

WU-LI SHI-LI REN-LI SYSTEMS APPROACH TO A MAJOR PROJECT ON META-SYNTHESIS RESEARCH*

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Abstract

Since 1999 we have participated in a major project sponsored by National Natural Science Foundation of China (NSFC), which aims to explore the macroeconomic system problems by meta-synthesis systems approach (MSA) proposed by Chinese system scientist Qian Xuesen (Tsien HsueShen). It is found that the oriental *Wu-li Shi-li Ren-li* system approach may be applied to describe the working contents and process all through the project. In this paper we describe the concrete contents of *Wu-li Shi-li* and *Ren-li* in this project. The three kinds of coordination, negotiation coordination, technical coordination and practice coordination are emphasized during the research process.

Keywords: *Wu-li Shi-li Ren-li* system approach, meta-synthesis, coordination

1. Introduction

Meta-synthesis method is proposed to tackle with open complex giant systems by Chinese system scientist Qian, Xuesen (Tsien HsueShen) and his colleagues around early 1990s (Qian, Yu and Dai, 1990). The method emphasizes the synthesis of collected information and knowledge of various kinds of experts, and combining quantitative methods with qualitative knowledge. Later it is evolved into Hall of Workshop for Meta-Synthetic Engineering (HWMSE) which emphasizes to make use of breaking advances in information technologies (Wang, et al, 1996; Qian, 2001). Then continuous endeavors have been taken to put those ideas into practice. In 1999, Natural Science Foundation of China (NSFC) approved a 4-year major project engaging to implement a pilot HWMSE demonstration for macroeconomic decision making under a budget of 5 million *yuan*, one of the largest investment for one project supported by NSFC in 1990s.

Around 60 researchers from 14 nationwide research institutes or universities are involved after several rounds of peer and expert reviews. Those people are separated into 4 groups or subprojects: Group 1. HWMSE platform; Group 2. macroeconomic modeling; Group 3. meta-synthesis method and systematology research; Group 4. knowledge discovery, data-mining and cognitive process analysis of macroeconomic decision making (NSFC, 2001). To facilitate the whole project undertaking, a special group is established for integrative system design and coordination of those 4 groups' work and communications between NSFC and this project as referred as Group 0.

As the members of Group 0 and 3, we find that the oriental *Wu-li Shi-li Ren-li* system approach may be applied to describe the working contents and process all through the project, and some results are analyzed after mid-term check of project (Tang and Gu, 2002). In this paper the concrete contents of *Wu-li Shi-li* and *Ren-li* in this project are addressed. Coordinating activities which

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cover negotiation coordination, technical coordination and practice coordination are taken during the research process. Initially the evolution process of WSR is reviewed briefly.

2. A Brief Review about *Wu-li Shi-li Ren-li* System Approach

Wu-li Shi-li Ren-li approach is an oriental system approach. The Chinese terms, *Wu-li* (Theory of Physics), *Shi-li* (Theory of Doing or Managing) and *Ren-li* (Theory of Humanity) are often used to reflect those laws or rules followed in practical activities as related to different situations. Since the end of 1970s systems engineering (SE) people in China began to discuss those terms. In 1978, a paper titled *Technology for Organization and Management - Systems Engineering* written by Qian, Xu and Wang (1978) was published in one Chinese newspaper *Wen Hui Bao*. In that paper, it is addressed that operations research (OR) can also be called *Shi-li* to refer the way of doing and managing regarding that *Wu-li* describes the movement of physical world. Xu (1981) also wrote specific paper on *Shi-li*, which was in consistence with the view that OR research includes OR theory, OR mathematics and OR practice. Later, Qian introduced their understandings on SE in a letter to a MIT professor Li Yao Tsu, who agreed with the concepts of *Wu-li* and *Shi-li*, and suggested adding *Ren-li*, which specifically means motivation. However, the saying of *Ren-li* had not got enough attention in the circle of Chinese SE scholars at that time. Gu (1988) began to put three terms together in the middle of 1980s and proposed a saying as “knowing *Wu-li*, sensing *Shi-li* and caring *Ren-li*”; while did not think from a methodological level. During the middle of 1980s to the start of 1990s Gu had engaged in several practical projects: Beijing regional development, global climate change, various evaluation projects and water resource management, etc. Some troubles were met when dealing with human relations, decision makers’ behaviors and interdisciplinary knowing during those projects. Gu found that most of existed western hard and soft system methodologies were difficult to solve those

kinds of troubles due to special Chinese cultures and social backgrounds.

In 1994 Gu took a 2-month visit to the Centre for Systems Study, University of Hull. He compared those western system methodologies with oriental ones based on his exchanges, observations and his own SE experiences. He had discussed with Zhu (who was a doctoral student in that time) for a long time about Gu’s experiences and troubles during SE practices in China. According to the western experiences in formulating system methodologies they formalized WSR system approach as an oriental system approach whose basic framework including main contents, philosophy, principles and working process were addressed at a research report and later in a paper (Gu and Zhu, 1995). Here using the adjective “oriental” they emphasized the differences between eastern and western cultures. A ready successful example of this approach was a undertaking project for local water resource management in Qinhuangdao area, north of China finished in the end of 1994 (Gu and Tang, 1995; Tang, 1995). Since then Gu and his colleagues have applied WSR approach to a series of practical projects in different fields (Gu, et al., 1997; Zhao, 1997; Gu, et al., 1998; Gu and Gao, 1999; Tang, 1999; Zhao, 2000; Tang and Gu, 2001; Abe, 2001; Yamamoto, 2001). There are also discussions about WSR and practices in China by other researchers (Zhao, 1996; Ouyang, 1998; Zhang, Shen and Zhang, 2000; Zhang and Sun, 2001; Attwater, 2002; Lu, Peng and Peng, 2002; Peng, Lu and Li, 2002). For a detailed WSR introduction, see Gu and Tang (2002). During the working process of the above-mentioned NSFC major project, we find the close relationship between MSA and WSR (Gu, 2000). We also find the possibility of applying WSR approach to organizing project and understanding the problems aroused during the project implementation. Next we address the WSR contents in the NSFC major project.

3. *Wu-li Shi-li Ren-li* Contents in the NSFC Major Project

In Tang and Gu (2002), the WSR approach to the

project has been discussed based on the mid-term check about the project by NSFC. Since July of 2003, the project has been waiting for final check by NSFC. Then we review our recent progress and consider what kinds of knowledge needed to explain the mechanisms of

what is concerned, the final observable technical achievements of the project based on 4 groups' whole work, and coordinating activities and results based on Group 0 and other groups' work. Figure 1 shows the WSR contents by a 3-dimension figure.

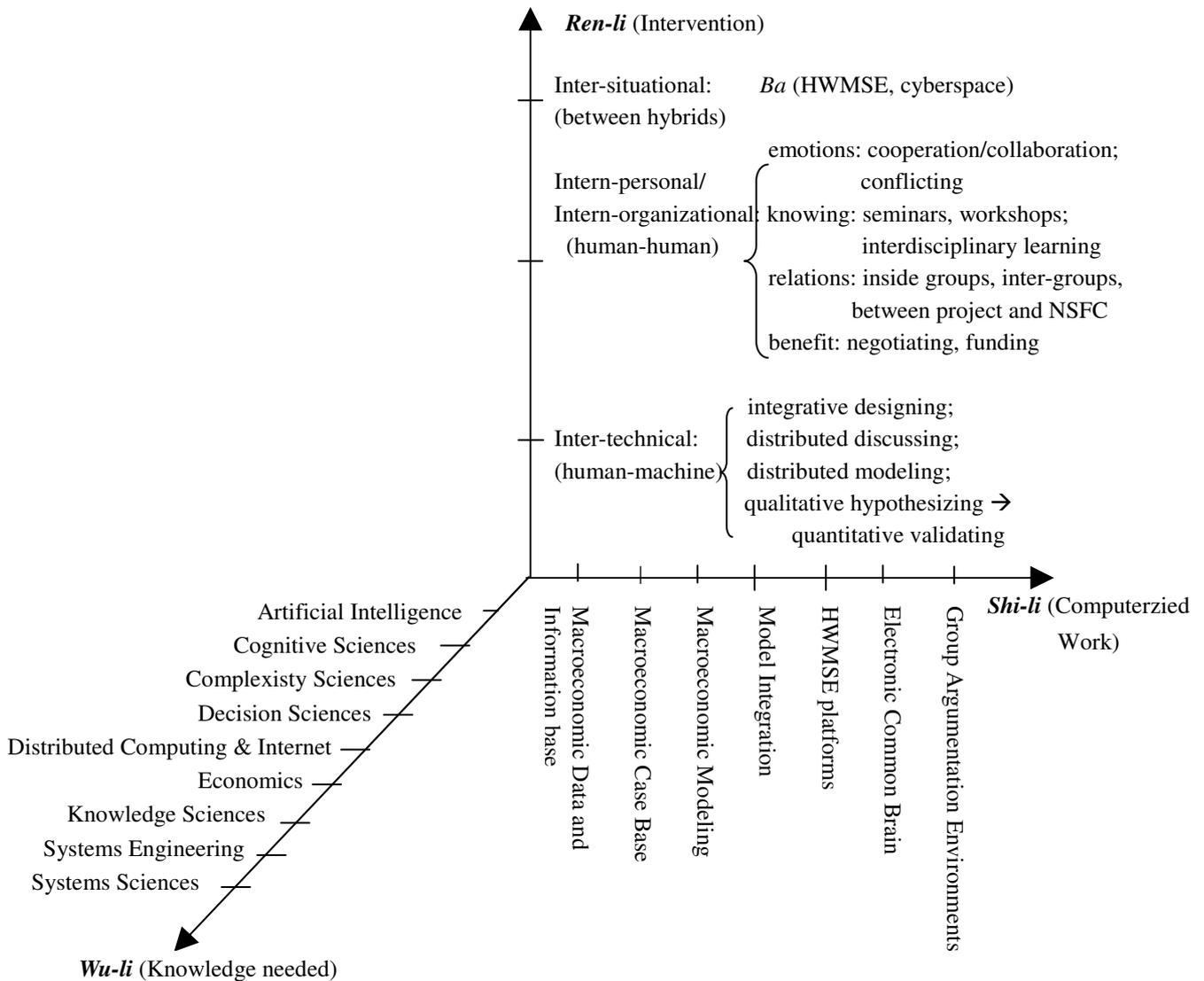


Figure 1. WSR Endeavors in the NSFC Major Project for Demonstration of HWMSE

Actually, the axis of *Shi-li* only lists the basic computerized work implemented by all 4 groups. For macroeconomic modeling, which is one of the principal tasks in this project, there developed a variety of models from different perspectives (Gu and Tang, 2003). *Ren-li* aspects emphasize more on human intervention. Linstone and Zhu (2002) had compared TOP approach and *Wu-li*

Shi-li Ren-li system approach where T, O and P denote technical, organizational and personal, respectively. We argue that such a correspondence does not reflect the essence of *Ren-li* aspect which actually covers more than TOP perspectives. Here we consider those impacts from integration and synthesis endeavors from man-machine, human and human, and hybrid perspectives.

Human-machine interaction denotes inter-technical intervention, which covers integrative designing fulfilled by Group 0, distributed discussing, distributed modeling, and MSA working process (combination between intuitive thinking and logic thinking, and qualitative hypothesizing and quantitative validating). Coordination between human and human refers to inter-personal and inter-organizational considerations which includes emotional facet on behavioral patterns, knowledge combination (interdisciplinary research), human relation (members inside the group, members within the groups, member outside the groups, researchers and users) and benefit negotiating. A higher level intervention is inter-situational, which refers to collaboration between hybrids which creates a *ba* for knowledge creation and wisdom emergence with help of computerized work. *Ba* is noticed by Japanese researchers (Nonaka and Takeuchi, 1995) and defined as a platform where knowledge is created, shared and exploited; the most important aspect of *ba* is “interaction”. The knowledge-creating process is also the process of creating *ba*, which means to create a boundary of new interaction (Nonaka and Nishiguchi,

2001).

4. WSR Working Contents in View of Coordination

Tang (2003) analyzed the trend of decision support system (DSS), especially group support system (GSS) based on a decision-making paradigm proposed by Courtney (2001). HWMSE can be regarded as one kind of DSS, while is beyond traditional DSS in providing meta-synthetic support for decision making. In our project, the main goal is to build an embryonic demonstration of HWMSE to serve a test bed of meta-synthetic support for ill-structured problem solving. Tang and Gu (1993) summarized three kinds of coordination relevant to DSS, coordination within a concrete DSS (technical coordination - TC), coordination during DSS development (negotiation coordination - NC) and coordination between DSS, users and environments (practice coordination - PC). Tang (1995) discussed the relations between three kinds of coordination and WSR, which here is applied to our project.

Table 1. The Interrelation between WSR and TC-NC-PC in the major NSFC Project

	<i>Wu-li</i>	<i>Shi-li</i>	<i>Ren-li</i>
TC	Research contents of individual group work (HWMSE platform, macroeconomic modeling, data-mining, model integration, idea generation and knowledge synthesis, systemalogy, etc.)	Integrative design, system methodologies, specific web page and BBS for communications/cooperation, system integration	Distributed discussion rooms for a HWMSE; distributed modeling
NC	Set up the objectives, proposals for NSFC; project's name change (prototype system → simple demonstration), MSA trends	Project organization; interdisciplinary learning (seminars, workshops, visits); international exchanges including series workshops on MCS and KSS; IFIP VEAM'2002; series JISR-IIASA CSM workshops)	Individual → cooperation → collaboration/ or negotiation/conflicts
PC	Validation of macroeconomic modeling; aggregation of computerized results of separate working groups; uncertain factors (e.g. SARS)	Alternatives of system integration: seamless integration → distributed integration → adhesion of group's computerized results; specific tests, MSA special session in IIASA	MSA developments; growing community; interdisciplinary knowing

(where CSM: complex system modeling; IIASA: International Institute for Applied Systems Analysis; JISR: Japan Institute of Systems Research; KSS: knowledge and systems sciences; MCS: meta-synthesis and complex systems;

IFIP: International Federation for Information Processing; VEAM: virtual environment on advanced modeling)

Table 1 briefly lists principal activities from interactions of WSR and coordination views based on work by Group 3 and collaborations with other groups, especially those preparing endeavors for simple demonstrations on how to evaluate China GDP growth with the impact of SARS by MSA for the special session on MSA held in IIASA just after JISR-IIASA workshop on CSM on September 11, 2003. (For introductions about this special session, please browse the relevant web page via IIASA web site.) The demonstration is a result of a meta-synthetic working process.

In order to present this demo, invited participants communicate more frequently via biweekly seminars on what to report for IIASA and how to integrate those computerized work (including macroeconomic models, data mining models, system reconstructability model, group argumentation environment, macroeconomic database, etc). A commercial software PathMaker is used to serve as the infrastructure to integrate all ready resources from Beijing Institute of Information and Control, Tsinghua University and Institute of Systems Science, Chinese Academy of Sciences. A work flow is designed to exhibit the power of our demo as synchronous meeting I \rightarrow asynchronous analysis \rightarrow synchronous meeting II. In detail, we have such a sequence of activities, M0 (preparing meeting); M1-1 (free discussion); M1-2 (topic discussion); brief summary; M1-3 (further discussion); analysis (qualitative modeling); M2 (detailed discussion) and consensus building to exhibit the basic ideas of meta-synthesis from qualitative hypothesizing to quantitative validating.

By the experiment design and demonstration in IIASA, some experiences and knowing are achieved as summarized in Table 1.

5. Concluding Remarks

In this paper, after a brief review about the oriental *Wu-li Shi-li Ren-li* system approach, we apply it to our current undergoing NSFC project. The WSR contents, the purposeful activities for the project from the

interactions between WSR and coordination views are addressed. Through a special session on meta-synthesis system approach held by IIASA, some experiences and knowledge are achieved by the whole working process of the experiment design, seminars, rehearsals and final demonstrations. Some new knowing about integrative designing and integration is acquired and listed in Table 1. Further research will be done to analyze the communications and collaborations among research units quantitatively for better understanding of effective operation of large NSFC project for new knowledge creation and wisdom emergence.

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