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THE CYBERNETIC ARTIFICIAL INTELLIGENCE (CAI) APPROACH TO INNOVATIVE ENTREPRENEURSHIP

PLENARY PAPER

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OUTLINE OF PLENARY PRESENTATION

- INTRODUCTION
- STATEMENT OF THE PROBLEM
- TODAY’s SITUATION
- EXISTING METHODS
- BASICS OF ARTIFICIAL INTELLIGENCE
- CYBERNETICS
- THE CYBERNETIC ARTIFICIAL INTELLIGENCE (CAI) APPROACH
- EXAMPLES
- FUTURE RESEARCH
- CONCLUSIONS

INTRODUCTION (1/3)

- There is a phrase which says “May you live in interesting times’”. It is widely reported as being an ancient Chinese curse but is neither Chinese nor ancient, it is recent and western. According to some historian this phrase was used in 1936 by Sir Austen Chamberlain, brother of the Prime Minister of Great Britain at that time.

- While purporting to be a blessing, this is in fact a curse. The expression is always used ironically, with the clear implication that 'uninteresting times', of peace and tranquillity, are more life-enhancing than interesting ones.

INTRODUCTION (2/3)

- Like it or not we live in interesting times. They are times of danger and uncertainty; but they are also more open to the creative energy of human than any other time in history.
- We are certainly living through times of great anxiety not only on economic terms but also on many other aspects of our everyday life.
- Today the whole world is phasing with an unprecedented set of problems never had before.
- COVID-19, WARS IN MANY PLACES, ENERGY AND ENVIROMENT, ECONOMIC DIFFICULTIES, WEATHER CATASTROPHIC PHENOMENA, …….

INTRODUCTION (3/3)

- Everybody looks back to a world that does not remain the same. Furtermore no one can deny that the world is changing, and changing very fast.
- Technology, education, science, environment, health, communicating habits, entertainment, eating habits, dress - there is hardly anything in life that is not changing, some changes we like, while others create fear and anxiety.
- Everywhere there is a feeling of insecurity. What will happen to us tomorrow, or what will happen to our children, are questions we keep frequently asking.
- One thing, however, is clear. It is no more possible to live in the way we have been living so far
- The life of the individual, the social structure, the working conditions and governance—all will have to be replanned.
- **Business will not be an exception**

STATEMENT OF THE PROBLEM

- Innovative entrepreneurship is the practice of establishing creating new business ideas intending to generate profit, assist their community and accomplish company goals.
- Innovation helps an individual entrepreneur or a group of entrepreneurs to improve or replace a particular product, process or service.
- Innovative entrepreneurship has been a subject of significant discursive research the last two decades.
- However innovative entrepreneurships have not taken advantage of new advanced technologies
- Can Artificial Intelligence (AI) and Cybernetics be of some serious use?

THE BUSINESS WORLD

- The business world **encompasses all companies, including lean startups, family-owned shops, freelancers, and solo entrepreneurs**.

- While the corporate world offers stability, structure, and resources, it can also mean bureaucracy, office politics, and lack of creativity.

- Business refers to **an enterprising entity or organization that carries out professional activities**. They can be commercial, industrial, or others.

- For-profit business entities do business to earn a profit, while non-profit ones do it for a charitable mission.

Leadership Theories and Styles for Managers

1) Democratic management style.
2) Inspirational management style.
3) Authoritative management style.
4) Results-based management style.
5) Laissez-faire management style.
6) Collaborative management style.
7) Example-setting management style.
8) Strategic management style.
9) Affiliative management style

Leadership Theories and Styles for Managers

10) Charismatic management style.

11) Paternalistic management style.

12) Transformational management style.

13) Delegative management style.

14) Coaching management style

Economic Theories

- **Supply and demand**
- **Classical economics**
- **Keynesian economics**
- **Malthusian economics**
- **Marxism of socioeconomic theory**
- **Market or liberal socialism**
- **Monetarism**
- **New growth theory**
- **Moral hazard theory**

Economic Theories (cont.)

- **Institutional economics**
- **Behavioral economics**
- **Game theory**
- **Comparative advantage**
- **Free-Market Economy**
- **Laissez-faire capitalism**
- **Command Economy or planned economy**
- **Influential Economic Theories in Business?**

What is entrepreneurship?

- At its most basic level, entrepreneurship refers to an individual or a small group of partners who strike out on an original path to create a new business.
- An aspiring entrepreneur actively seeks a particular business venture and it is the entrepreneur who assumes the greatest amount of risk associated with the project.
- Entrepreneurial pursuits often involve innovation.
- Employees are encouraged to think like entrepreneurs, cultivating an original perspective that may result in a new idea for the company.
- These workers may be given extra latitude, but the enterprise still holds authority over the project and absorbs any risk associated with it.
- Entrepreneurs benefit every sector, from large corporations to small businesses.

Entrepreneurship Theories

1. Schumpeter's Innovation Theory.
2. Resource-Based Theory.
3. Effectuation Theory.
4. Social Network Theory.
5. Opportunity Recognition Theory.
6. Human Capital Theory.
7. Institutional Theory.
8. Psychological Trait Theory.
9. Effectuation-Causation Duality.
10. Transaction Cost Economics.

Entrepreneurship Theories (cont.)

11. Network Effect Theory.
12. Cultural-Embeddedness Theory.
13. Social Capital Theory.
14. Institutional Entrepreneurship Theory.
15. Network Resource Theory.
16. Theory of Effectual Logic.
17. Absorptive Capacity Theory.
18. Institutional Embeddedness Theory.
19. Legitimacy Theory.
20. Evolutionary Theory of the Firm.

What industries do small business entrepreneurs work in?

- A recent small business owner survey from Guidant Financial found that the top three industries for small business startups are:
  - -Food and restaurant operations
  - -Retail
  - -Business services
- Other leading industries included health and fitness, finance, insurance, and law.
- No matter what type of venture a small business entrepreneur is involved in, it's vital that they prioritize innovation and perseverance.

Innovative Entrepreneurship

What is innovative entrepreneurship?

- Innovative entrepreneur is an individual who has the capability of creating and bringing innovative products to the market.
- Innovative entrepreneurship is the practice of establishing creating new business ideas intending to generate profit, assist their community and accomplish company goals.
- Innovative entrepreneurship can help professionals develop ideas to successfully manage businesses. Understanding this concept can help you become a successful entrepreneur.
- It allows them to upgrade the products by creating new ideas and values. Innovative entrepreneurs incorporate various strategies to overcome the challenges in their businesses.

The Most Common Business Challenges Entrepreneurship Companies Face & Strategies to Overcome Them

- **Running a business-Entrepreneurship is like sailing a ship. (Remember it)**

- It’s an exciting journey full of adventures, challenges, and rewards. But just like sailing, navigating the business world is no smooth cruise.

- You’re bound to face storms; these challenges may seem tough, but they also push your enterprise to adapt, innovate, and grow.

- In this exercise, we’ll explore the common challenges businesses-entrepreneurships encounter and provide practical strategies to overcome them.

DIFFERENCE BETWEEN BUSINESS AND ENTREPRENEURSHIP

- Although the difference between a businessperson and entrepreneur tends to be quite narrow, there are aspects where the two differ.

- If we were still living in the medieval age, businessman would be the merchant and entrepreneur would be the inventor.

- Merchants sold goods, foods, castles, etc. Inventors created new inventions like the agrarian system to improve the harvest, and of course earned money from their inventions.

- Businessmen and entrepreneurs were both indispensable for the economy and sustainable growth of a region.

DIFFERENCE BETWEEN BUSINESS AND ENTREPRENEURSHIP

BUSINESS-PERSON	**ENTREPRENEUR**
Existing ideas	New and unique ideas
Use existing models	Develop new models
Seek sheer profit	Change economic conditions
Calculate Risks	Crazy Risks
Usually act fast	Take some time to act
Has no vison	Has a vision and plan on it
Adapt to a plan	Change plans if needed
Keep things under control	Is spiritual/innovative-takes initiatives

The difference between innovation and entrepreneurship

- Innovation and entrepreneurship are two concepts that are often used interchangeably, but
- They actually refer to different aspects of the business world.
- Innovation refers to the creation of new ideas or methods,
- While entrepreneurship is the process of putting those ideas into action and building a successful business around them.

TODAY's SITUATION AND EXISTING METHODS

From all the above we see:

- There different sectors of the business world: a)Economics b) Business and c) entrepreneurships
- There are many different methods and theories that address similar problems in all three sectors
- All these methods do dot include systematically Artificial Intelligence (AI) and Cybernetics
- AI is used sporadically only in some "business problems"
- There are still many "business problems" that do need some new advanced methods

HOW ABOUT ARTIFICIAL INTELLIGENCE??

WHAT IS ARTIFICIAL INTELLIGENCE?(1/3)

- Just what do people mean by Artificial Intelligence (AI)? The term has never had clear boundaries. The concept of what defines AI has changed over time, but the central idea has always been the idea of building machines which are capable of thinking and performing like humans.
- Artificial Intelligence, AI, is a conceptual aspect of machine intelligence – that is intelligence demonstrated by machines.
- AI is an area of computer science that is based on the idea of computer programs that model aspects of intelligent behavior.

WHAT IS ARTIFICIAL INTELLIGENCE?(2/3)

- AI, is a conceptual aspect of machine intelligence – that is intelligence demonstrated by machines.
- It is based on the idea of creating machines to mimic human intelligence and behavior so that they could react like humans.
- Since the first computers were developed, AI has been an active scientific discipline and many developments in modern computing trace their roots to AI.

WHAT IS ARTIFICIAL INTELLIGENCE?(3/3)

- When it was introduced at a seminal 1956 workshop at Dartmouth College, it was taken broadly to mean making a machine behave in ways that would be called intelligent if seen in a human.
- If we want to build machines at least to help us do this more efficiently, then it makes sense to use ourselves as a blueprint.
- Efforts to advance AI concepts over the past 55-60 years have resulted in some truly amazing innovations.
- Medical diagnosis, electronic trading, e-learning, speech recognition, smart cities, robot control, remote sensing, healthcare, manufacturing, education, data mining, and autonomous vehicles are just some of the incredible applications emerging from AI development.

A HISTORICAL ROADMAP OF ARTIFICIAL INTELLIGENCE

- The scientific field of Artificial Intelligence (AI) has been officially started **in 1956 at Dartmouth College**. There the most eminent experts of that time (47 on number) gathered to brainstorm on intelligence theories and simulation.
- The Dartmouth Summer Research Project on Artificial Intelligence was a 1956 summer workshop. It is considered by most to be the founding event of Artificial Intelligence (AI) as a scientific field.
- It was organized by Marvin Minsky and John McCarthy, with the support of two senior scientists Claude Shannon and Nathan Rochester of IBM.

The first generation of AI researchers made these predictions about their work:

- 1958, H. A. Simon and Allen Newell: "within ten years a digital computer will be the world's chess champion" and "within ten years a digital computer will discover and prove an important new mathematical theorem."
- 1965, H. A. Simon: "machines will be capable, within twenty years, of doing any work a man can do."
- 1967, Marvin Minsky: "Within a generation... the problem of creating 'artificial intelligence' will substantially be solved."
- 1970, Marvin Minsky (in *Life* magazine): "In from three to eight years we will have a machine with the general intelligence of an average human being."

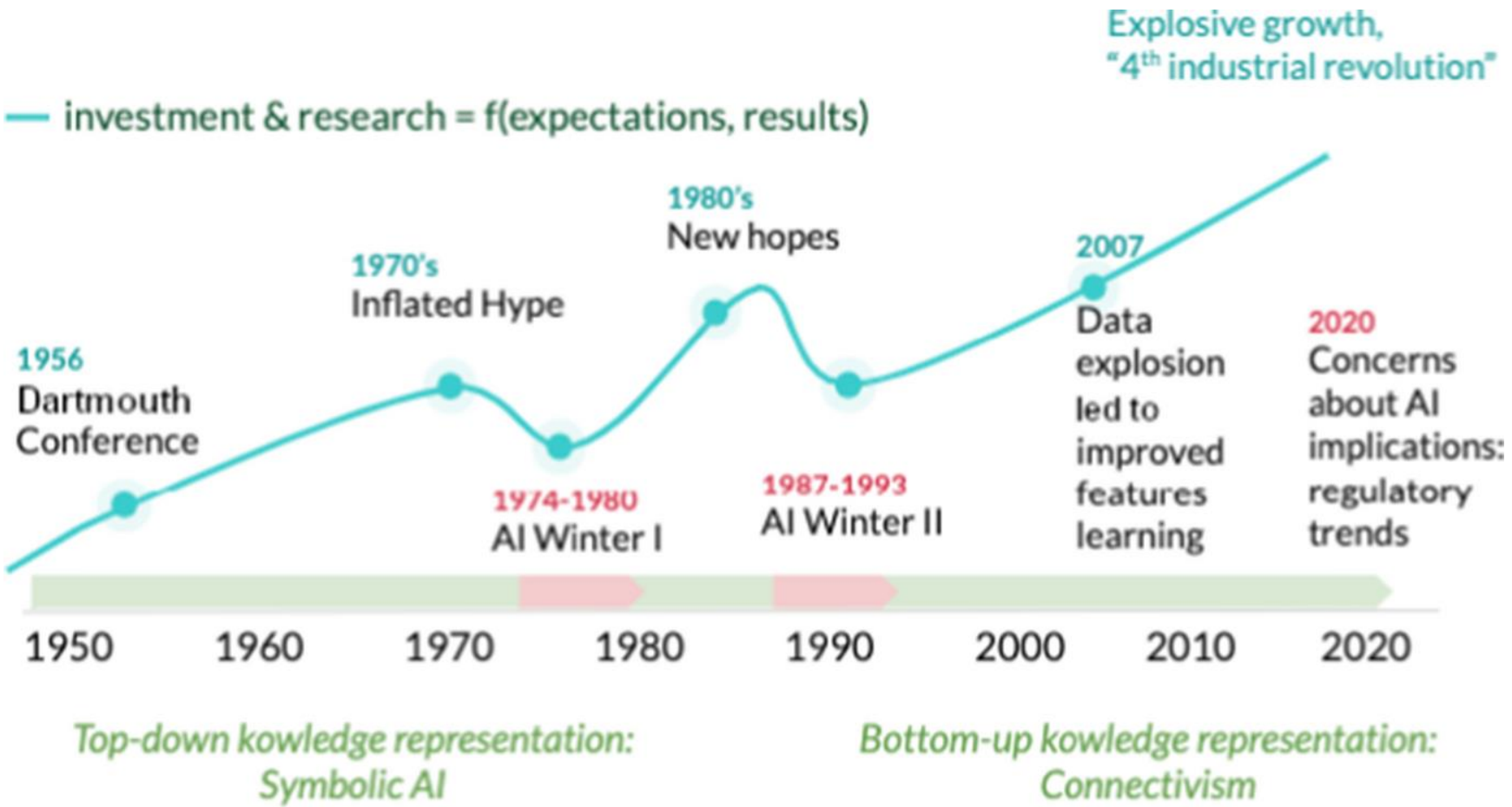
AI methods and architectures

1) Machine Learning (ML)
2) Neural Networks (NNs)
3)Deep Learning (DL) and
4) Edge Intelligence (EI). Briefly:

Furthermore, there are various DL methods and architectures:

- 1) Artificial neural networks (ANNs)
- 2) Deep neural networks (DNNs)
- 3) Convolutional deep neural networks (CDNNs)
- 4) Deep belief networks (DBNs)
- 5) Recurrent (or recursive) neural networks (RNNs) and
- 6) Long short-term memory (LSTM).
-

Figure below shows the AI summers and AI winters evolution over the years since the AI conception has been officially accepted by the scientific communities



What Some well known People are Saying About AI

- AI is a “demon” that is “potentially more dangerous than nuclear weapons” by Elon Musk Tesla chief executive
- … full artificial intelligence could spell the end of the human race” by Stephen Hawking

  British theoretical physicist
- “I don’t understand why some people are not concerned” by Bill Gates Microsoft co-founder

- Noam Chomsky believes that what we call artificial intelligence is simply theft. "The biggest theft of property since Native Americans were bled by European settlers ..

What is Cybernetics?

- Cybernetics is the interdisciplinary study of the structure of regulatory systems. Cybernetics is concerned with various kinds of feedback, compliance, and control mechanisms in living organisms, machines, and organizations.
- **IT INVOLVES A FEEDBACK SYSTEM**
- Cyberneticians investigate topics such as how goals are represented and achieved, how systems process information and make decisions, how they learn and adapt, and how they cope with uncertainty and fuzziness.
- It has had a profound impact on a wide range of disciplines, including engineering, economics and business, biology, psychology and sociology.
- The term “cybernetics” was coined in 1948 by mathematician Norbert Wiener in the book Cybernetics: or Control and Communication in the animal and Machine. It brings for the first time the English term “cybernetics”

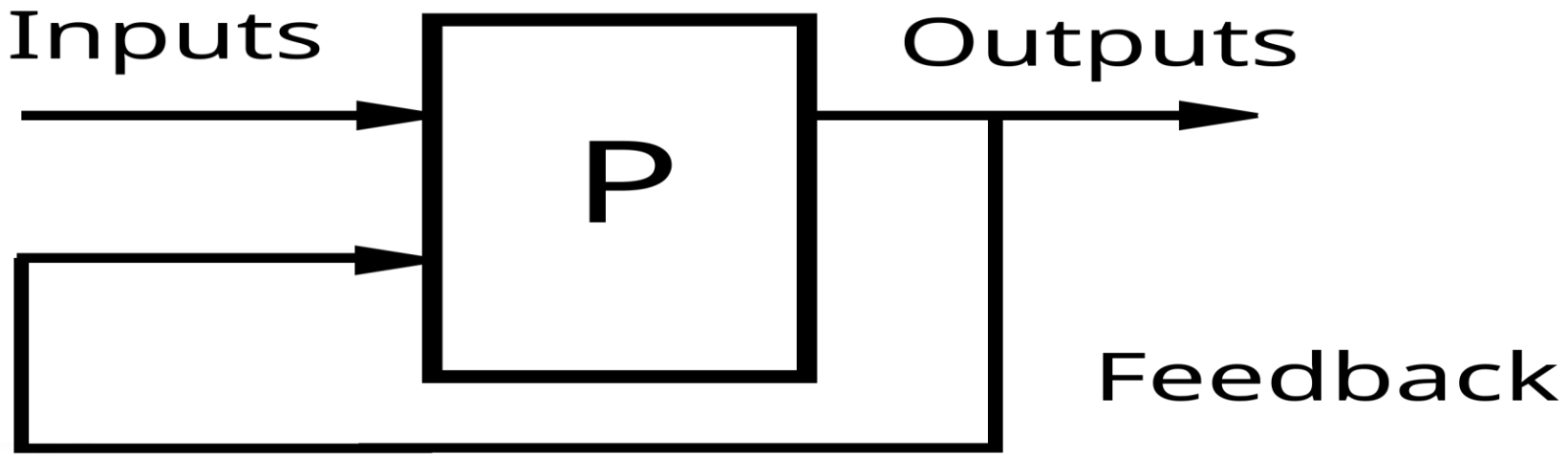
THE NAME CYBERNETICS

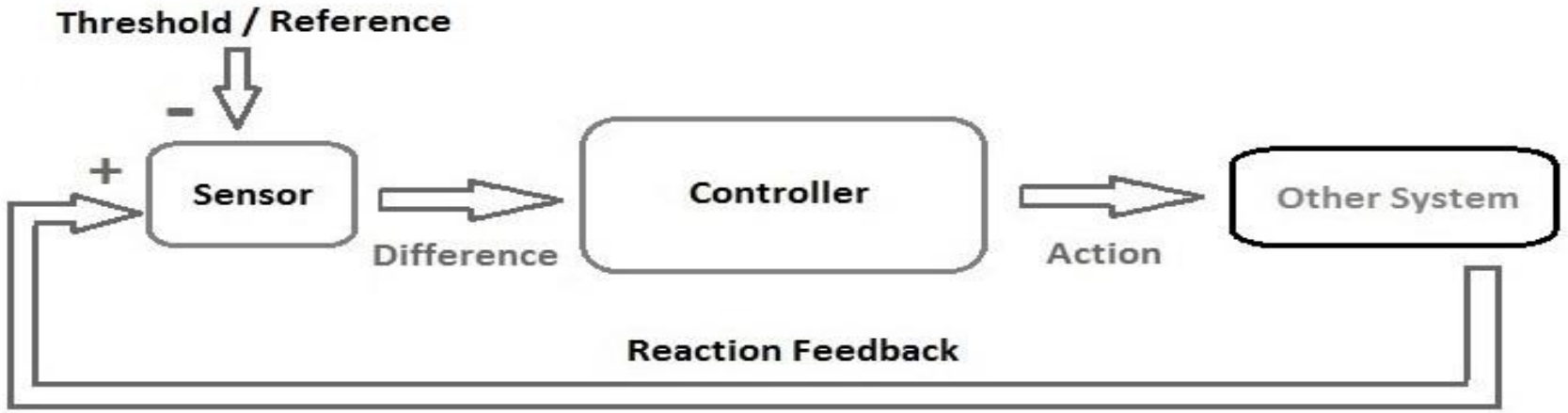
- The term derives from the Greek word for steersman which means

  “the art of steering”

- The Ancient Greek term κυβερνητικής (kubernētikēs, '(good at) steering') appears in Plato's Republic and Alcibiades, where the metaphor of a steersman is used to signify the governance of people: “Or again, in a ship, if a man having the power to do what he likes, has no intelligence or skill in navigation, do you see what will happen to him and to his fellow-sailors?” (Benjamin Jowett, translator)
- The French word cybernétique was also used in 1834 by the physicist André-Marie Ampère (1775-1836), to denote the sciences of government in his classification system of human knowledge.

CYBERNETIC MODEL



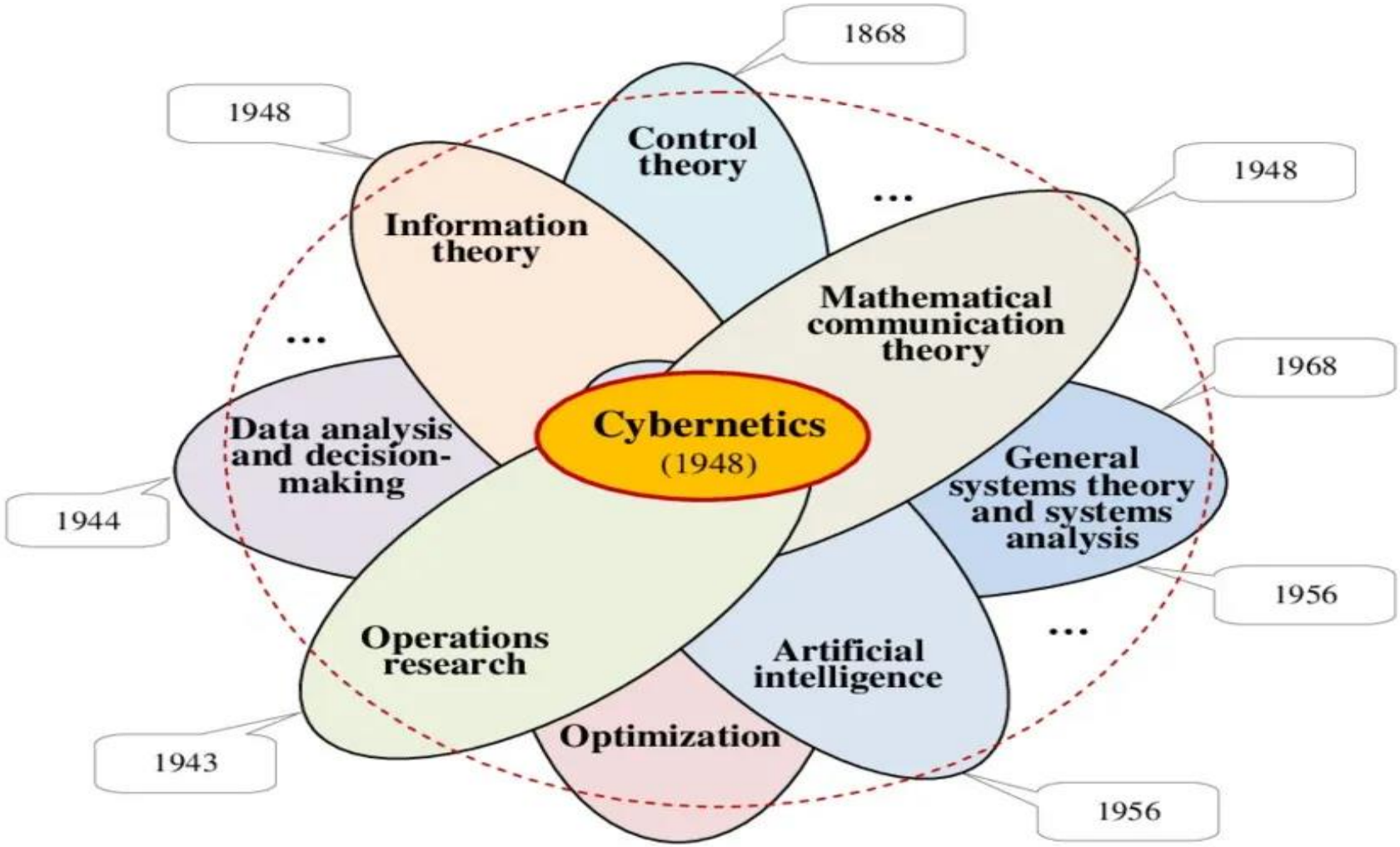


A Cybernetic Loop

CONCEPTS OF CYBERNETICS

- **General concept of feedback**
- **Homeostasis**
- **Negative feedback** (or **balancing feedback**)
- **Self-Control**
- **Wise learning**
- **Sensors**
- **Automation**
- **Cognition**

CYBERNETICS



THEORIES OF CYBERNETICS

1) **Autopoiesis**
2) **Black box**
3) **Double bind**
4) **Conversation theory**
5) **Cognitive Reflector**
6) **Learning strategies**
7) **Experimental epistemology**
8) **Perceptual control theory (PCT)**
9) **Radical constructivism**

10) **Second-order cybernetics**, also known as the **cybernetics of cybernetics**
11) **Self Organization Theory**
12) **Social Systems' Theory**
13) **Viable System Model Theory**
14) **Synergetic Cybernetics**
15) **Systemic Principles**

THEORIES OF CYBERNETICS

- MANY BUT VERY LITTLE KNOWN
  can be found on a limited number of books and research papers
- SMALL NUMBER OF COURCES ON UNIVERSITIES
- THEY HAVE NOT BEEN PUBLISIZED PROPERLY
- EXTREMELY LOW FUNDING
- VERY LIMITED APPLIED ON REAL PROBLEMS

CYBERNETICS AND THE WORLD!!!

VERY RELEVANT BUT NOT WELL RECOGNIZED

Although many scientists were aware of the important scientific contributions of Cybernetics, they intentionally chose the term Artificial Intelligence (AI).

In recent decades, Cybernetics has often been overshadowed by Artificial Intelligence, even though Artificial Intelligence was influenced by Cybernetics in many ways. Recently, Cybernetics has been returning to the public conscience and is once more being used in multiple fields.

It must be emphasized that Cybernetics is an interdisciplinary science that focuses on how a system processes information, responds to it and changes, develops control actions, or restructure the whole system for better functioning.

It is a general theory of information processing, feedback control, and decision making.

Today's interpretation of the term "Cybernetics" as it was pioneered by Norbert Wiener in 1948 as "the scientific study of control and communication in the animal and the machine" is more relevant to our lives today than ever before.

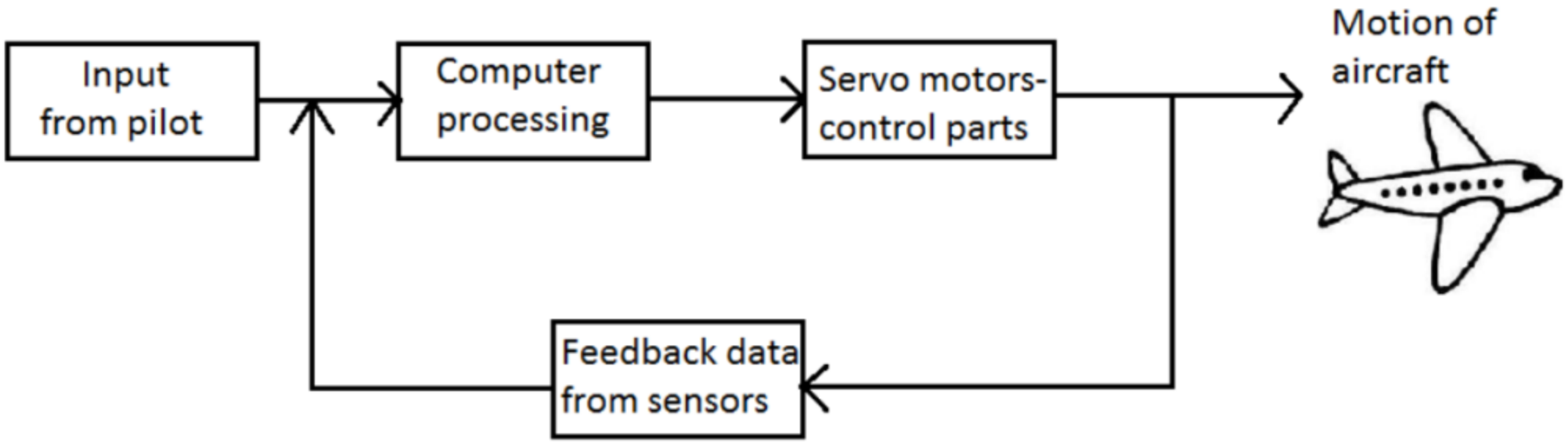
Difference Between AI and Cybernetics

- In a world where technology is constantly evolving, it can be difficult to keep up with the latest trends. In particular, there are two terms that are often used but have very different meanings: artificial intelligence (AI) and Cybernetics.
- Both the terms are often used interchangeably and thus confused one with the other.
- AI is based on the realist view that machines can work and behave like humans using the Big Data Driven World and correlation principles (probability).

Difference Between AI and Cybernetics (cont.)

- On the other hand Cybernetics is based on a constructivist view of the world.
- This particular aspect of cybernetics is based on control theory and is often utilized in order to improve performance while still ensuring that the goal is achieved.
- Cybernetics use cognitive science to understand and analyze better the world.
- Studies suggest that the differences between AI and Cybernetics are not merely semantic but rather conceptual.
- Though they share some similarities, AI and Cybernetics are actually quite different.

Feedback plays an essential role in cybernetic systems An example of airplane flight



THE CYBERNETIC-ARTIFICIAL INTELLIGENCE APPROACH (CAI)

We do not need to elaborate any more on the issues and methods of AI or Cybernetics.

However, we should high light key concepts of Cybernetics as have been formulated by scientists of it.

These include (but not limited): Feedback loops, Circular causality, Self-organization, communication, cognitive control, wise learning, seeking true knowledge, interdisciplinary nature, Homeostasis, Autonomy, Variety, Information, Regulation, Hierarchical structures, Structure vs Organization, and Observer's Influence.

THE CYBERNETIC-ARTIFICIAL INTELLIGENCE APPROACH (CAI) (cont.)

An important characteristic of Cybernetics is the emphasis on unifying principles differentiated it from more specialized fields, having had strong influence on early neural network research and machine learning and **providing models for self-correcting computations.**

By the 1970s onwards, Cybernetics was increasingly side-lined as derivative fields like computer science, cognitive science and systems theory took more specialized paths forward. While the core cybernetic principles remained in use in a number of disciplines, cybernetic pioneers became less referenced and ultimately, **the discipline itself progressively disappeared from scientific discourse.**

WHY CONSIDER CAI?

There are a few key reasons why Cybernetic perspectives could be valuable for developing effective AI safety paradigms and ethical systems and thus develop an innovative CAI.

Some are:

- Cybernetics offers crucial insights into regulating complex, adaptive systems.
- Concepts like circular causality and ‘second-order Cybernetics’ highlight the role of **the observer** within systems.
- Cybernetics emphasize how parts relationally regulate the wider system.
- Cybernetics focus on flows of information, communication, and control maps well to coordinating distributed AI systems through networks.
- Cybernetic models balance stability and adaptation.
- Ethical AI requires dynamic principles that can evolve responsibly as technology advances.
- The early pioneers of Cybernetics were highly interdisciplinary, collaborative, and creative.

THE CYBERNETIC-ARTIFICIAL INTELLIGENCE APPROACH (CAI)

- However, reviving ONLY Cybernetics is not enough.
- Similarly, rather than consolidated corporate control, cybernetic thinking opens possibilities for more decentralized, participatory paradigms for shaping the evolution of AI technology responsibly.
- The field’s boundary-challenging ethos mirrors the need for fresh perspectives that question prevailing norms as we build beneficial CAI.

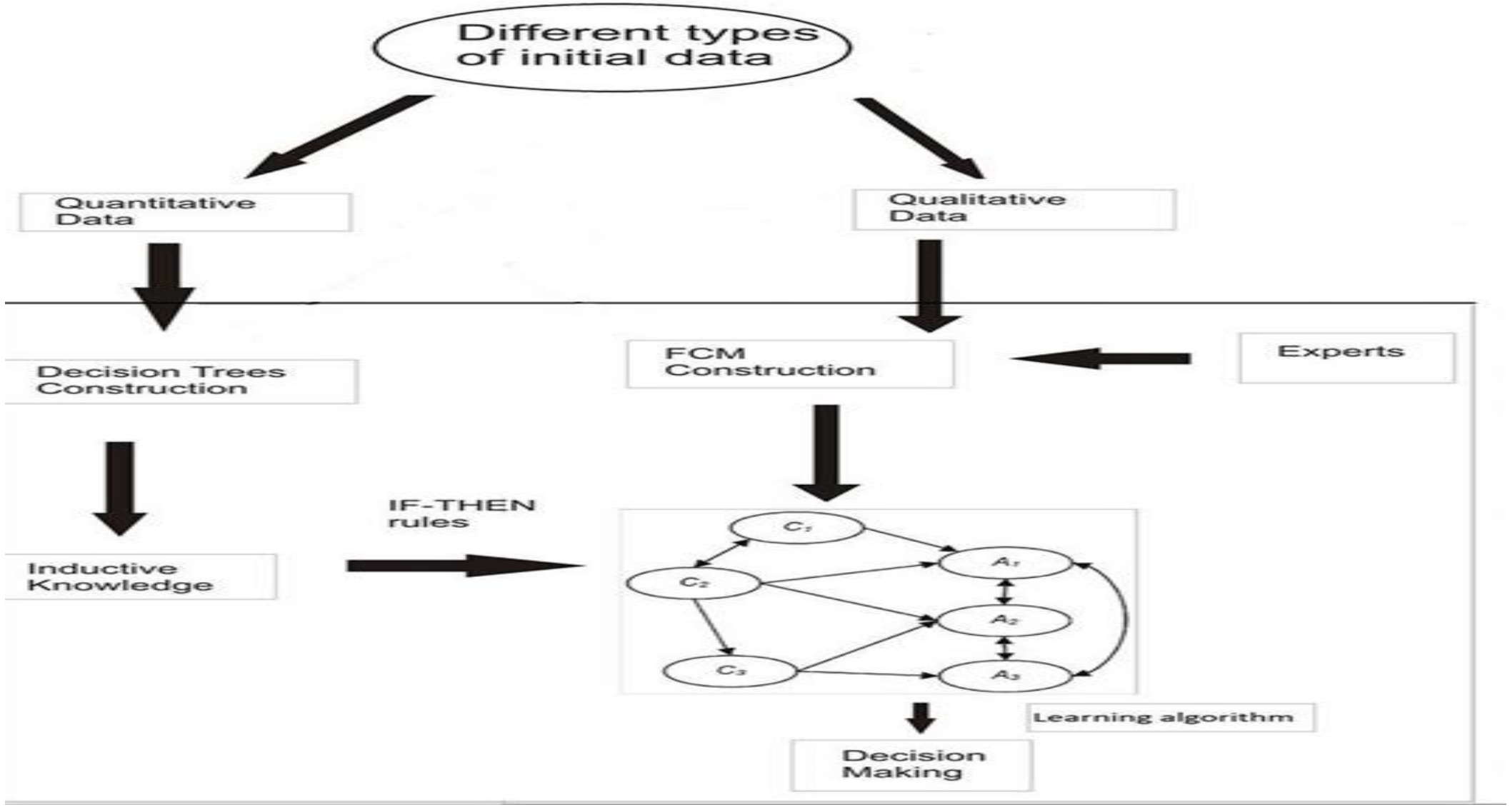
THE CAI APPROACH (cont.)

- As AI grows more capable and embedded in our lives, ensuring its safe and ethical development is an urgent priority.
- Concepts from the vital but overlooked field of Cybernetics offer timely insights into regulating complex adaptive technologies.
- **Thus, my proposed CAI is well justified**.

Here is why.

- Cybernetics has been used to several fields: engineering, medicine, psychology, international affairs, economics, and architecture.
- It is often used to comprehend the operation of a process and develop algorithms or models that optimize inputs and minimize delays or overshoots to ensure stability.

THE CAI APPROACH USES THE FOLLOWING



THE CAI METHODOLOGY

The CAI approach will need to follow the next steps:

1) Define and formulate the problem clear and well (involve all parties)
2) Collect all available information-data or develop appropriate methods to collect the needed data. (In fact this step is very crucial since you define the initial conditions of the problem)
3) Analyze it using AI theories and methods
4) Decide on the number and the quality-knowledge of experts
5) Perform an FCM analysis based on the previous diagram
6) Study extensively the problem using appropriate Cybernetics theories
7) Decide if the solution to the problem is acceptable and to the benefit of the society
8) If not repeat the above steps (with more Data for the AI part and more experts for the FCM part) till you reach an acceptable solution by ALL involved parties
9) End the CAI study

DISCUSSION OF THE ALGORITHM (1/2)

- The proposed algorithm is a generic approach of Decision-Making system for creating new knowledge.
- This is accomplished by combining Decision Trees and Fuzzy Cognitive Maps.
- Quantitative data: are used to induce a Decision Tree (AI).
- Qualitative data (through experts' knowledge) are used to construct the FCM model.
- Finally reaching a decision provides the opportunity for creating new knowledge.

DISCUSSION OF THE ALGORITHM (2/2)

- What are the advantages of this new method in generating new knowledge?
- Association rules derived from the decision trees have a simple and direct interpretation of AI.
- Procedure that introduces the Decision Tree rules (AI) into an FCM also specifies the weight assignment through the new cause-effect relationships among the FCM concepts.
- The proposed method using experts and based on causality and not in correlation utilizes much better and more efficient past data.
- This is not the case with AI which uses correlation coefficient and depends heavily on the availability of large amount of data.
- This technique fares better than the best Decision Tree inductive learning technique used on any AI method.

An Example: The Lean Start-up Model

- The Lean Startup Model emphasizes rapid experimentation, iterative development, and validated learning to bring new products to market efficiently.
- This approach focuses on creating a minimum viable product (MVP) to test hypotheses and gather **user feedback quickly**, enabling continuous improvement and reducing the risk of failure.
- Dropbox initially launched with a simple MVP—a video demonstrating the product concept—to gauge user interest before investing in full development. This approach allowed Dropbox to validate their idea and **gather valuable feedback**, ensuring that their product met market needs before extensive resources were committed.

Implementing The Lean Start Up Model

- The Lean Startup Model can be effectively implemented using innovation management software that centralizes and streamlines the entire innovation process. This software enables the collection and evaluation of ideas, helping teams prioritize concepts for developing minimum viable products (MVPs). It supports continuous improvement by tracking user **feedback** and product iterations, ensuring that **each version better meets market needs.**
- Additionally, the software can assist in **identifying and integrating new technologies to enhance MVPs, and managing multiple innovation projects efficiently.**
- **This integrated approach allows businesses to prototype rapidly, gather insights, and iteratively refine their products, ultimately leading to faster and more successful market launches**.

Embracing Innovative Entrepreneurship Models with the Right Tools

- By understanding and applying different innovation models like the Lean Startup Model, Stage-Gate Model, Design Thinking, Blue Ocean Strategy, and TRIZ, organizations can systematically approach innovation and maximize their chances of success.
- Innovation management software plays a critical role in facilitating these models, offering tools for idea management, continuous improvement, trend analysis, and collaboration.

Embracing Innovative Entrepreneurship Models with the Right Tools (cont.)

- The right software enables Entrepreneurship-Companies to streamline their innovation processes, gather valuable insights, and iteratively refine their products and services.
- This not only enhances the efficiency and effectiveness of innovation efforts but also ensures alignment with strategic business goals.
- Ultimately, the key to successful innovation lies in having flexible, **intelligent software** that supports various innovation models and **adapts to the unique needs of each organization**.

Where are AI and Cybernetics?

- NOWHERE IN ALL THESE PROBLEMS, CASES AND EXAMPLES
- HOWEVER LOOK AT THE PREVIOUS PRESENTATIONS
- YOU CAN IDENTIFY MANY POINTS THAT AI AND CYBERNETICS CAN BE APPLIED AND IMPROVE BUSINESS PERFORMANCE

FUTURE RESEARCH

THERE ARE MANY INTERESTING AND CHALLENGING AREAS

- To start working towards developing the CAI scientific field
- Integrate AI and Cybernetics methods
- Consider Ethics and human values in the CAI approach
- Update Cybernetic theories with modern understandings from AI , complex systems science, cognitive science.
- Apply these new CAI integrated methods to real applications to solve real-world pressing problems of business and entrepreneurships.

CONCLUSIONS

- The world is changing fast
- We need to understand the limits of the environment and of the whole Business world
- We need new scientific and technological approaches for Business
- Artificial Intelligence has contributed a lot in this direction
- Certainly there are a number of real threats
- Many challenges and opportunities
- AI cannot succeed disregarding human brain and Cognitive science

Conclusions (cont)

- We need to define ethics for AI before using it in Business
- Cybernetics has not been developed as needed by Business and Entrepreurships
- A new scientific field has been proposed the CAI approach
- Innovative Entrepreneurships need to incorporate CAI
- An urgent need for integrating Cybernetics and AI

LAST THOUGHTS

- It is vital to ensure that AI as a power is distributed to all and not concentrated in the hands of a few.
- As Hellas, Europe and as Humanity, we must reflect on our responsibility and seize NOW the opportunity.
- We can't afford to lose her

- WE MUST BE MAKING WISE DECISIONS THROUGH WISE LEARNING (WL)
- UTILIZING CYBERNETICS AND ARTIFICIAL INTELLIGENCE IN A ANTHROPOCENTRIC AND SYNERGETIC WAY

THANK YOU VERY MUCH

FOR YOUR KIND ATTENTION

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Modeling a system with FCMs

- Modeling a system as a collection of concepts and causal links between them.
- **Nodes:** Represent the system's concepts. Concepts correspond to the characteristics of the system.
- **Arrows:** Interconnection between nodes. Show the cause-effect relationship between them.

Fuzzy Cognitive Maps

- A Fuzzy Cognitive Map(FCM) is a soft computing technique that follows an approach similar to human reasoning and the human decision-making process.
- An FCM looks like a cognitive map, it consists of nodes (concepts)
- These nodes (concepts) interact with each other showing the dynamics of the model.
- Concepts may represent variables, states, events, trends, inputs and outputs.

Fuzzy Cognitive Maps (1/6)

Five main reasons require the utilization of FCMs:

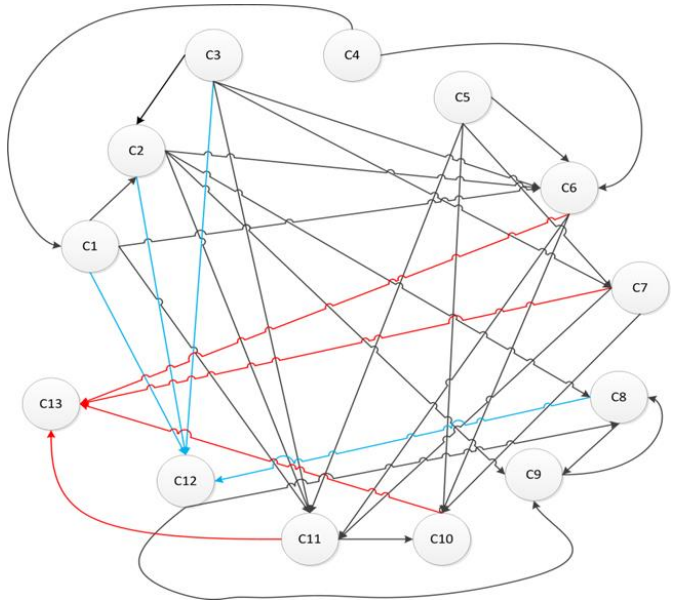
- Complexity
- Nonlinearities
- Uncertainty
- Fuzziness
- Ambiguity

The majority of the real-world systems include these FIVE (5) parameters.
The COVID-19 is not an exception

Thus, FCMs are about to play a major role in the future regarding the modeling, analysis, and control of COVID-19.

Fuzzy Cognitive Maps (2/6)

- Between concepts, there are three possible types of causal relationships that express the type of influence from one concept to another:
- Wij > 0 (Ci ↑ ⇒ Cj ↑)
- Wij < 0 (Ci ↑ ⇒ Cj ↓)
- Wij = 0 (Ci , Cj ⇒ not causality)



- **<u>Attention:</u>**

❑ Causality vs. Correlation

❑ Probability vs. Fuzzy Logic

Fuzzy Cognitive Maps (3/6)
Classical Method

$$A_i[k+1] = f(A_i[k] + \sum_{j=1, j\neq i}^{n} (A_j[k] w_{ji})) \quad (1)$$

ng

Where f is the sigmoid function (λ>0 steepness of the function)

$$f(x) = \frac{1}{1 + e^{-\lambda x}} \quad (2)$$

Fuzzy Cognitive Maps (4/6)

- Determination of the problem/system
- Utilization of the expert's knowledge
- Calculation of the causation among the concepts
- Input-Output concepts
- Definition of the desired function region
- Utilization of appropriate training methods
- Create true knowledge even from a small number of data.

Fuzzy Cognitive Maps (5/6)

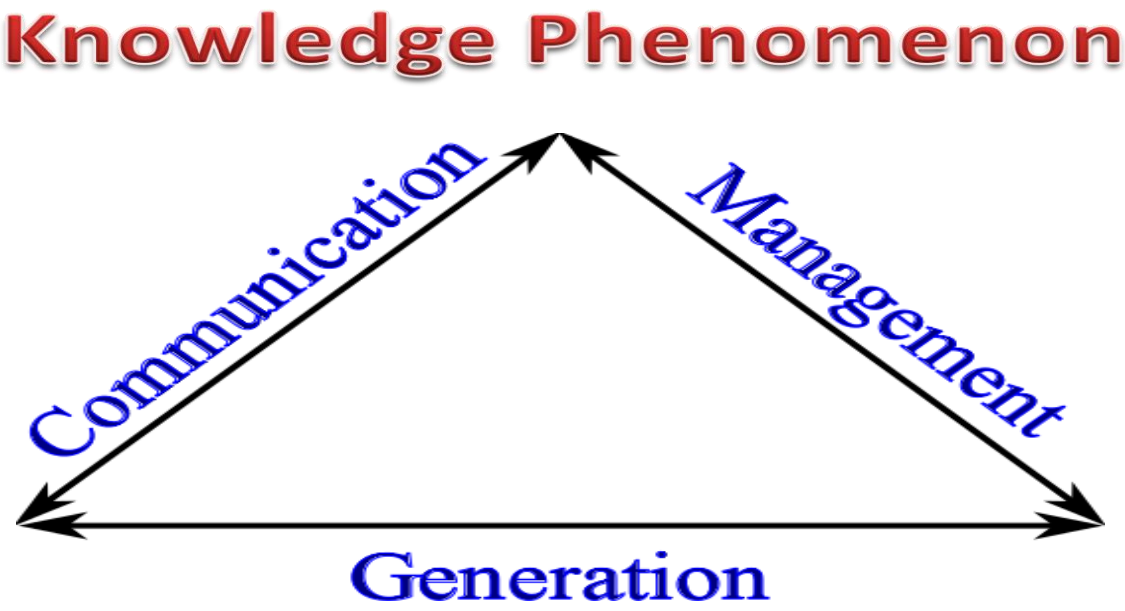
Assigning numerical weights

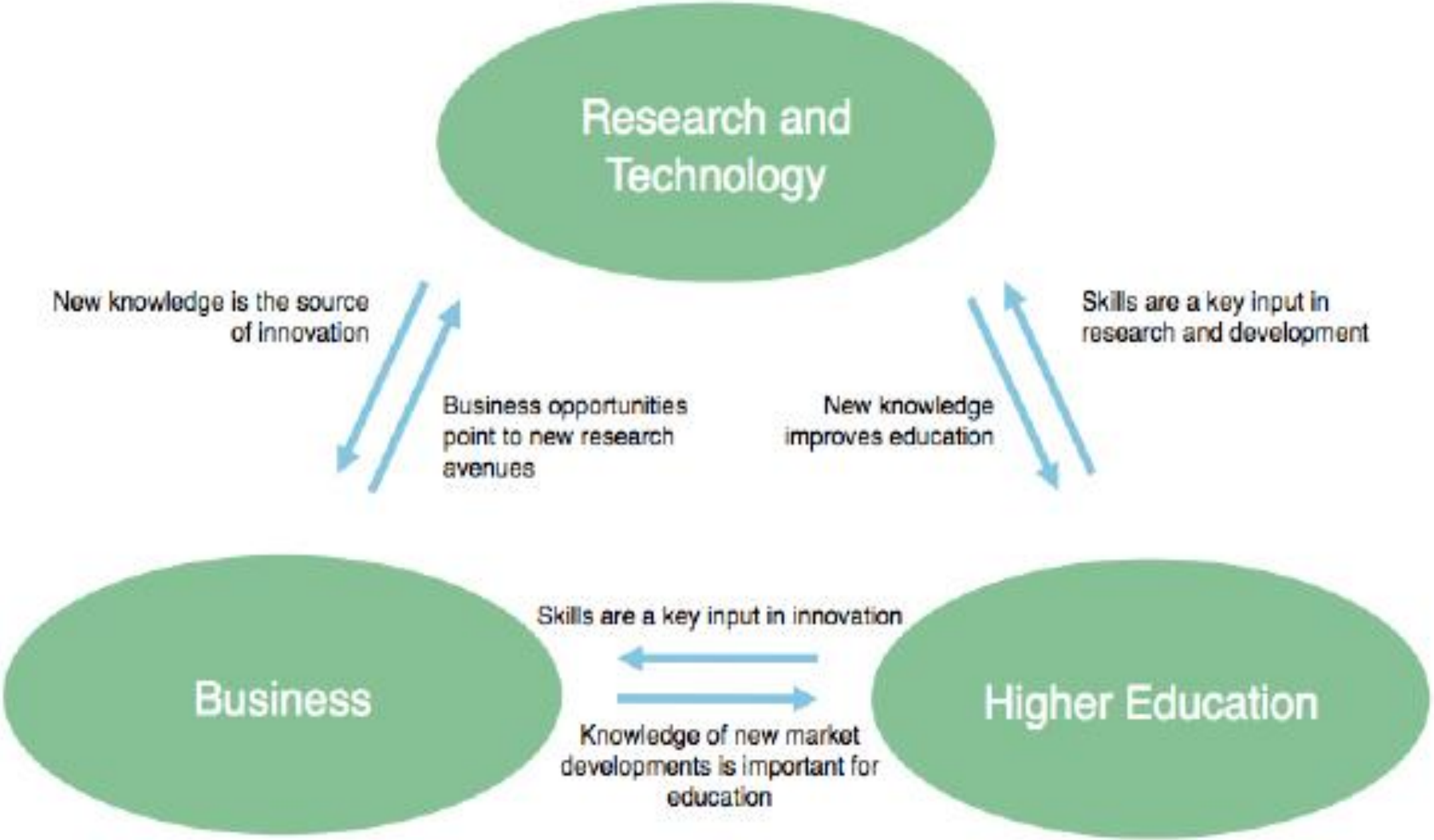
- Knowledge on the behavior of a complex system is rather subjective and in order to construct a more accurate model of the complex system it is proposed to utilize, the experience of a group of experts.
- **Experts** are polled together and they examine the relevant factors that stand as nodes of an FCM.
- They decide the number of concepts, which consist the FCM and what characteristic of the system each concept represents.

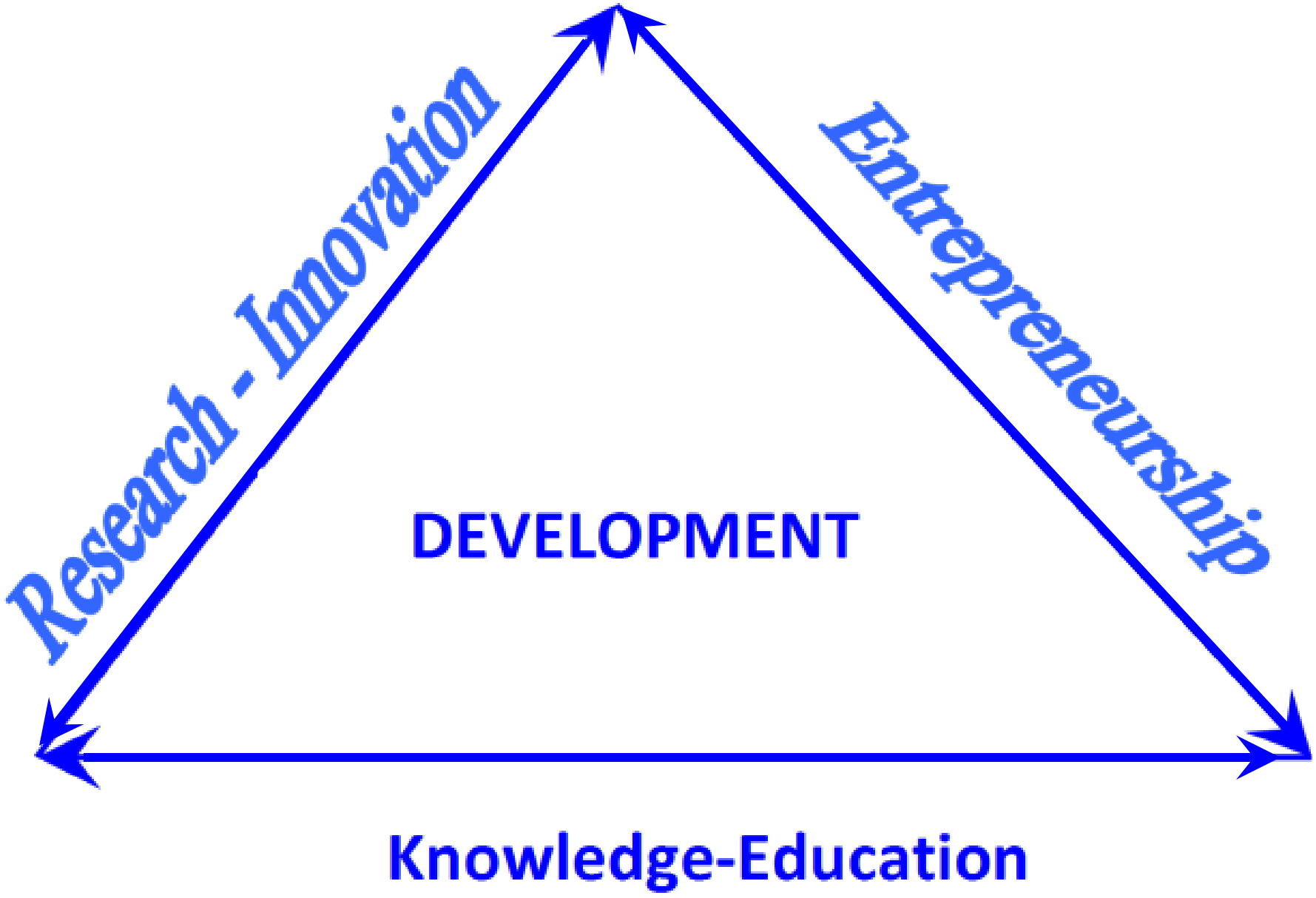
Fuzzy Cognitive Maps (6/6)

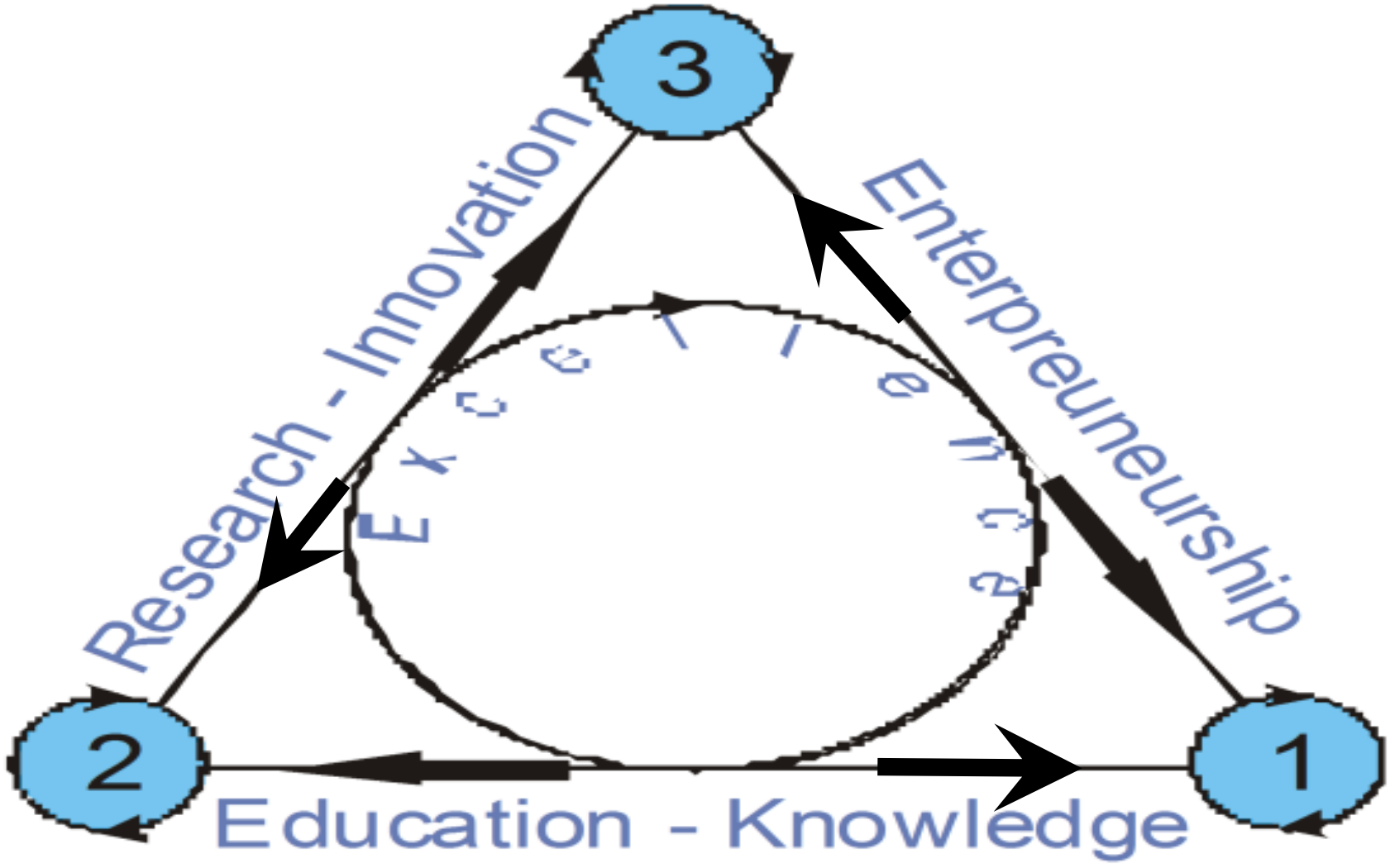
- Then, the experts are individually asked to express the causal relationship among these concepts.
- The result of this procedure will be a collection of individual FCMs
- The individual FCMs must be combined into one collective FCM and a method to combine the individual maps.

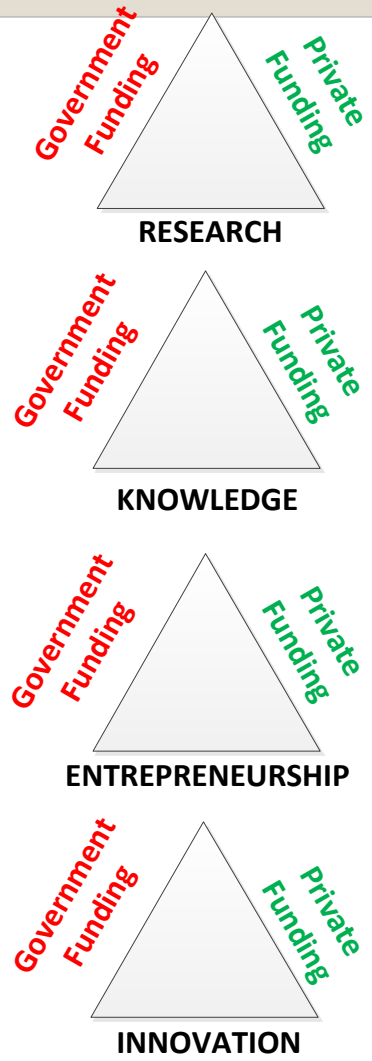
The knowledge Phenomena- “Phantasma”



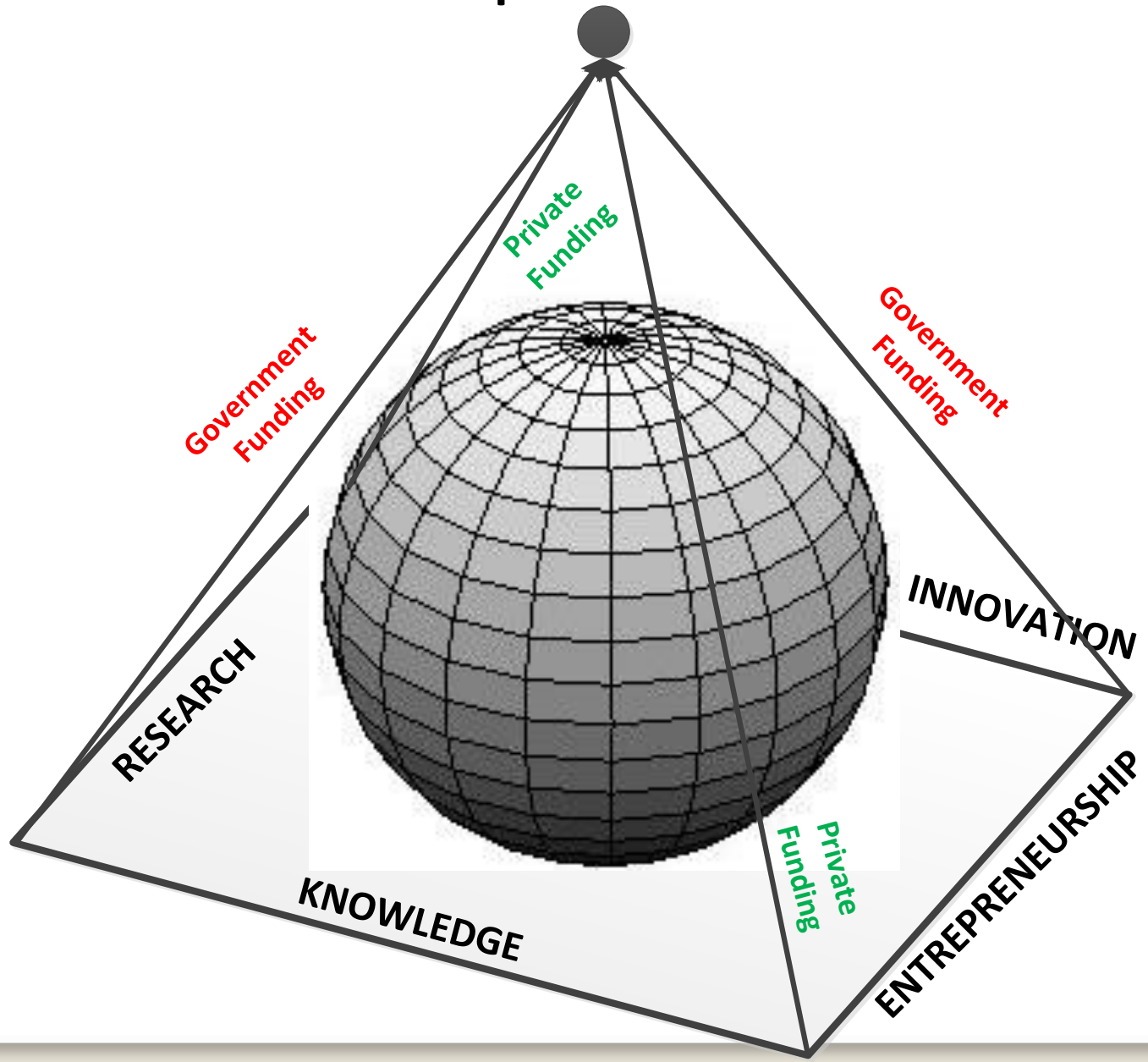

Research and Technology
New knowledge is the source of innovation
Business opportunities point to new research avenues
Skills are a key input in research and development
New knowledge improves education
Business
Higher Education
Skills are a key input in innovation
Knowledge of new market developments is important for education


Research - Innovation
Entrepreneurship
DEVELOPMENT
Knowledge-Education

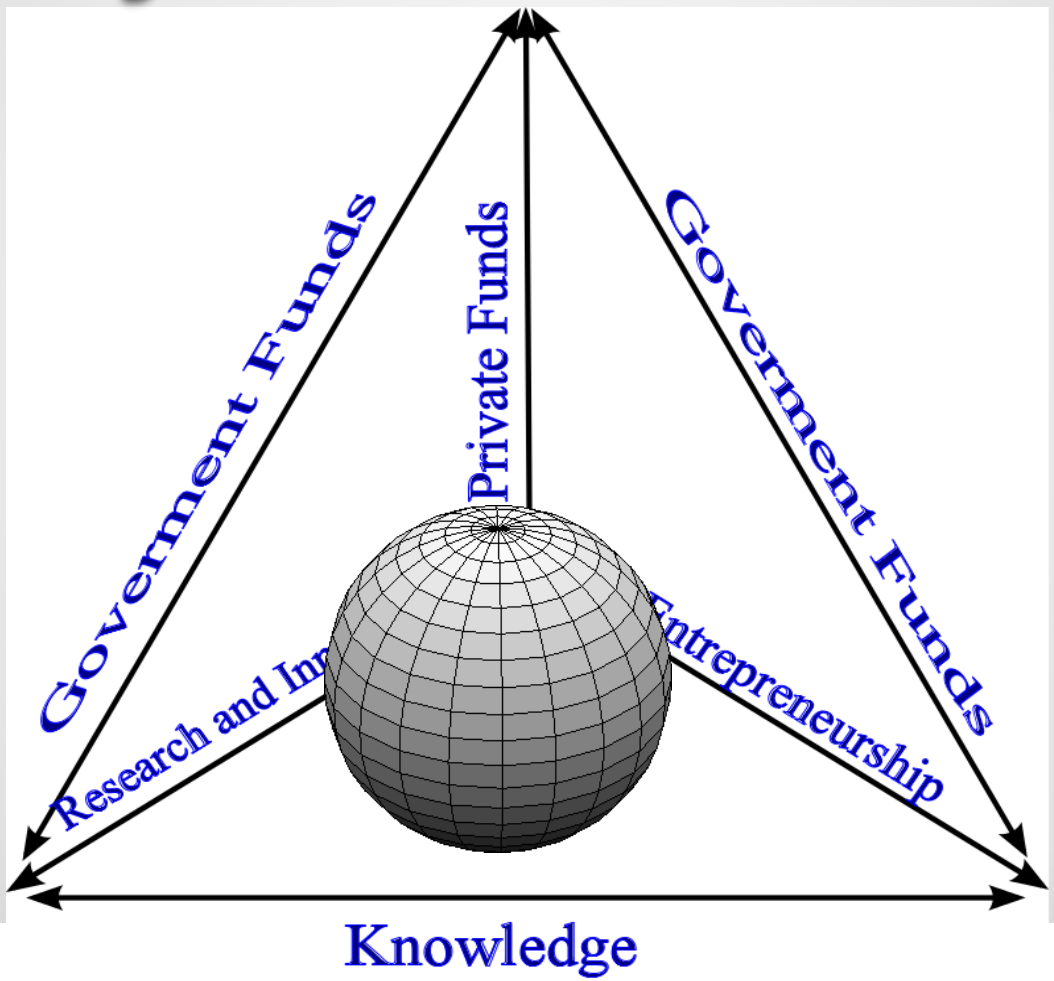

3
Research - Innovation
Entrepreneurship
Excellence
2
1
Education - Knowledge

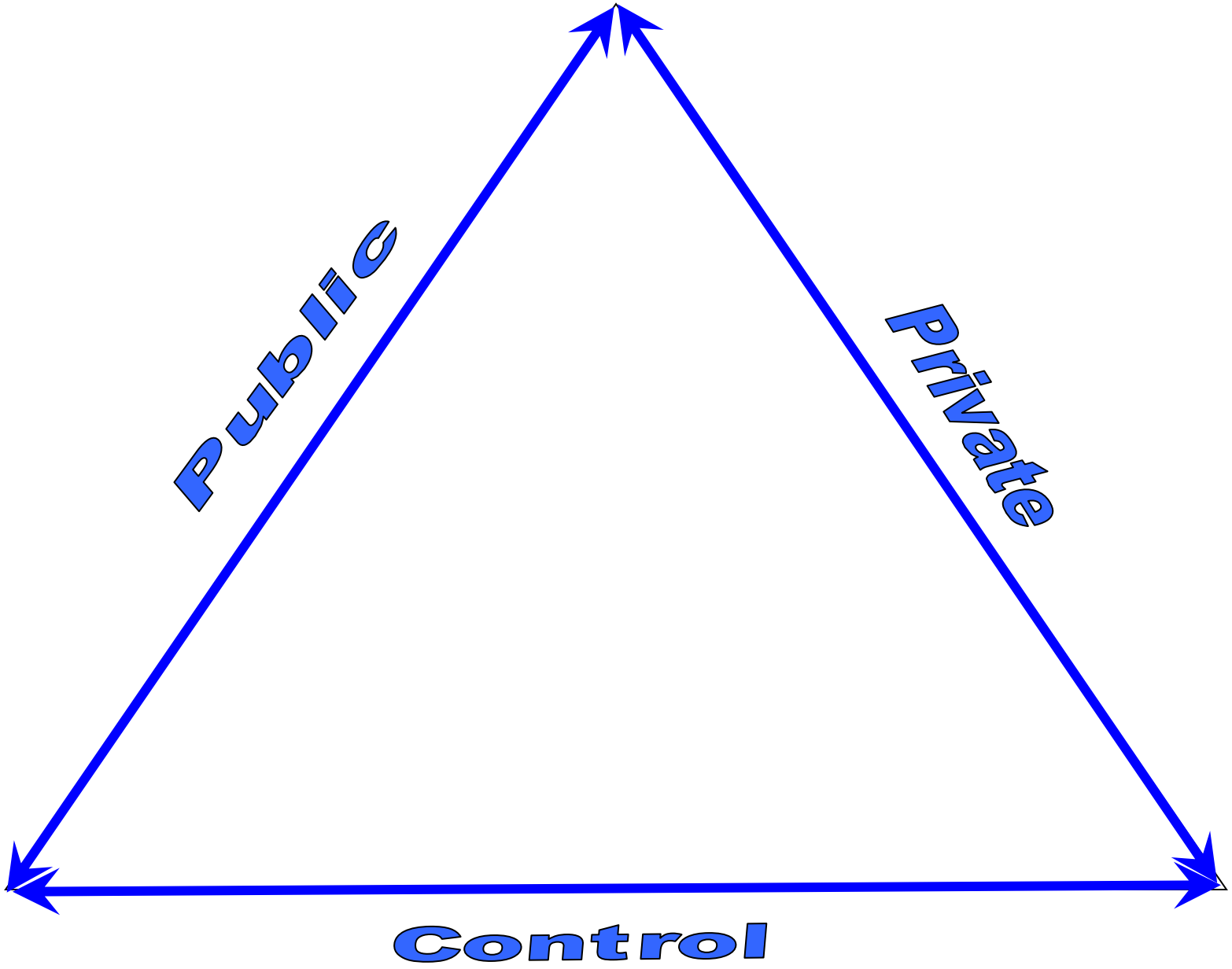


Development - Growth



The Pyramid of Knowledge




Public
Private
Control

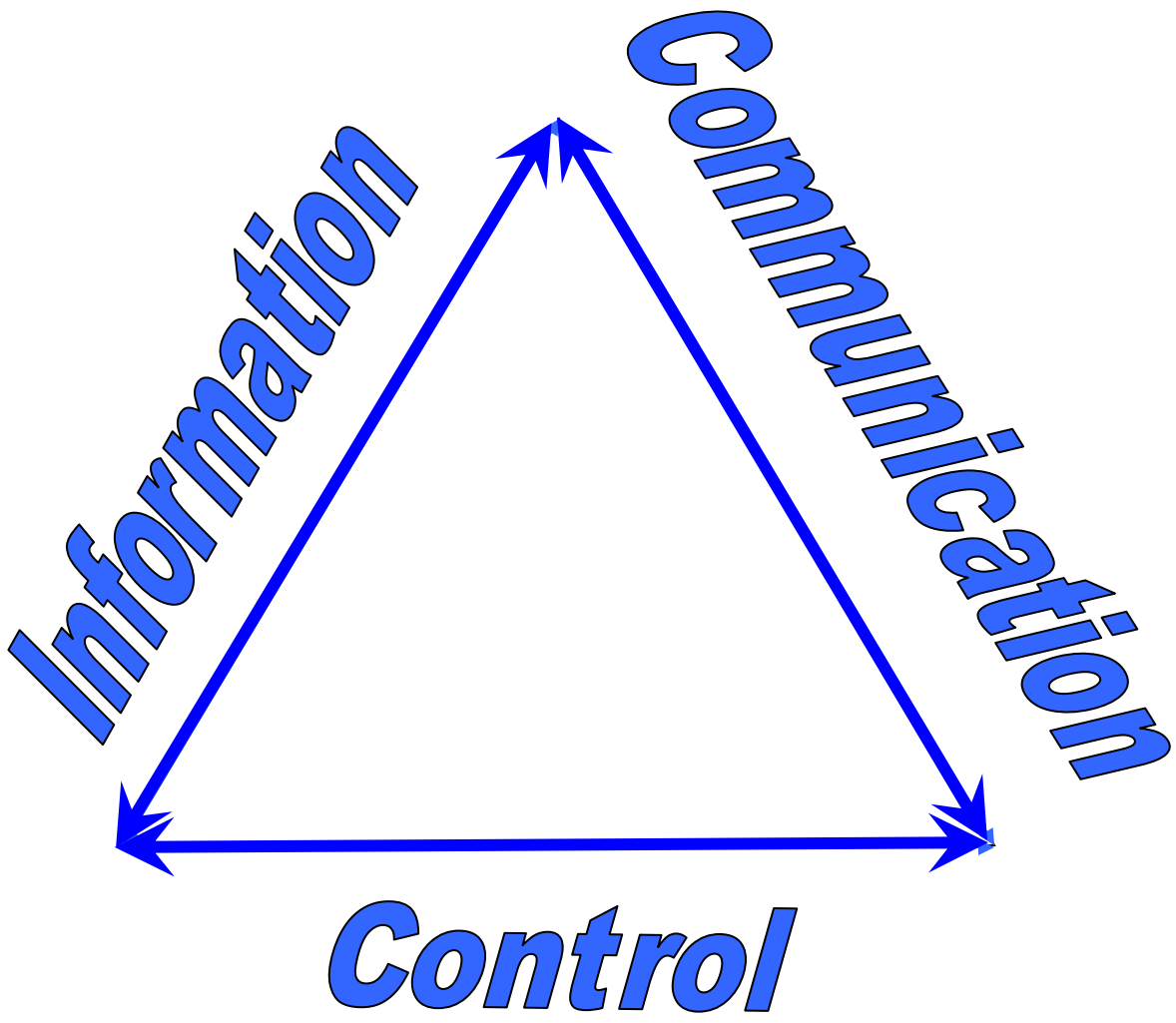
The Role Of Controls In The Triangle Of Knowledge

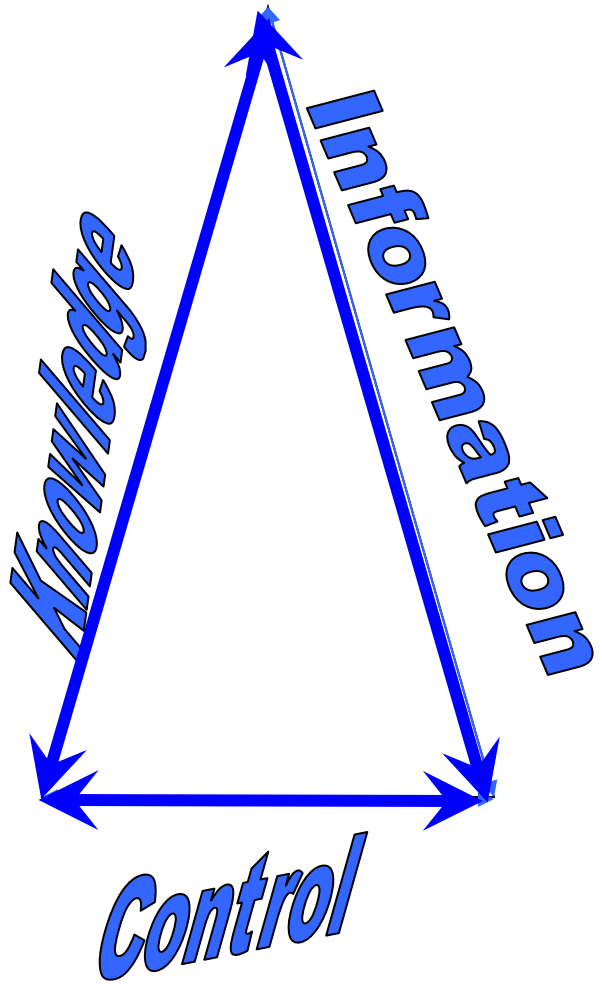
The triangle is one of the most powerful geometric schema-figure.

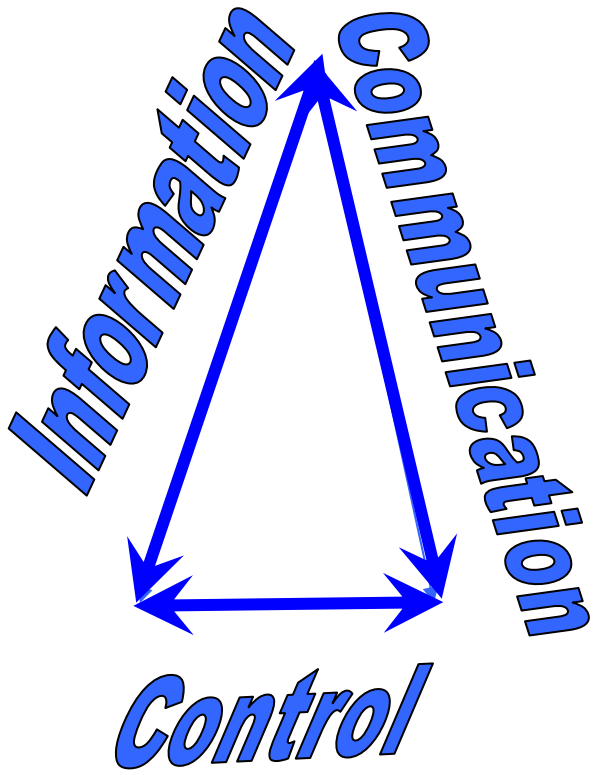
Let the three main characteristics or fundamental components shaping the Information Based Society (IBS). be 1) Information 2) Communication and 3) Control.

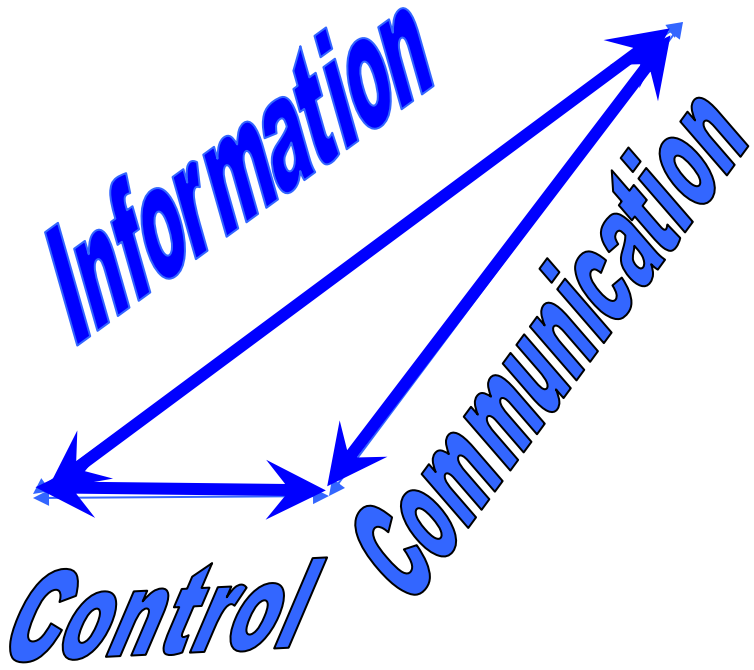
Let us now examine the fundamental relationships between these three characteristics-component under the power of the triangle. If the generated Information (that could also be considered as knowledge) will remain unused (idle) then is not at all useful.

However using the Control component as the basis for the IBS infrastructure and pushing Information=Knowledge through the third component of Communication, then an interactive dynamic triangular is formed


Information
Communication
Control


Knowledge
Information
Control


Information
Communication
Control


Information
Communication
Control

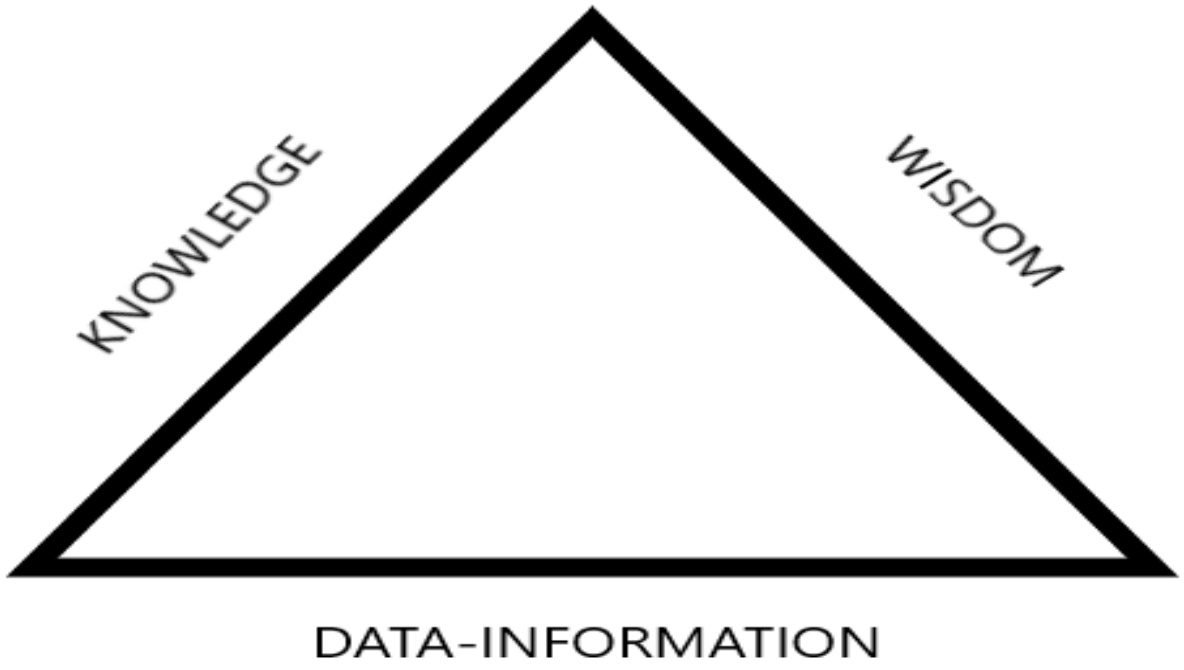
WHAT SHALL WE EXPECT IN THE FUTURE?!

- The crisis of our times is that we have science without wisdom. This is the crisis behind all the others. Population growth; the alarmingly lethal character of modern war and terrorism; vast differences in wealth and power around the globe; the AIDS epidemic; cultures and languages; the impending depletion of natural resources, and the rapid mass extinction of species;
- pollution of sea, earth and air; and above all, the impending disasters of climate change – all of these relatively recent crises have been made possible by modern science and technology.
- It is not that people became greedier or more wicked in the nineteenth and twentieth centuries; nor is the ‘new’ economic system of capitalism responsible, as some historians and economists would have us believe.
- The crucial factor is the immense success of modern science and technology. This has led to modern medicine and hygiene, to modern high-production agriculture and industry, to population growth, and to the destructive might of the technology of modern war and terrorism, conventional, chemical, biological, nuclear.

WHAT SHALL WE EXPECT IN THE FUTURE?!

- This is to be expected. Science produces knowledge, which facilitates the development of technology, enormously increasing our power to act. It is to be expected that this power will often be used beneficially, as it has been – to cure disease, feed people, and in general enhance the quality of human life. However, in the absence of wisdom, it is also to be expected that such an abrupt, massive increase in power will be used to cause harm, whether unintentionally, as in the case (initially at least) of environmental damage, or intentionally, as in war and terrorism.
- Before the advent of modern science, our lack of wisdom did not matter *too* much, since we lacked the means to do too much damage to ourselves and the planet. But now, in possession of the unprecedented powers bequeathed to us by science, our lack of wisdom has become a menace. The crucial question is: How can we learn to become wiser?

THE TRIANGLE OF WISDOM



THE TRIANGLE OF WISDOM