Öztürk, Z., & Kızılkaya, S. (2017). Chaos-complexity theory at management. *International Online Journal of Education and Teaching (IOJET), 4*(3), 259-264. http://iojet.org/index.php/IOJET/article/view/162/168

Received: 29.12.2016
Received in revised form: 09.03.2017
Accepted: 15.05.2017

CHAOS-COMPLEXITY THEORY AT MANAGEMENT

Zekai Öztürk

Gazi University

zosturk@gazi.edu.tr

Selman Kızılkaya

Gazi University

kselman@metu.edu.tr

Zekai Öztürk is an associate professor at Gazi University, Faculty of Economics and Administrative Sciences, Healthcare Management. His research focuses on Human Resources Management, Strategic Management, Total Quality Management, Career Management and Organizational Behavior.

Selman Kızılkaya is a PhD student at Gazi University, Healthcare Management. His research focuses on health marketing and mobile health marketing.

CHAOS-COMPLEXITY THEORY AT MANAGEMENT

Zekai Öztürk

zosturk@gazi.edu.tr

Selman Kızılkaya

kselman@metu.edu.tr

Abstract

Internal and external environment where operating continues their activities have a changeable structure continuously. It is stated that operating has to adapt to this structure which causes unexpected, undesirable and sudden results. How operatings behave during this period is stated in chaos-complexity theory. Thus, it is pointed out that organizations can evaluate the environment from not only one perspective but also different perspectives. This study contains three parts. First part involves theoretical information about chaos term. It mentions how some researchers use the chaos term. At the second part, how chaos complexity theory undergoes changes until today is uttered. Moreover, in recent years, the importance of chaos complexity theory from administrative perspective has been mentioned. The last part contains some main features of chaos complexity theory. In this regard, some basic properties like butterfly effect, mutual attachment, edge of chaos and self-organization have been analyzed in this study.

Keywords: chaos, chaos and complexity theory, edge of chaos, eelf-organization, complex adaptive systems.

1. Introduction

Chaos concept means open, vacuum of space, cliffs, making gaps in Greek. This concept which we often use in our daily speech and is in philosophy, sociology, education, organization have been defined differently by varied authors. According to these writers, chaos is not a science of case, it is science of a period and not a science of an existence, it is science of a formation (Çamlıbel, 2003). Chaos is also defined as a metaphor in which small changes cause great changes. Briefly, chaos is an order in irregularity of cosmos (Öğe, 2005, p. 286).

Chaos concept was first used in physical science by Boltsman in 19th century (Koçak, 2006, p. 10). Accordingly, chaos points out that complex, nonlinear and dynamic systems have acted disorganizedly (Gleick, 2000, p. 24). Complex means sophistication, nonlinear means mathematics formation; dynamics also shows that this system does not have a stable form (www.ittu.edu.tm/16.htm).

2. Chaos-Complexity Theory

Chaos Theory, one of the theories having come into prominence in organizational studies recently, is an approach which allows individuals to look at the environment they live in a different way and again. In chaos theory, the fact that everything is constantly changing, that change is immutable in a developing world, and that organizations have to adapt to such changes have been questioned (Sayğan, 2014, p. 413). If not so, it has uttered that system would move away from a structure organized itself. Chaos being in biology, ecology, chemistry, mathematics and physics as the result of the scholars' studies especially in the early

1970s and 1980s refers to the capacity to react the environment in which it is from not only one direction but also very different directions (Allen, 2001, p. 150; McMillian, 2004, p. 26; Goodwin, 2001, p. xii; Mitleton-Kelly, 2003, p. 23; Prigogine, 1987, p. 98). Luhmann (1985, p. 25) also defined chaos as the numerous possibilities that might occur within the system. With the works of the Sante Fe Institute in this area, the chaos theory has brought a new breath to the current organizational theories (Anderson, 1999, p. 217).

Chaos theory points out that the relationship in complex organization structure is nonlinear and there is a mechanism which reveals unexpected and sudden results (Töremen, 2000, p. 200-219). Especially currently, as a new perspective, chaos theory has brought a new expansion to scientific field with its finding and data by adapting to many scientific areas (Kaçmaz, 2005).

When we look upon the studies about chaos theory within the historical process, it has been seen that especially Ilya Prigogine has an important role. Russian chemist Prigogine enhanced "destructive structures" theory which identified self-organization systems in order to understand complexity theory. In this theory which is one of the main components of complexity theory, Prigogine had pointed out that systems had a nonlinear and dynamic structure (McMillian, 2004, p. 26-27; Prigogine, 1987, p. 97-99; Kondepudi & Prigogine, 1998, p. 427).

The other scientist having an important role in complexity theory is Goodwin. Goodwin had dealt with biological evaluation within the context of complexity theory and had dwelt on the terms like "edge of chaos and order emerging from complexity." He asserted that complexity theory had given a new point of view to the other science fields to understand phenomenon and nature (Goodwin, 2001, p. xiv).

Stewart is another scientist contributing to development of complexness. Maths scientist Stewart has uttered that mathematic is a significant means to understand cosmos and nature though it is abstract and delusive. Accordingly, natural events and universe can be understood by mathematics due to cosmos and natural events have a structure consisting of regular shapes. Stewart has stated that natural events in the universe have a simple and repetitive order in itself as a result of a long term observation even though they seems as much complex (Stewart, 1995, p. 1-13).

Chilean biolog Humberto Maturana and Francisco Vareko are the other scientists having contributed to the development of complexity theory. These two scientists improved self-organization approach. In questioned approach, thoughts that the organizations being advocated in traditional system approach have to be open to natural events have been criticized and because of this, that the organization have closure property has been asserted. According to this, interaction of the organizations with the external environment has been in fact circular reflection of its self-organization. It has also been mentioned that organizations interact with their environment to reorganize themselves. As a result, it points out that environment of the organization is a part of itself (Maturana & Valera, 1980). According to Morgan, (1998, p. 281-282), when organizations have closure property, it does not mean that they do not interact with their environment under no circumstances. On the contrary, it is thought that organizations will be interaction and harmony with its environment.

Finally, John Holland improved complex adaptive system approach in order to understand complexity theory. In this approach, John Holland pointed out that systems being called as "spy" consisted of so many components (Holland, 1992, 1995, 1998; McMillian, 2004, p. 28). Spy has contained decision maker unit like administrator, designer and control systems organizationally (McCarthy & Gillies, 2003).

Complex Adaptive System Features;

a. Having Learning Skill: Organizations search, in detail, the external environment where the organization operates. At the end of the research, organizations adapt itself to the environment (Marrison, 2008). In other words, complex adaptive system adapts to current circumstances by gathering required information (Lewin & Regine, 2003).

b. Being in interaction with: It is uttered that there is an interaction between components creating the system and the environment, because of this interaction, complex behaviours occur (Rammel et al., 2007). None of these components have an impact on the revealed behaviour.

c. Having experience: It is uttered that the organization gains experience as a result of the events faced with and so it reorganizes itself again (McMillian, 2004, p. 103).

3. Features of Chaos-Complexity Theory

a. Non-Linearity and Unpredictability:

It is known that minor events cause minor effects, beside this, great events cause great effects in the determinist universe which operates as the clock mechanism. These situations shows that events in the universe have a predictable structure and causality, linearity, control and universality features (Byrne, 1998, p. 14; Morrison, 2008, p. 16; Prigogine, 1987, p. 97; Stacey et al., 2000, p. 17).

b. Butterfly Effect, Sensibility and Bearing Upon Puller Items:

Butterfly Effect: From technical aspect, butterfly effect which is called as dependence to the initial conditions is that minor and unimportant changes in complex structure cause fundamental changes. The changes affect behaviours of the system because all these changes occur suddenly, unexpectedly and unpredictably (Anderson,1999, p. 217; Morgan, 1998, p. 291; Prigogine, 1987, p. 101). Edward Lorenz has stated this situation as that a butterfly fluttering in Peking may cause a storm in New York in the next month.

Sensibility and effect of puller items: According to Hayles, pullers are that any point of orbit pulls the other part of the orbit toward itself (Hayles, 1990). Puller item means that complex system having sensible stucture will be influenced by different puller items.

c. Dependence and Mutual Interaction:

It states that particles in the complex structure are in interaction with each other (Anderson, 1999, p. 216; Cilliers;1998, p. 3; Morrison, 2008, p. 17). This feature points out that change of a particle affects other particles (Mitleton-Kelly, 2003, p. 26-27).

d. Self Organization (Otopoyiyez):

Complex structure has self organization feature as mentioned before. This feature is that a group coming together to perform any task defines what will be done and where and when it will be done by itself (Mitleton-Kelly, 2003, p. 41-42). Wheatley says that every living organism does what requires to continue its life by spending energy.

e. Planning, Designing and Impossibility of Predetermination

Order in the universe occurs automatically and without planning and external intervention.

f. Formation/Organism:

Instead organisms in the system are analyzed one by one and evaluated as a whole (Ashby, 1962, p. 258; Byrne, 1997, p. 15; Morrison, 2008, p. 18; Stacey et al., 2000). It means that the whole has much more meaning and value than organism forming the whole (Ashby, 1962, p. 258; Mitleton-Kelly, 2003, p. 40-41).

g. Co-evoluation:

Factors in a system react to changes taking place in another sytem. The reason of this reaction is that environment and organization intercovert each other. That organization and environment have reciprocal interaction more than one sided interaction is the basis thought of evaluation (Baum & Singh, 1994, p. 3-20).

h. To Move away from Equilibrium:

It is mentioned that in the complexity theory based on open system approach, system performs under some conditions far from equlibrium because of energy, material and information exchange (Cilliers, 1998, p. 4; Comfort, 1994, p. 397; Kondepudi & Prigogine, 1998, p. 409; Wheatley, 2006, p. 79).

i. Varieties of Probability Areas:

Small changes cause a series of upheavals in complex systems which include several regular and dispersed interaction, so non-predictable results will reveal (Mitleton-Kelly, 2003, p. 35-36; Bryne, 1998, p. 14).

j. Edge of Chaos:

In the organizations based on open systems, organizations will be in an irregular position when they are far from equlibrium. A new order will take place of this ireegularity after a while and irregularity takes place again during this period. Edge of chaos includes an area between order and disorder (Mitleton-Kelly, 2003, p. 43).

k. Positive/Negative Feedback:

As positive feedback means convertion, refreshment and increasing degree of influence, negative feedback means finding the balance, ordering and nothingness in unstable conditions (Mitleton-Kelly, 2003, p. 37; Morrison, 2008, p. 17; Wheatley, 2006, p. 78).

l. Way Cohesion:

Nicolis and Prigogine calls way cohesion as bistable. It means that changes in any unit composing complexity sytems change another unit with themselves (Prigogine, 1987, p. 100).

References

Allen, M. P. (2001). A complex systems approach to learning in adaptive networks; *International Journal of Innovation Management*, *5*(2), 149-180.

Anderson, P. (1999). Complexity theory and organization science. *Organization Science*, *10*(3), 216-232.

Ashb, W. R. (1962). Principles of the self-organizing system. In H. Von Foerster & G. W. Zopf (Eds.), *Principles of self-organization: Transactions of the University of Illinois Symposium* (pp. 255-278). London: Pergamon Press.

Baum, J. A. C., & Singh. J. V. (1994). Organizational hierarchies and evolutionary processes: Some reflections on a theory of organizational evolution. In J. A. C. Baum & J. V. Singh (Eds.), *Evolutionary dynamics of organizations* (pp. 3-22). New York: Oxford University Press.

Byrne, D. (1998). *Complexity theory and the social sciences: An introduction*. London & New York: Routledge.

Cilliers, P. (1998). *Complexity and postmodernism: Understanding complex systems*. London & New York: Routledge, Taylor and Francis Group.

Comfort, L. K. (1994). Self organization in complex systems. *Journal of Public Administration Research and Theory*, *4*(3), 393-410.

Çamlıbel, N. D. (2003). *Belirsizlik ortamında planlama düşüncesi 'sinerjetik toplum - sinerjik yönetim ve sinerjist planlama modeli'. Örnek olay: 17 Ağustos - 12 Kasım 1999 depremleri sonrası kaos ve kendi kendine organizasyon süreci*. Yayımlanmış Doktora Tezi, Yıldız Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

Gleick, J. (2000). *Kaos* (Çev: F. Üçkan). Ankara: Tübitak Popüler Bilim Kitapları.

Goodwin, B. (2001). *How the leopard changed its spots: The evolution of complexity, Princeton*. New Jersey: Princeton University Press.

Hayles, N. K. (1990). *Chaos bound: Orderly disorder in contemporary literature and science*. New York: Corneli University Press.

Holland, H. J. (1992). Complex adaptive systems. *American Academy of Arts and Sciences*, *121*(1), 17-30.

Holland, H. J. (1995). *Hidden order: how adaptation builds complexity*. Massachusetts: Perseus Books.

Holland, H. J. (1998). *Emergence from chaos to order*. New York: Oxford University Press.

Kaçmaz, G. (2005). *Kaos teorisi ve sosyolojisi: toplumların denetlenmesinde yeni bir adım*. Yayımlanmamış Yüksek Lisans Tezi, İstanbul Üniversitesi, Sosyal Bilimler Enstitüsü, İstanbul.

Koçak, K. (2006). Kaos, fraktal ve atmosfer. *Bilim ve Ütopya Dergisi, 149*, 10-16.

Kondepudi, D., & Prigogine. I. (1998). *Modern termodynamics: From heat engines to dissipative structures*. England: John Wiley & Sons Ltd.

Lewin, R., & Regine, B. (2003). The core of adaptive organisations. In E. Mitleton-Kelly (Ed.), *Complex systems and evolutionary perspectives on organizations: The application of complexity theory to organisations* (pp. 167-184). Netherlends: Pergamon.

Luhmann, N. (1985). *A sociological theory of law*. London: Routledge & Kegan Paul.

Maturana, H. R., & Varela. F. H. (1980). *Autopoiesis and cognition: The realization of the living*. Holland: D. Reidel Publishing Company.

McCarthy, I., & Gillies, J. (2003). Organisational diversity, configurations and evolution. In E. Mitleton-Kelly (Ed.), *Complex systems and evolutionary perspectives on organizations: The application of complexity theory to organisations* (pp. 71-98). Netherlends: Pergamon.

McMillan, E. (2004). *Complexity, organizations and change*. London & New York: Routledge, Taylor and Francis Group.

Mitleton-Kelly, E. (2003). Ten principles of complexity and enabling infrastructures. In E. Mitleton-Kelly (Ed.), *Complex systems and evolutionary perspectives on organizations: The application of complexity theory to organisations* (pp. 23-50). Netherlends: Pergamon.

Morgan, G. (1998). *Yönetim ve örgüt teorilerinde metafor*. İstanbul: MESS Yayınları.

Morrison, K. R. B. (2008). Educational philosophy and the challenge of complexity theory. *Educational Philosophy and Theory*, *40*(1), 19-34.

Öge, S. (2005). Düzen mi düzensizlik (kaos) mi?: Örgütsel varlığın sürdürülebilirliği açısından bir değerlendirme. *Selçuk Üniversitesi-İktisadi ve İdari Bilimler Fakültesi Dergisi*, *13*, 285-303.

Prigogine, I. (1987). Exploring complexity. *European Journal of Operational Research*, *30*, 97-107.

Rammel, C. S., & Wilfing. H. (2007). Managing complex adaptive systems – a coevolutionary perspective on natural resource management. *Ecological Economics*, *63*, 9-21.

Sayğan, S. (2014). Örgüt biliminde karmaşıklık teorisi. *Ege Akademik Bakış Dergisi*, *14*(3), 413-423.

Stacey, R., Griffin, D., & Shaw, P. (2000). Complexity and management: Fad or radical challenge to systems thinking. London: Routledge.

Töremen, F. (2000). Kaos teorisi ve eğitim yöneticisinin rolü. *Kuram ve Uygulamada Eğitim Yönetimi*, *22*, 203-219.

Wheatley, J. M. (2006). *Leadership and the new science: discovering order in a chaotic world* (3rd ed.). San Francisco: Berrett-Koehler Publishers, Inc.

Wilding, D. R. (1998). Chaos theory: Implications for supply chain management. *International Journal of Logistics Management*, *9*(1), 43-56.