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When Newton meets Heinz Von Foerster, complexity vanishes and simplicity reveals

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Abstract

Purpose – Complexity is the real beast that baffles everybody. Though there are increasing inter-disciplinary discussions on it, yet it is scantly explored. The purpose of this paper is to bring a new and unique dimension to the discourse assimilating the important ideas of two towering scientists of their time, Newton and Heinz von Foerster. In the tradition of Foersterian second-order cybernetics the paper attempts to build a bridge from a cause-effect thinking to a thinking oriented towards "understanding understanding" and in the process presents a model of "Cybernetics of Simplification" indicating a path to simplicity from complexity.

Design/methodology/approach – The design of research in the paper is exploratory and the paper takes a multidisciplinary approach. The model presented in the paper builds on analytics and systemics at the same time.

Findings – Simplicity can be seen in complex systems or situations if one can construct the reality (be that the current one that is being experienced or perceived or the future one that is being desired or envisaged) through the Cybernetics of Simplification model, establishing the effect-cause-and-effect and simultaneously following the frame of iterate and infer as a circular feedback loop; in the tradition of cybernetics of cybernetics.

Research limitations/implications – It is yet to be applied.

Practical implications – The model in the paper seems to have far reaching implications for complex problem solving and enhancing understanding of complex situations and systems.

Social implications – The paper has potential to provoke new ideas and new thinking among scholars of complexity.

Originality/value – The paper presents an original idea in terms of Cybernetics of Simplification building on the cybernetics of the self-observing system. The value lies in the unique perspective that it brings to the cybernetics discussions on complexity and simplification.

Keywords Causality, Complexity, Second-order cybernetics, Cybernetics of Simplification, Self-observing system, Simplification

Paper type Conceptual paper

1. Introduction

Twenty-first century may be called a "conceptual age" (Pink, 2005), but it is the "age of complexity" where we willy-nilly encounter complex systems of different descriptions and varieties. No doubt, we are called upon, many a time with a self-exhortation, to deal with complex situations that concern complex problems solving as well. Herbert Simon (1995) observes that "complexity is more and more acknowledged to be a key characteristic of the world we live in and of the systems that cohabit our world. It is not new for science to attempt to understand complex systems: astronomers have been at it

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for millennia, and biologists, economists, psychologists, and others joined them some generations ago. What is new about the present activity is not the study of particular complex systems but the study of the phenomenon of complexity in its own right". Science has explored the microcosmos and the macrocosmos. The great unexplored frontier is complexity (Pagels, 1988).

In this paper, the discourse is taken to a new dimension. We argue that when we consider Newton's causal and deterministic world and observer in that world as someone in the system (of the system); observing and being observed, it could be seen, in a sense that "simplicity reveals and complexity vanishes". In any entity, artificial or natural, there is a natural simplicity ingrained. May be it is hidden. But, through interest and efforts, sometimes even automatically, the inherent simplicity gets revealed. This is enabled and achieved "when Newton meets von Foerster" in the sense that it is possible embracing and assimilating the important ideas of two towering scientists of their time, i.e. establishing the effect-cause-and-effect (ECE) in the systemic situation under study and simultaneously following the frame of iterate and infer as a circular feedback loop; in the tradition of Foersterian second-order cybernetics (including the role of eigenbehaviours in the explanation of cognitive phenomena and complex behavior; and the pervasive role of self-reference that we see in many domains).

2. Complexity is the real beast that baffles everybody

What is this thing called "complexity"? Where does it lie? Is it in the "observed" or in the observer? Defining or describing complexity has so far been like the often-cited story of the description of an elephant by a group of blind people. Etymologically, complexity is derived from the Latin word *complexus*, which means "entwined" or "twisted together". In the Oxford dictionary, something is "complex" if it is "made of (usually several) closely connected parts". And things get even more complex, if these parts or entities are themselves systems. Although the common use of the term "complexity" refers to issues that are difficult, or almost impossible to resolve, its technical meaning as defined by researchers from various disciplines has been extended over time, adopting different perspectives (Simon, 1995; Waldrop, 1992; Arthur, 1999; Edmonds, 1996; Glanville, 2007a, b; Lissack, 2005; Beinhocker, 2006; Mitchell, 2009; von Foerster, 2013). Seth Lloyd (2001) listed some three dozen different ways in which complexity term is used in scientific discourse. In fact, there have been many discussions, in the different traditions of scientific discourse on the word complexity. But, nothing concrete and universally accepted is available on this. Mitchell (2009) details several measures of complexity and their relative usefulness; however, none seems to have been universally accepted by scientists.

Ackoff (2010) says that "complexity is not a property of problems but of those looking at problems". Thus, some people connect the definition of complexity to the subjectivity of the observer. Complexity is an inherently subjective concept; what is complex depends upon how you look at it (Casti, 1995). It resides more in the eye of the beholder than in the observed thing (von Foerster). According to Fioretti (1999), complexity is subjective and that there is a distinction between the notion of a complex system, a complicated system and a simple system. Complexity is often thought as a property of the system under observation, much in the same way as its mass or its volume. An alternative approach could be to view complexity as a property of the relationship between a system and its observer: one who is observing a system would say that "this system is complex" when not satisfied with the mental model one has of it. One can thus deduce that higher the number of descriptions, higher is the complexity. For instance, I think, in case of a clock or a pen, the number of description is few, and hence complexity is less. But it is different for, say a painting or a poem (Agrawalla, 2011).

Rather than trying to define what complexity[1] is, perhaps it would be more useful to identify the properties that are commonly associated with the term. For instance, the defining characteristics of complex problems are a large number of variables and relationships (complexity), that interact in a nonlinear fashion (connectivity), changing over time (dynamic and time-dependent) and to achieve multiple goals (teleology and polytely) (Funke, 1991). There is considerable evidence that, from the viewpoint of cognitive capacity, we are poorly equipped to deal with complex problems (Forrester, 1971; Sterman, 2000). In fact, we see distinction between detail and dynamic complexity (Senge, 1990), "descriptive complexity" and "perceived complexity" (Schlindwein and Ison, 2004), and "people complexity" and "systems complexity[2]" (Funke, 1991; Clarke, 2001). It is suggested that complex problems can be understood by contrasting them with simple problems, which can be solved by simple reasoning and pure logic. It may not be that difficult to manage large amounts of detail (detail complexity). However, it gets difficult when it comes to problems where we might encounter the additional aspect of "dynamic complexity" that is characterised by time dependence, tightly coupled elements, feedback, non-linearity, history dependence, adaptability, counter-intuitive system response, policy resistance and trade-offs between short run and long-run remediation (Sterman, 2000).

Simplicity favoured

Looking at the history of science and philosophy, one can see that simplicity is taken as a virtue in scientific theories. Simpler theories are argued to be preferred to more complex ones, *ceteris paribus*. Understood as "Ockham's Razor", simplicity is often understood ontologically, in terms of how simple a theory represents nature as being (see Simon, 2013). It is argued that human beings have a fundamental cognitive bias towards simple hypotheses. Whether we are deciding between rival scientific theories, or performing more basic generalizations from our experience, we ubiquitously tend to infer the simplest hypothesis consistent with our observations. In recent years, the supposed role of simplicity in our inferential psychology has been attracting increasing attention from cognitive scientists (Lombrozo, 2007). Simplicity considerations have also been seen as central to learning processes in many different cognitive domains, including language acquisition and category learning (Chater, 1999).

In his *Posterior Analytics*, Aristotle argued that nothing in nature was done in vain and nothing was superfluous, so our theories of nature should be as simple as possible. Several centuries later, at the beginning of the modern scientific revolution, Galileo espoused a similar view, holding that, "[n]ature does not multiply things unnecessarily; that she makes use of the easiest and simplest means for producing her effects" (Galilei, 1962, p. 396). Similarly, at beginning of the third book of the *Principia*, Sir Isaac Newton included the following principle among his "rules for the study of natural philosophy": *No more causes of natural things should be admitted than are both true and sufficient to explain their phenomena.* In the twentieth century, Albert Einstein asserted that "our experience hitherto justifies us in believing that nature is the realisation of the simplest conceivable mathematical ideas" (Einstein, 1954, p. 274). More recently, Steven Weinberg has claimed that he and his fellow physicists "demand simplicity and rigidity in our principles before we are willing to take them seriously" (Weinberg, 1993, pp. 148-149), while the Nobel prize winning economist John Harsanyi has stated that "[o]ther things being equal, a simpler theory will be preferable to a less simple theory" (quoted in McAlleer, 2001, p. 296). Glanville (2007a, b) quotes Bruno Munari as quoted on the walls of the Design Museum in London "Progress means simplifying, not complicating".

3. Science and the scientific method

In the current scientific discourse, science is not limited to the search for truths or the search for the secrets of nature. Rather, science can be defined as the search for a minimum number of assumptions that will enable us to explain, by direct logical deduction, the maximum number of natural phenomena. These assumptions – like the gravitational law – can never be proven. Even when they can explain an infinite number of phenomena this does not make them true. It simply makes them valid. They can still be disproved. Science does not concern itself with truths but with validity. That is the reason why everything in science is open to constant checks and challenges (Goldratt, 1990, pp. 26-27).

Newton was a natural philosopher who made fundamental contributions to virtually all branches of science that were known at his time, in addition to studying alchemy, theology and history. He is identified with the ideas like reductionism, determinism, objectivity, linearity, causality and predictability. According to Newton, nature is exceedingly simple and comfortable or harmonious to herself. The Newtonian paradigm, as is well known, is the reductionist linear paradigm, the mainstay of most academic work in the natural and social sciences. In it, the observer is said to be neutral and objective. The observation of the same object by different observers, even at different time, yields same results. Such notion of value free observation seems okay when the object is a physical system. We call physical what can be described by relatively simple formulas (Hayek, 1964) and hence the nonphysical phenomena are more complex. Thus, the difficulty arises when the object is a social system, including business systems and economic systems; not to speak of the socio-cultural systems.

Goldratt (1990) argues that the three distinct stages that every science has gone through are classification, correlation and ECE. For example, Astronomy, one of the most ancient sciences had moved through these three stages. The classification stage dates back to prehistory, done by the Greeks, who classified 12 zodiac signs, did planetary classification, etc. The first known correlation on this subject was postulated by Ptolemy in Alexandria about 2,000 years ago and later Copernicus and Kepler contributed to this correlation stage and helped predicting eclipses. Till the emergence of Newton in the field, Astronomy was not considered a science. It is Sir Isaac Newton who moved the subject of Astronomy to the ECE stage, insisting on asking the question: why? Why do apples fall down rather than flying in all directions? And he assumed a cause for this phenomenon in terms of "the gravitational law". Citing Gregory Bateson's Metalogue: What is an Instinct? von Foerster (2003b) quips that "gravity is an explanatory principle". Because of the assumption of the gravitational law, many of Keplers correlations were explained for the first time.

According to von Foerster (2003c, p. 293), objectivity (in science) is tom-tomed as a "popular device for avoiding responsibility". To quote him: "As you may remember, objectivity requires that the properties of the observer be left out of any descriptions of his observations. With the essence of observing (namely, the processes of cognition) having been removed, the observer is reduced to a copying machine with the notion of responsibility successfully juggled away. Objectivity, Pontius Pilate, hierarchies, and other devices are all derivations of a choice between a pair of in principle undecidable questions which are, "Am I apart from the universe?" Meaning whenever I look, I am looking as if through a peephole upon an unfolding universe; or, "Am I part of the universe?" Meaning whenever I act, I am changing myself and the universe as well.

Besides considering objectivity, the hard sciences, following the process of reductionism, inevitably leads to success. However, von Foerster (2003a, p. 191) argued that "the hard sciences are successful because they deal with the soft problems; the soft sciences are struggling because they deal with the hard problems". In other words, the hard sciences get guided by the "divide and conquer" principle and thus they keep breaking up the things they cannot explain untill they can, and so they always succeed. According to von Foerster, "it is precisely Cybernetics that interfaces hard competence with the hard problems of the soft sciences" and "competence implies responsibilities". We should apply the competences gained in the hard sciences – and not the method of reduction – to the solution of the hard problems in the soft sciences. I am of the view that our responsibilities of our competence could also be in a sense; to be part of the system and apart from the system at the same time.

Capra observes that the patterns scientists observe in nature are intimately connected with the patterns of their minds; with their concepts, thoughts and values. Thus the scientific results they obtain and the technological applications they investigate will be conditioned by their frame of mind. According to von Foerster (2003d, pp. 203-204) the scientific method rests on two fundamental pillars: rules observed in the past shall apply to the future; almost everything in the universe shall be irrelevant. The second pillar is usually referred to as the principle of the necessary and sufficient cause. If P are the causes that are to explain the perceived effects Q, then the principle of necessary and sufficient cause forces us to reduce our perception of effects further and further until we have hit upon the necessary and sufficient cause that produces the desired effect: everything else in the universe shall be irrelevant. In fact, in our model, as described in "Cybernetics of Simplification"; the establishment of ECE employs this logic of necessity and sufficiency checks to establish causality. The model is also, depending on the nature of problems and situations, open to employ the ideas of Granger-causality and its other variants as used in econometric time series studies (Granger, 1969; Agrawalla and Tuteja, 2007).

4. Cybernetics of self-observing systems

In the history of cybernetics, one can notice a few significant cybernetic turning points and among them the most significant, revolutionary, conceptual and epistemological turn is the second-order cybernetics, thanks to the works of Heinz von Foerster (amongst others), which catapulted the idea of "observer" and "observing" to the centre-stage of cybernetics discourse and praxis.

Let me to quote von Foerster from his notes on an epistemology of living things:

> While in the first quarter of this century physicists and cosmologists were forced to revise the basic notions that govern the natural sciences, in the last quarter of this century biologists will force a revision of the basic notions that govern science itself. After that "first revolution" it was clear that the classical concept of an "ultimate science", that is an objective description of the world in which there are no subjects (a "subjectless universe"), contains contradictions. To remove these one had to account for an "observer" (that is at least for one subject): (i) Observations are not absolute but relative to an observer's point of view (i.e. his coordinate

> system: Einstein); (ii) Observations affect the observed so as to obliterate the observer's hope for prediction (i.e. his uncertainty is absolute: Heisenberg). After this, we are now in the possession of the truism that a description (of the universe) implies one who describes (observes it). *What we need now is the description of the "describer" or, in other words, we need a theory of the observer. Since it is only living organisms which would qualify as being observers*, it appears that this task falls to the biologist. But he himself is a living being, which means that in his theory he has not only to account for himself, but also for his writing this theory (von Foerster, 2003e, p. 247, emphasis mine).

In contradistinction to the classical problem of scientific inquiry that postulates first a description-invariant "objective world" (as if there were such a thing) and then attempts to write its description, now we are challenged to develop a description-invariant "subjective world", that is a world which includes the observer (von Foerster, 2003e, p. 248).

von Foerster's clear thinking debunked many commonly held but rarely investigated notions, including the notion that science tells us the truth and the notion of the objective observer, and hence, of objectivity (Glanville, 2002). In fact, there is no observation without an observer. To Maturana's aphoristic words "Everything said is said by an observer", von Foerster wittily added his own aphorism "Everything said is said to an observer" (von Foerster, 2003f, p. 283). Let me to independently observe that when everything said is said by an observer, and everything said is said to an observer then in such a scene or situation, both the sayer and listener could be the same self at the same time. In such a case, we may get, in a sense, the self-observing system.

Cybernetics of Simplification

While describing "systems theory", Ashby (1964) argued that the study of interacting parts goes back, of course, as far as Newton; and the solution of a set of simultaneous ordinary differential equations, studies, in some sense exhaustively, the interactions between n number of variables. In practice, such equations were manageable only when n was very small, with five as a practical maximum. It is a known concern that the amount of computation increases as the size of the problem increases and it increases at least as fast as the square of the number of equations. Thus, there is an upper limit to the size of the system of equations which can be solved. And in Newton's day, without computers at all, the practical limit of computations was well below 1,000 second-order differential equations, especially since Newton had just invented differential equations (Weinberg, 1991). I think, it will not be wrong to say that Newton is the father of simplification. It is well known, how through some simplifying assumptions, his works could explain a large body of natural phenomena, scientifically. As stated earlier, one of the important simplifications advanced by Newton was his law of universal gravitation, which stated that the force of attraction (F) between two (point) masses is given by the equation $F = \mathrm{G}m_1m_2/r^2$ where m_1 is the mass of the first body, m_2 is the mass of the second, r is the distance between them and G is a universal constant. From the viewpoint of simplification, this equation says more implicitly than explicitly, for it states that the force of attraction between two bodies is in no way dependent on the presence of a third body, so that only pairs of bodies need be considered in turn and then all of their effects may be added up. Unfortunately, it is only in mechanics and a few other sciences that superposition of pairwise interactions can be successful (Weinberg, 1991, p. 504). In other words, the relative motion of two bodies under the force of gravity could be calculated precisely; that of three bodies were already too difficult for an exact solution; and when it came to gases with millions of particles, the situation seemed hopeless (Capra, 1996, p. 120).

Science has, in fact, triumphed for 200 years largely because it exploited the many interesting systems in which interaction is small. Since 1940, however, a serious attempt has been made, aided by the new techniques, to grapple with the problems of the dynamic system that is both large and richly connected internally, so that the effects of interaction are no longer to be ignored, but are, in fact, often the focus of interest. The neurophysiologist no longer deals only with a bundle of unconnected reflexes. The economist wants to consider models which have something like the richness of interaction shown in the real world. The traffic engineer is no longer content to study the case of the crossroads to which cars come only at long intervals! So has arisen systems theory – the attempt to develop scientific principles to aid us in our struggles with dynamic systems with highly interacting parts (Ashby, 1964).

Thus, the reduction of complexity and the cause-and-effect sequence constitute the very foundation upon which natural science has been practiced ever since Descartes and Newton. In fact, by the end of the nineteenth century scientists had developed two different mathematical tools to model natural phenomena – exact, deterministic equations of motion for simple systems; and the equations of thermodynamics, based on statistical analysis of average quantities, for complex systems. And as we know, Newtonian mechanics and Maxwell's "statistical mechanics" both featured mostly linear equations. However, in the last couple of decades, it is decisively being recognised that nature is "relentlessly nonlinear" (Stewart, 1989, p. 83). So, nonlinearity cannot be ignored and as we know, most of the systems we encounter or experience as observers are nonlinear in nature and behaviour. And, since the last quarter of the twentieth century; the new mathematics of complexity, the mathematics of relationships, interconnectedness and patterns; widely known as dynamical systems theory is being employed for modelling nonlinearity and dealing with enormous complexity. The new sciences of chaos, complex adaptive systems, nonlinear dynamics, and quantum theory all provide revolutionary ways of thinking about causality in natural systems and these ideas are being applied to organizations and to their systemic management.

It is well known that the Mandelbrot set, a superfractal of inconceivable complexity, is generated by a few very simple rules. Unlike in the classical mathematics, in the new mathematics of complexity, simple equations may generate enormously complex strange attractors, and simple rules of iteration give rise to structures more complicated than we can even imagine. Mandelbrot sees this as a very exciting new development in science in which, "the effort was always to seek simple explanations for complicated realities" (Capra, 1996, p. 149).

Herbert Simon observes that "the goal of science is to make the wonderful and the complex, understandable and simple but not less wonderful". The path from complexity to simplicity is the same in the natural sciences as in aesthetics. However, it is important and instructive to keep in mind that in the process of finding a path from complexity to simplicity, it should be "simple enough" and not simpler or simplistic[3]. However, simplicity can be seen if one can construct the reality (be that the current one that is being experienced or perceived, or the future one that is being desired or envisaged) through the Cybernetics of Simplification (see Figure 1).

As per the epistemology of "constructivism", reality is not only to be found by subjects, but can also be constructed by them. Wallner (1994) talks about the

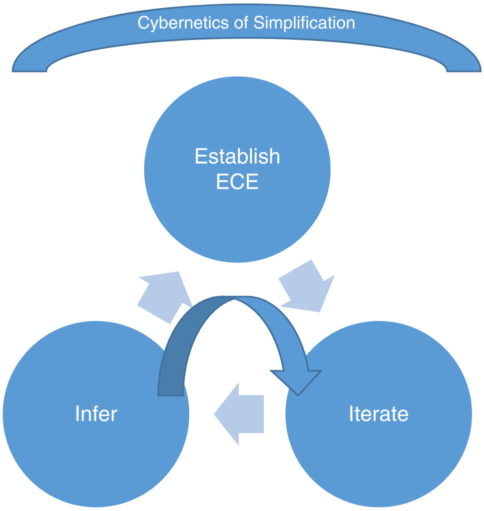

Figure 1.
Cybernetics of Simplification

constructed world as the cognitive reality (world we are capable of knowing). In the tradition of constructivism, which is the philosophical cornerstone of second-order cybernetics, we proceed with the creation of the following premise and axioms. That is, in the cybernetics of self-observing systems, we conjecture that there are one or more observers and one or more systems. Observer perceives complexity of a system. At the same time, its simplicity can also be perceived. Different observers perceive different complexity (levels, type, etc.). The "same" observer may perceive different complexity at different time. Perceiving complexity being part of the system need not be same as observing the system from outside. Simplicity or complexity is not there in itself, but its perception or observation depends on the observer's cognitive capability, interpretative capacity, knowledge and ability to understand it. It is recognized that in the process of coping with the complexity of the world, the word "system" is no longer applied to the world, it is instead applied to the process of our dealing with the world (Checkland, 1999).

Further, we take a view that any system is a "perceived whole". It is not a physical object in the real world. It is a subjectively defined concept for perceiving the world. And following Goldratt (1990, 2008) we take Newton's core belief in "inherent simplicity" as an axiom for the ideas in the work whose corollaries could be the ideas that "people see reality as very complex when actually it is surprisingly simple" and "problems start from our perception that reality is complex". And "simple" means fewer points (or fewer root causes or fewer degrees of freedom) that need to be touched in order to impact the whole system. It is well known what Archimedes said, "give me a lever long enough and a place to stand, and I will move the world".

For instance, to start with, while observing a system, what will be apparent or what will be perceived by the observer is not the "real" problem; rather only the visible effects of the real problem. When we say, establish the ECE, it entails linking or mapping out the interrelated ECE in the situation under study or of the system of interest; using or employing the principles of the necessary and sufficient causes. Thus, the reality can be constructed in which complexity vanishes and simplicity reveals and in the process it facilitates appropriate choices of responsible actions. And, in the model of Cybernetics of Simplification, we put forward the process of Establish ECE, Iterate, Infer, Iterate, etc. (see Figure 1). In the model, "Iterate" means more than doing again; rather we use it in the sense of a nonlinear process known as iteration, in which a function operates repeatedly on itself (like a baker stretches and folds a dough over and over again). And, for "Infer" in the model, various well-known and widely used analytical and inference-drawing methods can be employed.

While constructing reality and using Iterate and Infer and iterate, circular causality between multiple observers (may be with multiple roles by the single observer) can be visualized in the model. In a multiple-observer world, there could be observers in the system, observing and being observed and some self-observing as well. Further, there could be multiple or multiplicity of reality requiring (but not forcing) agreement on the minimum or on the essence. Thus, "iterate and infer" continues till the agreement is reached on the reality constructed through the establishment of ECE such that complexity vanishes and simplicity reveals. Even if there is no agreement and the process is required to halt; it may halt and "participant observers" can agree to disagree and suitably relook when needed; may be over time and with relationship till the finality is achieved owing to eventual agreement and "consensual coordination". Thus, in our model, no finality could be a finality.

Naturally, high-power and high-performance computing may come handy and catalyse the process of Cybernetics of Simplification. However, it is important to recognize Bremermann's limit and what Ashby (1964) epitomized with: "Everything material stops at 10^{100}". The number 10^{100} is based on a limit of our information-processing capabilities that was derived by Bremermann. Bremermann (1962) conjectured that "no data processing system whether artificial or living can process more than (2×10^{47}) bits per second per gram of its mass". Ashby (1964), for the first time, emphasized the significance of the Bremermann's limit for cybernetics as a systems science and explained that there is a limit to the computing capacity of even the most powerful conceivable systems. Beyond this limit we reach the transcomputable[4]. Ashby (1968) recognized the significance of this limit and discussed on numerous occasions its consequences for dealing with complex systems. Ashby (1964) argued that the restriction that prevents a man with resources of 10^{100} bits of information from carrying out a process that genuinely calls for more than this quantity rests on our basic ways of thinking about cause and effect and is entirely independent of the particular material on which it shows itself. Ashby (1964) reasoned that if this view is right, systems theory must become based on methods of simplification, and will be founded, essentially, on the science of simplification. It is instructive to see the way Ashby (1964) concluded – "The science of simplification clearly has its own techniques and its own sophistication. The systems theorist of the future, I suggest, must be an expert in how to simplify".

It has been elaborated above that the development of high-powered, high-speed computers has been instrumental in the discovery of new qualitative patterns of complex systems' behaviour; indicating a new level of order underlying the seeming disorder; reflecting apparent simplicity in the colossal complexity. At the end, let me to explain the idea of "complexity vanishes and simplicity reveals" in terms of a metaphor. That is, in the above process of Cybernetics of Simplification, it can be visualized as a sort of a dance of revelation and concealment between complexity and simplicity; when one vanishes the other emerges, as in the case of darkness and light; till the finality is achieved[5]. In other words, we can see complexity as a metaphor of darkness and simplicity that of light.

5. Conclusion

The paper presents an original idea in terms of Cybernetics of Simplification building on what I would like to call the "cybernetics of self-observing system". Emphasizing that "it is perceiving simplicity that is to be the choice"; the paper argues that when we consider Newton's causal and deterministic world and observer in that world as someone in the system (of the system); observing and being observed, it could be seen, in a sense that "simplicity reveals and complexity vanishes". This becomes possible through the Cybernetics of Simplification model, establishing the ECE in the systemic situation under study and simultaneously following the frame of iterate and infer as a circular (cybernetic) feedback loop; in the tradition of Foersterian second-order cybernetics. Thus, assimilating the important ideas of two towering scientists of their time, Newton and Heinz von Foerster, the paper proffers a process indicating a path to simplicity from complexity.

In fact, "more than his colleagues Maturana or Varela, Heinz was sensitive to the need to build a bridge from a cause-effect thinking to a thinking oriented towards understanding understanding. He wanted to keep what was radical and useful in the old and by revealing its inherent limitations use that revelation as a ground to embrace the non-trivial" (Leri, 2005). In this light, the present paper is a step in the direction of the elevated desire of Heinz von Foerster. And when "Newton meets von Foerster", one thing that glaringly becomes explicit relates to the distinction between the Newtonian machine-world-view and the world-view that distinguishes trivial machine to nontrivial machine. Every discovery has a painful and a joyful side; painful while struggling with a new insight, joyful when this insight is gained, observed von Foerster. In this paper, I have tried to explicate the insight that I got while being present "when Newton meets Heinz von Foerster" and I must confess that it is still a struggle, may be painful but there is also joy in such pain as it has made the journey enjoyable and it calls for more such research (future) efforts and the continuing "living in cybernetics" purposefully.

Notes

1. Sometimes, complexity is seen as a virtue and it becomes easier to appreciate when Ashby says "variety" is a measure of complexity i.e. the number of different states or modes of behaviour a system can adopt. And higher variety or rich variety is a good thing!
2. The aspect "people complexity" and "systems complexity" is specifically useful to categorise or classify the problems context.
3. This is a hazard that needs to be cognized and managed. The famous Einstein quote was invoked during the ASC 2014 conference by one of the participants during our conversations. "Things should be made as simple as possible – but no simpler" – Albert Einstein.
4. These vast numbers that exceed the physical possibility of even theoretical computation are called "transcomputable". Glanville (2007a, b) has demonstrated its importance in the context of design and has argued for design as an effective approach to complexity. To quote Glanville (2007a), "And when we come to specify the problems a design outcome has been designed to accommodate, we find that these problems are very complex indeed, that their interrelationships lead quickly to vast complexity and to those areas of problem space that the great cybernetician Ross Ashby referred to as the transcomputable: there is simply not enough physical stuff for us

to even dream of computing, exhaustively, logically driven solutions, which makes design an effective approach to complexity – for design is not so consequent upon a problem statement, which will often enter into the realm of the transcomputable (Ashby, 1964)".

5. This idea of continuity in the Cybernetics of Simplification process echoes with the idea of Gerard de Zeeuw and Gordon Pask. According to Ranulph Glanville, de Zeeuws work concerns constant improvement, and his view is of a continuing conversation in some respects, an extreme example of second order Cybernetics. For de Zeeuw it seems that involvement is more important than outcome. The point is less to reach some end point, than to continue being, together. His concern for continuity places him sympathetically with Pask, and they worked together for some time, developing the "Interaction of Actors Theory", which may be summarized as a theory for an unending conversation.

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