INSTITUTE OF CURRENT WORLD AFFAIRS

JYB-8

Systems Engineering in China
(Part I)

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Dear Peter:

In 1968, IBM Canada in Montreal hired me as a Systems Engineer in Data Processing. My job was to define and analyse systematically problems that my employer's clients had, and to come up with an intelligent solution that used IBM's equipment, software, and services. The computer company would then sell them the solution, and I would help them to implement it. Thus, the Systems Engineers contributed to the happiness of IBM, and hopefully to that of its clients. After four years of Data Processing Systems Engineering, I went to graze in other pastures: those of the Social Sciences, more specifically, Management.

I did not work in Systems Engineering (S.E.) again for over six years, until the Fall of 1978, when I was hired by the First Ministry of Machine Building (FMMB, which was responsible for much of the civilian manufacturing production in China), and the Shanghai Institute of Mechanical Engineering (SIME) under the Ministry. I helped them set up a S.E. course to train mid-carreer professionals in factory management (cf JYB-5). Not only did this new job bring me back to S.E., but it also gave me the opportunity to become a participant in, and an observer of, this field as it was emerging in China.

The National Science Conference, held in March 1978, was the first of its kind in the history of the People's Republic of China. At that conference, the Chinese government restated its strong desire to revive scientific studies and research, which had been in decline for 13 years. The

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objective was to make the modernization of science and technology the driving force of China's Four Modernizations Program. In line with this policy, the authorities took a number of actions. They restored to loftier positions the names, and the social and economic status of scientists and intellectuals, who were labelled the "9th stinking category" during the Cultural Revolution, along with landlords and counter-revolutionaries. The decision to do so was announced officially by none other than Vice-Chairman Deng Xiao-ping in a speech he gave at the Conference. In his speech, he stressed the high value of the scientists' work to the country's development. Institutions were established to engage in educational and research activities in scientific fields, which the authorities had considered anathema to Marxism during the Cultural Revolution. The Chinese Academy of Social Sciences was founded in 1977, and research began in a number of institutes under it. Other scientific fields, which were dormant during the tumultuous Revolution, were reactivated after the Conference. Also, new fields were established, a case in point was Systems Engineering.*

S.E. was the 107th item on the government's list of 108 key scientific areas and projects presented and discussed at the Conference. Notwithstanding its position on the list, and its embryonic state as a scientific field in China, S.E. rapidly gained the attention of many of China's leaders in government, military, and scientific circles. By mid-1979, many of my colleagues in China talked of a "Systems Engineering fever" sweeping across the country.

S.E. has the most nationally visible, ardent promoter in the person of Qian Xue-sen (Ch'ien Hseh-sen in Wade-Gilles romanization system). Qian was educated in the U.S. in aerodynamics and jet propulsion design at the California Institute of Technology and Massachusetts Institute of Technology. He was a brilliant student, and, later on, teacher and researcher in a strategic scientific field. He headed the Rocket Section of the U.S. National Defence Scientific Advisory Board during World War II, had the rank of Colonel in the U.S. Air Force, was the youngest full professor at M.I.T. at the time (1946), and headed C.I.T.'s Guggenheim Jet Propulsion Laboratory (1949-55). After some trials and

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* Based on the concept of "systems," the application of modern mathematical theories and techniques (e.g. Operations Research, modelling, and simulation), and the use of advanced computer technology, Systems Engineering is a body of methods and techniques that help conceptualize, analyze, design, and implement solutions to problems. Its areas of application are virtually unlimited, examples of which are mentioned later on in the newsletter.

tribulations with the U.S. government, he returned to his native country to continue his distinguished career in science and engineering. In addition to his many positions of leadership in Chinese scientific organizations, Qian is currently an alternate member of the Central Committee of the Communist Party, and a Vice-Chairman of the Science and Technology Commission for National Defence, a military body high up in the hierarchy of the People's Liberation Army (PLA), and closely linked to the Military Commission of the Communist Party, which exercises leadership over the PLA.

Qian Xue-sen co-authored a long article, which appeared on the front page of the Wen Hui daily in September 1978. The article, titled "Systems Engineering----The Technology of Organization and Management," briefly described to the Chinese reader what systems, and S.E. were. It gave an example of the workings of S.E. in rocketry. It urged that China should use this new technological field in the Four Modernizations Program, not only in engineering, but also in other areas such as Management. It called for the setting up of Management courses in engineering and technical education institutions.

In 1978 and 1979, Qian authored and co-authored other articles dealing directly or indirectly with S.E. A title selection of these articles reads: "Modernization and Futurology," "Modernizing the Management of Materials, Books, Documents, and Archives, and its Impact," "The Science of Science, the Study of the System of Science and Technology, and Marxist Philosophy," "Military Systems Engineering," and "Social Engineering----The Technology of the Organization and Management of Socialist Construction."

Articles by Qian and others rarely described S.E. in action on any specific project in China. This fairly advanced technology had hardly been used in China, and, if it had, it was mainly in security related areas such as the military. My understanding is that the military began to use it in the early 1960s. So most of the articles were of a theoretical nature, dealing with concepts and characteristics of systems and S.E., and with related mathematical theories and techniques. Or they introduced the reader to the present or potential applications of S.E. in a variety of areas, as understood or envisioned by their authors. Often, these writings reflected the current literature, rather than the authors' practical experience in S.E. They described applications in hydro-engineering, traffic control, power generation and distribution, communications, management of enterprises, large project feasibility study and management, manufacturing of large-scale integrated circuits, information management and processing, economics, management

of Science and Technology, ecology, agriculture, education, and so on. Usually, they finished up with a propaganda blurb exorting the reader to use S.E. to make greater contributions to the development of the motherland.

In addition to their publishing activities, many Chinese scholars, scientists, and administrators began to develop programs to study, research, and use S.E. Jiao Tong University (which was interested in large-scale systems), the Academy of Military Sciences (which set up the Department of S.E. and Mathematics), the Institute of Mathematics of the Chinese Academy of Sciences (which researched topics in Systems Science and Mathematics), and SIME(which established a S.E. speciality and a S.E. Institute) were among the first few academic and research institutions to begin formal work on S.E.. In 1980, and as an outgrowth of the Institute of Mathematics, particularly its Operations Research Division, the Institute of Systems Science was founded as part of the Chinese Academy of Sciences.

1979 saw at least three national conferences devoted to S.E.. In June, the Chinese Management Modernization Research Society ran a S.E. academic conference in Tianjin. The Chinese Automation Society did the same the next month, in Wuhu, Anhui Province. Professor John D.C. Little, from the Sloan School of Management, M.I.T., and I gave talks on the first day of the conference. Another one took place in October in Beijing. Its principal sponsor was the Science and Technology Commission for National Defence, and its theme was the application of Operations Research to the military. At that conference the Chinese Systems Engineering Society's Preparatory Committee was formed. Over a year later, the Chinese Systems Engineering Society under the Chinese Science and Technology Association was officially established with the strong backing of both the government and the military.

The Society's founding congress took place in Beijing, and lasted five days, from November 18 to 22, 1980. Leaders from military, government, and scientific circles took part in it. They included Li Da, Advisor to the Military Commission of the Central Committee of the Communist Party, and Deputy-Chief-of-General-Staff of the PLA; Xue Mu-qiao, noted economist, Advisor to the State Planning Commission, President of the Chinese Statistical Society, and an intellectual force behind the current reforms of China's economy; Liu Shou-zhou, Vice-President of the Chinese Science and Technology Association; Sun You-yu, Vice-Minister of the FMMB, and who had greatly supported the development of S.E. at SIME; and Qian Xue-sen. Leaders from many branches of the armed forces and civilian organizations were present at the meeting. 118 delegates and a large number of observers from all over China took part in the meeting.

Seeing Qian Xue-sen off after the closing of the inaugural meeting of SIME's S.E. Institute, Fall 1979. Leaders of the Education Bureau of the FMMB and the SIME looking on.

The Society's constitution was passed unanimously on the third day of the proceedings. It stipulates that the Society is an academic mass organization, under the leadership of the Communist Party, and administratively belonging to the Chinese Science and Technology Association. It states that the Society's major tasks with regards to S.E. are: to organize academic exchanges within and outside China; to popularize the education and the practice of S.E. by running training courses and publicising research achievements and their successful applications; to raise the level of S.E. both in education and research; and to play the role of consultant in major S.E. projects of the State, regions, or national organizations.

To become a member, one must have a university degree or the equivalent, and at least three years experience in teaching, practising, or researching S.E.. Those who are deprived of their political rights may not be members. Foreign scholars may be elected to become honorary members.

The Society is funded by the State, and subsidized by large organizations interested in S.E., such as ministries and military institutions. A small proportion of its funds

may come from income generated by the Society's activities, membership fees, and donations.

Every three years the Society must hold a national congress or a general assembly of its members. The congress elects a council, which is responsible for implementing the decisions of the congress, formulate a work plan, exercise leadership over the Society's work, and prepare for, and convene, the next congress. Also, the council elects a standing committee, and the Society's president, vice-presidents, and secretary. The secretariat undertakes the daily work of the Society, thus it exercises a key role.

In line with recent policies regarding the reform of the administrative system in China, the constitution contains a number of interesting articles governing qualifications and tenures of the Society's officers. Presidents and vice-presidents should in principle be experts in S.E., rather than administrators. This clause goes along with the policy of encouraging scientists to play a larger role in running scientific institutions. Their tenure can not go beyond two consecutive terms. When a new council is elected, a maximum of two-thirds of its membership can be incumbent. The constitution states that a special effort must be made to recruit young and middle-age scholars to the council. This too is in line with the new policy to rejuvenate the management of Chinese organizations by promoting capable young professionals to replace old administrators, and to give them the chance to be more active in the decision-making process in their work place.

The council is required to establish four working committees and a number of speciality committees. The four working committees (and their current host organizations) are: the Academic Committee (Wuhan Institute of Mathematics and Physics), the Editing and Publishing Committee (Institute of Information of the Science and Technology Commission for National Defence), the International Academic Exchanges Committee (Institute of Systems Science of the Chinese Academy of Sciences), and the Education and Popularization Committee (SIME). The speciality committees are set up as needed. At the meeting, three such committees were created: the Systems Theory Committee (Institute of Systems Science), the Military Systems Engineering Committee (Department of Shipping Systems Engineering of the Sixth Ministry of Machine Building), and the Social and Economic Systems Engineering Committee (Institute of Industrial Economics of the Chinese Academy of Social Sciences).

Some of the tasks the committees cut out for themselves for 1981 included: to help establish local chapters of the

Society; to broadcast, wherever possible in China, a television program entitled "A Popular Lecture on Systems Engineering," and hold two conferences, one on battle simulation, and the other on S.E. education; to publish the Society's quarterly journal, and prepare the editing of a book series on S.E..

The founding congress elected its first council, which was composed of 117 people, and which in turn elected its 35-member standing committee. The Society's president, six vice-presidents, secretary, and three deputy-secretaries were all members of the standing committee. The committee named Qian Xue-sen, a military, and Xue Mu-qiao, a civilian, as the Society's first honorary presidents. It invited nine prominent people to form its first advisory board. They were Yu Guang-yuan and Ma Hong, both economists and Vice-Presidents of the Chinese Academy of Social Sciences, one of many other national positions they each hold; Sun You-yu, Jiang Sheng-jie, and Jiang Zong-jing, all Vice-Ministers of the First, Second (responsible for the nuclear industry), and Fourth (responsible for the electronics industry) Ministries of Machine Building respectively; Wang Dao-han, who held vice-ministerial rank in a number of ministries and state commissions dealing with China's foreign economic relations, and was the President of the China Mechanical Engineering Society, and Vice-Mayor of Shanghai; Zou Jia-hua and Yang Guo-yu, Vice-director of the Office of National Defence Industries, and Deputy-Commander and Chief-of-Staff of the Navy respectively; and Zhang Jing-fu, ex-Minister of Finance, member of the powerful, newly established State Financial and Economic Commission, and First Secretary of the Provincial Party Committee and Governor of Anhui Province. The Society's president was Guan Zhao-zhi, Director of the Institute of Systems Science, and its secretary general was Xu Guo-zhi, a Senior Fellow at the Institute.

Apart from attending to the business of founding the Society, delegates to the congress had 39 papers presented to them. Some of these papers dealt with new theoretical developments in S.E. in China. But many others described the results of some of the research and application of S.E. to a variety of areas in China in the very recent years. Results of a coal mine feasibility study, of the study of the Huai River basin economic development, and of the implementation of S.E. in enterprise management were shared at the congress. Some reports dealt with new applications such as education, agriculture and Chinese traditional medicine. Also, reports were given in military applications such as battle simulation analysis, and weaponry systems analysis.

We have seen how since 1978 many Chinese scientists expressed openly an interest in S.E., and studied and researched it. They got organized, perpetuated the "S.E. fever " in their midst, and succeeded in winning the attention of some Chinese leaders in various circles in China. They formed the Chinese Systems Engineering Society, which could be a solid basis to facilitate the future development of this scientific field. My next newsletter will assess the chances for the success of such a development by examining important variables at play, and based on my experience of working in China in this field.

Sincerely,

Joseph Y. Battat

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