

Different Aspects of the Complex Technological Systems and Its Reviews

Vikash Soni
Research Scholar,
Jaipur National University
Rajasthan, India

Abstract: -Complex systems are those that have many components and can communicate with one another. It is useful in studying any system's physical, biological, ecological, and social components. There is a massive amount of data that complex systems analyze and study across all domains. This new science transcends traditional logical boundaries, opening up new and more limited avenues for researchers and hastening the progression of logical information. Complex frameworks science bridges the normal and sociologies, improving both and closing the gap between science, design, and strategy. Complex systems also help to bridge the gap between pure and applied science, which aids in the development of new innovative ideas for system design, management, and control. Integration of complex systems.

Keywords: - A primer on complex systems, Complex system characteristics, Important components of complex systems, Complex system development, Complex system applications, Complexity's disadvantages.

Introduction: -

All the domains in resent world consist of various types of systems. Broadly the systems are classified into two major parts: - Open system and Closed systems. Open systems are public systems which are easily accessible and one can understand the internal as well as external functioning of such systems by looking at it. On the other hand, closed systems are the systems where one cannot easily understand the internal functioning of the system from outside and can only observe the input given and the output result obtained. One such kind of closed system or we can say that enhanced form of closed system are complex systems. Complex systems are also used in almost across all the domains where there are many components present in the complex systems. One cannot study or understand the nature or working mechanism of the complex system as a whole but in order to understand it completely, one need to closely understand functioning of each part of the complex system. The nature and behaviour of each component of the complex system will explain the behaviour of the complex system. Each complex system will have unique properties like emergence, feedback loops, adaptive, nonlinearity, spontaneous order etc. The study of complex systems will explain that how its parts interact with each other and how do they behave in certain environments. As an interdisciplinary area, complex frameworks draws commitments from a wide range of fields, like the investigation of self-association and basic peculiarities from physical science, that of unconstrained request from the sociologies, disarray from math, transformation from science, and numerous others. Complex frameworks is thusly frequently utilized as a wide term enveloping an exploration way to deal with issues in numerous different disciplines, including factual physical science, data hypothesis, nonlinear elements, human studies, software engineering, meteorology, social science, financial matters, brain research, and science.

Key concepts used in Complex Systems: - [1]

Following are few key concepts which are used in any complex system: -

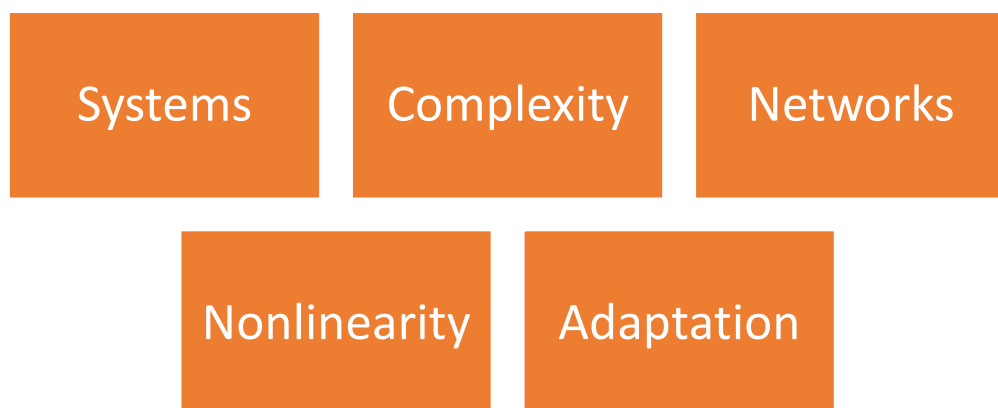


Figure 1 Key principal elements of Complex Systems.

1. Systems: -
 - Complex systems are always related to the characteristics and behaviour of the system. A system is defined as set of entities which will explain the interrelation between its elements and interact with each other.
 - Any system will have a certain boundary which will explain that which entities belong to this system and which does not belong to this system.
 - The properties of the systems can be different from its components and it will explain how a system behaves in a particular environment. Complex system is defined as subset of system theory which focuses on the study of the behaviour of its parts.
2. Complexity: -
 - The complexity of the system depends upon the type of components present, the number of its parts, its behaviour under different circumstances etc.
 - If the system behaves differently in different environment, then it will be difficult to understand its operation and hence complexity of such system will be complex as compared to other systems.
3. Networks: -
 - The various components present in the system will represent a network where each component will act like a node of the network and interact with each other.
 - Other role of network is that it helps to define the source of complexity in the complex system. One such application is used in graph theory and network science.
 - The way that the quantity of edges in a total chart develops quadratically in the quantity of vertices reveals extra insight into the wellspring of intricacy in huge organizations: as an organization develops, the quantity of connections between substances rapidly predominates the quantity of elements in the organization.
4. Nonlinearity: -
 - The nature of complex system is nonlinear which means that the same complex system can behave differently in different circumstances even though same input is given to them.
 - Complex frameworks are nonlinear dynamical frameworks, which are frameworks of differential conditions that have at least one nonlinear terms. A few nonlinear dynamical frameworks, like the Lorenz framework, can deliver a numerical peculiarity known as mayhem. Tumult, as it applies to complex frameworks, alludes to the delicate reliance on starting circumstances, or "butterfly impact", that a perplexing framework can show. In such a framework, little changes to starting circumstances can prompt decisively various results. Turbulent way of behaving can, hence, be incredibly difficult to display mathematically, on the grounds that little adjusting blunders at a middle phase of calculation can make the model create totally erroneous result. Moreover, in the event that a mind boggling framework gets back to a state like one it held beforehand, it might act totally diversely because of similar boosts, so disarray additionally presents difficulties for extrapolating as a matter of fact.
5. Adaptation: -
 - These are special types of complex system which are adaptive in nature which means that they have the tendency to make changes and adapt under specific conditions. For example stock market, ecosystem etc.

Characteristics of Complex systems: - [2]

Following are the features of the complex systems: -

1. Non- linear relationships: -

Linear relations are the ones where the effect is directly proportional to the cause. Whereas in non linear relationship a small change can cause large effect.
2. Feedback loops: -

Two types of feedback loops are identified in complex systems: -

 - a. Negative feedback due to damping
 - b. Positive feedback due to amplifying
3. Dynamic Network: -

It is important in complex system which have many local interactions and small area of interactions. In the human cortex for instance, we see thick nearby network and a couple of extremely lengthy axon projections between districts inside the cortex and to other cerebrum locales.

4. Nesting: -

In some scenarios, it is observed that the components of complex system have complexity in themselves. The game plan of connections inside complex bipartite organizations might be settled too. All the more explicitly, bipartite environmental and hierarchical organizations of commonly valuable connections were found to have a settled structure. This construction advances backhanded help and a framework's ability to persevere under progressively unforgiving conditions as well as the potential for huge scope fundamental system shifts.

5. Open systems: -

The complex systems can also be open systems who also exchange information and interact with each other in environments.

6. Memory: -

Complex system also has memory which is not located at a proper position but distributed across the systems. It is stored as history and it is the behaviour of the system.

How to build a Complex system: - [3]

The complexity of the complex system grows nonlinearly in size. In this case, the type of the system does not matter but since the size of the network will keep on growing, the complexity of the software will also increase. Following two factors should be kept in mind: -

1. Lower friction: -

This helps to make the changes happen faster. The ways to do so are to dump the centralised database, to adopt microservices, to use containers, etc.

2. Limit risk: -

The methods to achieve so is to Provide continuous delivery, PACT testing etc.

Application use of Complex system: - [4]

Following are few application uses of complex systems: -

1. Complexity management: -

As ventures and acquisitions become progressively complicated, organizations and states are tested to track down viable ways of overseeing super acquisitions like the Army Future Combat Systems. Acquisitions, for example, the FCS depend on a snare of interrelated parts which communicate capriciously. As acquisitions become more organization driven and complex, organizations will be compelled to track down ways of overseeing intricacy while state run administrations will be tested to give successful administration to guarantee adaptability and flexibility.

2. Complexity and education: -

In order to find solutions for the issues faced by the students, complex systems have been used to extend the methodological applications for physics education.

3. Complexity and biology: -

The features of complex systems have also been used in biology systems and also applied to living organisms. The goal of complex systems in biology field is to evaluate the health and identify disorders and illness and then provide best treatment.

4. Complexity and modelling: -

Scientist have considered using complex systems to perform modelling of the systems which can be used to study the structured or unstructured patterns whose results can then be used to perform decision making easily.

5. Complexity and network science: -

A complex system is made up of many components whose interaction will determine the behaviour of the system. It acts like a network where the components acts like nodes and the interaction between them is represented by the links.

Challenges of Complex systems: -

Following are the challenges of Complex system: -

1. Prediction: -
As the name suggests, in complex systems it is very difficult to understand the functioning of the system as many components are present in the complex system. Hence, this makes it difficult to perform future predictions of complex systems.
2. Risk analysis: -
The behaviour of the complex system depends upon the properties of the components of the systems which makes it challenging for the analysts to evaluate the risk factors involved with the system.
3. Security issues: - Since already it is difficult to understand the behaviour of the complex system in various environments, it is challenging to maintain the security of the system.

Conclusion: -

Complex frameworks are the frameworks which has a huge number and can speak with one another. It is useful in concentrating on the physical, organic, biological and social parts of any framework. Across every one of the spaces, there is colossal volume of information which is investigated and concentrated on by the perplexing frameworks. This new science cuts across standard intelligent cut off points, making new and more restricted ways among specialists and accelerating the movement of legitimate data. Complex structures science traverses the ordinary and social sciences, improving both, and reduces the opening between science, planning, and methodology. Complex frameworks additionally help to decrease the hole between the unadulterated and applied science which assists with giving new imaginative plans to plan, the executives and to control the frameworks. Complex frameworks is reconciliation of a huge number and the way of behaving of the complicated framework can't be seen effectively by the actual framework rather one need to concentrate on every part exclusively to figure out the functioning component of the entire framework.

References: -

- 1.<https://cssociety.org/about-us/what-are-cs>
- 2.<https://www.morebeyond.co.za/7-characteristics-of-complex-systems/#:~:text=>
- 3.<https://www.cloudbees.com/blog/how-can-we-build-better-complex-systems-containers-microservices-and-continuous-delivery>
- 4.https://en.wikipedia.org/wiki/Complex_system#:~:text=