Lessons from Modern System Science for MIS

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1. System Science is one of the bases for MIS

MIS as a cross-disciplinary application field, has three bases disciplines:

Modern IT;

Management Science;

System Engineering.

Modern IT —— Our Tool or Arrow;

Management —— Our Goal or Target;

System Science —— the approach let our arrow exactly hits our target.

Technology VS Science

- Science —— understanding on the natural principles and evaluation laws;
- Technology —— the tools and methods provide benefits for human-being based on Science.

- System Science —— Theoretical base for System Engineering.

2. MIS becomes more complex

As a new discipline in management science, MIS has started at 70's last century.

Since then, this filed has changed a lot, both in its tools and it concepts.

Change One —— Scope and Size

- Form Enterprise Oriented to more Society Oriented;
- Form Daily Work Oriented to more Decision Oriented;
- Form Inside Business Oriented to more Cross Organization business Oriented.

Change Two —— Its Structure and Functions

- Form single layer to multi-layers;
- More Complex, from just store and process, to capture, transfer and presentation;
- More Open, Form Inside Business Oriented to more Cross Organization business Oriented.

Change Three—— Techniques Update

- Environment: Network and Internet
- Data type: Multi Media
- Data Capture: as RFID and etc.
- Storage and Process: Data Warehouse and Data Mining.

Change Four —— Deep Influence

- Macro Organization: BPR —— Business Process Re-engineering
- Micro Industry Architecture: New Service Oriented Industries
- Law and Standard
- Culture

The tire tracks 30 years

A brief Review of these 30 years, we can see the change is very rapidly.

It can be divided into four steps.

A. Centralized Usage

Key Word : MIS (Management Information System)

key Technology: DBMS (Database Management System)

Main User: Government and Manufacture Factories

Motivation: Government push

B. Distributed Usage

Key Word : DSS
(Decision Support System)

key Technology: LAN
(Local area Network, 3-com)

Main User: Government and State-owned Enterprises

Motivation: Reform forced

C. Commerce Usage

Key Word : E-Commerce

key Technology: Web , HTML

(Internet Based Technique)

Main User: Enterprises

Motivation: Market Driven

D. Service Provide

Key Word : Web Service

key Technology: SOA

(Service Oriented Architecture)

Main User: Every enterprises and social organization, including Meddle and Small factories.

Motivation: Market driven

3. Development of Modern System Science

The Influence of Technology on MIS has been discussed a lot. What I want emphasize is we should pay more attention on another part: the Influence from the Modern System Science.

System Science has long history. However, in 20th century it has developed very fast because the new technology, specially the Modern IT.

Since 30's last century, it has experienced three stages:

—— Engineering Stage;

—— Thermo-Dynamics Stage;

—— Biology and Society Stage.

Engineering Stage

- **Famous Scientist：Norbert Wiener，John Von Neumann**
- **Background：Machine**
- **Key Concept：Information, Feedback**
- **Tools：Cybernetics and OR**
- **Control Model：Centralized Control**
- **Element of the system: dead, passive, no own motivation and behavior**

Thermo-Dynamics Stage

- **Famous Scientist：Ilya Prigoging, Hermann Haken**
- **Background：Thermodynamic system, Laser**
- **Key Concept：self-organization, fluctuate**
- **Tools：statistic physics,**
- **Control Model：Distributed Control**
- **Element of the system: random moving, Brownian Moving, still very simple**

Biology and Society Stage

- **Famous Scientist： John Holland**
- **Background：Biology and Social System**
- **Key Concept：Adaptation, learning**
- **Tools：Genetic Algorithm, simulation**
- **Control Model：mechanism design**
- **Element of the system: live, active, has own motivation and behavior rule, can learn and adapt, can communicate with environment, can change own properties and structure.**

CAS —— basic ideas

So called CAS Theory, Complex Adaptive System, has provided by Prof. John Holland at Michigan at 1994.

The lecture has been published under name Hidden Order.（中文译本名为《隐秩序》。）And his second book named Emergence also published at 1997.（中文译本名为《涌现》。）

Its basic idea is : Adaptation (of the individual) builds Complexity of the system.

其基本观点为：“（个体的）适应性导致了（系统的）复杂性”。

CAS —— basic ideas

1。Many Complex Systems consists of Adaptive Agents.

* Communicate and interact each others and among agents and environment;
* These Agents are changing them self during the communication and interaction;
* Both individual and system are changing and evolvement.

CAS —— basic ideas (Cont.)

2。Basic Mechanism of Adaptation (Stimulus ——response Model)

* “IF——THEN” rules;
* Variation and Multi-values for the rules.

CAS —— basic ideas (Cont.)

3。 Chromosome And its Fitness

* The Carrier of the response rules——chromosome。

* Evaluation of chromosome——fitness。

* Adjustment of the fitness

CAS —— basic ideas (Cont.)

4。Interaction between Agents and its Environment

* Two flows—material flow and information flow;

* Two roles of the Agents—— Each agent will be a part of the environment for other agents.。

CAS —— basic ideas (Cont.)

5. CGP, Constrained Generating Procedure

* For individual, CGP is the mechanism of its adaptation;

* For system, CGP is the routs of its involvement.

CAS —— basic ideas (Cont.)

6。ECHO Model

* SITE —— Geographic Concept has been involved.

* SOURCE —— Resource Concept has been involved.

CAS —— basic ideas (Cont.)

Eight common features of Emergency:

A。Appear in Generating System;

B。Whole is greater then the sum of its parts;

C。Stable pattern consists from varying parts ;

D。This pattern is also depended on the environment;

CAS —— basic ideas (Cont.)

E。The new function will appear also with the pattern ;

F。This pattern will follow some micro rules which is different from the macro rules;

G。Existence and stability of some difference among agents;

H。Multi-layers architecture appears during the evolvement.

To see the end remarks of the book “Emergency”

参见《涌现》一书的结尾

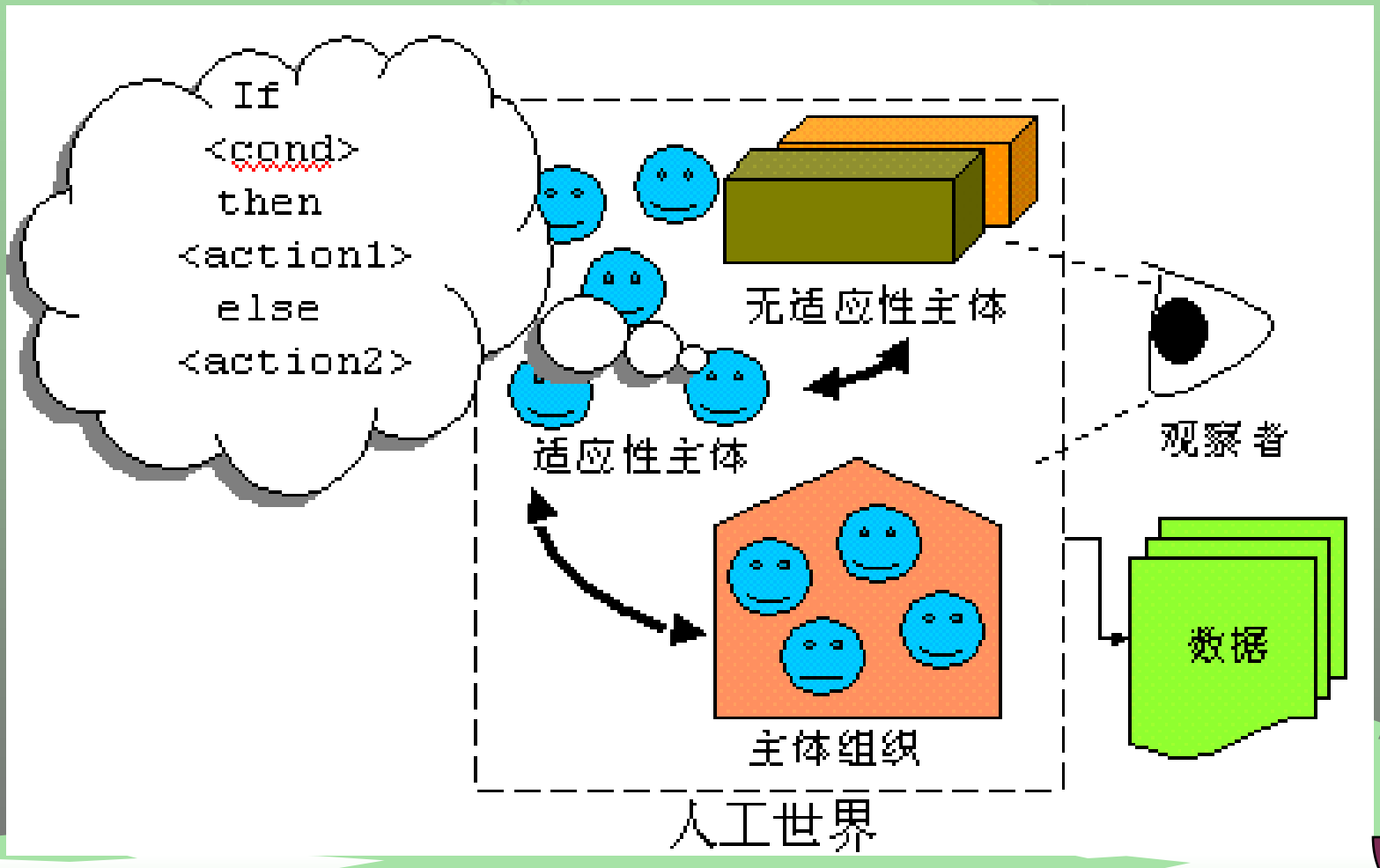
Summery

On the button line, the key idea of the CAS is :

Emphasize the elements of system is the Active Agents instead of dead 、passive objects

This idea has spreader wide, and known as ADM (Agent Based Modeling) or MAS (Multi-Agent System).

Button-Up Approach for modeling



What is valuable for us?

Compare with traditional approach in our MIS research and teaching, the new approach has four advantages:

——— Description of the active feature of the agents;

——— Hierarchical Feature;

——— Dynamic Feature;

——— operational and easy to handle with.

Other schools in Modern System Science

According to Prof. Cheng Si Wei, Modern, System Science has five main schools today. (see his speech at 2002 at Renmin University)

- System Dynamics（Forrester, DYNAMO)
- Chaos School (Chaos, Fractal)
- Adaptation School（SFI，Holland)
- Category School
- Post modernism

- Therefore , CAS is just one of the schools in the Modern System Science.

4. What are the lessons

During these 30 years , we have learned a lot from the practice.

The main lessons of them are as followings.

A. More Business Oriented

——Many projects have failed because of technique oriented approach

——Business Process Re-engineering

B. More People Oriented

——Everything is dong by people, if relative people don’t want to do, the computer can do nothing.

——Human behavior have important influence on the application system.

C. More Process Oriented

——It is Impossible to decide everything at the beginning. The implementation of Computer Application System is a growing process. The key successful factors are an extensible initial architecture and a continuable growing mechanism.

——The system should be grown up from the enterprises, not put in from outside.

D. mechanism Oriented

——The most important is to design proper mechanism, let the system can run its self.

——Understanding the behaviors of all the relevant parties is one of the key successful factors for projects.

Some direction of Research

To deal with those difficulties , we think following research direction needs pay more attention.

Field 1: New Technology

Modern Information Technology is growing rapidly. We should pay a lot of attention to trace its newest development, and try to understand its influence on MIS.

For example:

- **RFID**
- **Data Mining**

Track technique progress

*** How is a concept become billion-dollar industry?**

Communication of ACM 2008.8 P29

*** The tools we used during these 30 years**

Software 2008 sep/oct P19

Field 2: System Science

As a Complex System, we need new approaches and methodologies from the Modern System Science.

for example,:

—— CAS Theory (Complex Adaptive System), from J. Holland.

—— Scale Free Network, (from Prof. Albert-Laszlo Barabasi, University of Notre Dame)

—— SNA (Social Network Analysis)

Field 3: Game Theory

The Game Theory is a powerful tool for dealing with complex social problems.

In the Economics, the special field concerned Game Theory called Information Economics, it is very useful for the practical work.

End remarks

The Information Management and Information System is still a new field in academic world. And it has been changed rapidly and dramatically.

So we believe that learn form others disciplines, Including Modern System Science, will be useful.


Thank you very much
for your attention!
Q & A