

Y POLITECNICO DI MILANO



GAETANO CASCINI

Politecnico di Milano

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Gaetano Cascini – short resume



- 1999 : PhD in Machine Design First acquaintance with TRIZ
 - : Assistant Professor at University of Florence
 - : Associate Professor at Politecnico di Milano

Past:

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1999 - 2008

2008 – now

2006-2009

2009-2013

- 2003-2005 : Founder and first President of Apeiron, the Italian TRIZ Association
- 2005-2009 : Founder and Vice-Chair of the IFIP 5.4 Working Group (Computer-Aided Innovation)
 - : President of the European TRIZ Association
 - : Chair of the **Computer-Aided Innovation** workgroup and Publications and Events Officer of the TC-5 Committee (Computer Applications in Technology) of IFIP

Currently:

Coordinator of the Marie Curie Project IAPP (PIAP-GA-2011-286305):
 FORMAT (FOrecast and Roadmapping for MAnufacturing Technologies)



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- Member of the Editorial Board of the Journal of Integrated Design & Process Science
- Member of the Editorial Advisory Board of the International Journal of Design Creativity and Innovation
- Member of the ETRIA Executive Board
- Co-Chair of the Design Creativity SIG and member of the Advisory Board of the Design Society
- Author of **120+ papers** presented at International Conferences and published in authoritative Journals
- Author of **13 patents** (assignees University of Florence, Whirlpool Europe, Bracco Imaging, Logli, SCAM, Meccaniche Fiorentine, Otlav, Politecnico di Milano, Saes Getters, Rold)

Centro di Competenza per

Coster Group - Training

Intier Motrol - Training

Poste Italiane - Training

Intertaba Philip Morris - Training

John Bean Technologies - Training

Micron - Training & Coaching

SACMI - Training & Coaching

Krona Koblenz - Training & Coaching

Enel - Training

Esaote - Training

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Training and coaching in industry:

ABB SACE - 3 case studies + Training & Coaching

Electrolux Professional - Training & Coaching

Alenia Aermacchi - Training & Coaching Alluflon - Moneta - Training & Coaching





Samsung - Advanced Training + Keynote presentation Tecniplast - Advanced Training & Coaching Whirlpool - 1 pilot project (1 Patent) Zoppas Industries - Training © 2013 Gaetano Cascini – gaetano.cascini@polimi.it



Outline

Introduction

- Innovation, opportunities and threats
- Main obstacles to innovation
- Dealing with conflicting requirements
 - Essence of TRIZ (Theory of Inventive Problem Solving)
- Getting Inspiration from Nature
 - Principles of Bio-Inspired Design
 - Ask-Nature database The Biomimicry Taxonomy
- Case study
 - A hedgehog-inspired shock-absorber

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Introduction

Innovation, Opportunities and Threats

From basic research, to market exploitation



source: ca.gov

Introduction



- Innovation, Opportunities and Threats
 - Wasting time to solve useless problems



Introduction



- Innovation, main obstacles to...
 - Psychological Inertia

***** Which is the minimum size of a A4 printer?



Introduction

Innovation, main obstacles to...

Contradictions





Теория Решения Изобретательских Задач Theory of Inventive Problem Solving TRIZ





99% of inventions use already known solution principle
Less than 1% are really pioneering inventions
Breakthrough solutions emerge from resolving contradictions
Inventors and strong thinkers use patterns
Creative problem solving patterns are universal
Creative ideas can be produced in a systematic way

Теория Решения Изобретательских Задач Theory of Inventive Problem Solving TRIZ



- E.g.: Standard 2.2.4: Increasing a degree of system dynamization
 - Efficiency of a Substance-Field System can be improved by increasing the degree of dynamics of Substance-Field System, i.e. by transition to a more flexible, rapidly changing structure of the system.



Теория Решения Изобретательских Задач Theory of Inventive Problem Solving TRIZ





Life's evolution is estimated in 3.8 billion years

 Nature has resolved many of nature's challenges leading to lasting solutions with maximal performance using minimal resources

Biomimetics was coined in <u>1957 by Otto</u> Schmitt,

American inventor who tried to produce a physical device that mimicked the electrical action of a nerve.

Bionics was used for the first time by <u>Jack Steel</u> from US Air Force in 1960

 Science of systems which have some functions copied, imitated or learnt by Nature.

Biomimicry was invented by J. Benyus in 1990s

It is a catch-all term that covers Biomimetics and Bionics.



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"A conscious strategy by designers to observe and learn principles of design from nature"

Janine Benyus















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Cockleburs -> Velcro®

In 1941 his inventor, Georges de Mestral, "went on a walk with his dog... Upon his return home, he noticed that his dog's coat and his pants were covered with cockleburs. His [...] curiosity led him to study the burs under a microscope, where he discovered their natural hook-like shape". From this observation de Mestral creates the "two-sided fastener - one side with stiff "hooks" like the burrs and the other side with the soft "loops" like the fabric of his pants".



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Ask Nature http://www.asknature.org

AskNature is the world's first digital **library** of Nature's solutions, organized by **function**, that can serve as an educational and crosspollinating tool as well as a collaboration forum among biologists, engineers, designers and other innovators

Database Structure

 The information are classified following the Biomimicry Taxonomy

Database Contents

- Strategies;
 - Product;
 - Groups;
 - People;
- Forum discussion.



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perform ventilation



RESULTS 1-10 of 26: You searched for: ventilation in a limited search. Click <u>here</u> to search all of AskNature.







Strategy 1. Ventilated nests remove heat and gas: termites "The outside of this ovoid bunker is perforated by a series of vents or tubes (or vents converging on circumferential tubes giving rise to more vents, or an arrangement even more elaborate); the structure of these vents and tubes is so unique that...





Product 1. Upper Riccarton Community and School Library Warren and Mahoney Limited architects designed the Upper Riccarton Community and School Library located in Christchurch, New Zealand. The library was completed in 2006. The library enclosure is passively ventilated, and uses environmentally sust...



Biomimicry Taxonomy http://www.asknature.org/article/view/biomimicry_taxonomy



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Esempio di ricerca in "Maintain Physical Integrity"



Function Groups: 8 / Sub-groups: 30 / Functions: 162 Expand all Collapse all

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Esempio di ricerca in "Maintain Physical Integrity"



"The spines of hedgehogs function as shock-absorbers during falls thanks to their honeycomb-like core and longitudinal stiffening"...(2)

(2) http://www.asknature.org/strategy/a31c0ad475b3bbf2f396431bea629c78 * Maintain physical integrity >Manage structural forces>Impact

As written by J.Vincent, the hedgehog spines, thanks to their foam like structure, are able to support the thin outer walls against local buckling allowing the structure to bend further without failing.



Undeformed section

The hedgehog fall

Deformed section

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- Mechanical design of hedgehog spines and porcupine quills Hystricidae (Old World porcupines), J. Vincent , A. Owers, B. Group et al
- Survival of the cheapest , J.Vincent
- Efficient structural components using porous metals, a.Simone,L.Gibson
- Contribution ro the histology of the hedgehog, E.W.Carlier

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PATENT PENDING Citro M., Cascini G., Barbatelli P., Butera F.: **"Dispositivo assorbitore d'urti"**, deposito n. MI2013A001249, 25/07/2013

ROLD and getters

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SMA-Lab people

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No! I can't be bothered by any crazy INNOVATOR -We've got a battle to fight!



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