

## **Overview on Activity of Building Commissioning in Asia and Japan**

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### **Synopsis**

The (NPO) Building Services Commissioning Association, BSCA, of Japan was established in summer 2004 and it is now supported by almost one hundred individual members and eighteen supporting corporate members. The authors had first attended NCBC 2001 in Cherry Hill with twenty-two other participants from Japan and been encouraged to promote introducing commissioning process into Japanese construction society. In addition, because the author, Nakahara, had been in close contact with Chinese academic as well as practical people on HVAC engineering for twenty years since 1983, talking about building optimization, fault detection and diagnosis as well as the commissioning process from the design to operation, with the trigger of IEA/ECBCS/Annex25, which went further to Annex 40, he continued to discuss with them about strategy to propagate commissioning into Asian countries not only to Japan. As one of BSCA's activity he recognized a mission to hold APCBC, the Asia Pacific Conference on Building Commissioning, and had the chance of the first APCBC in Shenzhen, with the cooperation of ICEBO organizers and Annex 47 participants last November.

The present paper introduces the Asian status on building commissioning with the material presented at Shenzhen meeting, and then what the BSCA's mission is and how far it is attaining or expected to attain its goal, showing several examples of the real projects, are discussed.

### **About the Author**

Nobuo Nakahara is a professor emeritus of Nagoya University, runs Nakahara Laboratory, Environmental Syst.-Tech. and the chairman of Building Services Commissioning Association in Japan. He has a wide range of research experience and has made unparalleled contributions to Japanese HVAC engineering. He has initiated building commissioning activities in Japan, led the SHASE Commissioning activities for nearly ten years to establish the Japanese Guideline and model documents for the HVAC Commissioning Process. He used to be the chairman of Japan's committee for ECBCS/IEA Annex 40. He has experienced and is running formal initial commissioning process as the commissioning authority for several projects.

Michiro Shimazu is a general manager and HVAC engineer of the technical headquarters for Tonets Corporation. He is a member of SHASE and belongs to the BEMS technical committee. He has been engaged in a lot of energy conservation diagnosis projects and retro-commissioning projects. As to the experience of initial commissioning process, he was one of the active members of commissioning team for Toden Tachikawa building that is introduced in the present paper. He won the technical prize of SHASE several times.

## **Introduction**

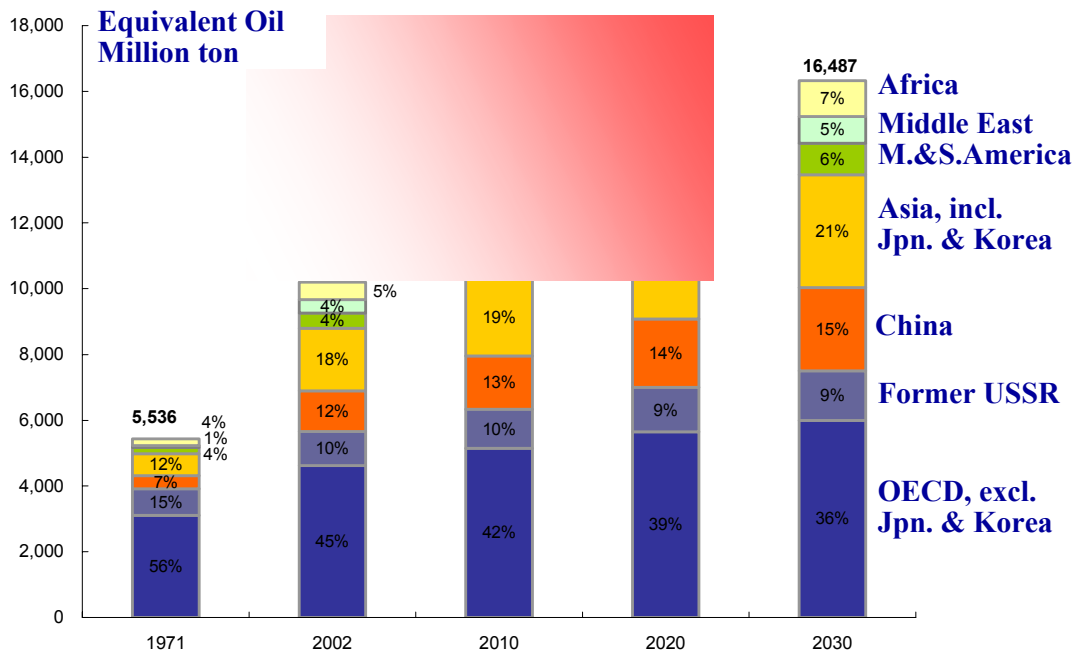
In Asia, only Hong Kong has the history of commissioning recognition since 1970s, where United Kingdom's sovereignty did popularize the term commissioning into building construction society. However, as the term commissioning had been used in UK for rather testing and adjusting of the system, the energy and environmental performance stressed meaning of commissioning, not to mention the commissioning process during building production, has come to be recognized only since several years before. In mainland China there has been no idea of building performance at the life cycle point of view during communist revolution in the mid twentieth century, so that commissioning idea never emerged from this social system before economic booming has emerged after the end of twentieth century and clearly revealed the danger in energy source and global environment. Korea and Japan have had some experiences on commissioning of American and/or European sense when industries contracted building and/or process construction works, both inside and outside these countries, with overseas countries where a certain sense of commissioning applications are popular. However, as far as commercial and public building construction works are concerned, no idea on commissioning process has ever been recognized until quite recent years.

Keeping this in mind, the author, Nakahara, proposed holding Asia Pacific Conference on Building Commissioning, APCBC, and the first one was held in Shenzhen, China, on November 8, 2006, within the program of ICEBO 2006 together with IEA/Annex 47 meeting in Hong Kong, a neighboring city of Shenzhen. The conference had been privately called for by the author, and delegates from Mainland China, Hong Kong, Taiwan, USA, Europe and Japan participated in. Present paper begins with introduction of his opening address for the APCBC sessions.

## **Opening Address to APCBC**

The idea of APCBC surfaced while Mr. Wong of Hong Kong Building Commissioning Center came to Japan four years ago to request cooperation for establishing the commissioning center. In advance in Paris at ICEBO 2004, I addressed on the title of "Japanese Vision of Commissioning Process and Asian View" and I formally disclosed the idea of this conference to be held either in Japan or in Hong Kong. After making sure that my proposal to hold this meeting among the ICEBO program was accepted by Prof. Turner and Prof. Claridge, I announced it at NCBC 2006 held in San Francisco this year in April.

It goes without saying that estimated energy demand in Asia is large and growing very rapid (**Figure 1**) and the energy-originated CO<sub>2</sub> in the world may increase almost by 70 % in the next thirty years (**Figure 2**), CO<sub>2</sub> generation originates from building and housing energy onsumption by almost thirty percent as shown in **Figure 3** as an example from Japanese data, no one can overlook the necessity of developing building commissioning among Asian countries.



From IEA/World Energy Outlook 2004

Figure 1 Actual and Estimated Energy Demand in the World

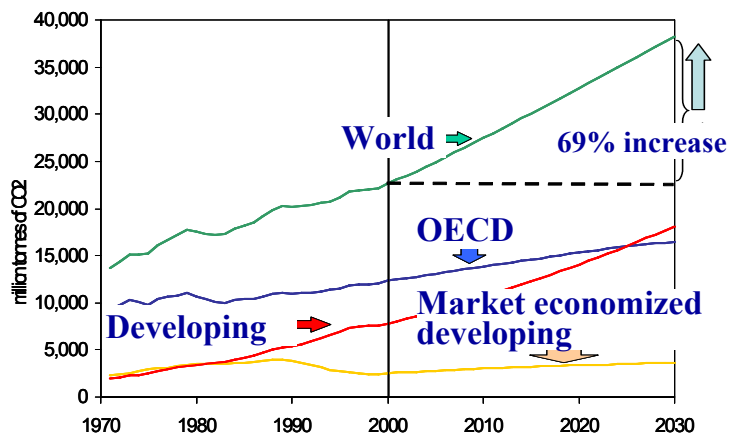
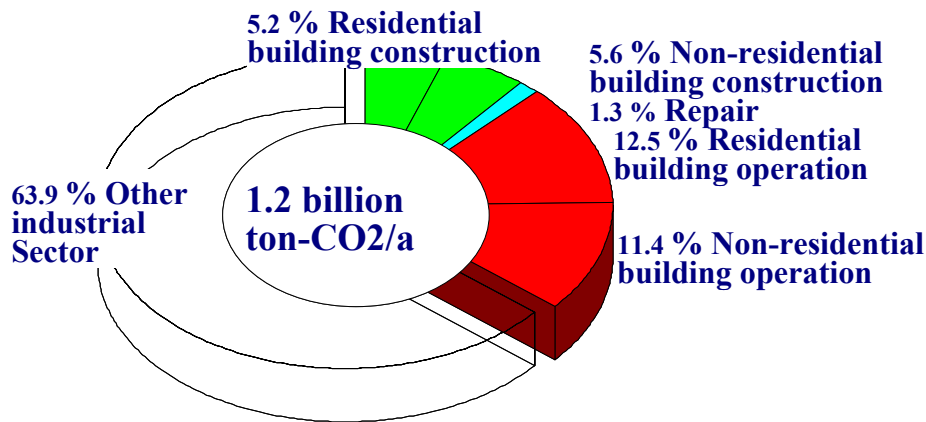
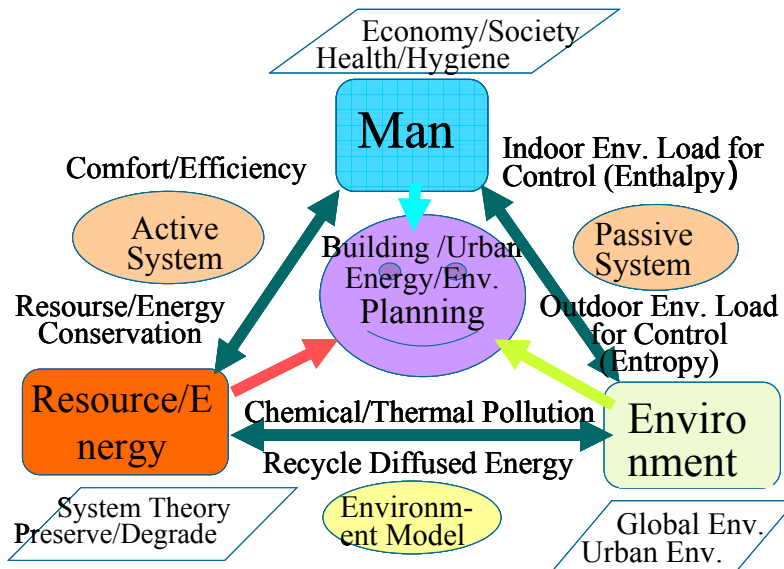


Figure 2 Energy-originated CO<sub>2</sub> in the World



**Figure 3 Origin of CO<sub>2</sub> generation in Japan**

There are four principles for reformation of buildings, towns and the globe. They are environmental circulation, energy conservation principle, commissioning and evaluation. Mechanism of the urban state change is expressed by **Figure 4**. Man, Resource and Energy, and Environment, including indoor and outdoor, compose a triangle that determines the speed of environmental state change. Various effects inside and outside of the building, various tools and systems, natural as well as artificial, and social environment are shown in this figure using typical keywords. We need to slow down the counter-clockwise vicious circulation and, if possible, reverse for virtuous circulation.



**Figure 4 Principles of Environmental Circulation**

The principles of energy conservation is shown in **Figure 5**. The Chinese character composes three kinds of meaning, that is, reflection, deliberation and saving. What is to be reflected is energy and environment. What is to be deliberated is energy saving technology and assessment.

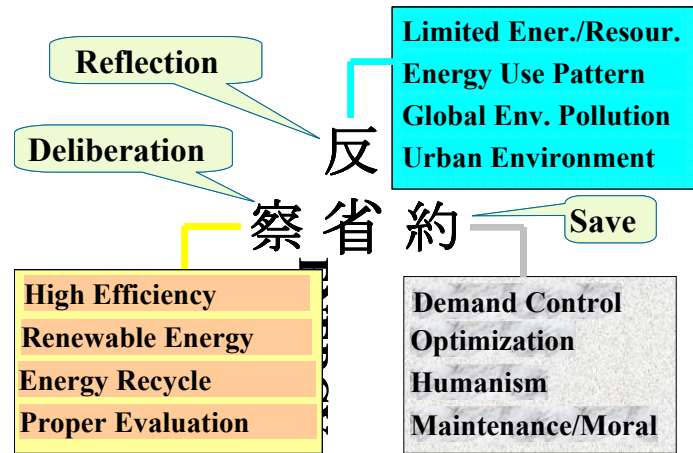


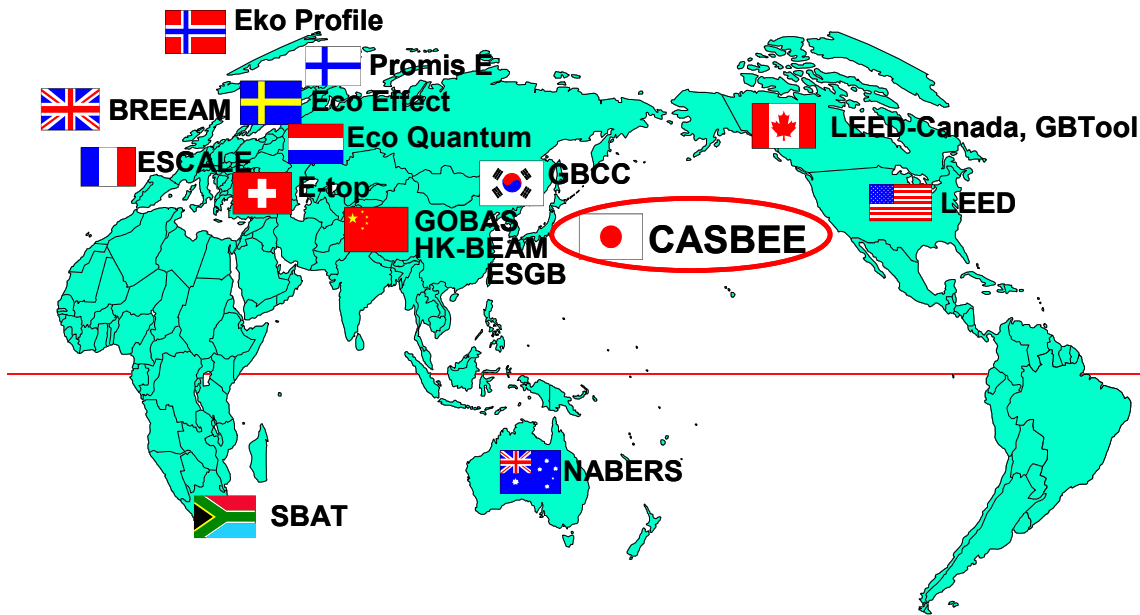
Figure 5 Principles of Energy Conservation

What is to perform energy conservation is optimal control and operation technology and humanism.

Next, the large effect of commissioning shall be recognized. Commissioning is defined in several ways from the difference of viewpoints. Here described are in two manners, one stands at process control point of view., as “commissioning is “the process to accomplish the real Owner’s Project Requirements through building construction stage and continuing to operation and maintenance stage as the life-cycle process”, and the other stands at the global point of view, as “Commissioning is performed in order to keep the system in optimal condition through the life of the building from the viewpoints of environment, energy and facility usage”.

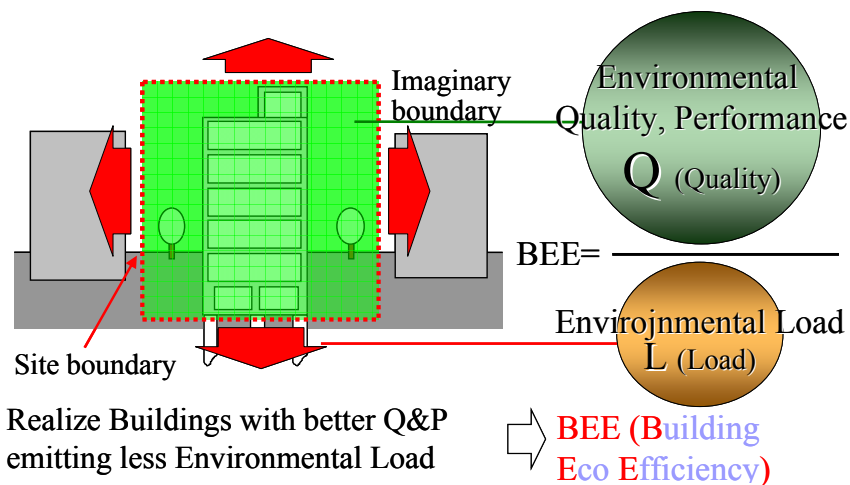
Then, proper and unbiased evaluation system for energy, environment and sustainability must be set up. **Figure 6** shows the green building evaluation system in the world. In Asian countries, CASBEE of Japan and GOBAS of City of Beijing is famous. The LEED of USA contains a prerequisite that the fundamental commissioning of building energy systems shall be applied and describes these items, beginning with nomination of commissioning authority and finalizing with submission of commissioning report. Additional requirements on commissioning are to be fulfilled for the higher LEED awardees.

CASBEE of Japan defined the index for sustainability as BEE that is the quality divided by the load, a kind of coefficient of performance. GOBAS also defined several other indices.



**Figure 6 Evaluation System of Sustainable Building**

Comprehensive Assessment System for Building Environmental Efficiency



**Figure 7 Index BEE of CASBEE (Japan)**

These are four principles to realize energy conservation harmonized with environmental issue and showed how commissioning is related. Commissioning process gives merits to building owners, design professionals, contractors and operation and maintenance engineers. Details are illustrated elsewhere. The last figure shows the commissioning history in Asia how it has developed in comparison to western world (Figure 8). It is true that the concept of commissioning process management is a state-of-the-art technology and only a few countries in Asia has recently introduced.

## World

- 1970s Cx Activ. started, USA  
CIBSE Code on Cx
- 1979 ASHRAE Symp. on TAB
- 1986 ASHRAE Symp. On Cx.
- 1988 First SIBSE Code in UK
- 1989 First AHRAE Cx Guide
  
- 1991 Annex25, BOFD
- 1993 First NCBC held, PEI
- 1995 Annex34, BOFD Demo
- 1996 ASHRAE New Cx Guide
  
- 1999 BCA (US) established
- 2000 Annex40, HVAC Cx
- 2003 UK Cx Code M issued
- 2005 ASHRAE/NIBS Cx Process  
200X-0 issued  
Annex47, Retro-Cx, etc
- 2006 ICEBO 2006 (Shenzhen)

## Asia

- 1980s (HK) TAB/Cx Activity started
- 1987 (J), First introduction of Cx
  
- 1991 (J,C) Annex25
  
- 1995 (J,HK) Annex34
- 1997 (J) Cx Activity started
- 1998 (J) First Cx Guide Draft
- 2000 (J,HK) Annex40 participation  
(J) First Application of ICx
- 2003 (TW) TAB/Cx began to work
- 2004 (J) BSCA established  
(HK) HKBCxC established
- 2005 (J) Cx Guideline issued
- 2006 APCBC 2006.11 (Shenzhen)  
(TW) Cx Guideline (to be issued)

Figure 8 Development of Building Commissioning in Asia compared with the world

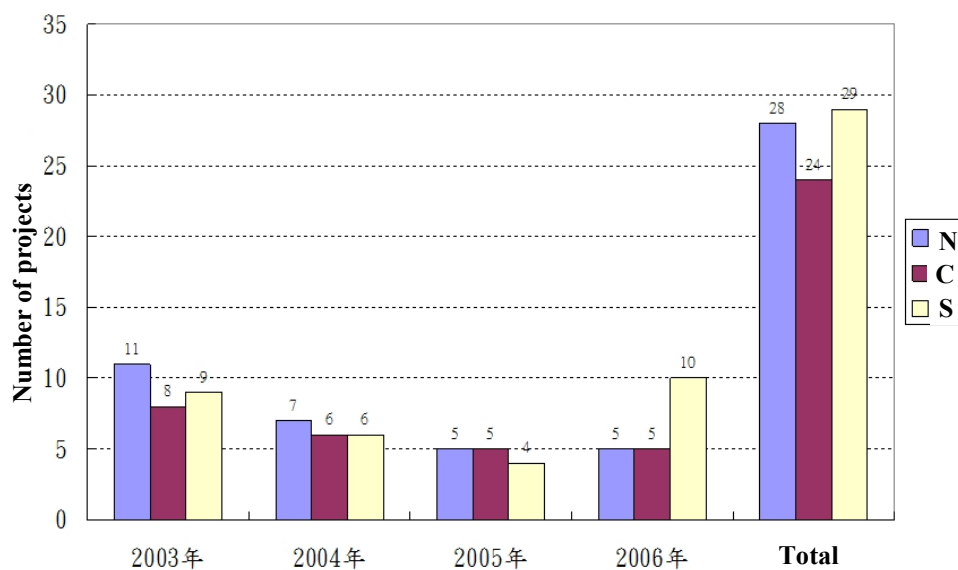
## Commissioning in Asian Countries

### *Commissioning in Taiwan*

Professor K.H. Yang of National Sun Yat-Sen University introduced the status of building commissioning in Taiwan [1]. Being located in subtropical area, hot humid weather in Taiwan imposes heavy cooling load and the power consumption of commercial and residential buildings counts over 14% of total power consumption of the whole nation. In 2003, the Ministry of the Interior, MOI, decided to conduct an overall renovation program for the HVAC systems of existing governmental buildings where BEMS adoption and system commissioning practice becomes mandatory. Public Projects with total budget sponsored by the government for over 50 million NTD (1.5 million USD) and floor areas over 2,000 m<sup>2</sup> should be regulated under the Green Building Labeling system where TAB/Cx procedure is considered a must.

All public buildings with central HVAC systems, when under renovation process, should adapt the TAB/Cx procedure recommended by the Bureau of Energy of Taiwan to be issued in December 2006. The procedure includes regulations under stages in design, installation, functional tests, and performance in conformity with the design intent. This structure has been adapted from the ASHRAE procedure. This program not only constructs an important step in responding to the national movement toward the Green Building concept, but provides a

remedial strategy for building energy conservation and CO<sub>2</sub> reduction.also. Figure 9 shows the number of projects allocated among the whole country since 2003 to 2006, totalled 81, all with TAB/Cx implemented. This renovation program results in reduction of oversized chiller capacity of 2,120 RT, or accounts for 21% of the total cooling capacity, with 44% energy saving effects, Prof. Yang says. System modification to VWV system from CWV system saved 228 kW, while 19.7 kW was saved for the VAV system. It is said that with 81 public projects completed and 16.6 million USD well spent, the TAB/Cx procedure is adapted well with successful results in Taiwan.



**Figure 9** Statistic data of the number of projects with TAB/CX implemented

It should be noted that TAB has never been performed sufficiently in Asian countries, the authors suppose, so that the expression TAB and Cx mandatory process has appeared at the same time.

### ***Commissioning in Hong Kong***

Mr. L.H. Leung addressed in his keynote speech at APCBC about the commissioning status in Hong Kong. [2] It has returned to China's sovereignty on 1<sup>st</sup> July 1997 and become a part of China as a Special Administrative Region (SAR). Hong Kong is maintaining a continuous growth on buildings and infra-structure developments continue in last 9 years. As to the building commissioning, as early in 1990, the Architectural Services Department (ArchSD) of Hong Kong Government has already published 12 commissioning booklets that regulated the testing and commissioning procedures on building services in Government Buildings. These commissioning documents then become commissioning specifications in 2002 and it is intended that these documents will be formalized to form part of the contract for all government building projects handled by ArchSD. Some two years ago, the Buildings Department of the HKSAR has launched a new voluntary scheme, termed the Consolidated Environmental Performance Assessment Scheme (CEPAS) that promote the design of environmental-friendly buildings in Hong Kong. The building commissioning has been

incorporated in this scheme as a major element for performance assessment. The Government of HKSAR has exerted a great effort and plays a leading role to promote high quality of buildings, not only in design and construction aspects, but insists that they should be commissioned to high standards for effective and efficient operation.

A group of local engineers has assembled to discuss the way forward for this issue and to promote good practices in the private sector. As a result, the Hong Kong Building Commissioning Centre was established and officiated by the Director of Building Department in December 2004. It is a non-profit making body aiming at promoting Cx practices for trade and benchmark competence of Cx people. It has issued its first local Building Commissioning Code, “M1 – A Practice Guide on Building Commissioning Management for Hong Kong” in March 2006. However, building owners’ unawareness of commissioning process and that no commissioning service provider does exist yet are the principal bottleneck for propagating through the construction society. [3]

### ***Commissioning in Mainland China***

According to Prof. Yingxin Zhu of Tsinghua University[4], there is no building commissioning in Mainland China from the viewpoint of full initial commissioning process. However, some pre-researches and trial practices on retro-commissioning have been done by universities and some research organizations. National code for HVAC system construction and acceptance was issued by Ministry of Construction in Oct. 1997. This code involved the regulations and standards related to the tasks in stages of construction and acceptance including TAB and synthesis performance assessment. National code for HVAC system operation and management written by China Academy of Building Research and China Disease Control Centre was issued at the end of 2004.

A green building assessment system named GOBAS (Green Olympic Building Assessment System), developed by Tsinghua University and other eight organizations, sponsored by Chinese Ministry of Science and Technology, was published in August 2003. GOBAS is, similar to the commissioning process, a rating system by stages: planning, detailed design, construction, acceptance and operation. Although many aspects related to resources and environment impacts are involved in GOBAS, energy consumption and system performance are still the most important contents in this assessment system. Using GOBAS, every stage of the project from planning to operation can be controlled to gain the best system performance and low energy consumption.

DeST (Designer’s Simulation Toolkit) is a tool developed by Department of Building Science, School of Architecture, Tsinghua University for aiding HVAC engineer to realize ‘design by analysis, design by simulation’. A design is performed by stages as follows:

*Program Phase → Schematic Design → Preliminary Design → Final Design → Post Design Phase  
→ Commissioning Phase → Post Occupancy Service*

DeST is an annual building energy consumption analyzing software doing simulation hourly for HVAC designers, applying simulation into different stages of design. So DeST can be used as an effective simulation tool for HVAC system design commissioning. Also, it has been used for commissioning of many existing HVAC systems in China.

Tsinghua Green Building Research Center, a low energy demonstration building with 3,000m<sup>2</sup> of total floor area, can be said the first project to which the initial commissioning process was applied in mainland China. Optimal design by simulation and analysis is implemented from the very beginning through the whole process, including the controllable fabrics design and energy and environment system design. GOBAS was used as the reference commissioning standard in this project. After completion testing, adjusting and optimal operation has been continuously commissioned by School of Architecture, Tsinghua University, which is a kind of on-going commissioning process by inhouse engineers, the author suppose..

Thinghua university has also been working as the commissioning authority on retro-commissioning for more than 20 central government buildings consigned by the Ministry of Governmental Affairs since 2005, and on design commisioning of buildings for Beijing Olympic '08. Thus, commisioning process is expected to become popular

## **Activity of Building Services Commissioning Association**

The BSCA, Building Services Commissioning Association, was established in March, 2004 and registered as NPO in August of the same year. The author, Nakahara, submitted a report to SHASE, The Society of Heating, Air-conditioning and Sanitary Engineers of Japan, board of directors after he had finished drafting Guideline of Commissioning Process for Building Services Systems at the SHASE Technical Committee, asking why it does not care about the importance of commissioning process to promote energy conservation as well as correct ill-done building production and maintenance process, in order to realize whatever functions and performances the building owners should request when they ask designers for energy and environmental systems design. An agreement was exchanged between the SHASE and newly established BSCA, Building Services Commissioning Association, about the role sharing of both organizations for promoting commissioning business and bringing up commissioning professionals as shown in the Table 1.

### ***Ties between BSCA and NCBC, PECl***

The authors with other twenty-two members first participated in NCBC in its 9th meting in 2001 in Cherry Hill. The group came through LBNL, TAMU and other points of interest from the viewpoint of commissioning, before arriving at Cherry-Hill Hilton, where they met people who welcomed us and gave him the chance to give a short speech at lunch meeting. Ms. Natascha Castro whom we knew there for the first time has become the co-presenter of international sessions at the twelfth and fourteenth NCBC meetings and Annex works as well. There, MQC matrix that was developed in the Annex 40 research for management of the commissioning process as well as the data base.

**Table 1: Work Sharing between SHASE and BSCA**

Division		SHASE	BSCA, NPO	Supposed Cx agents
No.	Organization	Corporation	NPO	Company, Individual professional
	Cx Works	Academic research and practical engineering for basic subjects of area	Promotion of commissioning process, proposal of commissioning business model, education and training	Commissioning agents doing business on commissioning process
1	Guide-line	Issue, update	Development of practitioner's commissioning documents and templates based on the guideline	Actual use for commissioning business and feedback to SHASE and BSCA
		Public information	News-letter and home-page, lectures and paper-submitting onto various media	Presentation to clients
2	Tool development		Verification and standardization of tools Provide tools to commissioning consultants	Application to actual business Feedback to SHASE and BSCA
3	Education / training	Guideline	Co-sponsoring lecture meetings	Participation, self study
		Training	Practitioner's training course Education of commissioning authority Providing commissioning tools	Self study for commissioning authority CPD application to SHASE, etc. Experience feedback to SHASE and NPO
4	Information exchange		Practical experience/knowledge exchange between international commissioning community	experience/knowledge exchange among association members
5	Qualification (yet to be studied)		Qualification system, hierarchy Training course and examination (?) Registration and follow-up CPD	Application, professional occupation
6	Social Enlightenment / PR	Lecture/Forum	Enlighten BSCA members Enlighten commissioning relating parties Enlighten citizens in general	
		Periodical publication	News Letter	
		Home page	BSCA home page	
		Publication	Commissioning handbook Reference documents, templates, example analyses	
7	Entrusted business		Research and development Commissioning business	Participation Participation

Though the size of the organization is incomparably small, BSCA had found its model in PECI and BCA, because it obliged its role to establish infrastructures for performing commissioning process such as drafting guideline and manuals, technical as well as managerial tools, education and qualification of commissioning professionals and to give a course for commissioning business. International collaboration has been a must to perform BSCA's objectives, because there was no ground at the time of inauguration among the governmental as well as commercial sectors for commissioning needs.

Last autumn in November BSCA invited Mr. Phil Welker, executive director of PECI, and Mr. Larry Luskay, commissioning authority of PECI, to introduce us how commissioning has been promoted in the US, how commissioning is profitable to building owners' point of view, how the design commissioning should be effective and how functional performance test differs from TAB. The information encouraged us to establish Japan specific commissioning process that shall follow Japanese culture but should mostly coincide with US and/or international common sense and persuade Japanese building owners as well as administrative people of the relating government.

Also discussed were if there are any chance to co-work on mutually beneficial subjects to both of BSCA and PECI. The authors think that international proliferation of HVAC and building commissioning, especially into Asian countries, where energy demand is rapidly increasing and its explosion without proper measure to control the speed of energy consumption and CO<sub>2</sub> exhaustion will definitely cause perilous results on the global environment, is the most probable co-working subject. Due to the co-working with people from various countries in Annex 40 and 47, the authors have come to believe that the models developed in the USA is not always applicable in Japan but also perhaps in the eastern world. Even in the western world, it is clear that the custom of construction business and desire for introducing commissioning process have different motivations.

### ***Commissioning Project Examples***

The earliest example of initial commissioning process on business basis is Yamatake Research Center in 2000, for which the author, Nakahara, took a role of commissioning authority. It began just at the beginning of construction phase and finished three years after the building completion. Without this experience he could not be able to lead BSCA to a right direction. Detailed information of this building and commissioning process can be referred to a report [5] that was introduced at NCBC 2004, in Atlanta.

### ***Toden Tachikawa Building***

Tokyo Electric Power Company decided to apply initial commissioning process in research basis, not in business basis, to a construction phase and post acceptance step of a newly designed building named "Tachikawa Building" in 2002, when Yamatake commissioning project had nearly approached the final stage to submit final commissioning report after post-acceptance step, and when development of commissioning guideline by SHASE had been going to mature for the final stage. The owner company aimed at establishing in-house HVAC commissioning concept and procedures for energy and environmental quality control of the building. The research team

consisted of the members who had joined the mission on visiting NCBC 2001 as described before. Mr. K. Matsunawa, now the president of Nikken Sekkei Research Institute, took a role of CA and chairman of the research committee, Nakahara participated as an advisor and Shimazu as a member of the research team as well as a member of the contractor of HVAC works of the building.

The total floor area of the office building with power control facility is 16,765m<sup>2</sup>. The energy plant consists of air-source heat pumps, water source heat recovery heat pumps and water thermal storage tank. Actions taken in the research process are as follows.

- Interview with the owner, designers and constructors.
- Development and verification of documentation tools
- Verification of construction conditions
- Verification of TAB results
- Execution of functional performance tests
- Operational data check assisted by BEMS
- Continuous commissioning and research until March 2006 and submit final report

Fortunately, the trial operations of the HVAC system were allowed by the owner for several months between the completion and occupancy of the building. It was very effective to satisfy the operational conditions requested by the CA during the functional performance test. As a result, the verification was successful in the performances of the heat source system, the thermal storage tanks and the air-handling units. However, it was difficult to verify in off-peak seasons and several problems in verification methods were remained. In addition, an opportunity like this is hardly obtained for usual buildings. It is found that commissioning process is generally challenging to be carried out for commercial buildings

The CA took the level of detail checkpoints into consideration when applying commissioning process according to available expense, then the checklists were prepared for three stage of commissioning; fully detailed, intermediate and simple commissioning. However, simple commissioning may only be available for in-house engineers to enhance their management level and should not be called commissioning process, according to Nakahara's opinion.

## **Japanese Red Cross Medical Center**

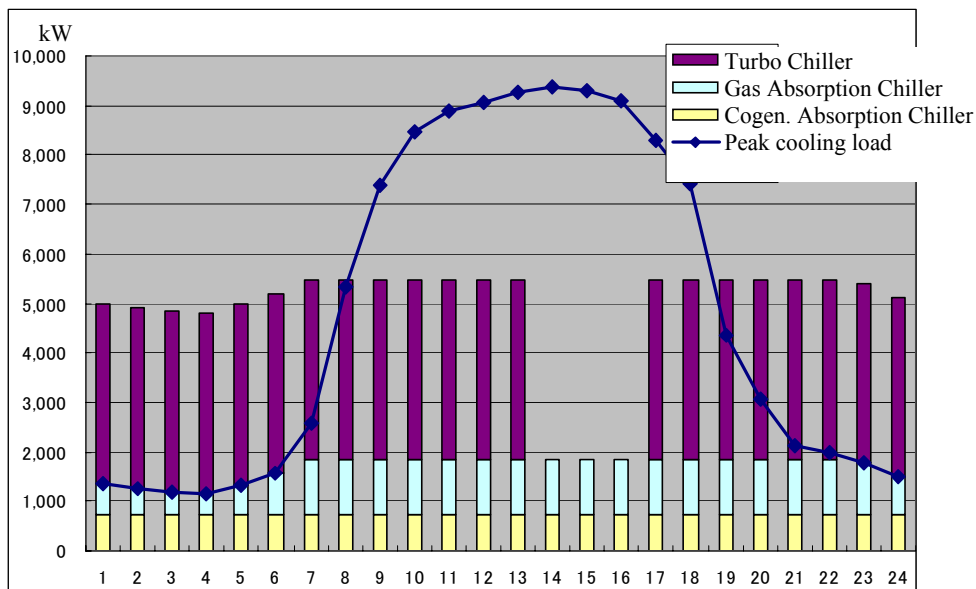
Existing facility of Japanese Red Cross Medical Center was completed in 1975. The facility includes a hospital, a nursing college, health-care facilities and dormitory for nursing personnel. After thirty years the facility becomes old enough to rebuild the new one, from the medical viewpoint as well as the viewpoints of indoor environment, energy performance and global warming index based on CO<sub>2</sub> exhaustion.

The owner appreciated the importance of energy system from the lifecycle cost and energy point of view, and the HVAC performance management with the help of initial commissioning process. The author, Nakahara, had a chance to make a presentation on how an optimal energy and HVAC system performance could be attained and how the commissioning process could help to arrive at the final goal of the Red Cross through the process. He realized that this would be the

biggest actual commissioning project the BSCA could imagine for the moment, and after finalizing it, vast amount of valuable experience and model quality process for commissioning would be summed up to provide BSCA members for their new business chance. He submitted a draft proposal document of commissioning process, for which several materials such as PECEI Model Commissioning and Guide Specifications, ASHRAE 2005 Guideline and the Building Commissioning Handbook of BCA were referred.

When the CA, Nakahara, was called for at the later stage of planning step of the program phase, the designer and his fee were already determined according to the business project proposal that includes schematic building, HVAC and energy plant design. And, though the designer promised to cooperate to the procedures of commissioning process, several basic matters concerning building project itself made the design schedule very tight and suggestions by CA could not be properly responded into the design document. Design modification was expected to be continued after the elaboration phase and construction phase, when the CA participated in NCBC 2006 and felt interested in the presentation “LEGAL AND LIABILITY ISSUES RELATING TO BUILDING COMMISSIONING” by Leah A. Rochwarg, et. al, where relations between design professional and CA as to responsibility to design content that includes CA’s suggestion was discussed. This was one of the motives the author think of inviting Mr. Welker in last autumn.

The project has just entered the construction phase. **Figure 10** shows the energy plant operation mode at the peak cooling mode that CA submitted in the commissioning report as the optimal system, a complex system consisting of centrifugal chiller, absorption chiller, heat recovery heat pump with dual water thermal storage tank and cogeneration system. The analysis was made using two kind of system simulation tools.



**Figure 10** preliminary simulation result of optimal energy plant system and operation mode at peak cooling day.

Brief building information is as follows.

- Total floor area: 81,700m<sup>2</sup>, hospital
- Number of floor: 12 and B3
- Provisional completion: September, 2009
- Energy plant load includes nursing college and health-care facilities
- 

The process that has been managed until now and for the near future is as follows.

- 1) BSCA contracts for commissioning process: Nov., 2005
- 2) Issued Owner's Program on behalf of the owner: Dec.2005
- 3) Review Preliminary design: Nov.2005
- 4) OPR workshop: Dec.2005
- 5) Issued OPR on behalf of the owner: Jan. ,2006
- 6) Issued commissioning plan, program phase: Jan. 2006
- 7) Issued commissioning plan, design phase: April. 2006
- 8) Energy system simulation report to the Owner by CA: February to March
- 9) Issued Commissioning Specification, Sept., 2006
- 10) Issued commissioning plan, construction phase, veision-1: Sept. 2006
- 11) Review Design documents but insufficiently, Oct. 2006
- 12) Follow-up of design change and add insufficient documents, Nov. 2006~

## **Acknowledgement**

The authors acknowledge Japanese friends, Professor H. Yoshida and others, who are working the best for BSCA's sake with them to propagate and promote commissioning process in Japan, Asian friends who are interested in commissioning and APCBC meeting, especially Mr. K.H. Leung and others, presenters at the Shenzhen meeting, ICEBO 2006 organizers, Professor Dan Turner and others who gave them the advantage of including APCBC day and sessions, Annex47 participants, Dr. N. Castro and others, for cooperating presentation at the APCBCsessions, people included in establishment of BSCA and participants of on-going commissioning projects and other activities and lastly Mr.P. Welker, PEI executive director, for giving them suggestion to make presentation at this meeting.

[1] Yang, K.H.: HVAC Commisioning--A Status Report in Taiwan, Proceedings of the 6<sup>th</sup> International Conference for Enhancing Building Operations, Nov. 6-8, Shenzhen.

[2] Leung, L.H.: Building Commissioning Process: Quality Buildings for Better Quality of Life, ditto

[3] Wong, C.F.: A Case Study on Management Process of Building Commissioning for a New Building in Hong Kong, ditto

[4] Yingxin Zhu: Building Commissioning in Mainland China, ditto

[5] Ito, K., Sumitomo, T., Nakahara, N.: First Experience of the Commissioning Process in Japan - Initial Commissioning and Continuous Improvement -, NCBC 2004, May, 2004, Atlanta