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Creativity: *open source for the open mind*



A few questions

- Is there a **real necessity** for creative thinking?
- What is the **Marconi Institute for Creativity (MIC)**?
- How is **creativity** defined?
- **What can we learn** from artists, inventors, and ICT champions?
- Are there any **models for creative thinking**, to be used for both understanding and training?
- What do we mean by **convergent/divergent** information, movement, assessment, implementation?
- Any **examples** for software development?

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Is there a real necessity for creative thinking?



Information as a commodity

- A possible future
 - all of the World's knowledge is stored and accessible through the Internet
 - we have unlimited broadband access to the Internet, irrespective of location, time, speed, weather
 - we retrieve information instantaneously on any topic through a semantic web
 - information is a pure commodity that we all share

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- What is the impact on human memory?
- What is the impact on education?
- What is the impact on competition?
- What will make a difference between individuals/companies/economies?
- What distinguishes man from other species?

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- In the future, there will be little left but CREATING new VALUE through original concepts and ideas
 - We must generate concepts which are not (yet) on the Internet
- Creative thinking is now a strategic necessity, not a luxury!
- How long before the education system recognizes this fact?
- Creative thinking is a process involving a set of skills that must be taught, developed, applied
 - Talent will always make a difference, but it's not a pre-requisite
- We need to establish a science of creativity

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**What is the
Marconi Institute for Creativity (MIC)?**



Marconi Institute for Creativity

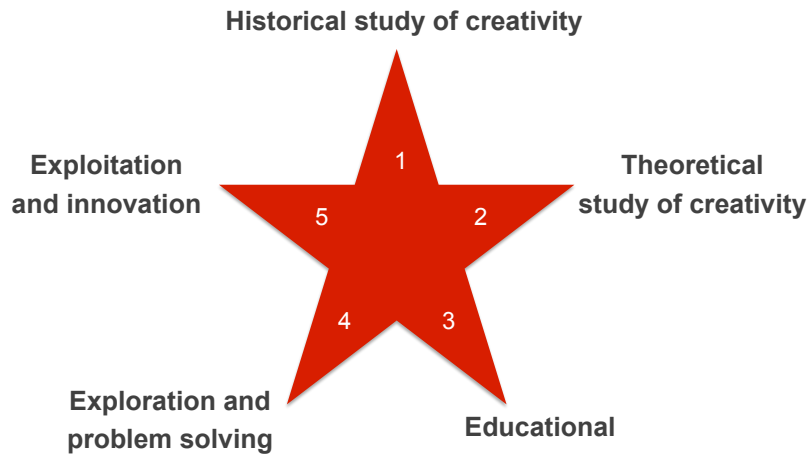


mic.fgm.it



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MIC: Goals



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How is creativity defined?

Creativity: domain-agnostic definition

- Individual
 - The generation of valuable new patterns in the mind space
- Academia/Work
 - The production of high-quality, original, and elegant solutions to complex, novel, ill-defined, or poorly structured problems
- Society
 - The generation of ideas that have an impact on the evolution of the human kind
- Common wisdom
 - *“Creativity is the domain of a few talented and/or lucky individuals, often at the margin of society. Education should be concerned with critical and logical thinking”*

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4Ps in the study of creativity

- Person
 - Discussion of individual characteristics, traits, talents, abilities
- Product
 - Discussion of originality, impact, usefulness
- Process
 - Discussion of underlying mental process (neuroscientific, cognitive)
 - Tools and methods for practical application
- Place
 - Discussion of environment, networks, social aspects

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- Creativity can be applied to all domains, with different nuances
 - Art and humanities
 - Science
 - Technology
 - Engineering
 - Artificial intelligence
 - Design
 - Education
 - Economics, management, entrepreneurship
 - Entertainment and wellness
 - ...
- Can common principles be identified?

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- Artificial Composer: EMI
 - won a competition to determine who could best compose pieces in Bach's style
- Artificial Painter: AARON 
 - exhibited at London's Tate Gallery, Brooklyn Museum, and many other international galleries and museum
- Artificial Mathematician: AM
 - came up with an idea (a three-dimensional unit for a computer chip) awarded a U.S. patent for its innovation
- Artificial writers: TEL-SPIN, MINTREL
- Artificial Orchestra

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**What can we learn from artists,
inventors, and ICT champions?**



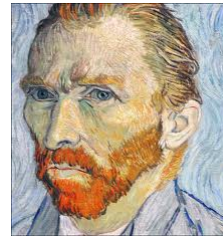
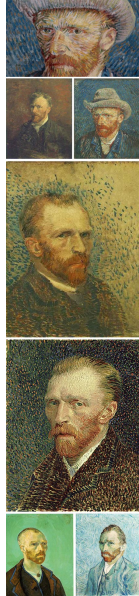
Vincent van Gogh (1843-1890)



- Background
 - No support from parents, but extremely close to his younger brother Theo
 - Their collaboration is a most remarkable interaction in the history of art
 - He spent nine years studying and acquiring drawing skills
- Methods
 - construction and reconstruction of a product
 - initial sketch or rough draft; more refined sketch; reforming it into a completed work
 - scraping-and-repainting
 - he (repeatedly) scraped off areas when he was dissatisfied with an effect
 - van Gogh was extremely severe in analyzing, criticizing, and revising his work
 - at the end of his career his skills were refined so that he could quickly execute a painting
- Principles
 - Self-discipline: years spent to acquire knowledge
 - Stubborn refinement of initial ideas until the goal is achieved
 - Self-assessment

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Self-portrait evolution



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Wilbur and Orville Wright (1867/71-1912/48)

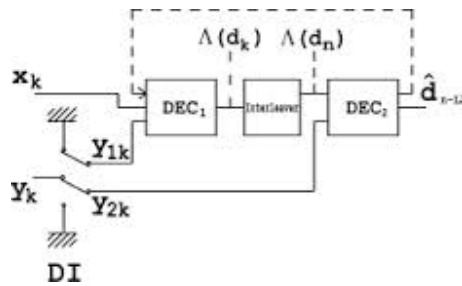
- **Background**
 - They lived in the suburban part of West Dayton, Ohio
 - They grew up during the early industrialization of America:
 - They had witnessed the emergence of numerous technologies defining the modern era
 - Neither Wilbur nor Orville received a high school diploma; they opened a bicycle repair shop
- **Inventions: method and process**
 - Very systematic approach
 - They did not set out to discover the theoretical principles of flight
 - They not only invented the airplane, but aeronautical
 - Mental graphic imagery and nonverbal thought
 - Used to conceptualize basic structures and mechanisms, even aerodynamic theory
 - Analogy: airplane as a bicycle, an utterly unstable but controllable machine
 - Resolved control of the airplane through wing warping
- **Principles**
 - Systematic development (changing one thing at a time)
 - Use of visual thinking to translate abstract concepts into workable machinery
 - Use of analogy and models



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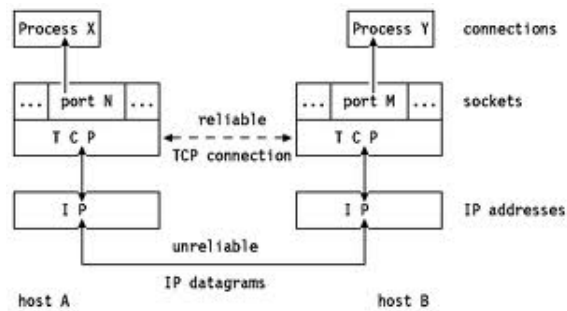
- Invention of the Turbo Decoder
- Metaphor
- Asymmetry



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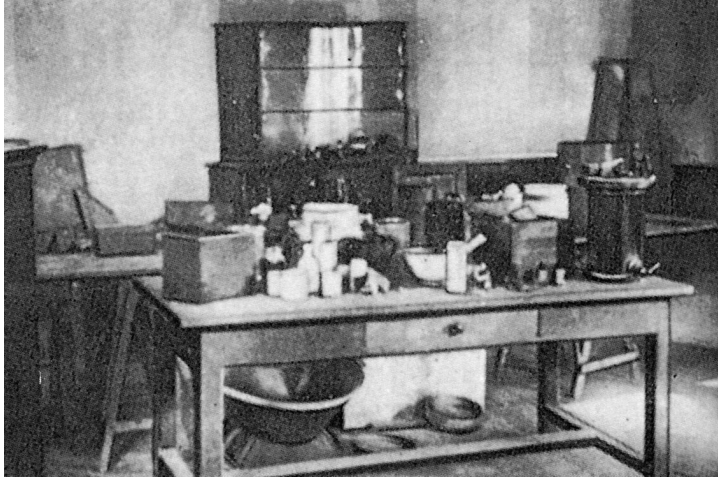


- Invention of the TCP protocol
- Reversal
- Abstraction



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The young Marconi: undergraduate passion

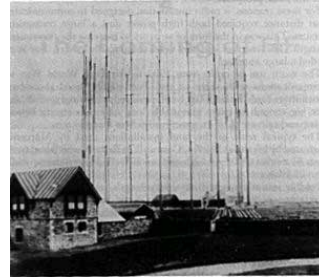


1894 in
Villa Griffone

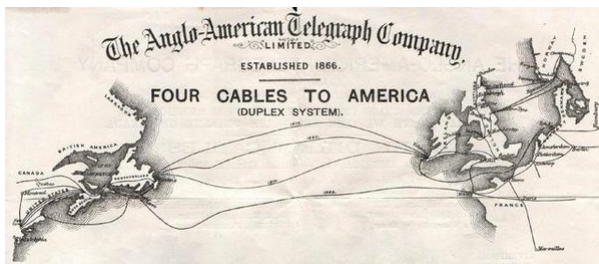
Celestini's hill: seizing the opportunity



Believe in your intuition



Facing resistance and irony



WIRELESS SIGNALS ACROSS THE OCEAN

Marconi Says He Has Received Them From England.

Prearranged Letter Repeated at Intervals in Marconi Code.

The Italian Inventor Will Now Leave St. John's, N. F., and Will Go to Cornwall to Continue the Transatlantic Experiments from His Station There.

ST. JOHN'S, N. F., Dec. 14.—Guglielmo Marconi announced to-night the most wonderful scientific development of recent times. He stated that he had received electric signals across the Atlantic Ocean from his station in Cornwall, England.

Signor Marconi explains that before leaving England he made his plans for trying to accomplish this result; for, while his primary object was to communicate with Atlantic liners in midocean, he also hoped to receive wireless messages across the Atlantic.

The Marconi station in Cornwall is a most

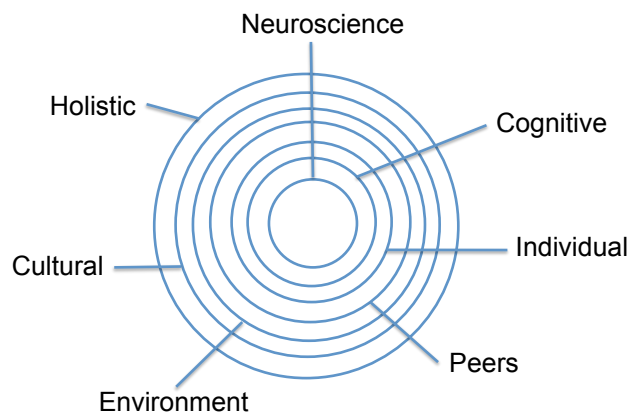
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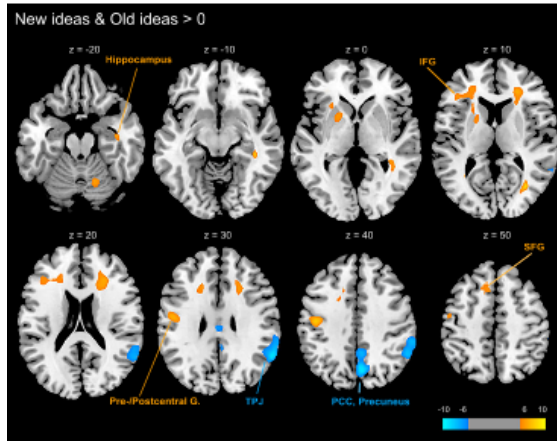
**Are there any models for
creative thinking?**



Levels of approach to creativity



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(Benedek et al., 2014)

- Medial temporal lobe (including hippocampus): essential for declarative memory supporting the capacity to recollect facts and events

- Left inferior frontal gyrus activation for creativity enhancement: inhibition of dominant but uncreative ideas

- Left inferior parietal cortex activity for novel ideas: integration of previous knowledge for construction and simulation of novel ideas

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CREAM An European Commission 7th Framework Programme Project
funded under FP7-ICT-2013-10

CReativity Enhancement through Advanced brain Mapping and stimulation



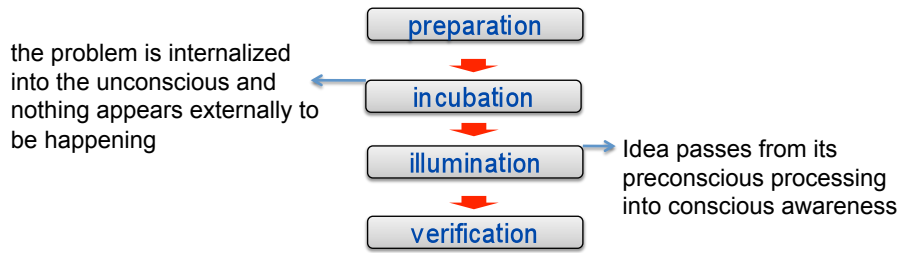
1. Multi-disciplinary approach to creativity analysis and enhancement
2. Non-invasive functional brain imaging of creative processes
3. Brain-Machine Interfaces for the stimulation of creativity
4. Cognitive approach to creativity
5. Fusion of neuroscience and cognition for creativity stimulation
6. Domain specific creativity measurement and enhancement

Partners: University of Bologna, FGM-MIC, Goldsmiths UoL, G-TEC, Universidad de la Laguna, Medical University of Wien, Engine

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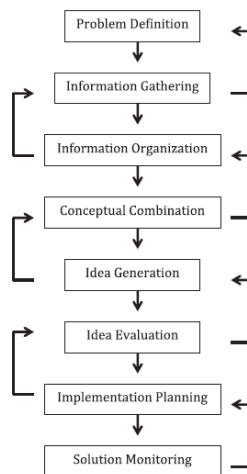
In his book *Art of Thought*, published in 1926, Wallas presented one of the first models of the creative process

Wallas (1926): four stages



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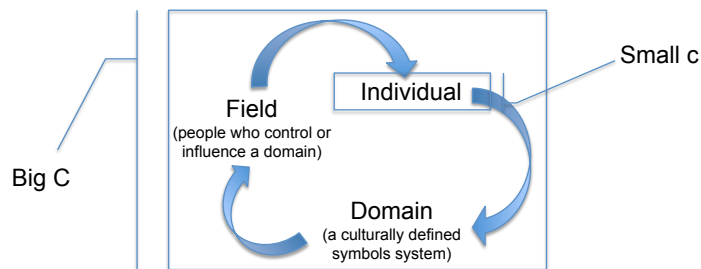
Mumford et al. (1991): eight dynamic stages



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Convergence between individual and social creativity domains (Csikszentmihalyi, 1988; Nakamura & Csikszentmihalyi, 2001)

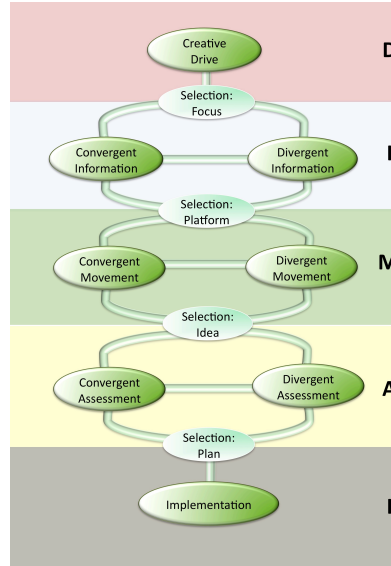
Creativity from a “systemic” point of view



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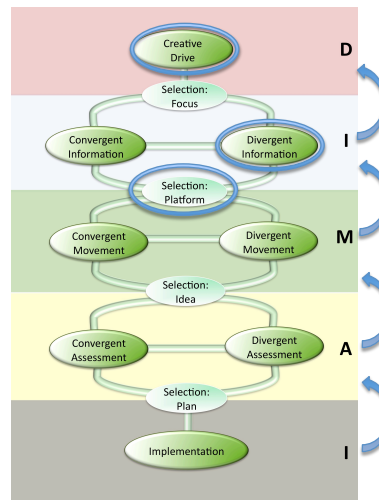
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***What are convergent/divergent
information, movement, assessment,
implementation?***




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- Drive contains cognitive, emotional, personality and social elements
- Systematic introduction of divergent information
- Process can be iterated by returning to previous states as many times as needed
- Selective gates help controlling the complexity of the process by focusing attention on those few alternatives with higher estimated potential



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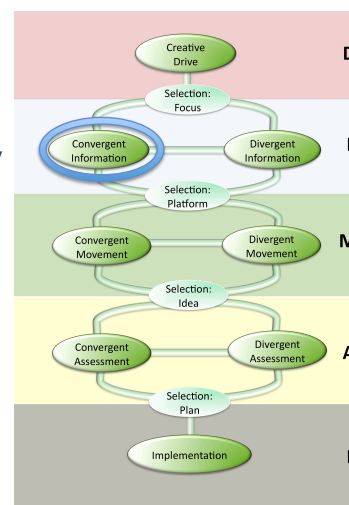
Drive: relating to focus

- Initial and refined focus areas
 - The individual (or team) receives from internal or external sources an initial focus area, upon which creative activity is expected
 - The initial focus area must always be elaborated into the refined focus area
 - Focus tree 
- The Drive represents the relationship between individual(s), external sources, and the creative focus
- Two kinds of relationships highly and mutually interlaced:
 - Cognitive: aware attention
 - Focus entails problem definition, at abstract and detailed levels
 - Emotional: motivation
 - mood, self-confidence, believing

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Convergent Information: items

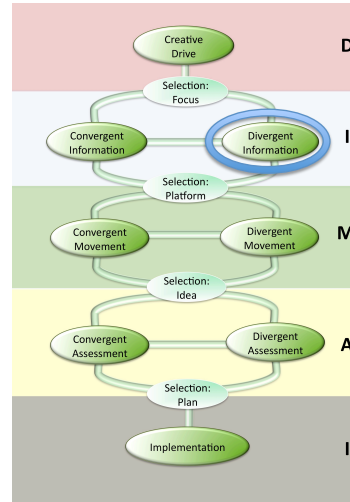
- The focus itself is part of our knowledge structure
- Related information should be activated: fluency is required
- List of convergent items to help fluency
 - Dominating ideas
 - Requirements
 - Facts
 - Assumptions
 - Boundaries
 - Bias
 - Avoidance factors



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Divergent Information: modifiers

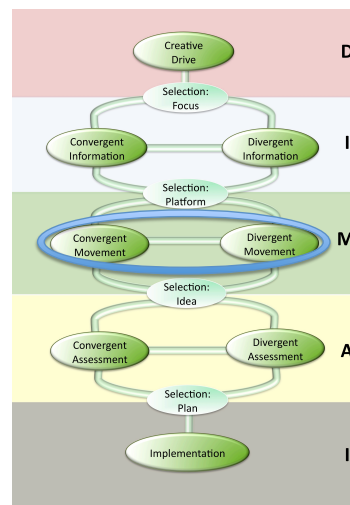
- Divergent modifiers can be applied to generate a platform for movement
- (Incomplete) list of divergent modifiers
 - escape
 - reversal
 - exaggeration (maximize, minimize)
 - distortion
 - substitute
 - wishful thinking
- Plus: Random entry
 - combine
 - adapt



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Movement

- The middle game
- Elicitation vs generation
- Convergent vs divergent movement



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Divergent Movement techniques

- (Incomplete) list of techniques for movement:
 - Metaphor, analogy, and role play
 - Unusual associations
 - Conceptual combination
 - Focus on the difference
 - Extraction of principles
 - Positive aspects in particular circumstances
 - Slow motion preview
 -

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Assessment

Convergent

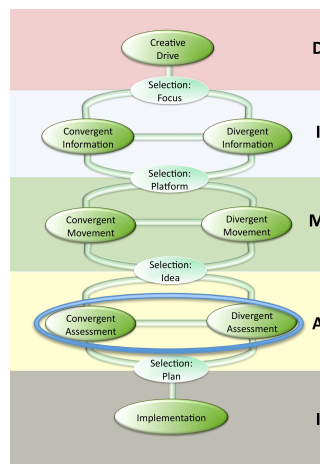


Evaluation of the idea with respect to the initial/refined creative focus

Divergent



Evaluation of the idea w.r.t any system of values



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Criteria for selection and evaluation matrix

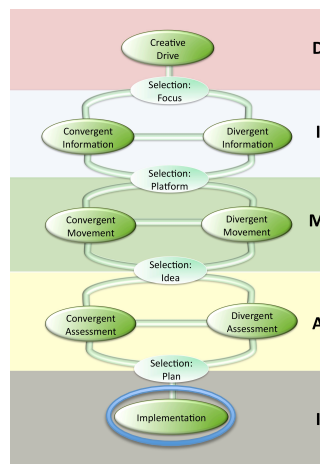
- Effectiveness
- Originality
- Fitness
- Elegance
- Feasibility
- Utility
- Features
- Economics
- Acceptability
- User-friendliness
- Subjective feel

	CR 1	CR 2	CR 3
Idea 1			
Idea 2			
Idea 3			

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Implementation

- Intrinsic (or idea) constraints
 - Time to bring an idea to realization
 - Funding needed to realize the idea
 - Knowledge to be acquired
- Extrinsic constraints
 - Cultural rules
 - Predominant ideas
 - Experts' opinions
 - Financial risks & functional risks (uncertainty of performance)



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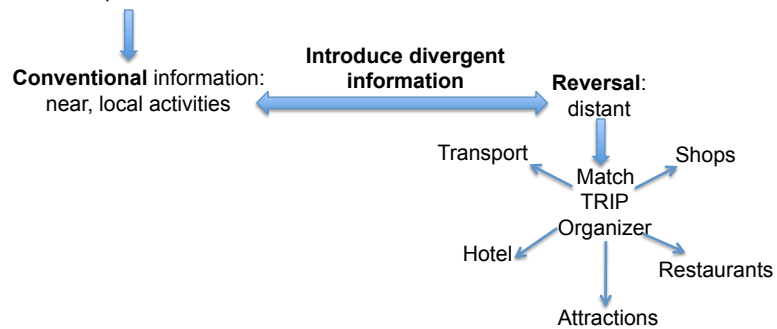
*Any good examples for
software development?*



Example A: reversal

D: New location aware application

Start with a main requirement: Georeference



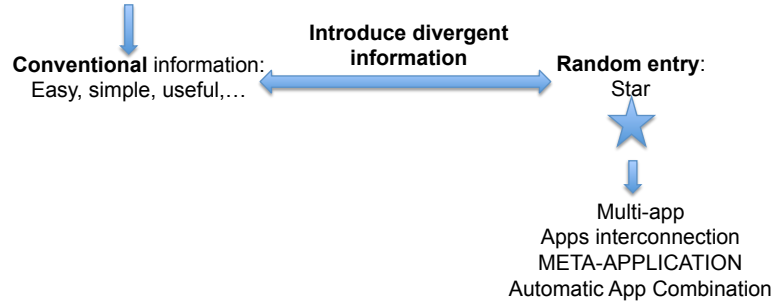
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Example B: random entry

D: New app



Start with the main properties of a good app



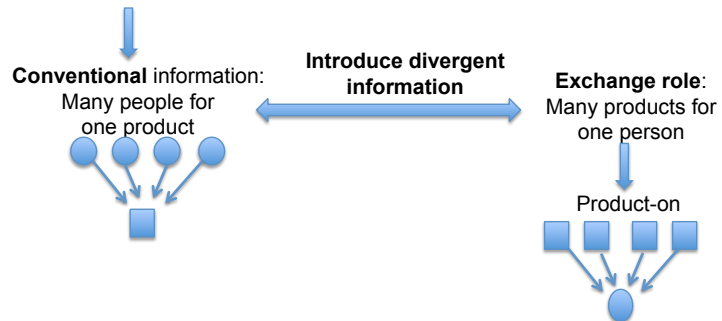
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Example C: exchange role

D: New application for e-commerce



Start with a well known App: Group-on



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Convergent information

- Refined focus:
 - assumptions
 -
 - facts
 -
 - requirements
 -
 - dominating ideas
 -
 - avoidance factors
 -

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Divergent modifiers

- Refined focus:
- Start from selected convergent information item:
 - Escape
 - Reversal
 - Exaggeration (maximize, minimize)

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- Start from selected divergent information item:
 - Extraction of principles
 - Positive aspects in particular circumstances
 - Slow motion preview

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