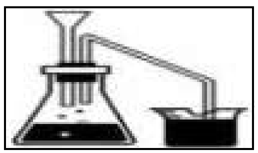
Evolution direction



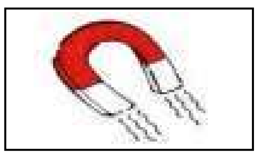
1. Mechanic field



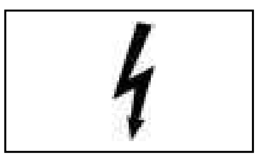
2. Thermal field



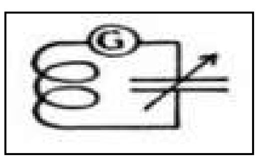
3. Chemical field



4. Magnet field



5. Electrical field



6. Electromagnetic field

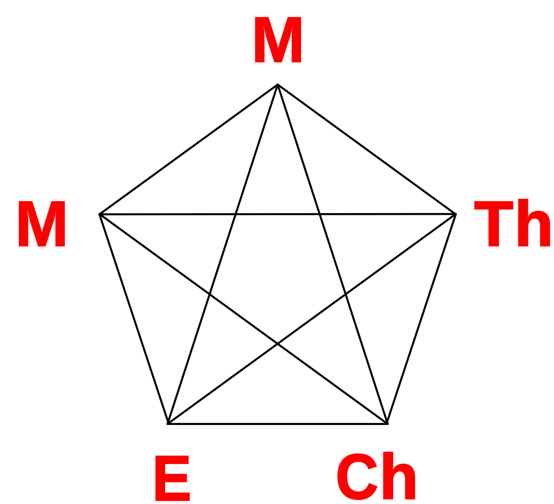
∑

7. Combination of fields

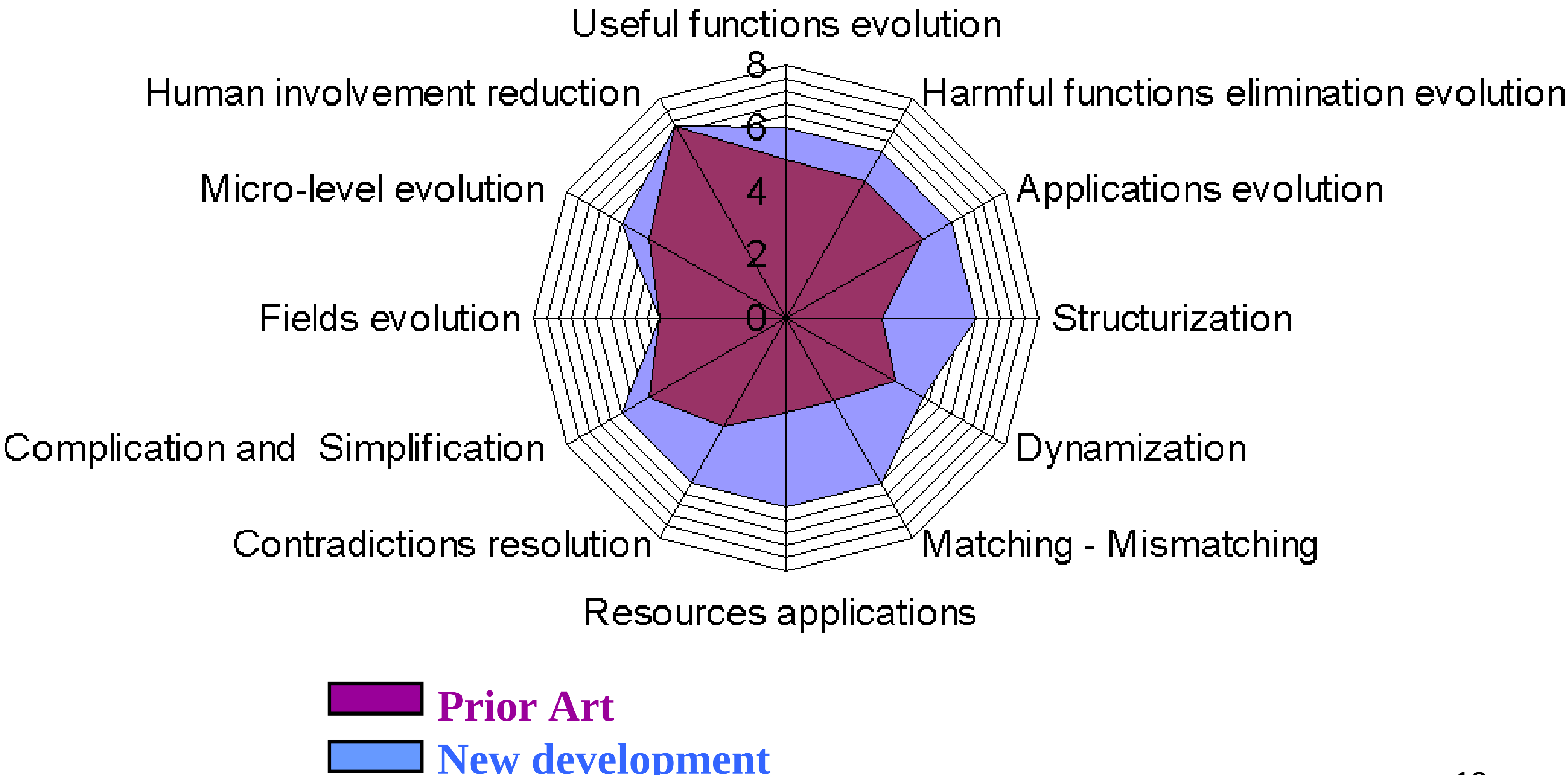
Remember!

M Th Ch E M

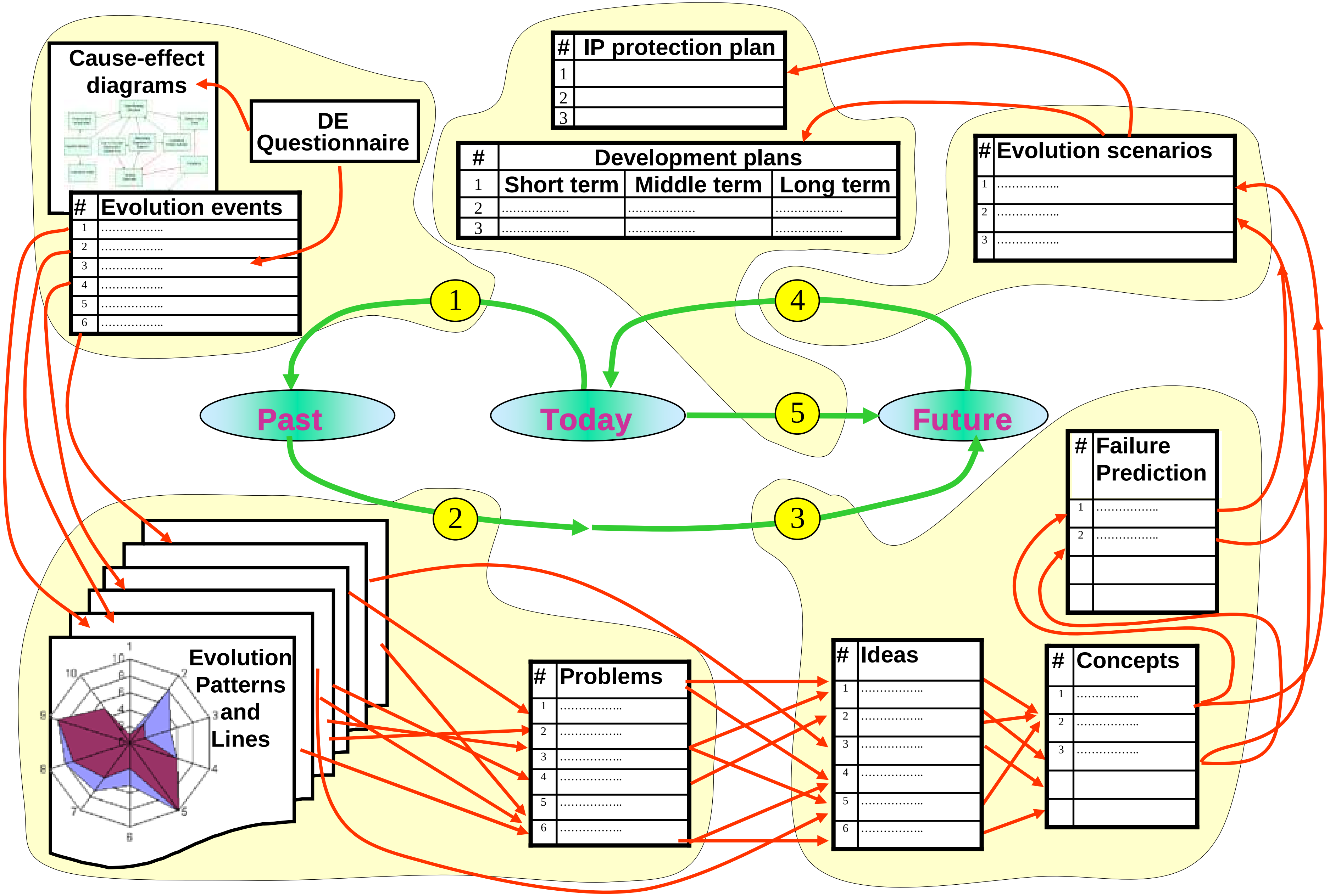
Fields combinations



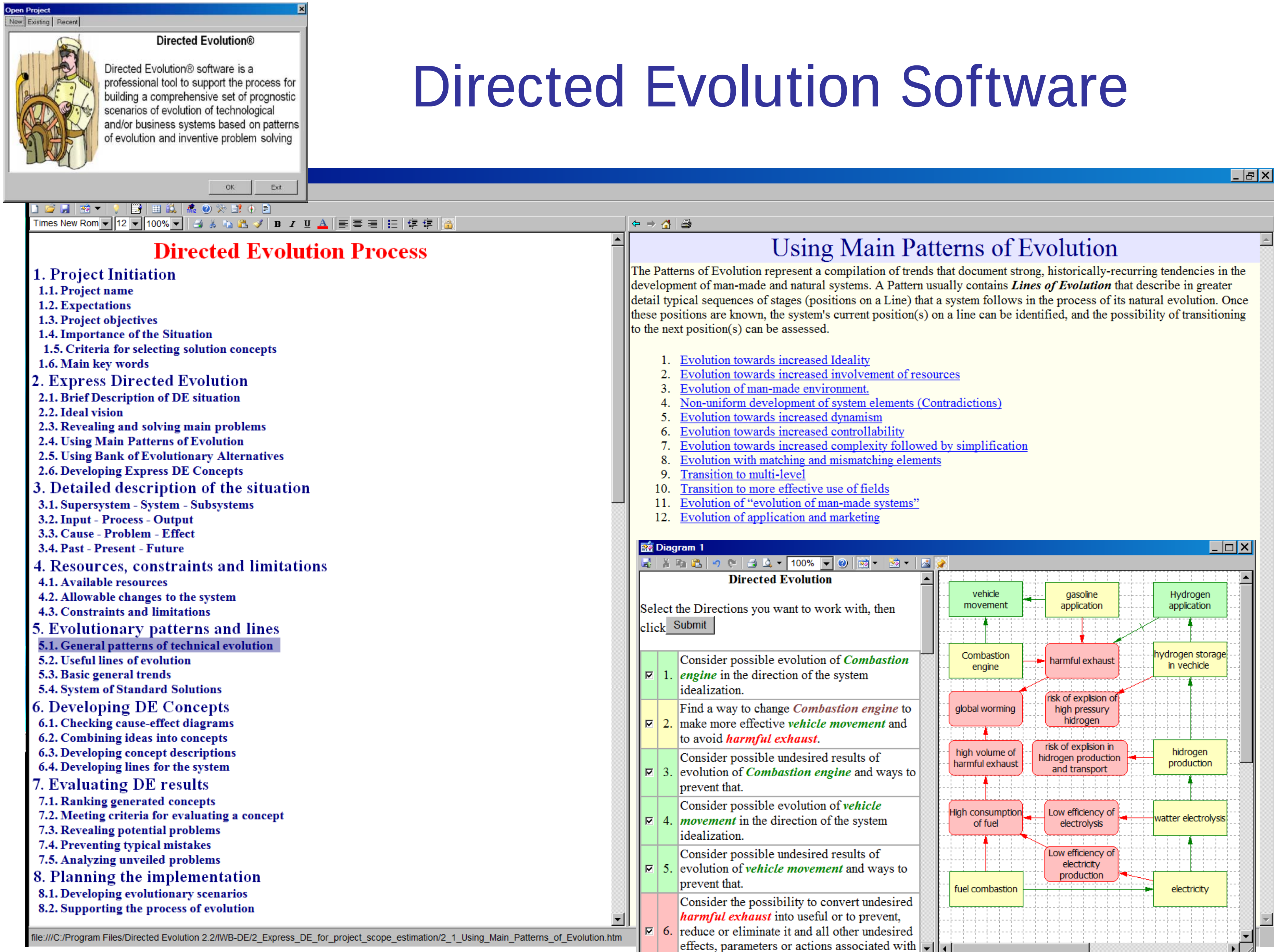
Assessment of Evolutionary Potential



Ideation Directed Evolution ® Process



Directed Evolution Software



Directed Evolution Software Tools

Open Project

New | Existing | Recent

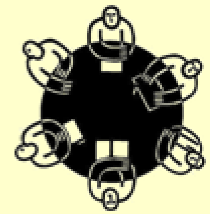
Directed Evolution®

Directed Evolution® software is a professional tool to support the process for building a comprehensive set of prognostic scenarios of evolution of technological and/or business systems based on patterns of evolution and inventive problem solving

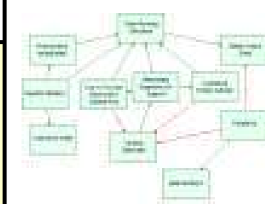
OK | Exit

DE Questionnaire

Experts interview



Cause-effect diagram



Literature / Internet search

Patent search and analysis

Patterns and lines of evolution

Bank of Evolutionary Alternatives

Listing of Evolutionary Resources

Listing of typical mistakes

Inventive Problem Solving

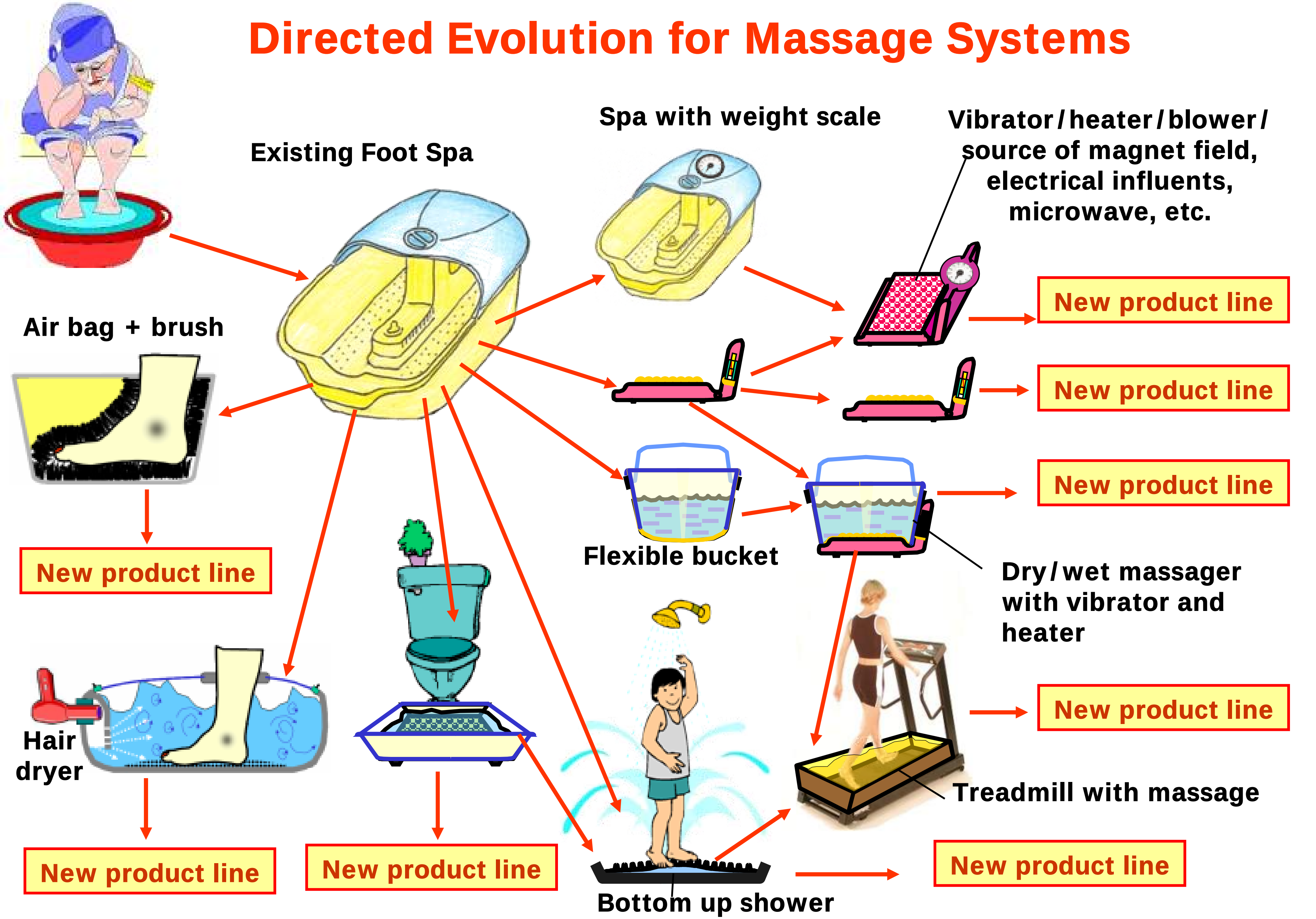
Failure Prediction

Evolution Scenario Development

Evolution scenarios on short, middle and long term

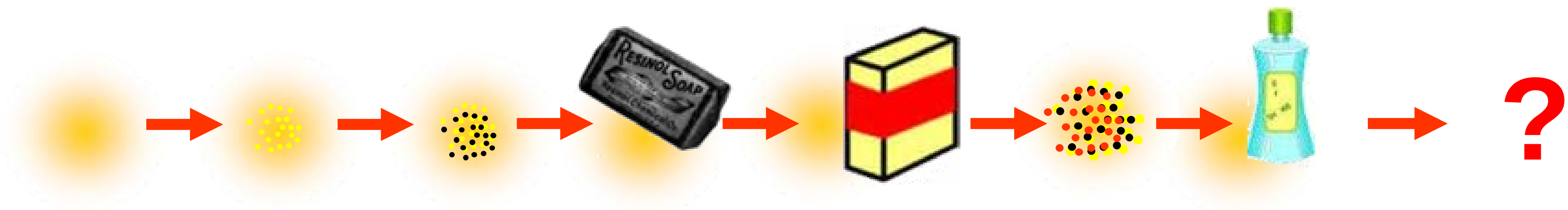
Protection of Intellectual Property

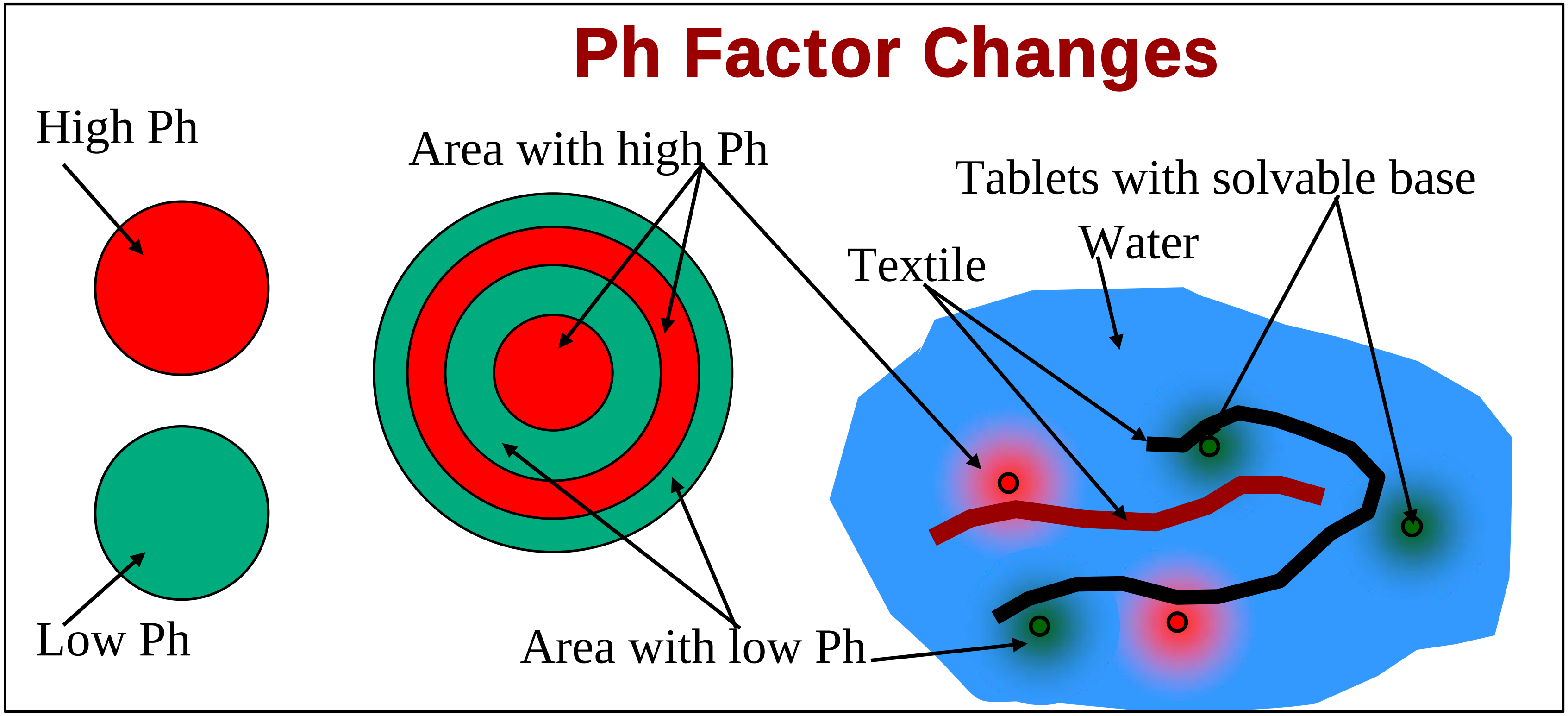
Directed Evolution for Massage Systems



Directed Evolution Project

Evolution of Detergent for Washing Processes



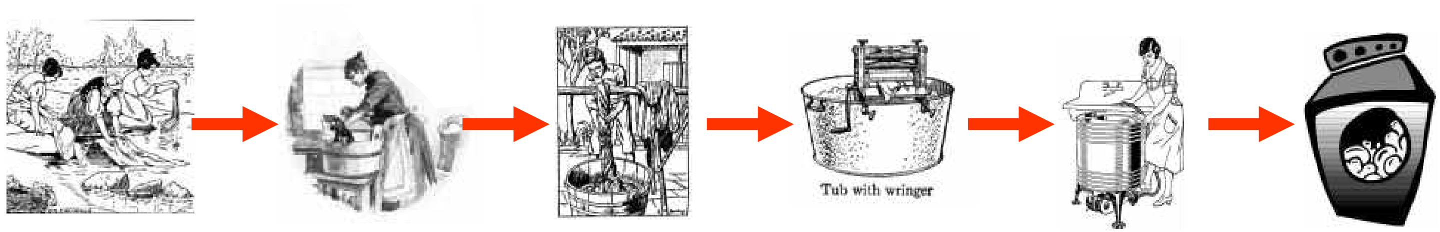


Technology + Business

+

= ?

Hybridization of Washing Processes and Detergent Evolution (Co-Evolution)

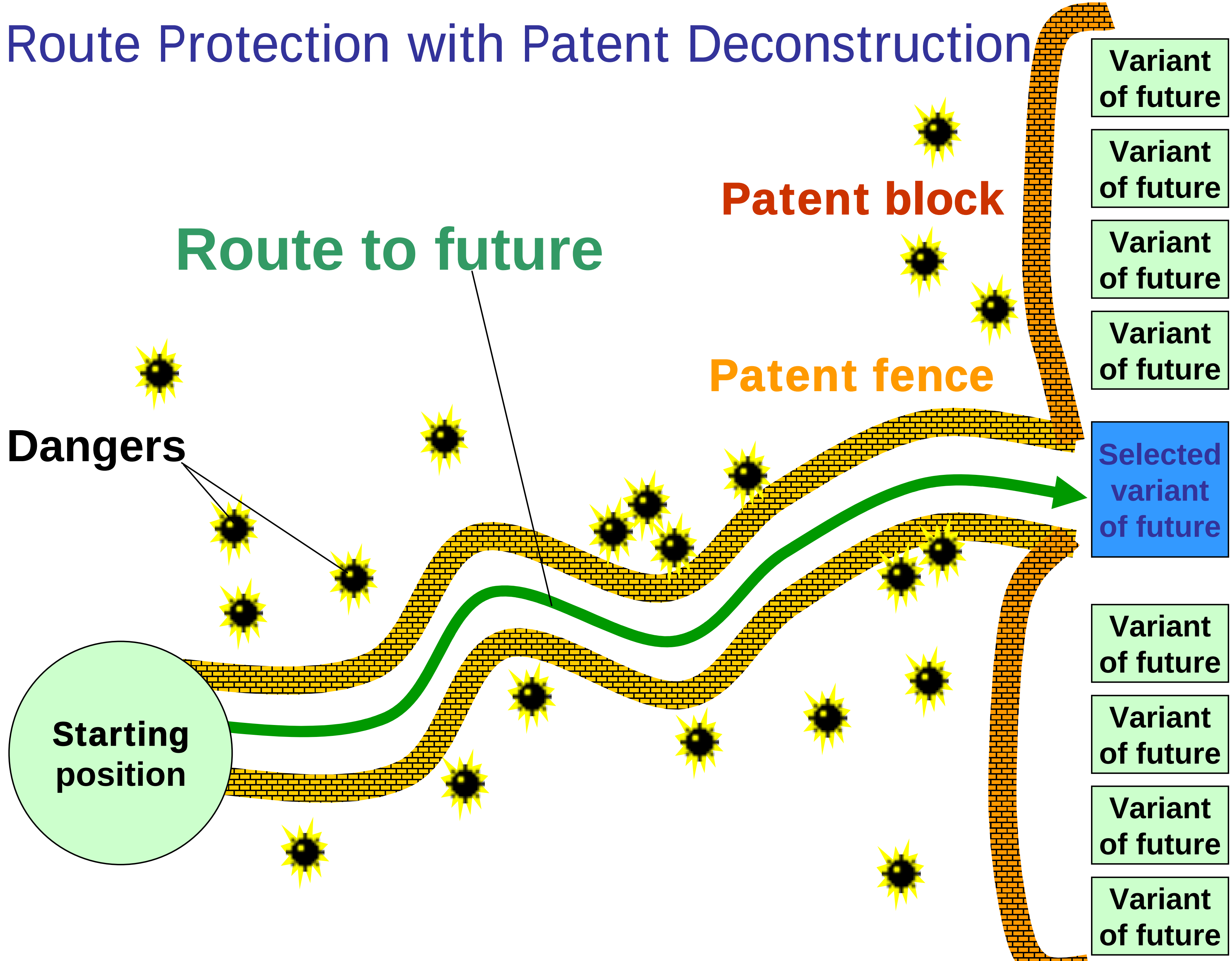


New technological ideas

New business ideas

High -Tech detergent. Hybridization of chemical processes and physical fields → Washing Process and Detergent hybridization. Detergent matches machine → Washing machine with adjusted detergent cartridges → "Printer kind" model of market – making money on cartridges → Cartridge with Internet connection – producer mails cartridge to user → Cartridge service access from outside of house

Route Protection with Patent Deconstruction

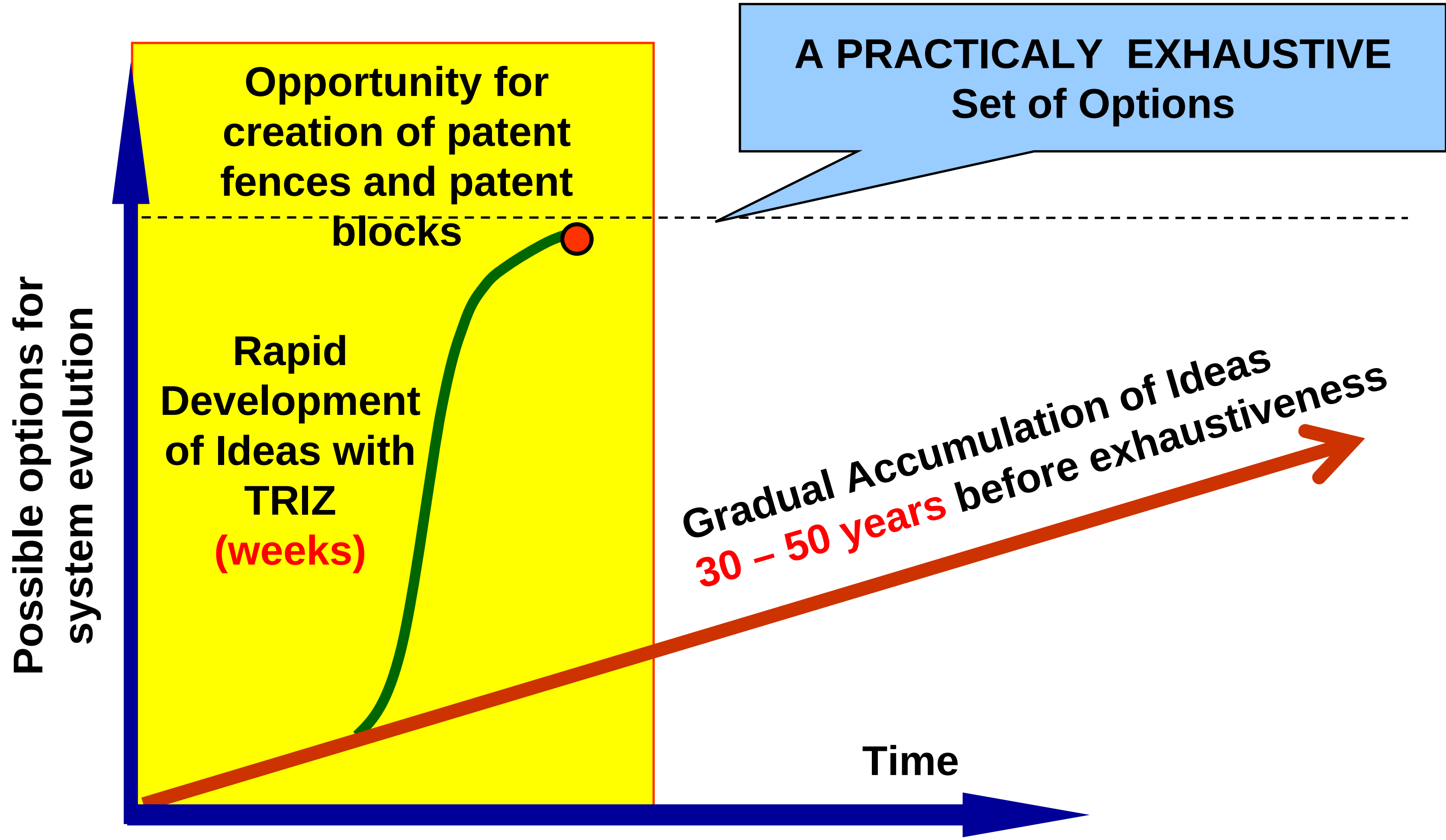


DE for Competitive Intelligence

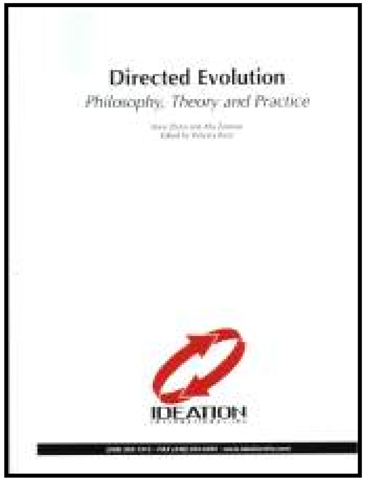
- Utilization of Directed Evolution techniques for Competitive Intelligence allows unveiling all promising directions for evolution for a given area, estimating which directions could be selected by competitors based on information about their traditions, experiences and specific resources.

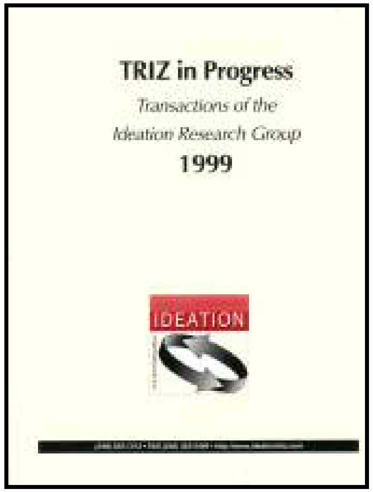
- It is possible to establish basic criteria and events as early indicators confirming preliminary conclusions. Monitoring and analyzing competitors' publications, statements made by employees, new products, patents and other information from open sources will allow verification of predictions.

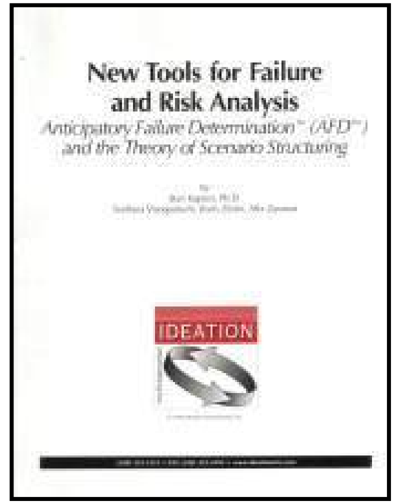
Directed Evolution for Enhancing Decision-Making Ability

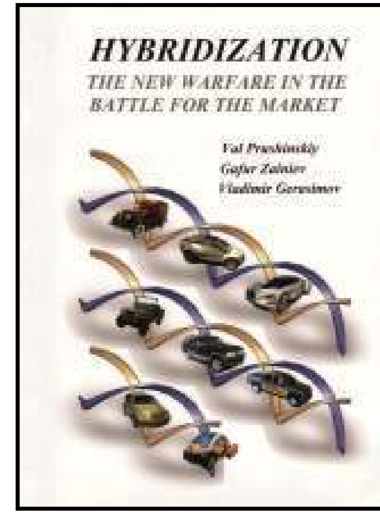


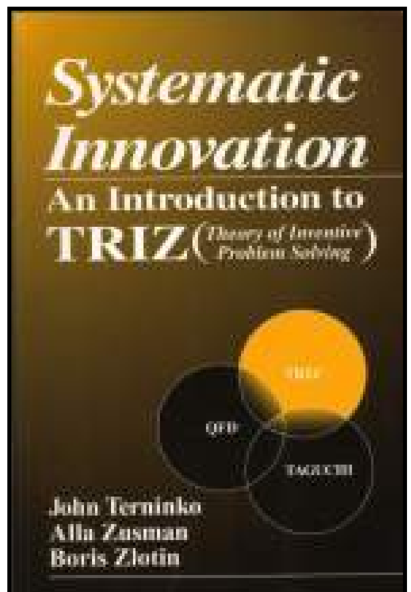
Ideation International I-TRIZ Publications



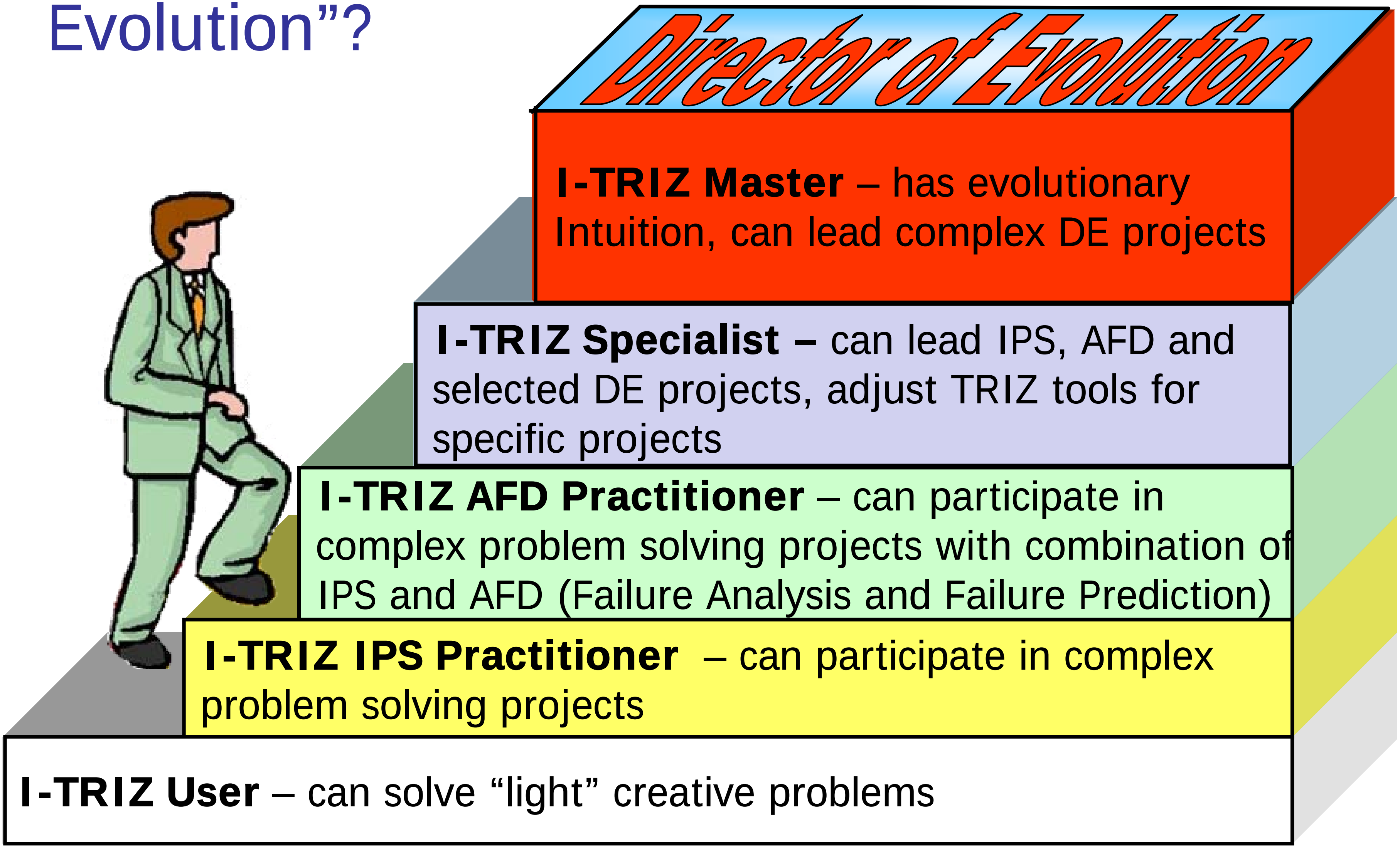








Who is “Director of Evolution”?



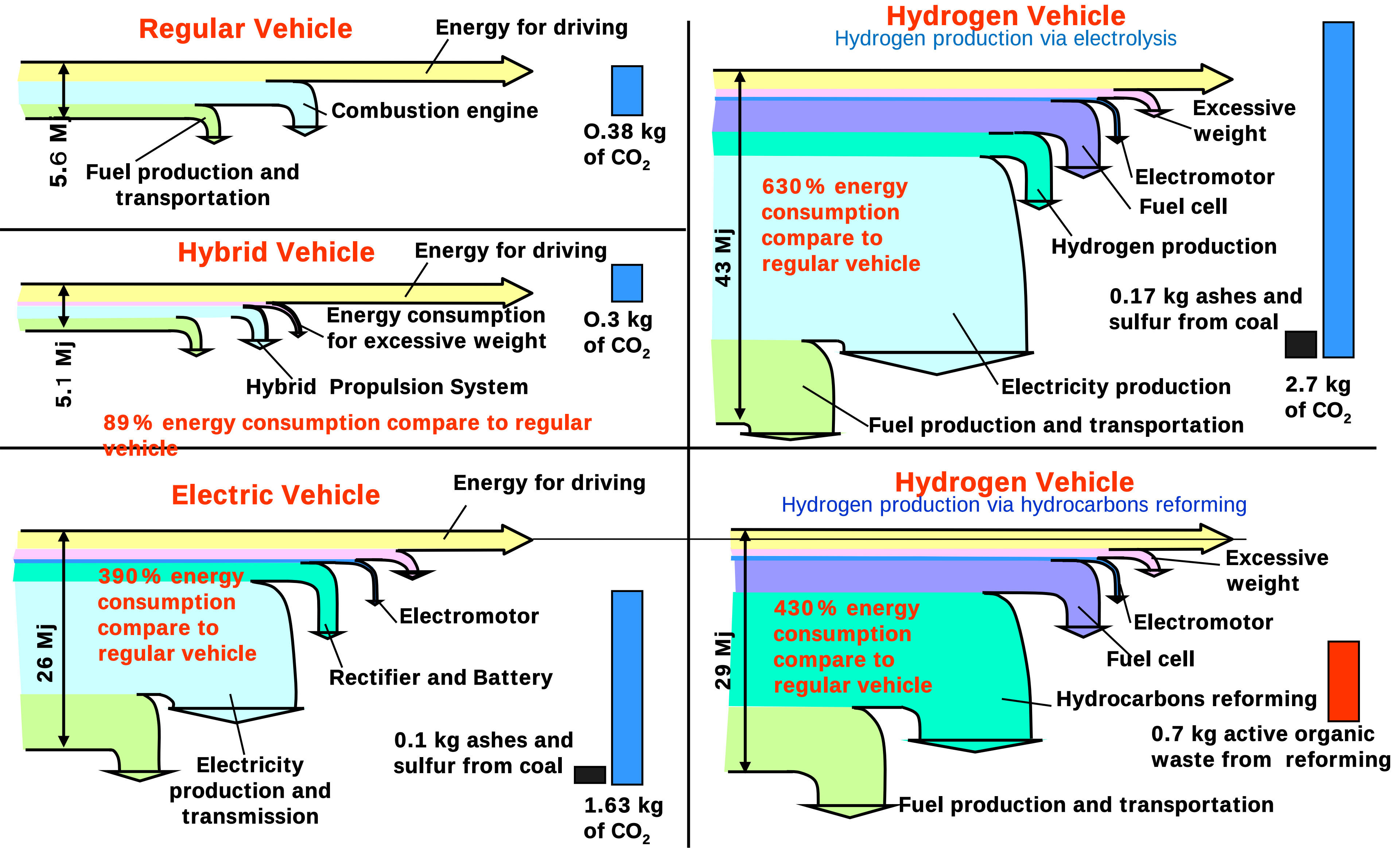
Thank you!

blzlotin@ideationtriz.com

Directed Evolution Project

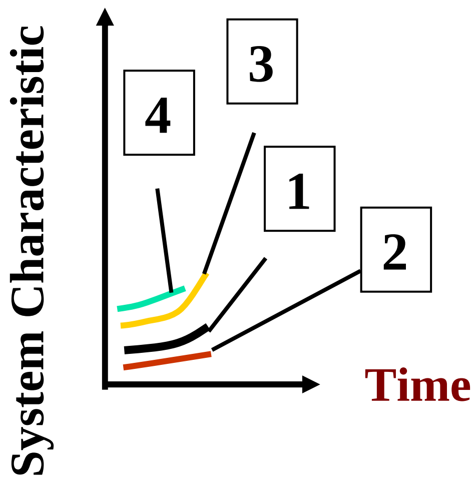
Vehicle of the Future

Energy Consumption and Waste per One Mile for Different Vehicles



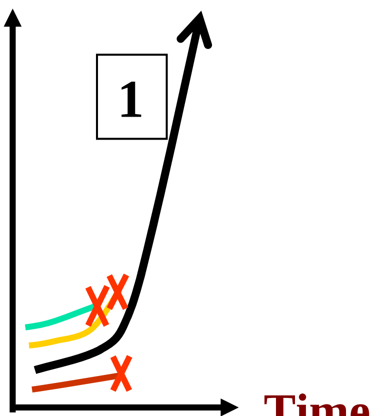
Evolution of Integrated Systems

Start of the system evolution



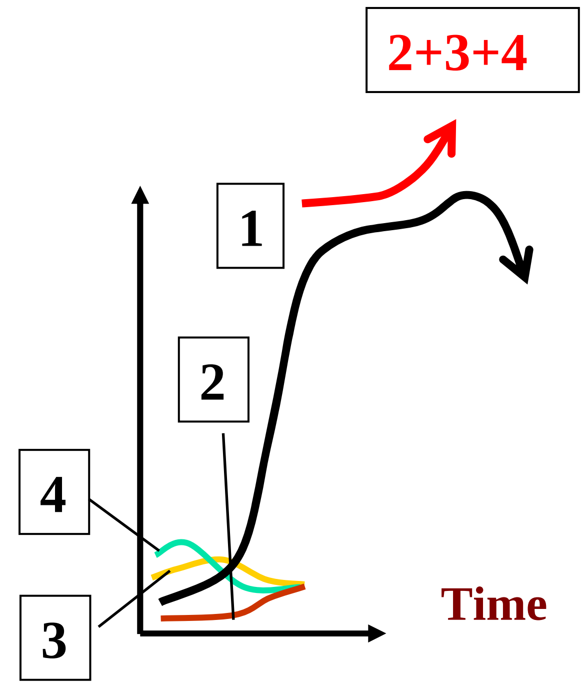
Different systems compete at the start

Success of the first system generation



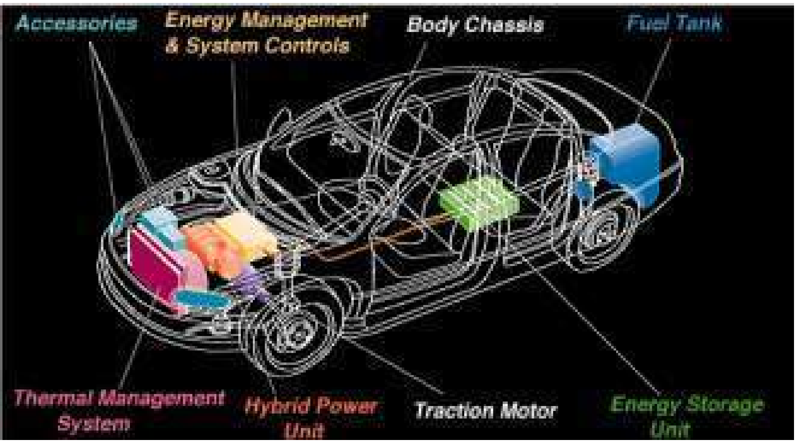
System 1 – winner, competitors are frozen

Loser's integration

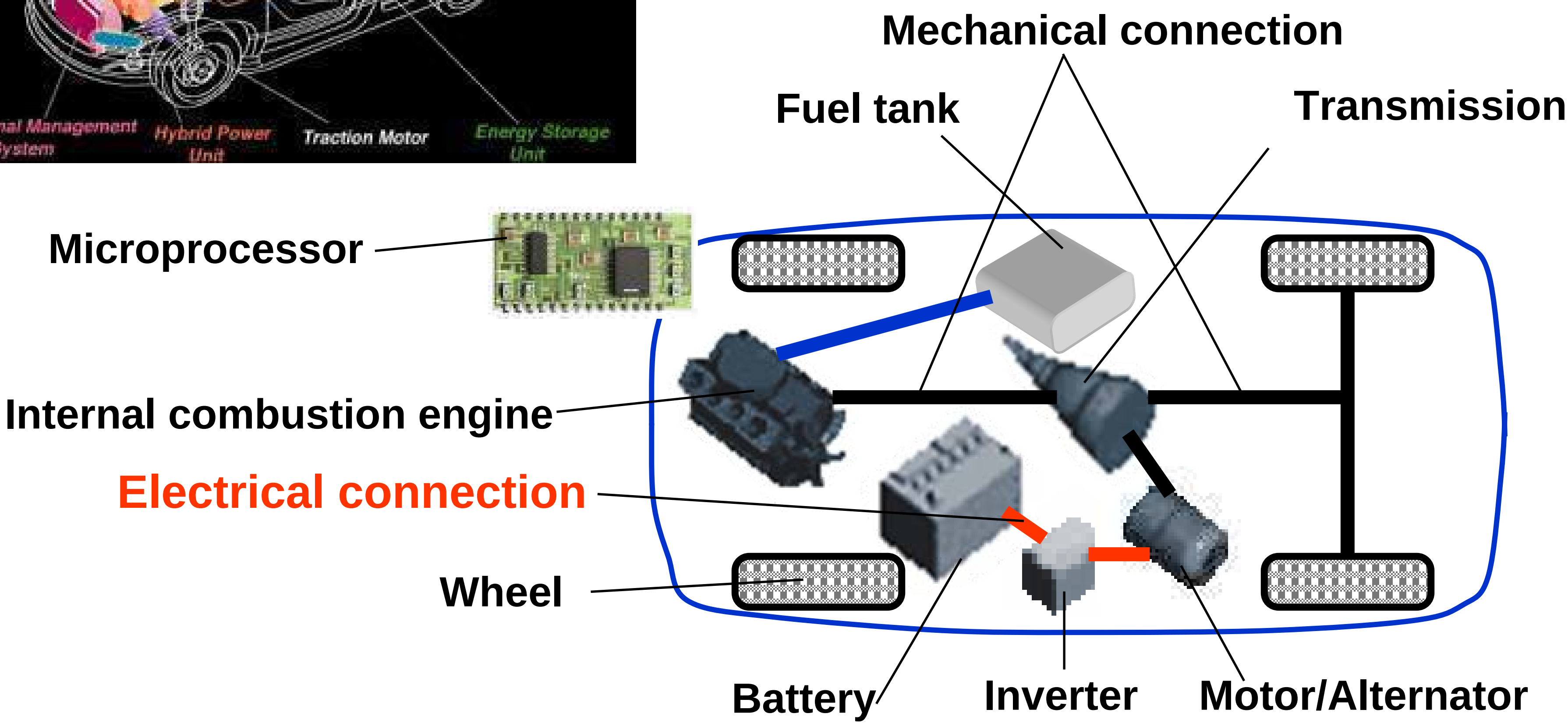


System 1 – loser, systems 2,3,4 win together

First Big Evolutionary Shift



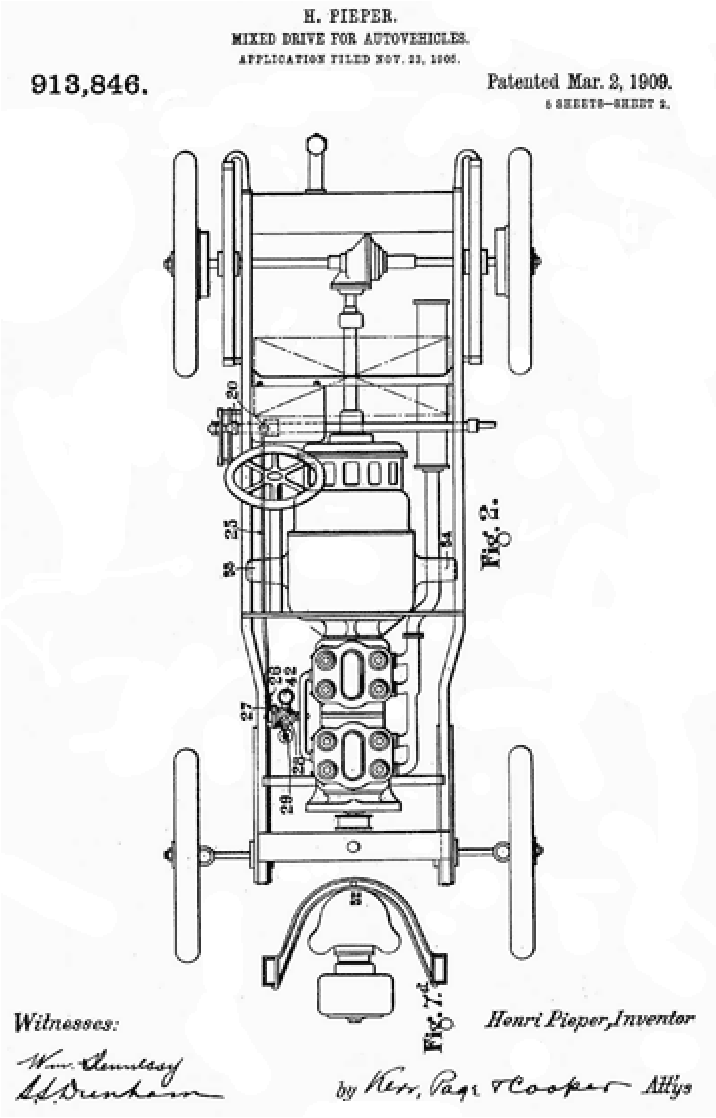
Hybrid Car Today



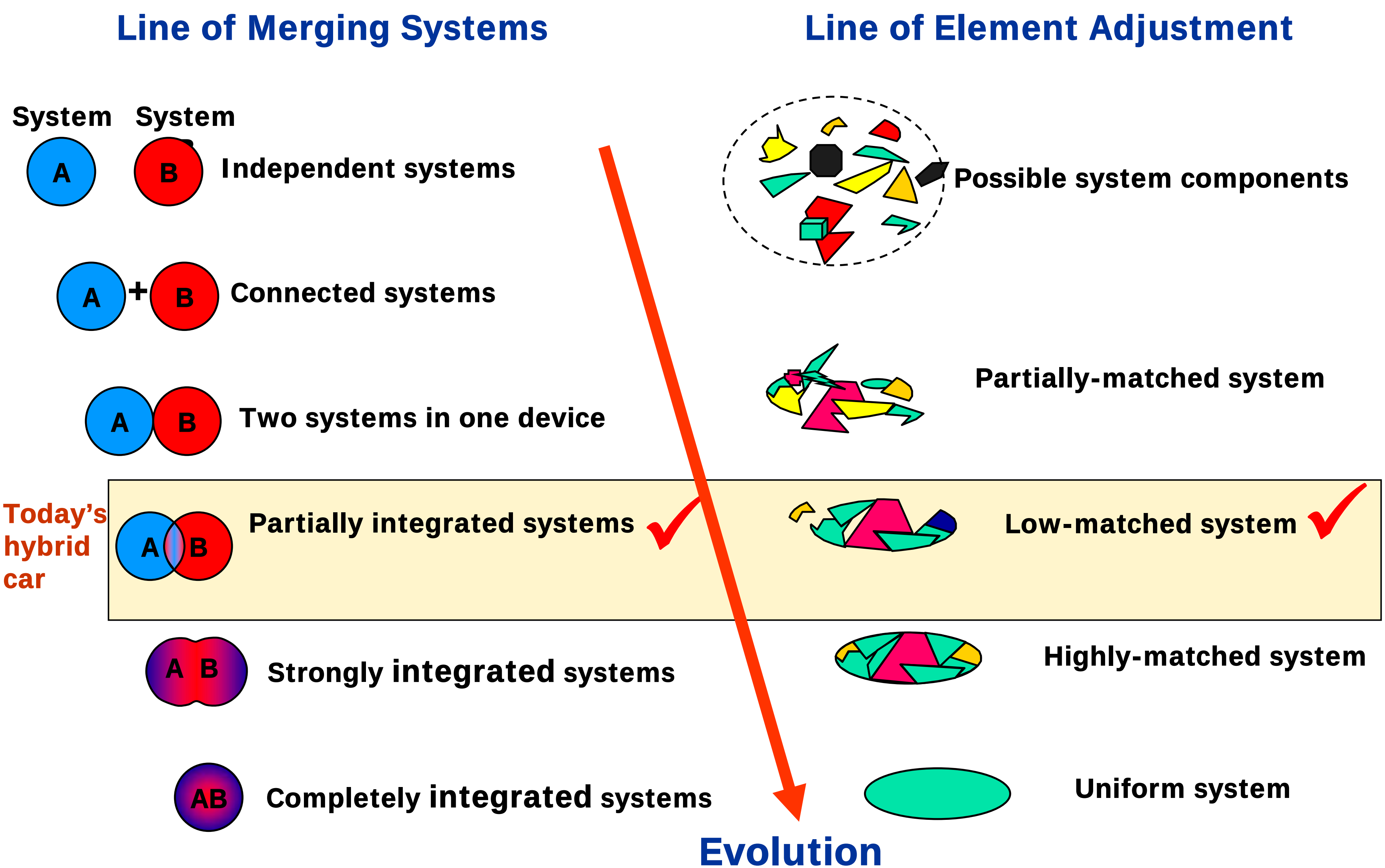
Attention!!! This is only the start of Hybridization!

First Patent on Hybrid Car

Henri Pieper 1909

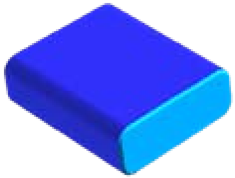


Evolution of Hybrid Systems



Comparison of Vehicle Elements

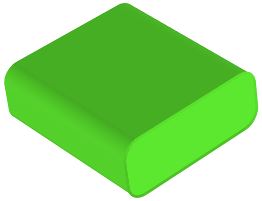
Gasoline



Thermal power 100%

Thermal power 69%

Alcohol
$C_2H_5(OH)$

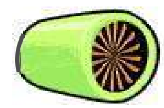
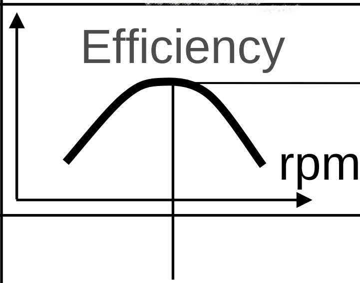
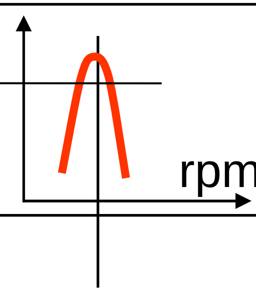


Loser

Combustion Engine versus Turbine Engine

1961 Chrysler TurboFlite

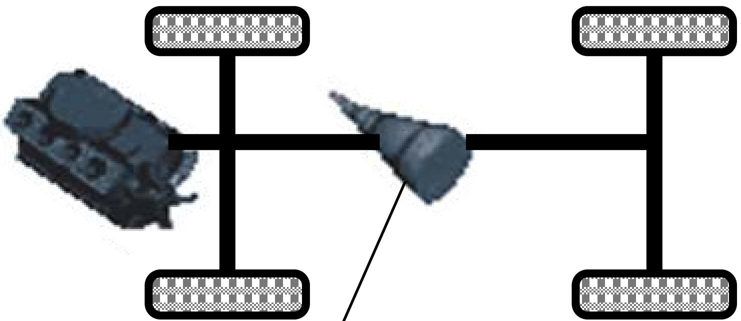
Loser

Problems of turbine engine	Combustion engine 	Turbine engine 	Possible solutions for problems in turbine engine
Problem 1 Narrow zone of turbine efficiency			Problem is solved via utilization of hybrid in which the engine always works in optimal regime
Problem 2 Complicated design of transmission for turbine	~2000 rpm	>30.000 rpm	Problem is solved via utilization of electrical transmission and the motor-wheel system
Problem 3 High temperature of flame	–	Turbine blades must be made from very expensive material with high thermal resistance	Problem is solved via utilization of ethanol with lower burning temperature
Problem 4 Complicated and expensive design	–	Very high precision of treatment is necessary	Problem is solved via utilization of bladeless trubine

Comparison of Vehicle Elements

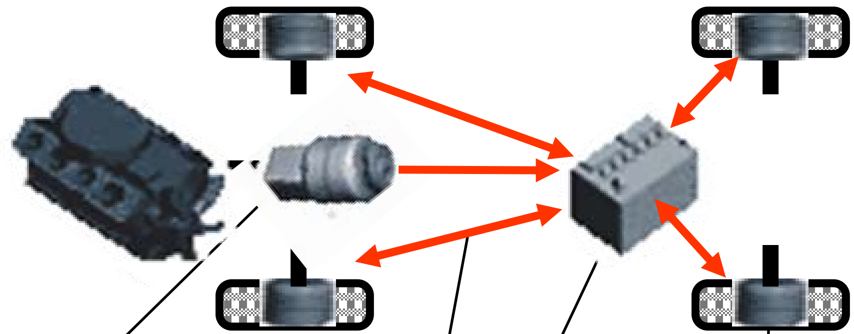
Mechanical power train

~6000 rpm max



Electrical power train

>30000 rpm



Loser

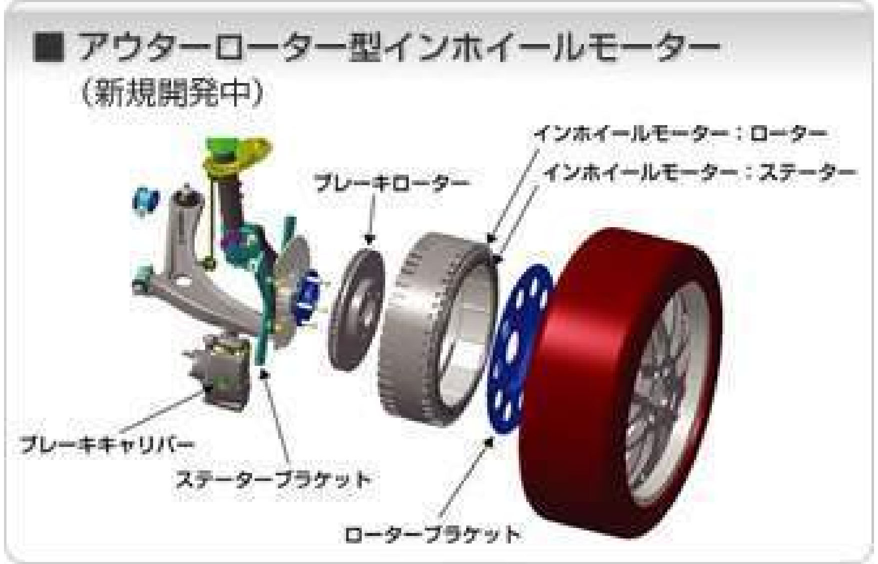
Two-directional electrical current flow:

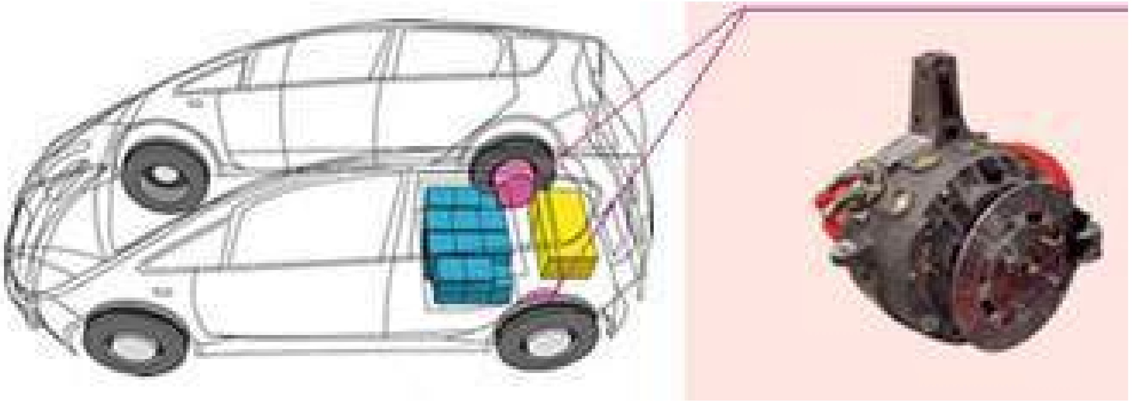
- Battery rotates motor in normal situation
- Motor/alternator charges battery in braking

Russian truck Б е л А З **-549 with electrical power train**

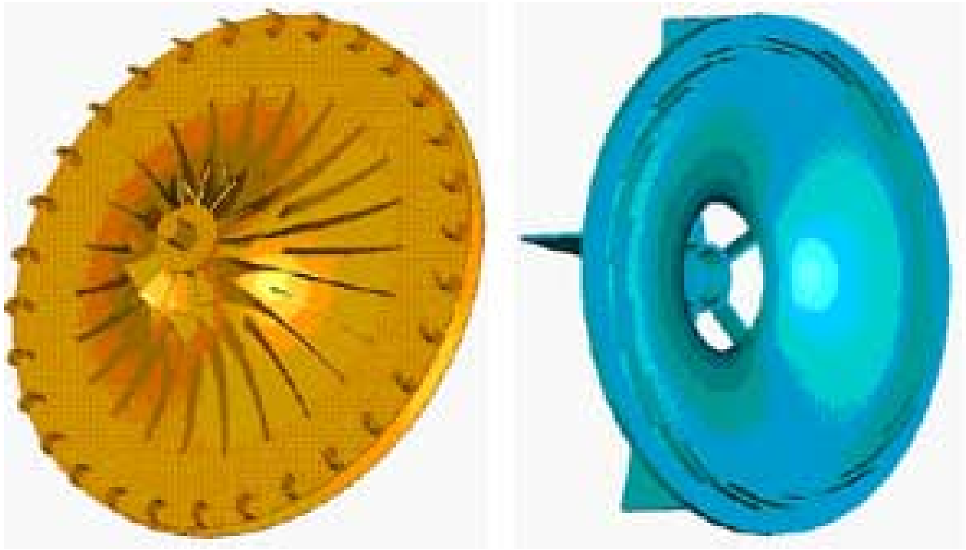
Electrical Motor + Wheel

Japan





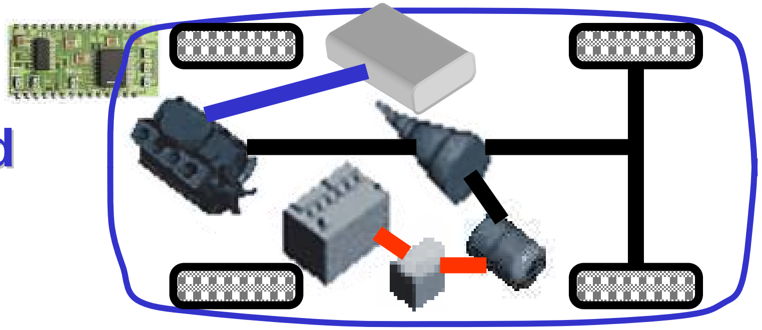
Bladeless Turbine Engine



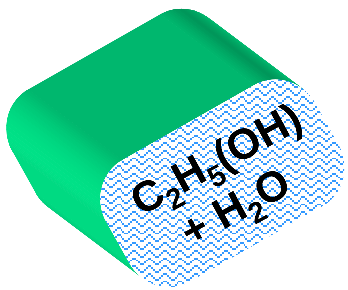
Southwest Research Institute (SwRI) have developed and built a radial flow gas turbine that is very rugged, low-cost and easy to repair.

Systems for Hybridization

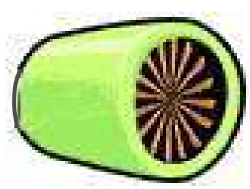
Hybrid car today



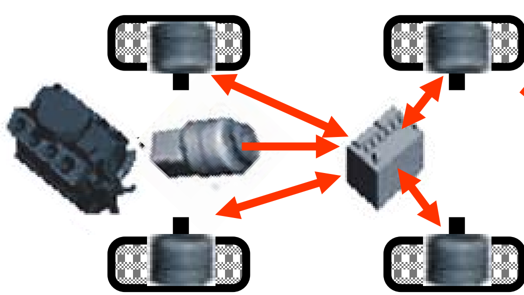
Ethanol and water mixture



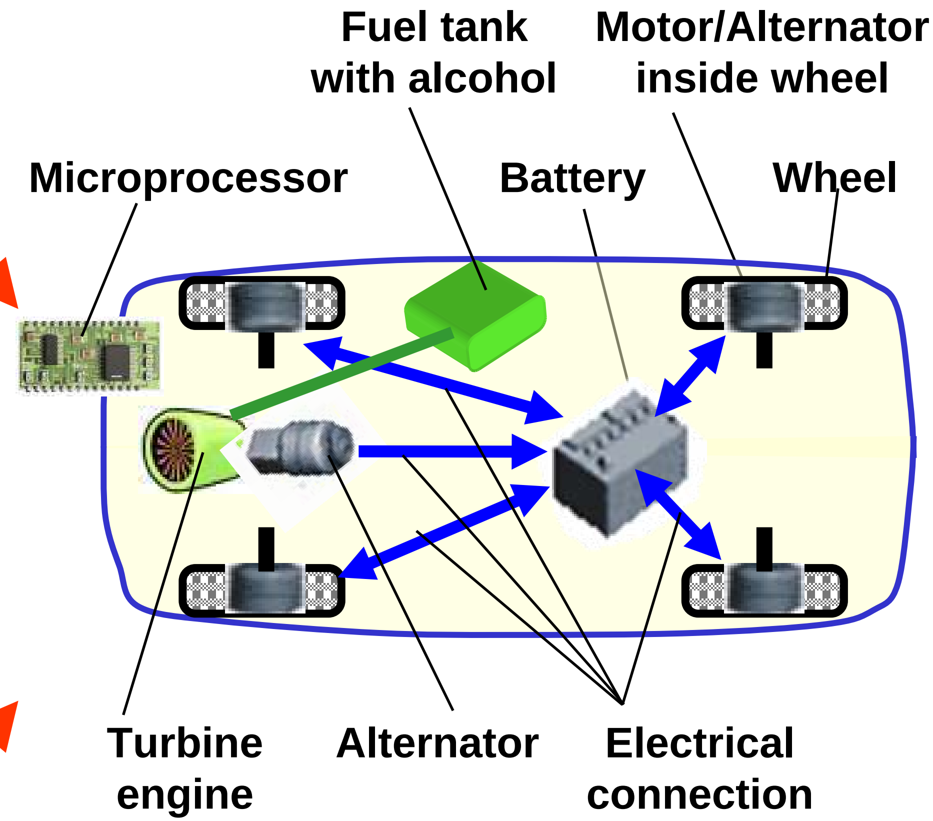
Turbine engine



Electrical power train



Futuristic Hybrid Car



More Effective and Less Expensive!