Soft OR in China: A critical report

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Abstract

As China's reform steps into the 'deep water zone' where value complexity becomes paramount, general-purpose decision-making aids such as Operational Research (OR) are increasingly confronted with the challenge of dealing with interest conflicts. However, due to historical events and institutional circumstances, OR in China to date is largely constrained by a technocratic approach which is not fit for purpose. Encouragingly, recent OR innovations inside China signify a conscious move to embrace value plurality and tackle social conflicts. OR is not merely a neutral tool for solving technical problems, but a world-building discourse that shapes society. The future of OR, particularly Soft OR, in China will be determined by whether OR workers are willing and capable to act as institutional entrepreneurs promoting scientific and democratic decision-making that deepens the reform toward an open, just and prosperous society. The implications go beyond the OR community and China's borders.

Keywords

OR in societal problem analysis; Soft OR; China reform; Value complexity; Historical–institutional analysis

1. Introduction

China's reform is now in its fourth decade. As the whole world is busy adjusting to the 'China miracle', inside the country there is an emerging consensus across political divides that the reform is at a critical point, though what direction China should be going remains a contentious question. During the past three decades the reform tackled problems mainly at the periphery, now it has to face the difficult core. The easy bit has been done. From now on, every step forward, or backward, will be accompanied with enormous risks. After years of 'crossing the river by touching stones', China is entering the 'deep water zone' (Wu, 2010).

As a body of research and practice embedded in society, what has OR achieved and failed to achieve? How is it doing and where is it going amid China's unprecedented transformation? These questions are relevant and timely, we believe, not only for the fate of the OR community inside China. As China is taken as the model by an increasing number of developing countries and China itself is becoming a big consumer of 'Western' management know-how, OR's China experience has far-reaching implications beyond its borders.

This article is a tentative attempt to investigate those questions from a historical–institutional perspective. In this article 'OR' will be used as a conceptual umbrella to denote the rich body of general-purpose decision-aiding research and practice which includes not only quantitative techniques (linear programming, waiting line analysis, etc.), but also systems approaches and problem structuring/solving methods. 'Soft OR', accordingly, refers to the systems approaches and problem structuring/solving methods that aim at facilitating the 'framing and definition of issues constituting the problem' in complex social contexts (Mingers and White, 2010). This is a custom initiated by Checkland, 1981, Flood and Jackson, 1991 and Rosenhead and Mingers, 2001, adopted by many in the OR community (e.g., Brown et al., 2006 and Ackermann, 2012), which is, we expect, familiar to the readers of this journal.

There is no lack of reviews on OR, in fact 'hard' OR, in China (e.g., Li et al., 2000 and White et al., 2011), but reviews on 'soft' OR remain scarce. We claim this article adds value on the grounds that (1) whilst previous studies focus on the tenets and applications (e.g., Qian et al., 1993, Gu and Zhu, 1995, Gu and Zhu, 2000 and Li, 2010), this article investigates the development of OR in China through a historical–institutional perspective and (2) unlike available reviews which are mainly underpinned by East-West philosophical comparisons (e.g., Wilby, 1996, Midgley and Wilby, 1995, Midgley and Wilby, 2000, Zhu, 1998 and Zhu, 2000), this piece examines China-born OR approaches in the specific context of China's reform.

The article is organized into three sections. We begin with an assessment of the inadequacy of (soft) OR in China: analyzing urgent challenges confronting decision-makers, presenting a historical account of the OR metamorphosis, and investigating the impacts of Western Soft OR contributions. We then present three indigenous innovations that aim at facilitating strategic decision-making, presumably with 'Chinese characteristics'. In the final section we reflect on the Chinese experience, expose OR's world-building effects, and argue for value-

conscious, interest-sensitive, truly 'soft' and 'systemic' OR that fits the purpose of aiding scientific and democratic decision-making in contemporary China and beyond.

2. China calling

2.1. The emergence of interest plurality

Decision-makers are often frustrated by the complexity involved in the decision-making process. Few would disagree with this observation. The question immediately pops up, however, when we tackle problems at hand: what does complexity mean?

Wu (2010), an influential pro-market economist and key adviser on China's reform, distinguishes two complexities: (1) information complexity which is due to bounded rationality and distributed knowledge (Hayek, 1945 and Simon, 1955) and (2) value complexity which is associated with interest plurality and power relations (Crozier and Friedberg, 1977 and Cyert and March, 1963). Wu further posits that there are costs in dealing with both complexities: information cost to the former and motivation cost the latter. Central planning as an approach to decision-making fails because it confuses the two complexities. It is based, instead, on the assumptions of full information and a single interest subject (Kornai, 1992). As the assumptions do not fit with real life, central planning in practice faces almost unlimited information cost as well as motivation cost. In this sense, reform is to reduce the costs of dealing with information and value complexities. Accordingly, the historical challenge to OR is to aid decision-makers to tackle the two complexities.

At the early stage of the reform, as many have acknowledged, China adopted an 'organic strategy', allowed non-state sectors to develop, bottom-up and outside the systems, so as to gain experience, nurture entrepreneurship, cumulate original capital, and generate momentum for further transformation. During this stage, reformers intentionally tackled problems at the periphery, delayed changes at the core, and avoided offending vested interests, by measures such as 'dual-track mechanisms'. In complexity terms, the growing non-state sectors reduced the demand for central planning and control, resulting in decreased information costs. Meanwhile, value complexity remained insignificant and motivation cost low because the organic strategy managed to benefit the majority of society: farmers in the countryside thrived by running private businesses while city workers and officials improved their lot with decentralized managerial rights. At this stage, it was largely a 'Pareto improvement process', a 'reform without losers' (Lau et al., 2001 and Zhu, 2007).

After 30 years of experimentation, tinkering at the periphery is no longer an option. Reform changes economic interest relations via re-arranging socio-political institutions. There are gains in the process, but the gains are not evenly distributed. A halfway reform created a rent-seeking heaven for the few to rob the many. Though annual GDP growth averages 10%, China is today one of the most unequal societies in terms of wealth distribution (Lum, 2006, McGregor, 2007 and Sun, 2003). Its Gini coefficient climbed from 0.16 before the reform to the current 0.47 (UNDP, 2010), and the urban–rural income disparity reached 6:1 against the world's normal 1.5:1, with 20–30% of GDP going into rent-seekers' pockets (Wu, 2010,

pp. 386, 388, 389). The 'Pareto improvement process' and the Maoist 'single interest subject' are gone. Now there are losers.

Reform has made interest diversity apparent while accelerating the emergence of multiple 'interest subjects', i.e., social groups with divergent, even conflicting, expectations and demands (Sun, 2006). The urgency is for all to see: 280,000 'mass incidents', i.e., public protests, were officially reported in 2010 alone. This shook society from the bottom to the top (Coonan, 2011). 'We must survey and investigate changes in interest relations, understand and analyze development trends in China's social interest structure, so as to better coordinate interest relations and interest demands of stakeholders,' said President Hu (2012).

In today's China, while information complexity remains, value complexity has become paramount and motivation costs are intolerably high. Dealing with value diversity and interest conflict is now the primary concern of China's decision-makers in governments as well as in enterprises. Can OR, or Soft OR, pass this acid test?

2.2. The ambivalent technocratic competence

OR was introduced into China in the 1950s chiefly by Qian Xuesen. After completing his studies at Shanghai Jiaotong University and the Massachusetts Institute of Technology, Qian briefly worked on the Manhattan Project and then pioneered the ballistic missile industry in the US, quickly establishing himself as one of the brightest minds in the new field of aeronautics. During the McCarthy era, Qian was stripped of his security clearance and kept under virtual house arrest. In 1955, the US let Qian go, trading him for its pilots captured by the Chinese during the Korean War. Within ten years since then, isolated from the outside world, China launched its ballistic missiles and, shortly afterwards, atomic bombs and satellites. In 1956, Qian setup the first OR team in the Chinese Academy of Sciences. In 1978, when the chaotic Cultural Revolution ended, he immediately promoted systems engineering in government projects, industries and universities. Qian emphasized *shili* (conceptions and ways of organizing activities) in addition to *wuli* (science and technology know-how), which resulted in one of the 'Oriental systems methodologies' and inspired others (see next section).

Qian was exceptional in many other ways. He had a life-long, keen interest in art, music, literature and philosophy. His painting was of accomplished quality and his wife was a celebrated opera singer-professor. Qian was critical of those who 'bully with mathematical symbols and equations': 'Mathematics is an important tool. But it cannot change rights and wrongs. You cannot right a wrong concept with mathematics; the right will remain right, however, although it may advance a bit slowly without the help of mathematics' (Qian, 1994, p. 122).

Nevertheless, Qian embodied the constraints of the time. He defined OR as 'technical science', much narrower than his contemporary OR pioneers Churchman et al. (1957) did. He never touched any socio-political thought other than the official Maoist ideology. He was concerned about social systems and human problems, but only within the confines of cognition and life science. He never mentioned interest, value, power or social conflict in

'open complex giant systems'. During the Great Leap Forward campaign that cost tens of millions of lives, he, as the father-figure of science in China, signed articles ostensibly proving Mao's outlandish farm output targets (for an introduction to Qian's life see, e.g., Wang, 2011).

Qian's legacy is thus ambivalent: he was strong in dealing with information–cognitive complexity, yet his contribution to the tackling of value-interest complexity is almost zero. While his systems idea is influential, the idea in effect expels the most important aspects of social life from OR altogether. Whilst we should not judge historical figures through the lens of today's circumstances, it is a critical question whether Qian's information-without-value, brain-without-soul technocratic approach should be pursued as the exemplar of OR, in contemporary China as well as anywhere else.

History supplies answers. Before the reform, OR was a convenient tool for the Chinese state to implement central plans via government and state enterprise projects. OR workers' technical competence — Qian style — fitted well with the time. It did not challenge the official ideology, nor did it undermine the status quo. Rather, it bypassed purposes and values to just get jobs done – whatever job decided by the state. At the early stage of the reform when value complexity was not paramount, the Qian-style OR still worked reasonably well and 'systems engineering' gained popularity. Emphasizing *shili* that addressed issues such as multiple perspectives, expert communication, human–machine interaction and combined use of quantitative and qualitative methods, Qian's 'softened' version made OR more efficient for reducing information cost.

When China's reform enters the 'deep water zone' full of interest conflicts, however, the limitation of Qian's legacy becomes plainly apparent. As Qian never embraced value complexity, his 'softened OR' has almost nothing to say about decision-makers' urgent policy concerns: prevalent corruption, wide-spread rent-seeking, massive unemployment, worker–management tensions, messy housing systems in cities and healthcare systems in the countryside, widening regional disparities, rapid environmental deterioration, and so forth (Zheng and Tok, 2007). Excluding issues of value complexity, Qian's OR failed in protecting the marginalized social groups; it failed, too, in helping the leaders to handle social conflicts.

No doubt, Qian's softened OR will continue to play a role in the economy: building and running railways, airports, dams, stadiums and factories more efficiently. But it no longer aids strategic decisions, such as *whether* China should build those dams or stadiums, let alone social policies inevitably charged with conflicting demands. In Qian's framework, OR can only tackle the technical bit and itself remains a technical bit.

Today, 'social systems engineering' is still popular in China's political vocabulary, but its meaning becomes increasingly hollow. Even before Qian's death in 2009, decision-makers no longer came to OR workers for aid when making strategic decisions. Instead, they turned to policy scientists and public administration experts who are by definition good at dealing with value complexities (Li, 2004 and Li, 2008). Left with decreased status and job opportunities, OR workers have to look for new application domains, noticeably in the financial sector (Gu, 2011). The move is not without risks, however. While China was lucky in

not getting burnt by the 2007–2008 financial crisis — thanks to the lack of 'financial innovations' — the latest move of China's OR workers may change just that.

2.3. The rise and fall of Western influence

Western Soft OR (hereafter WSOR) is not unfamiliar to the Chinese. Since the 1990s, Russell Ackoff, Peter Checkland, Robert Flood, Michael Jackson and John Mingers all delivered seminars in China. Checkland's *Systems Thinking, Systems Practice* was published in Chinese in 1990, followed by the works of Flood, Jackson and some others. Meanwhile, Chinese scholars, after studying at Lancaster, Hull, Kent and Wharton, eagerly applied WSOR to solving China's problems (see Zhu, 1998 and Zhu, 2009 for overviews). When the dust settles, however, evidence of success is scarce and real differences difficult to find. Worse, the popularity of Soft OR appears in decline. In 1998 and 2000, for example, the proceedings of the Chinese Systems Engineering Society biennial conferences both had a (soft) methodology section, featuring 11 and 13 papers respectively. A decade later, in the 2008 and 2010 proceedings, the sections were gone, leaving only two and four 'soft' papers to appear in other sections. Apart from underlying China-West philosophical differences (a topic in itself that deserves dedicated investigation and will be pursued elsewhere), what are the reasons?

Let us face it: WSOR was not designed for China – which WSOR inventor had China's peculiar circumstances in mind when she/he constructed her/his approach or methodology? With all their goodwill, experiences and skills, WSOR inventors had their own interests, and they worked in specific historical–institutional contexts different from China's. Academic exchanges and comparative studies have been to date mainly serving the purpose of expanding WSOR applications to the wider world. Under heavy workload and pressure for publication, Western pioneers were too busy to really engage China. After delivering seminars in the country, they had to leave the real job to their Chinese collaborators. Should they happen to be involved in practical projects, the ultimate focus was not China's problems but their own research agendas, e.g., to see whether Soft Systems Methodology or 'multi-paradigm multi-methodology' works in China, never mind that such agendas were thousands of miles away, literately, from China's urgent needs. This is not meant to criticize WSOR, because no one can step outside the historical context one is working in.

WSOR's rationalistic logic – seen as such in Chinese eyes – does not help either. The think-before-you-act, end-driving-means instructions do not fit with the pragmatic Chinese temperament particularly well. Insofar as choosing/mixing hard-vs.-soft methods is concerned, fitting real-world ambiguity and uncertainty into a two-dimension grid is problematic, establishing dominant metaphor(s) or paradigm(s) is reductionism, and the clear-cut, sequential divide between problem-structuring vs. -solving will do more harm than good, or so the Chinese believe. Are social problems not analyzed, solved, constructed at the same time (Nonaka and Zhu, 2012)? Again, this is not meant to be a criticism toward WSOR. Instead, it means to bring forth the differences in styles of thinking.

Perhaps the key hindering factors lie in China. First, there are institutional difficulties. While WSOR needs a Western-style liberal polity to work, in contemporary China that condition is

absent. WSOR takes play-by-the-rule and free-expression-of-viewpoints as the norm, but in China that norm is currently unstable at best.

The educational background of Chinese OR workers plays a part. Over the decades, China's 'modern' education system had been pursuing an arbitrary divide of disciplines. Students in high school were, and still are, separated into 'science' or 'liberal arts' classes. Those who went to 'science' classes touched no social sciences or humanities subjects except for the Maoist ideology. Chinese OR workers, trained in a 'science' mindset, gained little knowledge of philosophy, sociology or political science. They hence had enormous difficulty in appreciating the philosophical foundations exposed by WSOR, such as the thoughts of Husserl, Habermas, and Bhaskar. Consequently, WSOR such as Soft Systems Methodology (Checkland, 1981) tends to be reduced into technical toolkits populated with decoupled 'rich pictures', 'CATWOE analysis', 'root definitions', and so on. Where the central-control mentality dies hard and raw power is still favored, such freestanding technical toolkits risk being used to legitimate the agendas of the rich and the powerful. In this, China is typical.

The timing is unfavorable too. WSOR ventured into China in the 1990s when the country was busy tackling problems at the periphery. The economy was underdeveloped and interests less differentiated. Citizens at that time were used to following instructions from above and few would pursue their own interests as boldly as they do today. In those circumstances, Qian's softened OR worked well and gained popularity, leaving the imported WSOR look alien and redundant. As interest conflicts were not prominent and motivation cost not urgent, the demand was low for 'soft', 'critical', or 'community' OR of the Checkland, Jackson, Midgley, Mingers, Rosenhead, Ulrich sort (Li, 2011a).

Twenty years on, the world has changed. China has become confident, assertive, and increasingly insists on doing things its way. The power-shift in the last few decades is taken by the Chinese as evidence of the decline of 'the West' not only in 'hard power' but also in the supremacy of ideas and ways of doing things. As a consequence, rightly or wrongly, China's decision-makers and OR workers today do not consider WSOR suitable for solving the country's problems. History matters, events matter, circumstances matter. WSOR just missed the China train.

In deep waters full of value complexity and interest conflicts, China calls for scientific and democratic decision-making. As WSOR has failed so far to make its mark, solutions have to be generated from within. Let us examine a sample of indigenous innovations.

3. Indigenous innovations

In this section, we introduce three indigenous approaches that meet the following criteria simultaneously: oriented to aid strategic decision making, with a clear theoretical framework, invented in China and visible in both domestic and international OR communities.

3.1. Meta-synthesis approach (MSA)

Promoted by Qian and his scientist-engineer disciples, MSA is perhaps the most visible 'softened' decision-making aid inside China, which aims at dealing with 'open complex giant systems' 'where exist a large variety of components and subsystems' with 'hierarchical structures and complex interrelations' and 'exchanges in energy, information and materials between the system and external environments' (Qian et al., 1993). Taking 'cognitive science or noetic science' as the basis (Wang et al., 1996), MSA is to handle 'ill-structured human problems', which is done by synthesizing (1) quantitative analysis and qualitative judgments, (2) machines and experts from multiple disciplines, and (3) data, information, models, knowledge and wisdom. The approach is derived from Qian's all-embracing scheme that ranges from 'practical intuition', 'scientific disciplines' to 'Marxist philosophy'. It is regarded as the triumph of 'systemology' over reductionism.

The most intriguing feature of MSA is perhaps its 'Hall for Workshop of Meta-synthesis Engineering (HWMSE)'. It is proposed as a state-of-the-art man–machine interaction platform that supports problem-solving in and of 'open complex giant systems'. The Hall consists of three sub-systems: (1) database and model-base, (2) experts with diverse discipline knowledge, and (3) interfaces between experts and machines. The 'seamless working' of these sub-systems, suggested the MSA pioneers, will facilitate expert communication, hypothesis formation, problem-structuring, insight-deepening, model integration, solution generation, and knowledge validation (Wang et al., 1996). At the core of the Hall are consensus-building techniques such as Delphi, AHP (analytical hierarchy process), NGT (nominal group technique) and an arsenal of computer-aid tools including 'electronic common brain', 'integrated modeling environment', 'distributed expert systems', and so on (Gu and Tang, 2005). It turns out, as one might expect, that in MSA projects ICT hardware and software always consume the biggest chunk of budgets.

Qian's iconic status guarantees MSA's high profile, substantial funding, and mega projects. Reported applications include, among other things, weapon system analysis, complex engineering management, macro-economy analysis, and the Qinghai–Tibet railway construction. The climax to date is a 4-year National Science Foundation of China (NSFC) top-class project launched in 1999 on a HWMSE prototype for macroeconomic decision-making. Having consumed five million RMB and involved over 60 researchers from 14 prestigious institutes, the project produced considerable technical advancements and research papers. Conclusions were reported to the then president Jiang Zemin, and a 'computerized embryonic model-integration prototype' was demonstrated at the International Institute for Applied Systems Analysis (IIASA). Both events received 'positive comments'. The effect on the real economy remains nevertheless unknown: 'satisfying and convincing results have not yet been gained' (Gu and Tang, 2005, p. 602). It is anyone's guess whether the expensive project will ever produce a real difference amid China's market-oriented reform.

Deeply rooted in Qian's technocratic thinking and attached mainly to engineering projects but silent on social problem solving, MSA has nothing to do with the most challenging policy and strategy issues in today's China (Li, 2004). MSA's seemingly ideology-neutral, value-free, all-purpose definition of 'open complex giant systems', despite its vagueness, has no place for value complexity. Its version of 'ill-structured problems' is concerned with information complexity only. It deals with bounded rationality and distributed cognition but assumes

away interest diversity. Synthesis of multiple perspectives is taken exclusively as a matter among elite experts and multiple viewpoints are hence meant to be the experts' technical disputes, void of any personal or sectional interest. Since all issues and ideas must go through a from-qualitative-to-quantitative process, anything not ending up in numbers is considered insignificant. The MSA process is elite-only, aiming exclusively at producing quantified options for 'top leaders'. In the Halls, technology defines the content, logic and criteria of decision-making, as if 'the more impressive on the screen, the truer the findings, and the more scientific the decisions', which confuses everyone but those who build it. Some NSFC project insiders call it 'the emperor's new clothes' (Li, 2004).

All this effectively ensures that MSA is losing touch with decision-makers' urgent concerns. It is a machine in a sheep's skin. Democratic decision-making it is certainly not aiding. How well it aids 'scientific decision-making' remains an open question — how scientific is OR if it is based on a one-dimensional, reductionist, 'value free' model of the social world?

3.2. Wuli–Shili–Renli (WSR)

In 1979, busy softening OR and promoting systems engineering, Qian wrote to a Chinese-born American colleague Li Yaozi. In his reply, Li stressed 'motivation' and suggested considering *renli* (matters of human relations) alongside with *wuli* (science–technology know-how) and *shili* (cognitions and ways of organizing activities). Unsurprisingly, Qian put it aside. It took the tremendous efforts of the next generation of OR workers to take up Li's insight, move beyond Qian's technocratic approach, and explicitly establish value complexity as an inherent part of OR in China's circumstances. WSR is an outcome of such efforts.

WSR is rooted in Chinese soil, practically and intellectually. Engaged in real world projects for years, OR workers found that time and again OR solutions were turned down by client government officials and state enterprise managers not because of failures in *wuli* or *shili* but due to inadequacy in coping with *renli* — the project owners' unspoken intentions and agendas. Decisions are made to realize the intentions and agendas of those involved. Usually, for an OR project to succeed or just to keep going, compromises of *wuli* and *shili* excellence have to be made to satisfy officials. 'Optimal solutions' are unviable not just because of what Simon called bounded rationality (information complexity); 'satisfactory solutions' are largely shaped by what Li Yaozi called 'motivation' (value complexity). This is particularly so when 'the single interest subject' is gone, the society stratified and interest conflicts paramount. Making decisions and solving problems in the real world, we need to know *wuli*, understand *shili*, and care for *renli* (Gu, 1988). Hence WSR (Gu and Zhu, 1995 and Gu and Zhu, 2000).

Wuli–shili–renli quickly captures the Chinese imagination. This is not surprising given that enduring Chinese traditions are profoundly *renli*-centered and holistic in scope. In *Great Learning*, for example, Confucius promoted 'eight exemplary doings', which are usually grouped into three clusters: (1) investigating things, extending knowledge; (2) being sincere, rectifying the mind, cultivating character; and (3) regulating families, governing states, pacifying the world (Chan, 1963, Chen, 1986 and Cheng, 1972). It is these 'exemplary doings' that correspond to *wuli*, *shili*, *renli* respectively: to investigate the 'objective' world,

to reflect on our 'subjective' minds, and to care for 'intersubjective' human relations (Zhu, 2000).

In a similar manner that Vickers (1968) paved the way for WSOR by stressing that 'human systems are different', Xu Guozhi, one of China's OR founders who originated the concept of *shili*, supported WSR's move beyond Qian's information-without-value paradigm: "truly complex systems with human beings must be explained and handled with *renli*," Xu suggested (2000, p. 340). WSR promoters take great pains to avoid Qian's hollow 'scientific' definition of 'open complex giant systems'. In WSR, *renli* might begin with social capital, *guanxi* and the navigation of human-relation minefields for getting jobs done. But it will not and should not stop there. If it did, it would still be brain-without-soul. *Renli* in WSR is ultimately geared to promoting ethical decisions, social justice, public interests and higher purposes. With WSR, OR not just aids building high-speed railways or synthesizing expert knowledge, but also asks: high-speed railways for whose benefit, and does expert consensus serve the common good (Zhu, 2011)? On top of 'how to manage?' we are obligated to deliberate 'to what end?'.

In Wu's (2010) terminology, WSR embraces both information and value complexities. It is a balanced act: enrich OR beyond technical competence, not displace it. WSR is critical of partisan, one-dimensional OR, be it 'hard' or 'soft'. In the end OR must deliver substantial, practical differences, not just changes of viewpoints. For this, WSR introduces OR workers to a wide range of methods, techniques and tools, 'hard', 'soft', 'critical', and encourages pragmatic usage of whatever resources at hand. It is history, experience and learning-by-doing, not rationalistic grids, that inform the choosing, mixing and improvising methodologies. WSR has a process guidance, which practitioners may or may not use, and, if used, it can be modified in many ways — depending on circumstances. Coping with social policy and strategic issues, WSR relies less on machine power, more on human imagination and judgment (Nonaka and Zhu, 2012). For this, it is criticized by some as 'lacking operability'. Others reject the criticism but agree that WSR is a tougher call than technocratic approaches of the MSA sort.

WSR has been applied in projects such as water resources distribution, sustainable regional development, agricultural agencies cooperation, state-owned enterprise restructuring, service industry standard formulation, labor market construction and project/performance evaluation. Beyond formal projects, WSR has been used in state-owned land management, innovation and entrepreneurship, knowledge management, value chain analysis, supply-chain partner cooperation, customer relationship management, and so on (Gu and Tang, 2006, Nonaka and Zhu, 2012 and Zhu, 2002). A trend can be discerned that the application of WSR is being expanded from government-sponsored engineering projects to broader areas of public administration and private enterprise management. For example, WSR enabled local companies to beat foreign giants such as McKinsey in the competition for consultancy projects (Wang, 2006).

3.3. Experimental policy research methodology (EPRM)

Experimental policy research methodology, or EPRM, was invented as a response to China's current policy-making challenges. The challenges include: First, people have been more

willing to get involved in public decision-making process and many decision-makers are also keen to incorporate the interest appeals of stakeholders, but there are very few institutionalized mechanisms for political participation (e.g., authentic elections) or public participation. Second, marginalized groups are weak, less organized and lack resources, which makes it difficult to get them heard in the confrontation with stronger stakeholders that possess political clout and professional support. Third, government decision-makers often get confused and trapped in dilemma when citizens and/or stakeholders present to them contradictory appeals and evidence. In short, the challenges are how to effectively address the interest conflicts and evidence conflicts in modern China, a less-democratic and less-organized context (Li, 2010, Li, 2011a, Li and Li, 2004a and Li and Li, 2004b).

As a purposefully designed response to the value complexity and information complexity in policy issues, EPRM aims at providing a 'simulated democratic forum' for stakeholders of a specific social issue to seek acceptable policy solutions through a facilitated participative learning process. As a 'soft laboratory', EPRM is to help policy makers, policy researchers, and stakeholders 'acquire a better understanding of the interest conflicts' and to 'testify relevant evidence systematically' through three distinctive mechanisms (Li, 2010).

The first is 'simulated interest gaming'. Based on prior stakeholder analysis, EPRM interveners invite a panel of participants from different interest groups to conduct interest expression and bargaining adversarially by putting their competing viewpoints, evidence, expectations and demands on the table, and to pursue possible win–win solutions through facilitated negotiation to achieve interest coordination. This is a multi-round process, which enables participants to understand more fully the cases of their own and of others as well as of the whole situation by questioning and clarifying, and to further improve their positions to resolve conflicts by searching for jointly acceptable and workable solutions.

The second is 'meta-synthesis support'. To ensure interest gaming is meaningful, fair and effective, equal access to resources is the key. EPRM involves professionals with various discipline expertise, experiences, skills and, if necessary, machines to support stakeholder participants, particularly those from marginalized social groups. Each social group is supported by a dedicated team of professionals to make the expression, debate and negotiation more professionally and deliberatively. The job of the professionals, including policy analysts, domain experts and technical assistants, is to help competing groups to collect data, analyze situations, enhance evidence, clarify demands, evaluate options, seek common grounds and deepen learning-by-doing. They do this by qualitative and quantitative methods such as providing knowledge, conducting surveys, modeling and simulation. Adopting the MSA terminology, EPRM calls this 'meta-synthesis support'. But there are significant differences. Whereas in MSA experts are the masters of problem-solving by overriding values, in EPRM professionals are facilitators and supporters. Their role is to help stakeholder participants and the wider public better engage in the gaming and learning process. And the use of technologies is pragmatic, entirely contingent on situated particulars.

The third mechanism is 'participative learning'. Starting from a problematic and messy situation, an EPRM process can help EPRM interveners, policy makers and participants learn more about the policy issue, stance and concerns of relevant interest groups, points of

interest conflicts, credibility of evidence, acceptability of options, and feasible solutions to accomplish interest coordination. These findings or learning are crucial for policy-making. In this sense, the simulated democratic forum can be deemed as a 'policy laboratory', as implied by the word "experimental" in EPRM. Further, the EPRM process is designed to be open to the public so the learning process within the laboratory publicizes and stimulates the learning of citizens. This opens the door for deliberative policy analysis and participative decision-making (Fischer, 2003 and Hajer and Wagenaar, 2003).

While the success of EPRM still depends on the leaders' goodwill, participants' commitment, professionals' competence and resource availability, with the above three features EPRM in our view displays substantial potential to aid scientific and democratic decision-making in China's circumstance. On the one hand EPRM extends OR's application and competence scope beyond MSA for better dealing with information and value complexities. On the other hand it supplies an operable device to care for *renli*, a key contribution of WSR to OR. So far EPRM has been applied in government-sponsored public pricing hearings (Lu et al., 2007), teaching simulation (Li, 2011a) and policy research arena (Li, 2011b).

4. New OR, new reality, new uncertainty

China's experience is a wellspring of lessons for OR development. We stress the following.

4.1. Indigenous learning

The OR innovations we examined, MSA, WSR and EPRM, all benefit from encounters with the West. As a discipline of management practice and research OR was introduced chiefly by Qian and his colleagues from the US. Even under Mao's isolationist regime, Qian maintained prestigious channels to follow latest scientific developments in the outside world, which proved an important inspiration and intellectual source of MSA (Qian et al., 1993).

WSR is a direct outcome of encounters between China's OR practice and WSOR innovations *à la* Ackoff, Checkland, Jackson, Mingers, Rosenhead, and many others. Without Gu and colleagues' substantial project experience in China, but for Zhu's arrangement for Gu's early 1990s visits to Hull, or absent of Gu and Zhu's collaboration particularly in the early foundation years between Beijing and Hull, WSR might be in an entirely different form from what it is today (Zhu, 1998 and Zhu, 2010).

From EPRM, we see the obvious influence of Western adversarial methods (e.g., Mason and Mitroff, 1981). Inventors of EPRM make the similarity apparent between its 'professional-supported gaming' and the 'policy analysis support system in the US' (Li and Li, 2004a). Li's visits to Hull and Syracuse only make the intellectual links with the West more explicit. Recently, the connections between EPRM and Western deliberative policy analysis (e.g., Fischer, 2003, Hajer and Wagenaar, 2003 and Innes and Booher, 2010) were explored more fully (see Li, 2011a and Li, 2011b).

Thus, Western innovations contribute a lot to Soft OR in China, in many ways. For this, we are deeply grateful to our WSOR colleagues. Nevertheless, no one can learn for China; there can be no substitution for indigenous learning (Li and Li, 2003 and Zhu, 2009). Even in the

midst of deepened globalization, China – and other developing countries for the matter – must develop OR that fits its circumstances, through its own efforts. Developing countries must learn their own ways to improve their well-being. Whether China's OR innovations will have impact on Western countries is, by the same logic, chiefly the judgment and effort of WSOR workers.

4.2. Path dependency

OR development, like other human activities, is conditioned by culture, history and events. All MSA, WSR and EPRM strive to reassemble China's traditional holistic mindscape as systems thinking today maintains great appeal to the society. As a result, OR and the systems approach grow into each other more deeply in China than in its Western counterparts. In various ways Chinese OR workers are cautious of what they see as the over-cooked skeptical attitude of some in WSOR toward 'hard' approaches (Gu and Tang, 2006 and Li, 2011a). You cannot build a strong, rich country with inefficiency and irrationality — the Chinese always argue. Changing people's worldviews is of course important but OR should not stop there, it must maintain a strong interface between the 'hard' and the 'soft', the Chinese repeatedly emphasize (Zhu, 2011). Both WSR and EPRM put into practice the cooperation between soft and hard methods, while MSA promotes 'synthesis of qualitative and quantitative researches' at least in its peculiar way. A reminder: exporting WSOR in the forms such as Soft Systems Methodology (Checkland, 1981) to China will likely encounter long-haul frustrations, especially amid the current East-West mega power-shift.

Although dedicated to move beyond Qian's technocratic approach, WSR and EPRM make substantial usage of the materials supplied by it. WSR is built upon the *wuli–shili–renli* concepts, all bearing Qian's fingerprints. As to EPRM, its 'meta-synthesis support' for interest gaming is explicitly incorporated from MSA Halls. Of course, during the process WSR and EPRM make paradigmatic changes on Qian's materials. What does all this tell us? It tells us that Soft OR innovations will not come from nowhere and that learning is an enterprise of creating something new out of materials available at hand (Freeman, 2007 and Schumpeter, 1934). This is an example of Rorty's point that "we cannot step outside history" (Rorty, 1999).

China's OR metamorphosis is evidently shaped by events. Without McCarthy and the FBI's 1950s investigation, there might have been no Qian's 'homecoming', and OR's China history would be entirely different. Absent Gu and Zhu's unexpected 1993 stranger's hand-shake in Beijing, we might not have WSR as we know it today (Zhu, 2009). Without Li's shift of focus from systems engineering to policy research, EPRM may not have emerged (Li, 2011a). History matters and is full of accidents, surprises, seemingly insignificant happenings that produce significant consequences (Chia and Holt, 2009). OR development is not different.

Events tend to have unintended lock-in effects that shape development paths (Arthur, 1994 and North, 1990). Qian's OR success in launching missiles, for example, nurtured a deeply engrained command-and-control, big-is-beautiful mindset that molded MSA. If it works well in building complicated weapons, it must work equally well in managing the economy and society, or so it is believed. As late as the late-1990s, when China had

embarked reforms for almost 20 years and non-state sectors produced over half of national output, Qian and his colleagues still forcefully argued for creating a 'National Economic System Totalizing Design Agency' and a 'Social System Totalizing Design Agency' so as to 'serve people's interest'. The argument goes, 'we are a country with public owned [read 'state-owned'] means of production as its backbone', where 'parts must be subordinated to the whole' (Ma, 1996 and Yu, 1996). They still argue for it today in Qian's name. Between central planning and a market economy, there is no doubt which direction the technocratic OR is striking for. Which reminds us of 'the men of system' who, as Adam Smith noted hundreds of years ago, failed to comprehend the complexities that they presumed to resolve into order (Smith, 1976, pp. 233–234).

4.3. OR, problem-solving, world-building

OR is a pragmatic art of problem-solving. As China is now in the reform deep water zone, we believe the priority of OR workers is to enhance competence in aiding decision-makers dealing with value complexity. It is China's historical call.

Nevertheless, we do not believe in functionalism. The fate of different versions of OR, hard, soft, critical, MSA, WSR, EPRM, will not be determined solely by how well they aid solving problems. Beyond functionality, subtly, OR's fate is itself a result of interest gaming where power and politics are in play. OR is more than merely a tool for solving technical problems: it is a collective discourse for value-charged world-building (Foucault, 1994). Engaging in discourse, each OR group struggles to construct a reality in its favor, creates problems that its competence is meant to solve, expands the domain of opportunity for its interest, and makes all this appear natural, self-evident and inevitable (Bourdieu, 1991).

MSA is a case in point. The 'Totalizing Design Agency' proposal was turned down wisely by consecutive Chinese leaders from Deng Xiaoping, Jiang Zemin to Hu Jintao. The leaders were pragmatic enough to know the true value of those expensive 'scientific' toys. Technocratic OR succeeded, however, in other ways. With Qian's iconic status, his high-placed disciples managed to control the intellectual, financial, institutional apparatus such as the National Science Foundation, Ministry of Science and Technology, prestigious research institutes and publication outlets. Ignoring his warning against 'mathematical bullying', Qian's scientist-engineer disciples effectively established a technocratic mode of decision-making with perpetuating 'truth' effects. As a result, OR in China to date is largely under a rationalistic grip, with the 'scientific' leg long and the democratic leg short, making other styles of OR innovation extremely difficult to come by. Sadly, the unintended consequence of such dominance is the reduced relevance of OR for strategic decision-making (for a similar analysis in the British context see Rosenhead, 1992). OR in China, as everywhere else, is not just about mathematics, statistics or engineering modeling, but also interests, power, politics, and ethics. OR workers are in effect institutional entrepreneurs (Garud et al., 2007); they are world-builders (Hardy and Maguire, 2008). Their 'agency' makes a critical difference (Davis et al., 2005).

WSR, EPRM and other innovations should, we would suggest, also be seen in this light. As the future is wide open, those who recognize this – OR discourse as world-building and OR

workers as institutional entrepreneurs – and act skillfully will have better chances to succeed.

5. Conclusion

To aid decisions that matter most to society, OR needs to deal competently with both information and value complexities. Historical circumstances in contemporary China had forged OR into a technocratic mold that was impressively effective in building engineering systems but seriously handicapped in coping with interest conflicts. At a time when society is crying for scientific and democratic decision-making, mainstream OR in China is still struggling between a technical-bit self-image and an ambition to deal with social systems. The key challenge to the technocratic OR is that value complexity is not reducible to information complexity. Or, as Max Weber put it, with technical rationality we can settle scientific facts but no scientific fact can settle value judgments. Encouragingly, there emerge indigenous OR innovations that dedicatedly embrace value complexity while maintaining a holistic outlook. Growing out of the technocratic approach, the late-comer innovations move beyond it. It is a paradigm-shift process, of which this article can only present a snapshot.

How will the process play out? There is no historical inevitability and functionalism is no crystal ball. Instead, reform starts in uncertainty, proceeds with uncertainty, and tends to end up in uncertainty, too. China is in this regard a lively example. So is OR. Despite the technocratic pretention, OR cannot be neutral in politics or free of interests. OR's fate, and OR workers' well-being, is embedded in society, closely tied with China's future. As the reform is at a critical juncture, everything is up for grabs and worth fighting for. To revert to the glorious days of central planning, to line up with rent-seekers reinforcing the status quo, or to deepen the reform toward to a rich, democratic, just China? OR workers have a decision to make. In this, our 'agency', i.e., our technical competence, imaginative capability and moral sensitivity, matters.

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