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Multinational Enterprises as Complex Adaptive Systems: An Exploratory Study

Gene F. Brady
(Southern Connecticut State University, New Haven, CT 06515-1355, USA)

Abstract: The Multinational Enterprise (MNE) is recognized as a Complex Adaptive System (CAS). General characteristics of a CAS are identified and explored as to their particular relevance to organizational processes associated with MNEs. The exploration suggests useful insights into the macro behavior of MNEs. Analysis supports CAS research as a potentially valuable model in understanding the macro processes found in MNEs. The author discusses the implications of further research into the CAS–MNE relationship.

Key words: multinational enterprises; complex adaptive systems; complexity theory
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MNEs have been defined as corporations and non-profit organizations that actively manage their substantial foreign direct investments in two or more countries (Bartlett & Beamish, 2014). MNEs are complex adaptive systems (CASs) and not metaphors for CASs (Pascale, Millerman, & Giola, 2001). MNEs fit the definition of systems because they are assemblies of elements or agents that are connected to produce a whole in which the attributes of the agents contribute to a behavior of the whole (Wendell, 2003). Further, MNEs are social systems because the elements or agents are identified as individuals, groups and institutions that engage in a patterned series of interrelationships to form a coherent whole (Soanes & Hawker, 2005). For MNEs the prominent groups in this social system definition are identified as subsidiaries or satellite operations. The individuals in the definition are employees of the MNEs, or representatives throughout the MNE's value chain. MNEs are *complex* social systems because the interconnectivity among the many different and connected parts is complicated and difficult to understand (Soanes & Hawker, 2005). Further contributing to the complexities of MNEs are their size and magnitude. MNEs are among the largest economic organizations on the globe. An estimate indicates that the 300 largest MNEs control at least one-quarter of the entire world's productive assets, worth about US$5 trillion. MNEs total annual sales are greater than the annual gross domestic product (GDP) of most countries. Together, the sales of Mitsubishi and General Motors are greater than the GDPs of Denmark, Portugal, and Turkey combined, and US$50 billion more than all the GDPs of the countries in sub-Saharan Africa (Greer & Singh, 2000).

The number and diversity of employees in large MNEs add to difficulties in communication and information flow within those MNEs. These difficulties are further exacerbated by agility-seeking MNEs attempting to optimize cross-fertilization and pollination of ideas, and cross-subsidization of resources among their satellites.

Gene F. Brady, Ph.D., Adjunct Professor of Management, Southern Connecticut State University; research areas/interests: integration processes of multinational enterprises, strategic management of multinational enterprises. E-mail: bradyg1@southernct.edu.

Further, the generic strategies of MNEs in some industries have evolved since the early 1990s such that these strategies have become more dimensional in their growth patterns. For example, to become more adaptive in the world market, MNEs are attempting to balance the economies of globalization (economies of scale, scope, and the learning curve) against the seemingly paradox attempts to profit by customizing to meet local country needs. While pursuing the most profitable balance between globalization and localization, competitive MNEs also strive to acquire continual learning from worldwide sources in order to innovate and then leverage these innovations widely across their satellites (Bartlett & Beamish, 2014). The four paths of this multi-faceted strategic initiative (globalization, localization, learning and innovation) are to be followed simultaneously, further adding to the burden of MNEs to manage and integrate extraordinary complex systems. Ghemawat (2007), for example, refers to the paradoxical and complex nature of MNEs, pointing to their need for *adaption* (localization), *aggregation* (globalization), and *arbitrage* (innovative practice of locating linkages in the value chain worldwide, wherever the factors of production are optimal). Contrary to the simultaneous pursuit of all strategic initiatives, Ghemawat further suggests that no more than two of these paths can be followed simultaneously; otherwise MNE management will become overwhelmed by unfathomable complexities. To complicate matters even further, MNEs are expected to be *ambidextrous*, that is, take advantage of existing market opportunities while creating and innovating to meet the challenges of future markets (Andriopoulos & Lewis, 2009; Benner & Tushman, 2003; Duncan, 1976, Gibson & Birkinshaw, 2004; Patel, Messersmith & Lepak, 2013; Tushman & O'Reilly, 1996). Finally, in the pursuit of agility, MNEs attempt to manage the tensions between ensuring predictability of satellite behavior through traditional forms of structure and control while simultaneously seeking to empower the same satellites so as to give them freedom and flexibility to respond to unpredictable environmental challenges. Successfully promoting worldwide learning and innovation through emphasis on intricate social networking and coordination has become particularly challenging to global MNE strategists. MNEs represent organizational systems that have reached levels of complexities that would have been difficult to imagine two decades ago.

1. Complex Adaptive Systems

Contributing still to the complexities of managing MNEs are mechanistic perspectives of organizations as systems comprised of discrete blocks of activities, and processes that are typically linear in direction. That perspective began to change in the 1980s even though traditional teachings based on restructuring, dissection and linear causal inferences are still fairly universal. An exception to the traditional method of teaching is the work of Bartlett, who teaches MNE management from an open system and process perspective, but without direct reference to the characteristics and terminology of CAS.

CAS, an offshoot of the broader field of Complexity Theory, is an interdisciplinary model of system behavior, taking root in the1980's with the formation of the Santa Fe Institute, a New Mexico science laboratory comprised partly of former members of the Los Alamos National Laboratory. The Santa Fe initiative emerged from several disciplines, such as economics, physics, and ecology. Aided by high speed and mobile computers, the Institute's mandate was to enhance cross discipline scholarship on the issue of complex systems. The scholarship was to make extensive use of computer simulation as a primary research tool in the search for a common theoretical model to explain the dynamics of complex systems. The search for a holistic model remains ongoing. Yet, potentially useful characteristics of the model have been revealed. The purpose of this paper is to examine these characteristics within the context of MNEs to determine how well CAS processes extends to MNE phenomena. To begin, we start with the *ad priori* claim that MNEs in the 21st century are more complex than the several existing and competing organizational theories would leave one to believe. For example, the early classical perspectives, including the rational models of Max Weber (1968), Fredrick Taylor (1911), and Adam Smith (1904) are essentially man-made constructions and show little recognition of the general and natural fluidity of complex systems. Neoclassical models, including a number of human relations perspectives stemming from the Hawthorne Studies of the 1920s, proposed that organizations would be more predictable if lower level participants enjoyed their working experiences. In the Contingency Theory of Organizations, it is recognized that the design of the organization and its subsystem must "fit" with the environment. The theory does not, however, venture deep into the behavior of systems themselves since that kind of data could not be generated at the time the theory was developed. The forerunner of CAS, General Systems Theory (GST), rooted in the early twentieth century works of Ludwig Bertanfly (1969), is an interdisciplinary field devoted to understanding how systems work. Bertanfly's work is important to *organizational* systems because ensuing learning models, such as that developed by Peter Senge (2006), stem from GST. It is important to remember that early GST did not have the benefit of high speed computer modeling as does CAS.

In the cross-border managed MNE of the modern era simple rules of cause and effect are of little help in understanding the dynamic and interactive processes needed of MNES to evolve and adapt in uncertain environments. Today, if an enterprise' effectiveness has somehow gone awry; no longer does it suffice to dissect the organizational structure in an effort to seek out the causal roots. Adherents to traditional management methods might view the elimination of structural tiers, or the firing of dysfunctional personnel as ways to counter MNEs ineffectiveness. This is what happened in the late nineteen eighties, for example, when the Philips Company attempted to rebalance the culture of extreme localization among national (satellite) organizations against the then emerging trend toward greater globalization. The plan was to level the playing field between the cliquish national organizations and the less prestigious product divisions by switching personnel assignments between the two. The result was that the reassignments caused resentment and confusion among valuable personnel who felt a loss of status. Post analysis revealed that it would have been more effective overall to leave personnel assignments in place, and concentrate more effort in improving coordination, cooperation and communication between national organizations and product divisions (Bartlett, 2014).

A number of commonly repeated characteristics noted in the CAS literature (Dodder & Dare, 2000; Holden, 2005; Brownlee, 2007) were selected for purposes of further exploration as to their particular relevance to MNEs. These are:

1.1 Edge of Chaos

CASs are balanced between orderly and random domains, at the edge of chaos. However, the orderly domain emerges rather than is pre-determined; it continually unfolds and is always in transition. Adaptability and innovation near the edge of chaos causes near random situations to become more orderly. Even so, the CAS will continue to push out toward new areas of randomness in its search for a competitive edge against rival systems. MNEs as CASs also display this balance between randomness and orderliness in their decisions to seek out new foreign locations where rewards are potentially great, but uncertainties high. The uncertainties are linked to environmental conditions in the form of hostile governments, untried markets, different cultures, or vagueness regarding the availability of production factors. In the effort to adapt to chaos, i.e., make some sense out of confusing and complicated surroundings, the MNEs are composed of a network of many satellite agents (individuals and satellites) gathering information, learning, innovating and performing in parallel ways in an environment produced by the interactions of these systems with one another as well as with the environment itself (co-adaptation). As with CASs in general, MNE systems exist at many levels of organization, in the sense that agents at one level are the building blocks for agents at the next level. An analogy is cells (people), which make up organisms (satellites), which in turn make up an ecosystem (the entire MNE). Once the edge of chaos has been pushed further out, the MNE will continue to move toward new regions of randomness. It is closest to the edge of chaos where innovative coping solutions are most likely to thrive. Finally, the MNE, because of the nonlinear trajectories of its satellites, as with CASs in general, has a future that is hard to predict. Difficulty in prediction is associated with agents' search for feedback in order to remove uncertainty, although uncertainty can never be entirely removed. However, agents will continue innovate and seek solutions, and then self-organize so as to become more effective at interacting with uncertain, even chaotic, conditions.

1.2 Self-organizing

The agents of a CAS have the capacity to spontaneously arrange themselves in a purposeful and adaptive manner without the influence of external systems. The agents find ways to crystallize and adapt to their environment, assisted by being in close proximity to one another so as to benefit through a mechanism of continual feedback. Cells in CAS generally display this property of continual feedback, whether they are biological or social. Counter-intuitively, a system left alone, without any external interaction, tends to become increasingly more organized. Normally, we think of weakly managed satellites as being disorganized. We sometimes see reference to work situations where in the absence of active and effective leadership, the disorganization that follows creates a leadership void. In such events, subordinates may rise to the occasion; adapt to meet the exigencies at hand, and somehow fill the leadership void on their own (more organized). In MNEs this self-organizing process might flow as follows: Global headquarters experiences difficulties in exercising an effective leadership role over satellite operations. The difficulties arise as a result of distance, administrative cost and foreignness. Because of administrative costs global strategists decide to back off from detail surveillance of local activities, and to empower the country managers to deal more directly with their challenges. At the same time, Headquarters intensifies support in the form of functional expertise, financial resources, information technology, and select expatriates who are technical experts. In carrying out these measures, Headquarters has redefined its role as a detail manager, and has adopted a new role as a facilitator to the satellite. The satellite as a CAS is now better prepared to behave according to natural processes without external interference while realistically adapting to the unique exigencies of its local environment.

1.3 Chaos Theory and the Butterfly Effect

Chaos Theory is an offshoot of the studies of complex systems. Examples of complex systems that Chaos Theory helps us to understand are earth's weather system, the behavior of water boiling on a stove, or the migratory patterns of birds. Complex systems are systems that contain so many moving elements that computers are required to derive all the various outcome scenarios. Chaos Theory would not have existed before the 1960s, because the theory addresses so much movement of elements that computers are needed to identify all of the possible states of nature. In Chaos Theory minor changes in initial conditions can ultimately alter the consequences of complex systems. The term, *butterfly effect*, is associated with this dynamic process. The term has its origins in 1961 when Edward Lorenz decided to round some of his number sequence in an effort to predict the weather. He discovered that the rounding of the decimal 0.506127 to 0.506 resulted in an entirely different weather condition than if he had not performed the rounding. The discovery that such a miniscule change in initial conditions could ultimately have such far reaching effects led Lorenz (1963) to surmise that the flap of a butterfly's wings in one part of the world could cause a tornado in another part of the world. Application of the butterfly effect to the behavior of MNE systems is not difficult. Small innovations in one part of a system can have unimaginable consequences throughout the system. For instance, the invention of the personal computer in the 1970s, not only evolved into entirely new hardware and software industries, not only affected other industries through association and transference, but hastened the speed of business systems interrelations throughout the world. As a result, the social fabric of today's world societies would have been barely recognizable fifty years ago. Among MNEs today, an innovation in an MNE satellite in one part of the world can change the behavior of the other satellites throughout the world. A by-chance technical innovation in an MNE's subsidiary in Taiwan can ultimately evolve into a major global product of the MNE, and then of the industry as a whole. The innovation would, even then, continue to affect external subsystems until the behavior of most of the world's population became somehow altered. Elements of complex systems seem to run through cycles, even though the cycles are rarely and precisely redundant. If one would graphically plot a multitude of systems in graphs it would likely show that there is some kind of equilibrium situation around which elements tend to crystallize. For instance: imagine a MNE subsidiary located in a country of one million people. The subsidiary is primarily local-to-local, that is, it produces only to serve its domestic population. In order to maintain operations at a pace needed to service the population, the MNE satellite, for instance, will create one manufacturing plant, one R&D center, and a building for sales and administrative offices. It will also have a recreational center and a library. For sake of illustration, this configuration represents a state of equilibrium. But then the company decides to introduce a product modification that has almost overnight success, increasing local demand for the product by 20 percent. The plant expands to service an additional 200,000 potential customers. 500 new employees are recruited, a plant expansion is added, and a swimming pool is added to the recreation center. That new equilibrium is called an *attractor*. But then suppose, for some reason, this products success becomes offset by a decline in demand for another product the company offers. The company now needs to retrench. It closes the library and reduces the size of the plant and the recreational facility. If then, a sudden surge in demand reappears the satellite would again expand to its previous full capacity. Over time this back and forth process would continue to repeat itself. This repeated up and down process is qualified a *strange attractor*. Unlike the *attractor*, the equilibrium doesn't settle down, but forms a trajectory of possible events. No element or situation along the trajectory will show exactly the same pattern as another, although they will be alike since they are derived from one element. This *self-similarity* is found in snowflakes; they are alike, but no two are identical.

1.4 Co-evolution

In biology, the term co-evolution is used to define situations where two or more species reciprocally affect each other's evolution. These interactions could involve the relationship between predator and prey; parasite and host, competitor against competitor, or competitor with competitor. In the broader context of CAS these species are systems, consisting of numerous subsystems at different levels. In the specific context of MNEs these systems may be viewed as country satellites. As in biology, MNE systems influence their environments, and vice versa. Changes may occur in all satellites as a result of their interaction within and across the larger MNE system, permitting change to be driven by both direct interactions and feedback within the rest of the MNE and its environment. A satellite that stimulates the evolution of another satellite is, in turn, responsive to that satellite's evolution. In direct co-evolution, two interacting satellites evolve in response to each other. In diffuse co-evolution, one or more satellites evolve in response to several other satellites in the context of the larger, encompassing system (Baum & Singh, 1994). The idea suggests that changes in subsidiaries can have unexpected and even non-intuitive effects on other subsidiaries, especially in complex contexts. The effects can be *mutual* in that relationships between two or more subsidiaries can benefit all of the interacting organizations through their common association. This seems to imply that one would need to know headquarter operations, and its effects of direct interactions and feedback loops with satellite systems, to better understand and predict satellite change. Mutualism can even extend to competitive organizations, as when a satellite and a domestic company co-determine that the risk associated with non-cooperation is greater than the risk of cooperation.

2. System Decline

Systems do not always successfully adapt; they sometimes fail. True to Darwinian Theory it is the fittest systems that survive in challenging environments. Due to the sometimes strong connections between subsystems, the unfitness in one or several subsystems may trigger a cascade of failures among other subsystems. This cascade may eventually lead to devastating consequences on the functioning of the broader system. The ways in which the subsystems in a larger system connect and respond to one another is important to the effectiveness of the subsystems as well as the supra system. It is from the richness of these connections that the productive patterns materialize. Conversely, dysfunctional patterns can develop into a downward spiral and the eventual demise of the system. The relationships, therefore, between subsystems are generally more important than the subsystems themselves. We saw this previously in the Philips Company case where personnel reassignments did not resolve problems between satellite managers and headquarter product managers, but improvement in communication and cooperation did offer a solution.

The application of cascading failures to MNEs and their satellites may be further delineated by an understanding of how satellites and their parent companies need to cross-communicate and coordinate in order to appropriately cross-leverage their ideas and resources. It is the effectiveness of this cross-communication that ensures that sufficient cooperation is in place so that knowledge and resources can be exchanged for the betterment of the whole MNE. When the quality of these connections deteriorates or fails to become established patterns of behavior, then satellites and the parent base continue to devolve around a faulty base. The home office reacts to this cascade of failures by divesting itself of satellites destined to fail, or by continually redistributing assets until even the best satellites perform marginally. There are practical limitations on how efficient satellites need to be to survive within a decentralized MNE federation. They do not have to be perfect in order to be highly productive. The satellites need only be better than their competitors. The same may be stated for the MNE in its entirety. An MNE, for example, will trade off increased efficiency for greater effectiveness once it has *satisficed* conditions of general superiority over its competitors (Simon, 1956).

2.1 Hysteresis and Memory

As in CAS generally, the history of an MNE may be important. This is because CAS tends to exhibit *hysteresis*, a phenomenon in which the reaction of a system to an external stimuli becomes a function not only of the present strength of that stimuli but also of the previous history of the system. Past conditions tend to influence present and future situations. This happens when the CAS continuously learns from environmental changes surrounding it, and integrates that learning to adapt to future need for changes. Such learning systems may be said to have a *memory.* In practice MNEs engage in strategic planning which is an effort to prepare and adapt to the future through scanning, identifying, observing, assessing and forecasting relevant environmental conditions. As multiple scenarios unfold over time, the MNE is learning about what works and what doesn’t. Thus, the MNE is continuously adjusting its plans taking into account environmental changes as well as what it has learned in the way of adaptation. Under conditions of relative environmental certainty, strategic plans might be unchanged except that some of the MNEs action plans might need tuning based on learning from past experience. Over time, a series of environmental consistent situations might find the pattern of the MNE's strategic readiness to be similar, but never quite identical; like the snowflakes mentioned earlier.

3. Open and Synergetic Systems

Similar to CAS in general, MNEs are *open systems* since they continuously interact with their environments. The interaction can take the form of information, resources, factors of production, or other competitive systems. In MNES that are organized as decentralized and interactive systems, the satellites within the MNE can be *synergetic*. By being synergetic, the subsidiaries work together, cooperating for an enhanced (or synergistic) effect among themselves as well as the MNE as a total system. The interactive subsidiaries and their parent company focus their attention on capturing synergy through the *self-organized* emergence of new qualities which may come in the form of structures, processes or functions. Synergy seeking efforts may take place between parts of a satellite, between different satellites, between individuals or even between scientific disciplines.

3.1 Nesting

In complexity theory a system that is nested is contained within another system. Since systems reside within systems, the adaptation of a supra system to environmental influences affects the adaptation of its subordinated systems. Among MNEs, satellite systems are nested and interrelated. In an open and freely interactive environment no one satellite operation can be fully understood without the context of the supra system, and often the interaction among sister satellite systems. Interaction among all satellites leads to continually adaptive behaviors that are basically non-linear and cannot be extrapolated in detail. Even so, general patterns of order and effectiveness are discernible. In general, satellites may share similar attributes and processes, but they are, again, not symmetrical. In open systems individual satellites may act in unpredictable ways, but because of the interrelationship with others, the contexts are altered among all related satellites. The implications for management of MNEs offer that satellite subsidiaries in sum are not mechanistic entities. People transfer in and out, challenges and priorities change. Traditions and cultures may not be readily identifiable, creating unanticipated behavioral changes. Evolving systems within a satellite's structure might change, creating a catalytic reaction throughout the galaxy of satellites. Natural evolving processes may clash with formal policy and regulatory restrictions, resulting in increase formalization rather than the loosening of controls.

3.2 Emergent Phenomena and Level of Abstraction

Related to the nesting of systems is the notion of multiple levels of abstraction. A system may be studied thoroughly until it seems that it is completely understood. Yet, that system cannot be completely understood until the system is viewed at a higher level of abstraction. The study of the ant is an example. A student might collect data on an ant's mannerisms and behavior. The student might then believe that she really knows the ant. Yet, the ant cannot really be known apart from its role in the broader social network—the anthill, the cells, the queen, and the army versus the workers. The ant is a biological system, but is also a part of a larger social network. Tracking an ant's movements may eventually reveal an emergent behavioral phenomenon. The significance of the phenomenon cannot be understood until we understand it in the context of the colony to which the ant belongs. In the world of MNEs the ant metaphor suggests that individuals populate a subsidiary. We might understand an individual's anatomy, physiology and psychology, yet still not understand the individual until we know her role within the satellite subsidiary. Becoming aware of that role will still not reveal all there is to know about the individual; viewing the role of that subsidiary within the entire galaxy of satellites might reveal even more. Depending on the purpose of enquiry we may not need to extend the borders of abstraction. If the purpose is to develop a macro theory of the MNE's behavior, then the galaxy of satellites is an appropriate level of analysis. A hypothetical case example might clarify this point. The XYZ Company has several satellite operations. One particular satellite (W) has a commendable track record for both product and process innovation. Efforts have successfully been made to leverage these skills and knowledge to a number of other satellites of the company. As a result satellite A has been designated a R&D center for the XYZ Company. Every satellite within the company is similarly structured with a Director at its head. John, the Director for satellite A, is a powerful person. John has personally championed many of the significant process innovations which have indisputably given the whole company a competitive edge. John is a powerful person in the sense that the whole company is highly dependent upon his skills. If one were to examine John in his work activities it might appear that he was simply another Director doing his job. But if John was examined in terms of the significance of his contributions to Corporate, it might be discovered that the current sustainability of the entire company largely hinged on John's use of his power and the acceptance of his power by significant other agents in the system.

3.3 Requisite Variety

The more variation within the system the better it is able to resist environmental impediments as well as capitalize on environmental opportunities. As a CAS teeters on the edge of chaos it experiences not only increased randomness, but increased ambiguity and paradox as well. It is the continual trial, error, and learning of new possibilities that enables the CAS to co-evolve with its environment. As the CAS practices and absorbs the lessons of new innovative processes it becomes better prepared to venture into ever new chaotic regimes (untried markets). Extending *requisite variety* to MNES one might consider how the MNE's Board of Directors becomes comprised of a variety of nationalities to enable it to develop insightful strategies for penetration into uncharted international territories. Democratic or consensus governance allows all perspectives to be on the table for the sake of finding novel solutions. Conversely, a Board where the self-select of members are of the same nationality or schools of thought might be ultra conservative in their decision-making, for fear of the unknown. An ethnocentric Board will soon be seen to be inadequate when the MNE takes on increased variety in the form of new foreign markets. A geocentric Board would be more appropriate in such a situation.

3.4 Period Doubling Cascade

From time to time, CASs experience entry into new and elevated phases of development. These successive phases are known as the *period doubling cascade*. For example, the caveman discovers how to make and use tools, a teenager finally catches on as to how to maneuver the automobile and the football team finally seems to pull it all together and begins winning every game after a long losing streak. In the MNE, examples might include: a technological breakthrough in how work is done precipitates a need for social restructuring. After considerable trial and error, an MNE finally catches on and develops a routine that allows it to enter other countries with relative ease. Wal-Mart International, for instance, initially experienced problems in Europe while adapting its store model to suit local customs. Early MNE pioneers entering China had a tough go in adapting to cultural and local government conditions. Subsequent entries, however, had learned much from the experiences of their predecessors. New entries were then able to operate at higher levels of awareness and effectiveness.

4. Serial Incompetence

Proponent agents of MNEs pursue serial incompetence (Godin, 2000). Upon acquiring a state of readiness in one area, these open-minded agents strive to transition to another area in order to develop new and relevant proficiencies. Unlike in conventional business models, there are fewer specialists among organic MNEs spending years on one subject area. This is particularly valid in fast cycle industries, such as computers, software, and the like. In these industries, MNEs are continually probing uncharted waters; products, services, resources and the information-flow they will need to use in order to adapt many times over. This is a positive process. It contributes to the learning and readiness (poise) of the MNE to venture further into chaotic regions.

4.1 Implications

Although CSA modeling is still a new area of scientific enquiry, it does appear to have revealed some characteristics that can be applied to the understanding of unabated MNE processes. The characteristics do offer indirect implications for the improvement of MNE management in the sense that it is much more difficult to manage a system that is not understood. CAS offer some understanding, but there seems to be a need to replicate or augment existing CAS research using actual MNEs as the system of interest. Even so, CAS research of social systems in general is still limited. Much more research has focused on biological and other natural systems, like weather. However, management can undoubtedly do more to learn and understand the complex adaptive systems in nature. Then, through the process of *biomimicry*, management may learn how to integrate nature’s lessons in designing complicated organizations, such as MNEs.

If we apply CAS research directly to MNEs then we need to recognize challenges stemming from the non-linearity of CAS processes, such as attaching causal inferences, probabilistic theory, and variable manipulation. In light of CAS research linear predictions represent a simple approach, limited to less complex systems. We live in a nonlinear world and work in nonlinear organizations. Acceptance of this world is of nonlinearity clash with traditional views of management and control of organizations. Predicting organizational behavior based on direct observation is of relatively little use in predicting future behavior. Rather, concentration on initial conditions, in highly interactive CASs, will offer more information about future events than conventional forecasting methodology. Tracking CAS processes in relevant areas of interests, with minimal intrusion, should be more rewarding than simple, vaguely-informed, top-down variable control. We saw this in the Philip’s case cited earlier.

But, this being the case, how do we make MNEs do what we want them to do? For one, we loosen the constraints to allow the flexibility of local agents to respond to the environment in real time. In such a scenario responses are not prescribed ahead of time before we really know real time conditions. In this way the MNE, and its satellites, can interact with their environments, responding to valid feedback, until a natural solution emerges. This allows for spontaneous responses to novel conditions, an effect that is difficult when high emphasis is placed on structural solutions at the exclusion of process and cultural inputs. To aid responders, the traditional notions of intercession between cause and effect are supplanted by monitoring of the feedback loop. With negative feedback an output change contradicts the original cause, returning the system to a stable state. Positive feedback, on the other hand, reinforces the ongoing process, allowing the system to continue to thrive, learn, grow and adapt to development opportunities. For a system to change from a less to a more effective state, some catalyst needs to trigger an alteration in that system. That catalyst may be introduced randomly from natural sources, or be purposely imposed by system agents (leaders), such as a process innovation. If the system, in its revised state of equilibrium, is more in balance with environmental contingencies, then the system has successfully adapted and thereby evolved. This pattern of continual change and adaptation is true of all complex systems, and therefore true of MNEs. Unlike the mechanistic view of MNEs where blocks of authority and job functions may or may not work, adaptive MNEs have flexible functions that adjust to the environment. MNEs migrate to the edge of chaos, i.e., untried foreign markets, as a willing strategy that will pressure them into finding innovative ways to thrive in a complex world. In a sense, MNEs "evolve to evolve". Poised MNEs, those that value being at the edge of chaos, seem to have the ideal capacity for adapting to external stimuli. Their ability to evolve is high because they have developed a repertoire of responses. Their agility is high through their abilities to employ their accumulation of learned and useful variations of behavior (Kauffman, 1993).

References:

Andriopoulas C. and Lewis M. W. (2009). "Exploitation-exploration tensions and organizational ambidexterity: Managing paradoxes of innovation", *Organization Science*, Vol. 20, pp. 696-717.

Bartlett C. (2014). "Philips versus Matsushita: The competitive battle continues", in: Bartlett C. & Beamish P. W., *Transnational Management*, New York: McGraw-Hill.

Bartlett C. and Beamish P. (2014). *Transnational Management*, New York: McGraw-Hill.

Baum J. A. C., Jitendra V. and Singh J. V. (1994). "Organization-environment coevolution", in: J. Baum & J. Singh (Eds.), *The Evolutionary Dynamics of Organizations*, New York, NY, Oxford University Press.

Benner M. J. and Tushman M. L. (2003). "Exploitation, exploration, and process management: The productivity dilemma revisited", *Academy of Management Journal*, Vol. 28, pp. 238-256.

Bertalanffy L. Von. (1969). *General System Theory*, New York: George Braziller.

Brownlee J. March (2007). "Technical report 070303A", Complex Intelligent Systems Laboratory, Centre for Information Technology Research, Faculty of Information Communication Technology, Swinburne University of Technology, Melbourne, Australia.

Dodder R. and Dare R. (2000). "Complex adaptive systems and complexity theory: Inter-related knowledge domains", *ESD.83: Research Seminar in Engineering Systems*, Massachusetts Institute of Technology.

Duncan R. (1976). "The ambidextrous organization: Designing dual structures for innovation", in: R. H. Killman, L. R. Pondy, D. Sleven (Eds.), *The Management of Organization*, Vol. 1, pp. 176-188.

Ghemawat P. (2007). "Managing differences: The central challenge of global strategy", in: C. Bartlett & P. Beamish, *Transnational Management*, New York: McGraw-Hill.

Gibson C. B. and Birkinshaw J. (2004). "The antecedents, consequences, and mediating role of organizational ambidexterity", *Academy of Management Journal*, Vol. 47, pp. 209-226.

Godin S. (2000). *In the Face of Change the Competent Are Helpless: Fast Company*, January–February, pp. 230-234.

Greer J. and Singh K. (2000). *A Brief History of Transnational Corporations*, New York: Global Policy Forum.

Holden L. M. (2005). "Complex adaptive systems: Concept analysis", *Journal of Advanced Nursing*, Vol. 52, pp. 651-657.

Kauffman S. A. (1993). *Origins of Order: Self-organization and Selection in Evolution*, Oxford, England: Oxford University Press.

Lorenz E. N. (1963). "Deterministic nonperiodic flow", *Journal of the Atmospheric Sciences*, Vol. 20, pp. 130-141.

Pascale R., Millerman M. and Giola L. (2001). *Surfing the Edge of Chaos*, New York: Crown Business.

Patel P., Messersmith J. and Lepak D. (2013). "Walking the tightrope: An assessment of the relationship between high-performance work systems and organizational ambidexterity", *Academy of Management Journal*, Vol. 56, pp. 1420-1442.

Senge P. (2006). *The Fifth Discipline: The Art and Practice of the Learning Organization*, New York. Crown Publishing Company.

Simon H. A. (1956). "Rational choice and the structure of the environment", *Psychological Review*, Vol. 63, pp. 129-138.

Smith A. (1904). *An Inquiry into the Nature and Causes of the Wealth of Nations* (5th ed.), London: Methuen and Co., Ltd..

Soanes C. and Hawker D. (2005). *Compact Oxford English Dictionary*, Oxford University Press.

Taylor F. W. (1911). *The Principles of Scientific Management*, New York: Harper Brothers.

Tushman M. L. and O'Reilly C. A. III. (1996). "Ambidextrous organizations: Managing evolutionary and revolutionary change", *California Management Review*, Vol. 38, No. 4, pp. 8-30.

Weber M. (1968). "Bureaucracy", in: *Economy and Society: An Outline of Interpretive Sociology*, Berkeley: University of California Press, pp. 956-969.

Wendall J. (2003). "Beyond intractability", in: G. Burgess & H. Burgess, *Conflict Information Systems, Conflict Information Consortium*, University of Colorado, Boulder, Colorado, p. 1589.