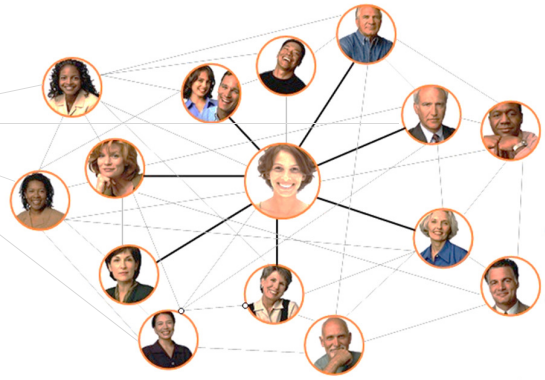
Entrepreneurship Methods

Computational Creativity and Open Innovation Paradigm



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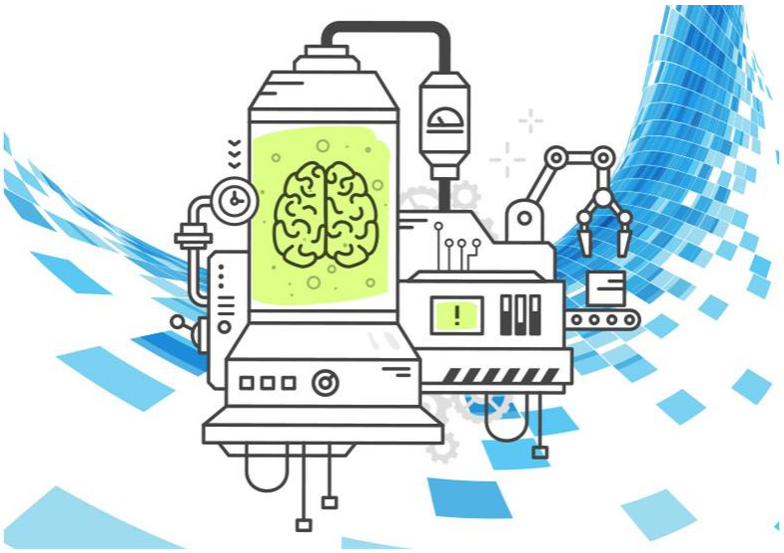
What is Computational Creativity?

Computational creativity is a effort that is located at the **intersection** of the **multidisciplinary fields** of **artificial intelligence**, **cognitive psychology**, **philosophy**, and the **arts**.

Goal Of Computational Creativity

The goal of computational creativity is to **model**, **simulate** or **replicate creativity** using a **computer**, to achieve one of several ends:

1) To **better understand human creativity** and to formulate an algorithmic perspective on creative behavior in humans.
2) To construct a program or computer **capable of human-level creativity**.
3) To design programs that can **enhance human creativity** without necessarily being creative themselves.

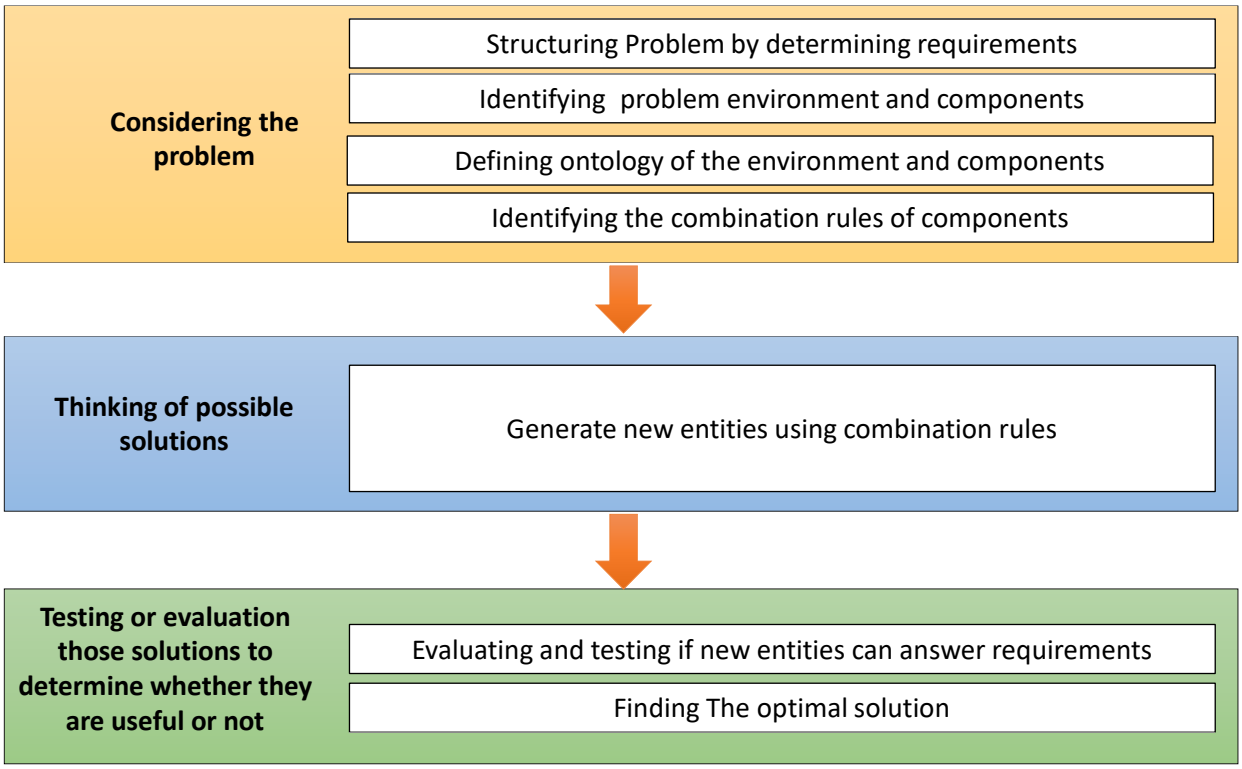


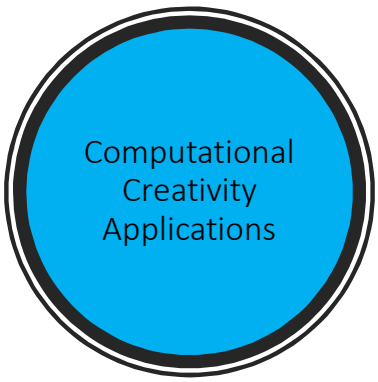
Example!

Architecture of Computational Creativity to

Construct a program or a computer capable of human-level creativity

Based on Psycho-metric Model of Creativity





Category Name	Description
Story	Story telling, plot development , character development
Language	General language syntax, lexicology, translation
Analogy	Analogy and metaphor(test-based)
Literature	Poetry, haiku, sonnet generation or analysis
Humour	Language systems based on understanding or generating humour
Design	Design implementation, description or augmentation
Coding	Programming and generating coding solutions
Games	Generating, augmenting or playing computer games
Sound	Sound generation and analysis, sound effects
Music	Music generation, analysis or composition
Math (and Science)	Mathematical formulae, scientific problems, numerical problems, theorems
Logic	Logical problems, genera problem solving
Image	Image generation, analysis or composition
Concept	General high-level concepts (not text based)

Industry 4.0 Applying Computational Creativity

- **Industry 4.0** is a name given to the current trend of **automation** and **data exchange in manufacturing technologies**.
- It includes **cyber-physical systems**, the **Internet of things**, **cloud computing** and **cognitive computing** and **computational creativity.**
- The key to the success of an Industry 4.0 transformation is **proper planning** and **execution**, along with **capital**, **risk tolerance**, and a **commitment to collaboration** and **creativity**.

Computational Creativity Market

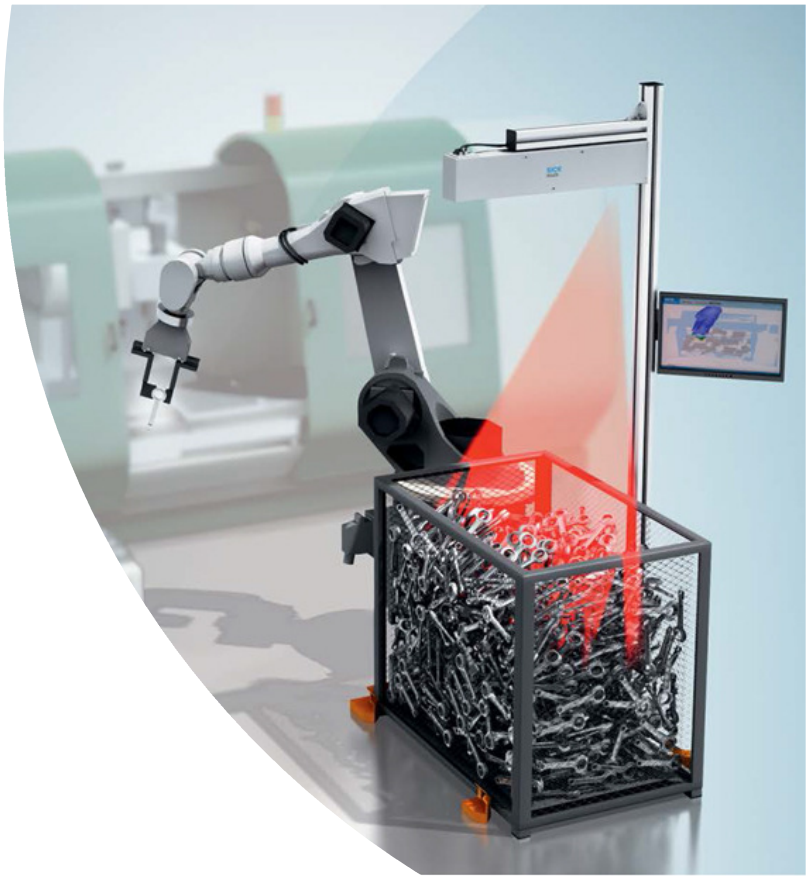
- According to Zion Market report, global computational creativity market was approximately USD 205 million in 2018 and is expected to generate around USD 1,115 million by 2026, at a CAGR (Compound annual growth rate) of around 26.6% between 2019 and 2026.
- Major growth factors for the market include :
  - automation of creative tasks ;
  - and the adoption of computational creativity solutions to improve the creative process.
- The computational creativity market by application has:
  - marketing and web designing;
  - product designing;
  - music composition;
  - photography and videography;
  - high-end video gaming development;
  - automated story generation;
  - and others (training simulation and R&D) segments.

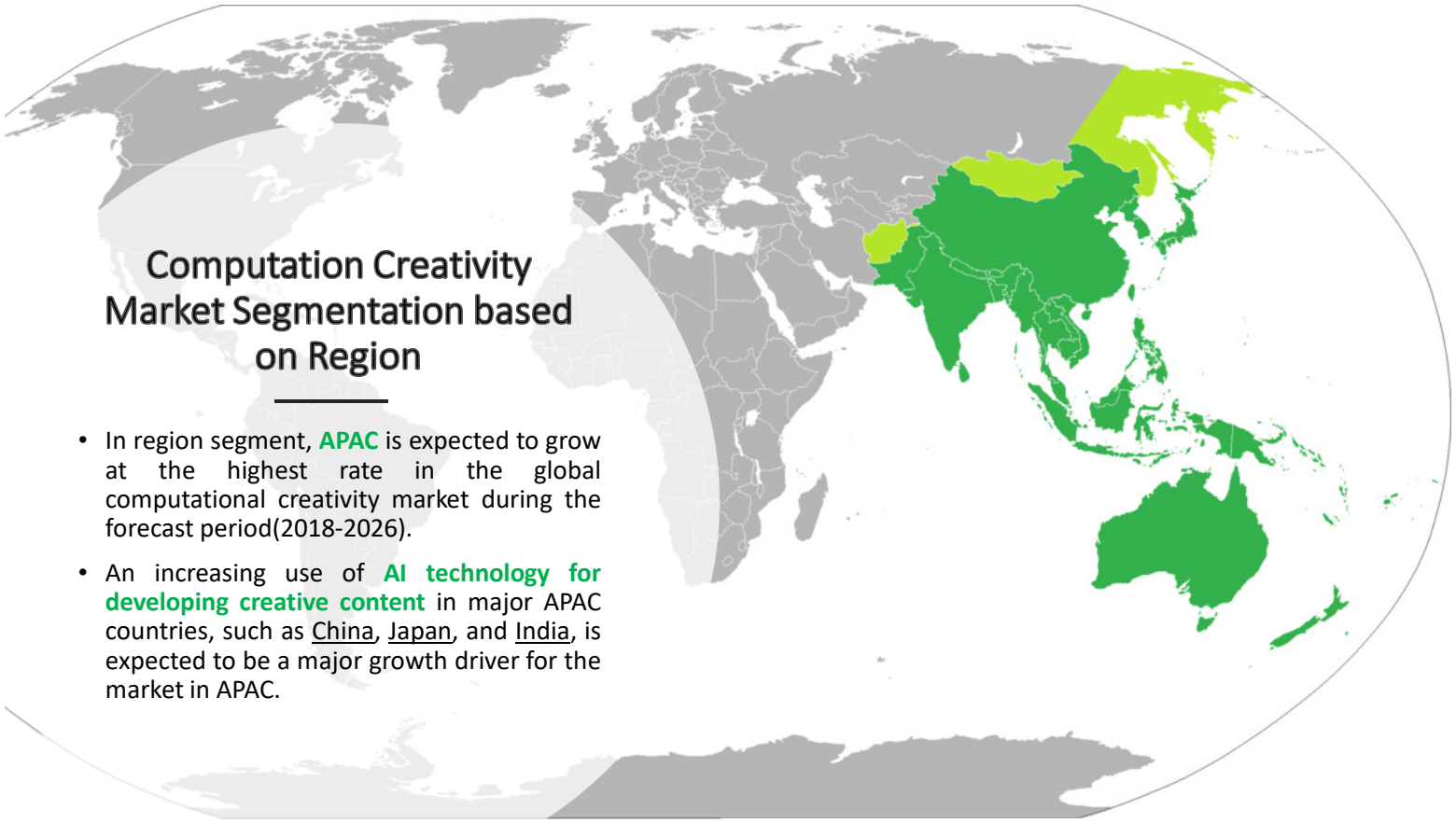
Best Predicted computational creativity market by application

- **The marketing and web designing** application is expected to grow at highest rate, as users can quickly build creative website with a few simple clicks, without requiring prior coding experience or knowledge.
- vendors in the computational creativity market are offering **AI-powered platforms** to help markets build effective marketing campaigns.

Computation Creativity Market Segmentation based on Technology

- Based on the technology, computational creativity market is segmented into:
  - Natural learning Processing(NLP)
  - Machine Learning (ML)
  - Deep learning
  - **Computer vision**.
- The computer vision technology is expected to grow at the highest rate during the forecast period.
  - Research Group Example: in ROBOPARTNERS project that lead by RICS group, researchers used vision technology in robots path planning.
  - Company Example: NeAdvance company in Portugal using vision technology for developing software for detecting breast cancer.





Computation Creativity Market Segmentation based on Region

- In region segment, **APAC** is expected to grow at the highest rate in the global computational creativity market during the forecast period(2018-2026).
- An increasing use of **AI technology for developing creative content** in major APAC countries, such as China, Japan, and India, is expected to be a major growth driver for the market in APAC.

Collective Creativity

- Collective creativity is an approach of creative activity that emerges from the **collaboration and contribution of many individuals** so that new forms of innovative and expressive art forms are produced collectively by individuals connected by the network.
- Many researches on collective creativity focus on the importance of **collaboration in the work environment** to solve **complex and interdisciplinary problems**.

Computational Creativity and Collective Creativity

- Using the internet to develop and encourage creative communities has led to large scale collective creativity.

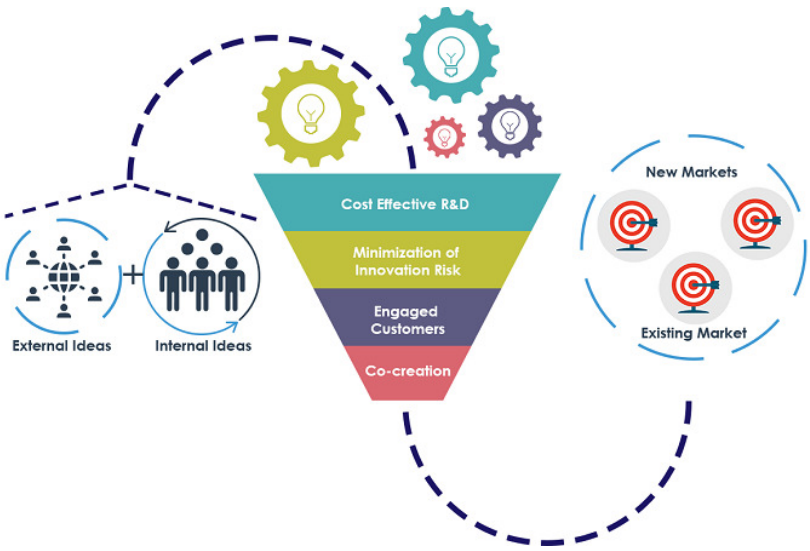
  Designcrowd.com is an example of website that source creative work from a very large community of people that identify themselves as designers.

- Computational Creativity provide knowledge and tools for supporting Collective creativity by helping in :
  - Recognizing creative people
  - Helping individuals to generate creative ideas
  - Connecting creative people to each other
  - Providing environment for creative people for generating creative ideas
  - Evaluating generated creative ideas
  - Searching for implementation of the creative ideas
  - Transmitting creative ideas to the innovation
  - Etc.

What is Open Innovation ?

- Open Innovation is a concept developed by Chesbrough (2003, 2007) based on his study of large multinationals (IBM, Procter and Gamble).
- Open innovation was defined as :

  "The use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively".
- The open innovation paradigm can be understood as the **antithesis** of the traditional **vertical integration model** where internal R&D activities lead to internally developed products that are then distributed by the firm.
- Open innovation is a paradigm that assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance their technology.

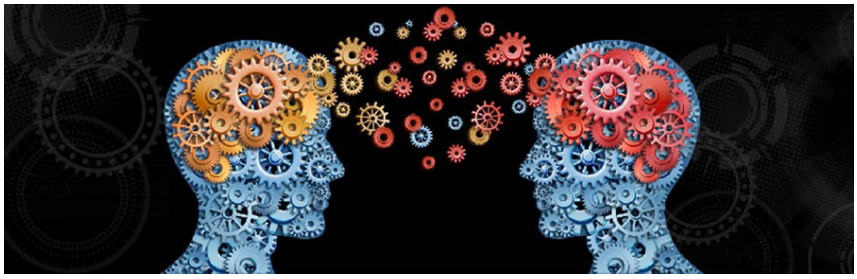


Closed Innovation VS. Open Innovation

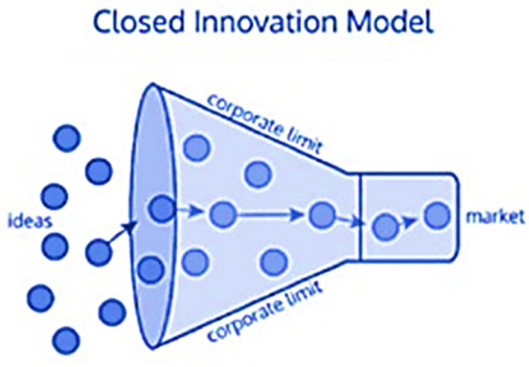
The distinction between open innovation and closed innovation is determined by **the way in which innovation is created**.

While a closed innovation is developed in a self-contained company environment, Open Innovation incorporates external knowledge into innovation management.

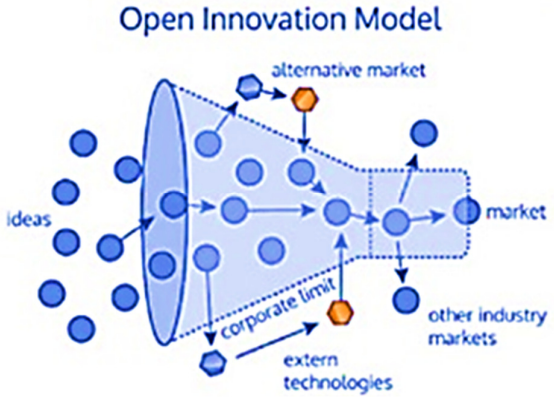
- A closed innovation is based on the view that innovations are developed by companies themselves. From the generation of ideas to development and marketing, the innovation process takes place exclusively within the company. Know-how, technology, processes and intellectual property remain under the control of the innovative company.
- Open innovation means opening up the innovation process beyond company boundaries in order to increase one's own innovation potential through active strategic use of the environment. Innovation therefore arises through the interaction of internal and external ideas, technologies, processes and sales channels with the aim of the company to develop promising innovative products, services or business models. Own employees, customers, suppliers, LEAD users, universities, competitors or companies of other industries can be integrated.



Closed Innovation VS. Open Innovation



Place of innovation = within the company



Place of innovation = inside and outside the company

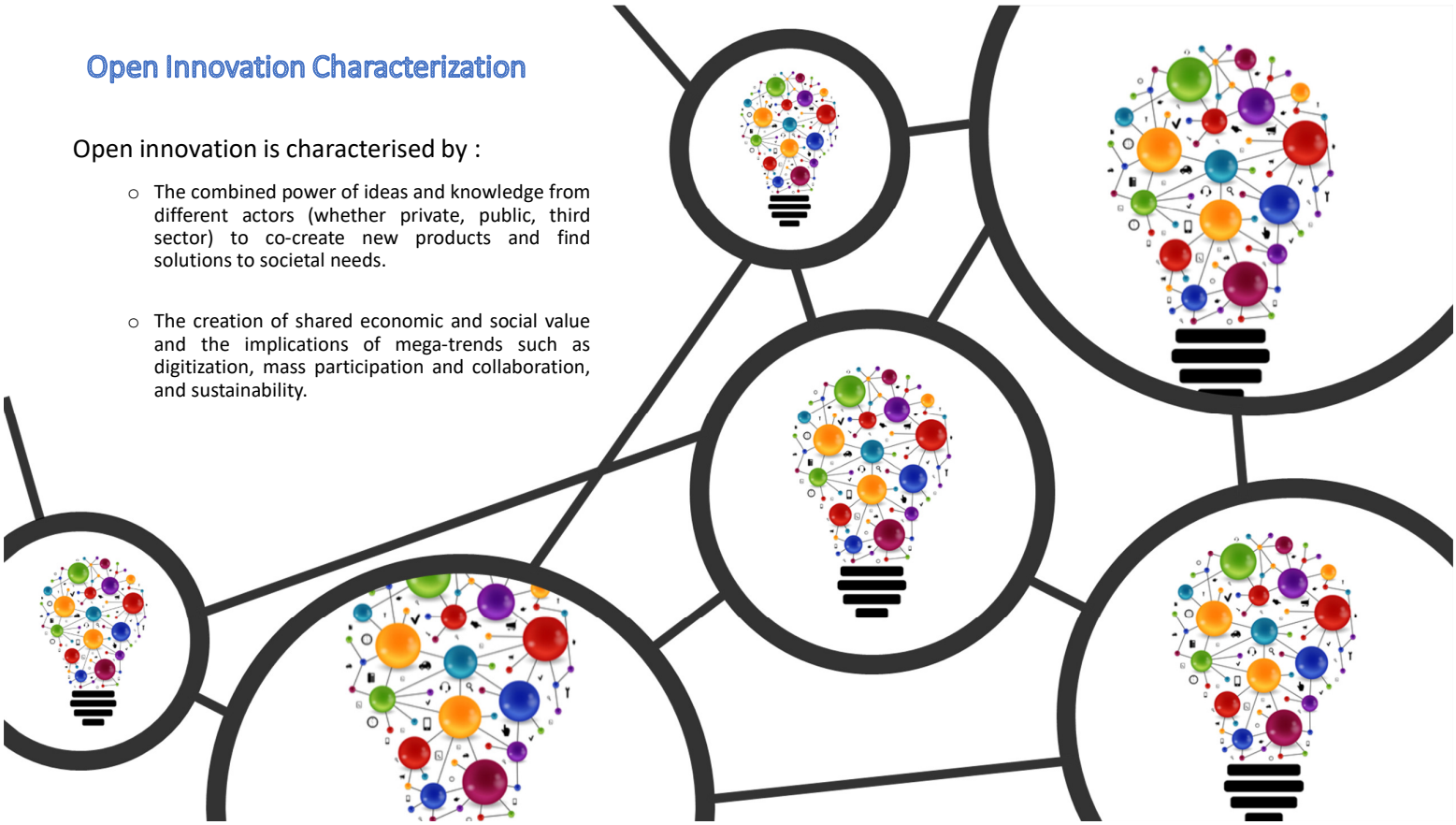
Closed and Open Innovation Principles Comparison

	OPEN INNOVATION	CLOSED INNOVATION
Company philosophy	The Best from anywhere Conscious import and export of knowledge to improve and accelerate your own innovations.	We can do it, we will do it Innovations emerge from the company's internal resources.
innovation ideas	Open exchange of ideas beyond company boundaries	internal ideas
Role of the customer	Active co-innovators	Passive recipients
Mobility Employees	high	low
Venture Capital	plays an important role	plays only a minor role
Qualified persons	The company works with bright minds inside and outside the company.	It is important that the brightest minds in the industry work for the company. Highly qualified employees, especially researchers and developers, are the most important source of innovative ideas.
Role of R&D	Innovation can come from inside and outside. External R&D can create significant value, but internal R&D is still needed to capture part of this value.	Design, development and marketing of in-house innovations: Our own innovative ideas, technologies, processes and markets offer a long-term competitive advantage.
Competition	To lead the competition, it is not necessary to offer the best ideas, but to make the most of internal and external ideas.	To lead the competition, it is necessary to offer the best ideas.
	Developing a better business model is more important than being the first on the market.	The winner is who brings the innovation to market first.
Intellectual Property	Innovation does not have to be created in order to profit from it. A competitive advantage can be created and profit can be generated by others using their own intellectual property and the company acquires third-party intellectual property.	The own know-how is treated confidentially in order to protect it and to avoid free rides by competitors. Patents, copyrights and protection of intellectual property were intended to protect the company's ideas and research from the theft of ideas by other companies.

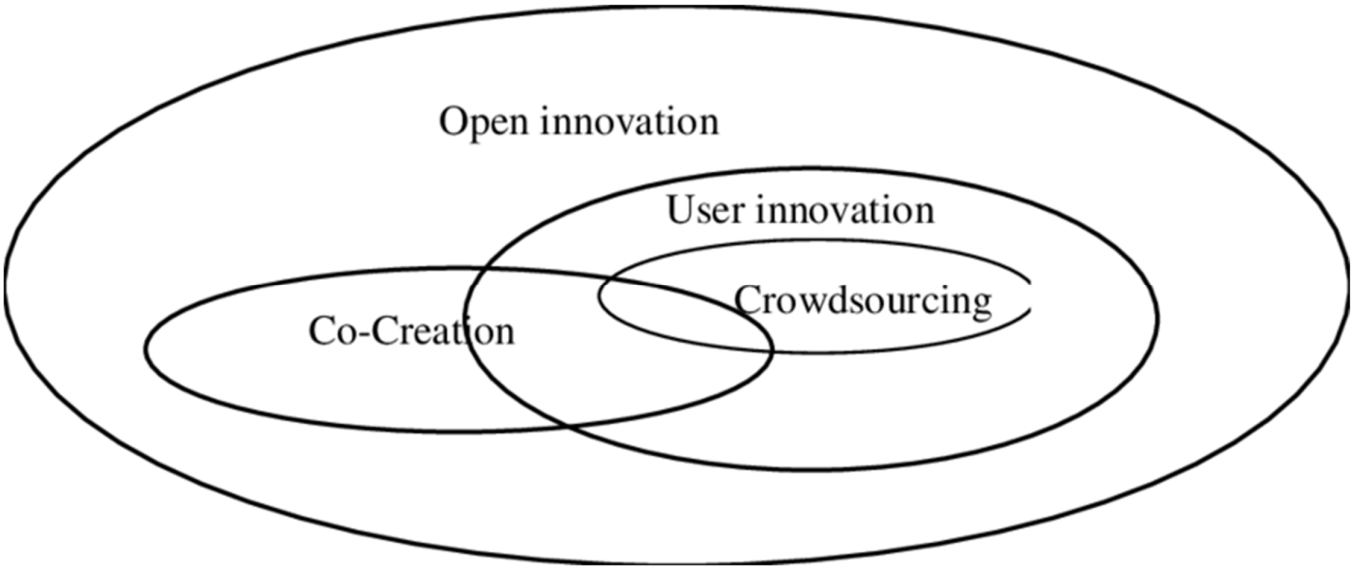
Open Innovation Characterization

Open innovation is characterised by :

- The combined power of ideas and knowledge from different actors (whether private, public, third sector) to co-create new products and find solutions to societal needs.
- The creation of shared economic and social value and the implications of mega-trends such as digitization, mass participation and collaboration, and sustainability.



Intersection areas between Open Innovation, User Innovation, Co-Creation and Crowdsourcing



Open Innovation VS. Open Source

- Open Innovation is sometimes conflated with open source methodologies for software development.
- There are some concepts that are shared between the two, such as the idea of greater external sources of information to create value.
- However, open innovation explicitly incorporates the business model as the source of both **value creation** and **value capture**.
- This latter role of the business model enables the organization to sustain its position in the industry value chain over time.
- While open source shares the focus on **value creation throughout an industry value chain**, its proponents usually deny or downplay the importance of value capture.

Open Innovation and Managing Intellectual Property

- Open Innovation Companies regard IP as an **integral part of technology strategy**, and insist on managing it at a strategic level within the company.
- OICs are not only interested in **selling IP**; they are **motivated and informed buyers** of IP as well.
- These firms accept that the **ability to control an important technology** exclusively for an extended period of time is seldom achieved, and even more rarely maintained.
- The forces that **diffuse knowledge** are so many and so strong.
- One implication of Open Innovation is that companies must increase their own "**metabolic rate**" at which they access, digest, and utilize knowledge. Companies cannot treat their knowledge as static; they must treat it as fundamentally dynamic.
- Open Innovation companies use **licensing** extensively to create and extend markets for their technology. And the **faster technology gets out of the lab**, the sooner researchers will learn new ways to apply, leverage and integrate that technology into new offerings.

Why the importance of Open Innovation is constantly growing?

According to Henry Chesbrough, the following factors are responsible for development of Open Innovation:

1. The availability and mobility of highly qualified specialists is increasing.
2. The availability of venture capital is increasing.
3. The innovative environment of a company offers external opportunities for unused potential innovations.
4. The increasing number of competent customers and specialized suppliers available as cooperation partners.

Open Innovation or Closed Innovation?

Although the importance of open innovation is increasing, it may make sense for a company to continue following the approach of closed innovation or a mix of open and closed innovation. Whether a company prefers open or closed innovations as part of its innovation strategy depends in particular on three factors:

1. **Complex innovation**: If technologies are very closely linked, open innovation can carry certain risks: inappropriate elements could be included that harm the innovation process itself or even have a negative impact on the entire product range. A prime example of this is Apple with its highly integrated and coordinated product range. The company is therefore more inclined towards closed innovation.
2. **Unique innovation**: A closed innovation is usually preferred when an innovation produces fundamental technological improvements that give the company an unassailable advantage over its competitors. Open Innovation therefore works best where innovation is an ongoing process in which benefits can be generated through cooperation.
3. **High competition**: In industries with intensive competition, closed innovation is usually better suited to exploit advantages for the company itself.

Open innovation offers several benefits to companies operating on a program of global collaboration:

- Reduced cost of conducting research and development
- Potential for improvement in development productivity
- Incorporation of customers early in the development process
- Increase in accuracy for market research and customer targeting
- Potential for synergism between internal and external innovations
- Potential for viral marketing

Open Innovation

Implementing open innovation is naturally associated with a number of risks and challenges, including:

- Possibility of revealing information not intended for sharing
- Potential for the hosting organization to lose their competitive advantage as a consequence of revealing intellectual property
- Increased complexity of controlling innovation and regulating how contributors affect a project
- Devising a means to properly identify and incorporate external innovation
- Realigning innovation strategies to extend beyond the firm in order to maximize the return from external innovation

Open Innovation and European Commission Research Projects Example

TOPIC : Open Innovation for collaborative production engineering (IA)

Topic identifier:	DT-FOF-05-2019
Publication date:	27 October 2017
Focus area:	Digitising and transforming European industry and services (DT)
Types of action:	IA Innovation action
DeadlineModel:	single-stage
Planned opening date:	16 October 2018
Deadline:	21 February 2019 17:00:00

Time Zone : (Brussels time)

Horizon 2020 H2020 website
Pillar: Industrial Leadership
Work Programme Year: H2020-2018-2020
Work Programme Part: Nanotechnologies, Advanced Materials, Biotechnology and Advanced Manufacturing and Processing
Call : H2020-NMBP-TR-IND-2018-2020 Call budget overview

https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/dt-fof-05-2019

Specific Challenge

- The transfer to industrial companies of the **Do It Yourself (DIY)**, **Fablabs**, **micro-factories** and **makers approaches** can pioneer ways towards engineering solutions throughout the whole value chain.
- These innovative methods can **lead to new processes**, **machines** and **products** with **new functionalities** and **shorter time** to market.
- Industry is not yet widely using such innovative approaches to **engage consumers** and respond to societal needs, also taking into account the **individual preferences** of **women** and **men**.
- **Collaborative production liaising companies**, **especially SMEs**, with these new approaches can however create **Open Innovation networks** that can unroll a wide range of entirely **new business opportunities** for the **benefit of consumers**.

Scope

- Proposals should particularly cover **consumer-goods sectors** and **couple design**, **creativity** and **knowledge** with a **customer-driven production**.
- The co-creation of products in both ends of the value chain represents customer involvement in the production.
- In particular, proposals should cover at least three out of the following areas:
  - **Novel approaches to capitalize on the knowledge and ideas of design and engineering coming from different and even new actors;**
  - **Design of new strategies based on creative and agile methodologies for analysis;**
  - **Development of knowledge, technologies and tools to share and analyze relevant data and demands from users as well as to fully enable collaborative engineering in the production network, allowing all actors to propose innovative solutions;**
  - **Development of open source product data exchange and standard representations of products and processes that ensure the compatibility of modelling and simulation with different process information systems;**
  - **Development of new Manufacturing Demonstration Facilities (MDFs), where companies will test new technologies in cooperation with fablabs and makers in order to develop real industrial products and where training is offered.**
  - **Proposals also need to take into account Social Science and Humanities (SSH) aspects regarding creativity.**
- Proposals submitted under this topic should include **actions designed to facilitate cooperation with other projects**; to **enhance user involvement**; and to ensure the **accessibility and reusability of data produced in the course of the project**.
- Activities should start at **TRL 4** and achieve **TRL 6** at the end of the project.
- The Commission considers that proposals requesting a **contribution from the EU** between **EUR 4 and 6 million** would allow this specific challenge to be addressed appropriately.
- Nonetheless, this does not preclude submission and selection of proposals requesting other amounts.

Expected Impact

- Establish **Open-Innovation networks** for **manufacturing** that support **customer-driven production** all around Europe;
- Creation of **specific business models** for the engineering of customized solutions, particularly for SMEs, rapid demand changes and shorter time to market;
- Improvement of the **co-design** and **co-development** capabilities towards a **reduction of development costs** of new **products** and **services**;
- Increase of product **variety and personalization** for higher **customer satisfaction and loyalty**.

Work 6 : Computational Creativity and Open Innovation Paradigm

Read well the DT-FOF-05-2019 call, and design an open innovation platform conceptual model which answering this call requirements.

Note: A **conceptual model** is a representation of a system, made of the composition of concepts which are used to help people know, understand, or simulate a subject the model represents.

Delivering Deadline: 14/03/2019
Sending to : Sanaznik@uninova.pt