

# Limit of Complexity

Hemant Purohit

**Key Words:** Stability, Instability, Complexity, Infinity, Equilibrium, Limit, Apparatus, New Complexities

***Abstract:** Complexity is interpreted in many ways, from mathematical equations to analogous explanations. Most systems understood as complex are primarily on the basis of parameters considered and explorations made. Essentially, the idea of complexity may be one which is 'need-based'. The paper puts emphasis on the capability of the observer to categorise a system as complex or simple. Moreover the idea of equilibrium is also conceived by the observer. Since uncertainty is uncomfortable, all unpredictable or uncertain processes are termed chaotic. All systems, left in isolation would attain absolute equilibrium or chaos. In fact, the usage of word 'attain' is questionable. It can instead be understood that every system **'produces'** its very own unique equilibrium or chaos. Most systems come under direct or indirect influence of external factors constantly and hence get deviated from this natural tendency regularly. Cities can be understood as complex systems but city design is relatively static as compared to most dynamic processes which operate in the city. The built city must be considered an apparatus only for these processes and the planning strategy can at best give a direction to civic processes but not govern them. The ideas of self organisation and fractals are 'observed' phenomenon and the result of 'old' complexities. The initiation of new complexities is an interesting idea for design of new cities.*

---

## Constants of Complex System

The two exercises carried out as part of the Complex Systems seminar (Iaac, 2007-2008, Barcelona) have helped more in expanding the perspective to view complex systems than in narrowing down on their general explanation. The advantage, of course has been to indulge in arguments at 2 completely different scales. The first project, Bridge design on the River Tordera, explores structural design options for a certain scale of material, dimension and weight: sticky tape, soft-drink straws & corrugated paper sheet as material, 100 cms as dimensional span and 600 gms. weight. These 3 criteria create the framework which limits our proposals. Their relational parameters would form the true essence of the challenge for us to be deciphered. The second planning exercise, Masterplan Strategies for Mataro with reference to the Barcelona-Mataro coastal stretch, requires solutions for barrier-like situation created by railway line running along the beach in Mataro which can be 'generally' applied to this region. A 'solution' based alternative equilibrium is explored based on the experience of a train ride to the victim town. In both assignments, stability is projected in various forms. Stability is defined in terms of material strength, site conditions and psychological needs or economic prosperity. In both cases the problems are taken as given – the option of crossing the river by foot and crossing the railway line to access beach are understood as problematic right from beginning. In other words, new proposals are born from processes which already freeze, in part, some of the variables of the complex system. Although, identification of the 'problem' is a primary step, this intuitiveness (the idea of considering 'given that constants') which influences our understanding of solution may seem to be a handicap in truly appreciating the complexity of a situation.

### Absence of equations of instability

The role of science has been as much important in solving problems as in explaining these problem, the problem as identified by our need. The changing theories of science from time to time can be understood precisely as a result of the changing needs of man. Hence, complexity has been attached and detached from various situations. For example, the invention of zero and the invention of infinity may not have occurred simultaneously although their co-existence may seem obvious as opposites. Their birth can be understood as a result of the void they created in mathematics while explorations were being made in related topics. Dealing with infinity would have been regular while solving taxing equations of universe. The birth if 'infinity' resolved the problem of inventing ever new and larger numbers. Zero was invented long before. Today equations with infinity as a parameter are not uncommon. Yet the problems of universe remain unsolved as the idea of infinity made the problem of universe more complex. One of the major equations still missing from mathematics and physics is that of the 'big bang'. Although physicists have been able to explain the situation mathematically upto a millionth of a second after the big bang, the equation 'of' big bang remains elusive. The limitation of not having an equation for the big bang can be understood as an aspect of human behaviour. Since determinism governed most parts of classical human science and mathematics, there was hardly ever the room for uncertainty, especially within the tool that was primarily given birth to account for it. The absence of equations for instability and the debate on the meaning of instability form a larger part of the reason for the limited understanding of complexity.

Probability is one of the few methods which form a bridge between that which is completely determinate and which is completely uncertain. Hence, it's acceptance in various branches of study was questioned. As explained by W. Brian Arthur, the very essence of economy was being challenged by his theory on 'increasing returns' and probability as a tool to explain that took some time before being given due regard.

### The Limit of Complexity and Production of Equilibriums

The limit of complexity lies in the limitations of observer and his habit to measure complex systems on a scale of stability or instability. Consider the situation that a number of processes actually occur and operate in the present scenario, many lasting for infinitesimal time. Let's also assume that such processes collapse primarily because of the lack of 'sufficient sustenance' or stability as understood conventionally. Hence, the remaining processes which come under our observations and category of complex systems are essentially stable enough. While many other complex systems collapsed, their existence cannot be ignored solely on the basis of an insignificant time. Instead, it is the nature of a system to remain complex primarily for the sake of its existence. The idea is reinforced in the text of Richard Dawkins in *The Selfish Gene*. Gene, in its attempt to adapt and survive encourages the creation of higher life form and mutates in clusters and complex life forms. This ability of a system to exist in multiple ways of its own self or to mutate can be understood as a rigorous process with outcomes. These products are essentially demonstrations of possible equilibriums. Hence multiple equilibriums are not attained but 'produced'. A complex system must be seen as an active state which generates equilibrium. The termination of a system is the end of complexity. Both equilibrium and chaos are possible outcomes of the process of complexity. Complexity is an ongoing process.

## Analogy, Complexity and City

Apart from equations, analogy has been used as another way to tackle the problem of complexity. While classical mathematical equations constantly try to simplify a problem by making assumptions and omitting rare circumstances, to parameters which can be solved, analogous processes attempt to change the *format* of the problem to a state which can be identified with or imagined. Simulations are the best form of analogous processes today. But the method of analogy is not new. Modernism's fetish of equating the city with human body was a way to simplify the problem faced by contemporary architecture then, of designing cities for a post industrial world. Later, Aldo Rossi selected a closely related idea, that of a human skeleton, to be analogous to a city. He managed to induce complexity in this process by including key factors like time and psychological factors like memory. This idea developed into an architectural tool of the 'built type' which continues to influence architectural debates till date. Computer simulations seem much more elaborate and accurate because they can generate multiple connections between 2 conditions – the diagram of visualisation of the simulator and the reality of a situation. But, with its basis in maths, which essentially is a science of cause and not chance, there are limitations of using simulations as design tools.

Cities today form the largest human agglomerations with many operative levels. To conceive them as complex systems is natural. But city design based on this understanding of complexity (as discussed above) may become too ambitious. City design forms just one (and mostly static) part of the city complex system. The many processes that operate on cities – global economy, migration and security to name a few, are the ones that generate dynamic complexity. It is true that these parameters use the city as their host, the built city mass must be considered only as an apparatus to direct these activities. As any other complex system, this system also results in or produces multiple equilibriums. City designs at best can be 'remedial' or 'directional' (for already built cities) and 'accommodating' spaces for cities from scratch. Even better, city architecture can initiate a complexity rather than attempt a 'conventional' stability. For Pier Vittorio Aureli, it is not important today to argue the form of architecture with respect to Zaha Hadid or Frank Gehry or Renaissance style, but it is more crucial to assess the domain of architecture and its new role. Since the limitation of understanding the complexity of a city lies essentially in observation of the 'existing' cities, (and considering their form and problems as 'given standard') the more important task is to re-invent cities or envision contemporary role of cities. Cities can be treated as a product of complexity and (if) vice versa.

The ideas of self organisation and fractals are 'observed' phenomenon seen in communities which have grown organically since past. To debate the validity of these 'automatic phenomenon' can reveal new forms of cities and introduce new complexities. If we need to invent new complexities, we may wish to differentiate between what we observe in existing cities and what we wish to propose in new ones.

---

Aldo Rossi – Architecture of the City

Ilya Prigogine – End of Certainty

W. Brian Arthur – Increasing Returns and Path Dependence in Economy

