The Shape of Experiment-Based Management Science to Come

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Experiment-Base Management Science (EBMS) we are developing is an emerging new field of both scientific and practical activities. This paper will give some perspectives on EBMS based on the plenary talk at General conference on Emerging Arts of Research on management and administration (GEAR) held on August 11, 2012. The paper discusses when EBMS was born, why now they require EBMS, what are their research elements, where should we focus, which are the ways, and how should we go from here.

1. The Shape of Jazz to Come: Introduction

When Ornette Coleman, a jazz alto sax player, started "free jazz" activities in the end of 1950s. On those days, they thought that Onette played only nonsense without any jazz theories and that audiences could not welcome the music. However, the jazz history says Ornette was an excellent player, who was able to vividly play Charlie Parker's adlib music as he was alive. Also, his activities have gradually become popular in the jazz literature [Segell 2005].

Same as the history of jazz, it is often the case in some scientific researches such as physics or mathematics. The birth of quantum mechanics, non-Euclidean geometry, or recent econophysics is a typical example of such fields. First, they usually think bland new theories and ideas nonsense, they neglect them, then, however, they gradually accept new ones because of the appearance of new evidences. I believe that experiment-based management science (EBMS) should follow such traditions of new scientific and practical activities. In this short paper, I would like to draw the shape of EBMS to come referring to the titles of (fairly) popular (jazz) music.

2. A Child is Born: When EBMS

"A Child is Born" is composed and played by Thad Jones, a jazz trumpeter.

In the literature, the experimental approach to management or organizational sciences started from the pioneering work by Cyert and March in 1960's [Cyert 1962]. Also, the Garbage Can model by Cohen, March, and Olsen [Cohen 1972] is well-known. The existence of such early works is very remarkable, as both Fortran and Lisp, traditional programming languages for numerical and symbolic computation were developed in 1960. However, because of the limits of computer performance and the hurdles of programming difficulties for social scientists, the approach has not been successful in those days.

The second leap with agent-based modeling was found in the early 1990's. Interestingly, the movement of agent-based approach to social simulation or experimental management science spontaneously emerged in the worldwide [Terano 2007] .

In European region, they started SIMSOC (SIMulating SOCiety) meetings, which are followed by the activities of ESSA (European Social Simulation Association) and JASSS (J. Artificial Societies and Social Simulation). In the North American region, COT (Computational Organization Theory) workshops were started at AAAI and Informs conferences, then CASOS (Computational Analysis of Social and Organizational Systems), CMOT (Computational and Mathematical Organization Theory) Journal, NAACSOS (North American Association for Computational Social and Organization Sciences), then CSSSA (Computational Social Science Society of America) activities followed.

In Japan, we organized PATRA (Poly-Agent Theory and ReseArch) group and then continue to have the series of AESCS (Agent-based approach to Economic and Social Complex Systems) workshops were hosted by PAAA (Pan-Asian Association for Agent-based Approach in Social Systems Sciences).

In summary, therefore, we have already had a long history on EMBS.

3. Now or Never: Why not Now

"Now or Never" is composed and played by Hiromi Uehara, a jazz pianist.

Now, we must develop, extend, then establish EBMS research in front of a large number of audiences because of the following two reasons:

- Recent rapid progress of computer and network technologies makes us possible to easily implement computer-based simulation models. Such models help us to carry out EBMS with both machine agents and human subjects. Also, using such models, we are able to *operationalize* the concepts and ways of thinking of traditional management sciences. By the word *operationalize*, we mean that i) social and organizational systems are observed by human experiments and computer simulations, ii) with both machine- and human- readable documentations, they are comprehensively and consistently understood for human experts and students related to management sciences.
- Because of the recent crises of economic conditions in worldwide and the tragedy of the great earthquake in Japan, we must deeply understand the mechanisms of human societies. We must develop the new principles of design and implementation of societies. Contrary to physical sciences domains, there are no first principles in management science domains. Therefore, the experimental approach is indispensable to uncover the secrets of human societies.

4. Pick up the Pieces: What are the Elements

"Pick up the Pieces" is mainly played by the Candy Dulfer's fusion music group. She is both a singer and a sax player.

To build a new EMBS architecture, we have already had various pieces, or tools and techniques in our laboratory. Some of them are listed in another paper by Kunigami and Terano [Kunigami 2012]. The most important idea in EBMS is the approach to uncover the interactions of micro-, mezzo-, and macro-scopic levels among agents shown in Figure 1.
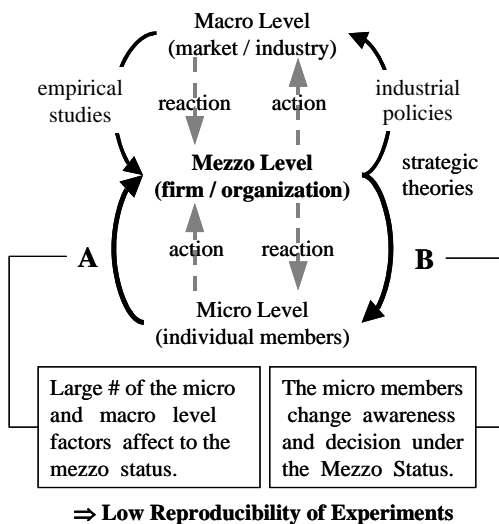

Figure 1: Structure & Difficulties of Management Problems

Our current pieces include: i) agent-based simulation techniques to explore vast parameter spaces with evolutionary algorithms and grid computers [Yang 2012]; ii) the combination of the organizational bottom up simulations and the orthogonal designs of experiments, iii) a new experimental method to measure the awareness via the integration of Business Games, the Manga / Narrative Business Cases, iv) visualizing techniques for human decisions and behaviors of business processes, v) conjoint analysis techniques with Personae and/or organizational profiles, vi) abstraction techniques of the agents' semantic networks, and vii) virtual Scenarios and case set generation techniques based on the concept of design of experiments.

About the detailed explanations on these pieces please refer to the papers elsewhere.

5. Place to be: Where should we Focus

"Place to be" is composed and played by Hiromi Uehara, a jazz pianist.

Using the pieces, we are attacking several critical problems on social, organizational, and/or economic fields. The recent lists are found in our GEAR website [GEAR 2012]. They are categorized into i) research and development of advanced knowledge systems, which include data mining, marketing, education, social networking, recommendation, and manufacturing task domain problems ii) application of agent-based social system sciences, which include organization, business, history, education, and financial task domains; iii) integration of gaming and case methods, which include marketing, business competition, finance, MANGA cases,

human/computer participating gaming task domains, and iv) theories for EBMS, which include doubly structured networks, chaos controls, behavioral finances, and games.

These task domains are on the boundaries of traditional academic fields such as economics, organizational sciences, statistical physics, operations research, artificial intelligence, computer science, and system science. To address EBMS, we must focus on the principles of traditional experimental methods discussed in the paper and agent technologies, which are characterized by their internal states, problem solving and decision making functionalities, and interaction capabilities.

6. Act Your Age: Which Way to Go

"Act Your Age" is composed and played by Gordon Goodwin with his Big Phat Band. He is a jazz pianist and a sax player.

To act our age in EBMS fields properly, I would like to emphasize the following three points:

- Architecture [Hamano 2008] and Code [Lessig 2006]: The term *architecture* usually means a building, a typical artificial object. However, some of artificial systems we have built often show emergent properties. The internet and social network sites are typical examples. In these artificial systems, they often become autonomous and out of control. The term *code* means such implicit rules determined by laws, cultures, and customs. They determine our both conscious and un conscious behaviors and/or beliefs. The concepts of architecture and code are critical to develop EBMS, because our experiments in social systems are deeply affected by the concepts.
- Control and Harness [Axelrod 2000]: About complex adaptive systems, the book states that they are not be able to controllable and they should be harnessed. By *harness*, they mean to deal with things by natural forces, thus, compared with *control*, *harness* is a very calm concept. To harness (social and organizational) systems, Axelrod and Cohen emphasize the principle of evolution of life: copying, recombination, and selection. Their statements are very conformable to EBMS, because our experimental strategies heavily depend on evolutionary computation techniques.
- Body points for acupuncture and moxibustion in oriental medicine: In oriental medicine, acupuncture points are important concepts to transfer therapy knowledge to others. Without the concepts, they are hard to make therapies of acupuncture and moxibustion, because the treatment itself requires very tacit knowledge and experience. They say the concepts of body points were invented once upon a time. To make clear the name and place of body points, the treatment techniques are considered to be distributed. Out pieces of EBMS have similar properties. Using our pieces, we are able to translate and transmit the results of EBMS with clear explanations.

7. Adios Nonino: Concluding Remarks

"Adios Nonino" is composed and played by Astor Piazzolla, a Latin musician. The tune was composed, when the father of Astor passed away in order to pray for his death. The tune is, however, very beautiful with little feeling of the sadness on his death.

In this short paper, I have discussed the basic principles and key ideas of EBMS. EBMS is a just started new field of both scientific and practical activities. I believe, however, EBMS will be a major field in the near future to deal with real world problems in our societies. Interestingly, Segell emphasizes the importance of the network of herds in a new community in the music world in his book [Segell 2006]. To make progress in EBMS, I would like to ask a favor for your participation with your herds.

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