

INNOVATIVE AND GREEN BUILDING CONFERENCE



By
Hong Kong Science & Technology Parks Corporation - Green Technology Cluster



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1st Innovation and Green Building Conference

Co-organized by Hong Kong Science Technology Parks Corporation (HKSTP) and
Hong Kong Green Building Council (HKGBC)

Date: 27 February 2019 (Wednesday)

Venue: Charles K. Kao Auditorium,
Science Park, Shatin

Time: 9:30am - 5:00pm

Speakers



Mr Albert Wong



Ir Alfred Sit



Dr Tian Peng Wei



Ir Dave Chan



Ir Conrad Wong



Dr David Chan



Prof. S W Wang



Ir Dr Peter W.T. Tse



Mr Terence Lo



Dr James Huang



Ir Calvin Tang



Mr Alan Seigrist



Ir Gary Chuk



Dr Linda Xiao



Ir Cary Chan

Executive Summary

AI revolutionizes building systems. Are you ready?

On February 27, 2019, the Innovation and Green Building Conference was successfully held at Science Park Charles K. Kao Auditorium. More than 430 attendances including representatives from government, industry players, academies, property developers and facility managers attended the conference.

The theme of this year was artificial intelligence (AI) on Building Services System, especially on Chiller Plant operation; predictive maintenance and smart energy management.

This conference presents recent technological advancement, emerging trends and case studies where AI has been applied. It is observed that to make the model more useful and practical to use, leveraging domain knowledge on big data analytic with the AI expert is the key of success.

It is very popular for systems using Big Data Analytic techniques to provide insight and recommendations for the operator to run the system. Based on data correlation or trend of data and ruled based algorithm, systems can determine priority and impact of the event in terms of energy wastage or equipment poor performance. This kind of system can help people to make a better action plan in operating the plant so as to save energy and enhance operational efficiency.

On top of that, systems embedded with AI algorithms will look more advanced and intelligent. There are two approaches, either the Solutions Integrator works with their customer operation team to co-create the AI model or Company with domain knowledge offers an industrial specific system for the market. Both approach have demonstrated significant results, insight and control on the plant operation.

However, users still question the correctness of the decision on this kind of expert system. To improve the system performance, people need to put more resources to make the system work otherwise the recommendation outcome from the model may not be relevant or inappropriate for the operation use. AI algorithms can be learnt by themselves provided people offer feedback and the right response for them. Hence the system needs to trial with expertise for a certain period of time in order to have a reliable performance which create barrier for people to adopt these kind of system in a wider application. People are still observing the general outcome and implementation complexity. Return on Investment is still not certain which is one of the hurdles for the industry to adopt this kind of technology in a speedy way.

The conference had served the purpose of sharing insights and technology trends for property owners, operators and building professionals in the pursuit of Smart building performance outcomes and speeding up the innovative technology deployment for Smart Building in Hong Kong.

Conference Statistics



430+
Attendance

- Government/Public Bodies/Utilities **19%**
- Contractor/Equipment Supplier **17%**
- Solutions Provider **12%**
- Consultant **12%**
- Property Developer **11%**
- Facilities Manager **8%**
- Others **21%**



14
Supporting
Organisations

- Building Services
- Energy
- Engineers
- Environment Protection
- IoT
- Property Management



12
Renowned
Speakers

- ATAL
- CityU
- DataInsights
- Energybox
- Negawatt
- Planon
- Schneider Electric
- Siemens
- PolyU (2 speakers)
- Carrier
- Yau Lee/REC



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Exhibitors

Presenting the latest Smart,
AI-enabled & Green Building Technologies

Hong Kong Science Park as a living lab for smart buildings



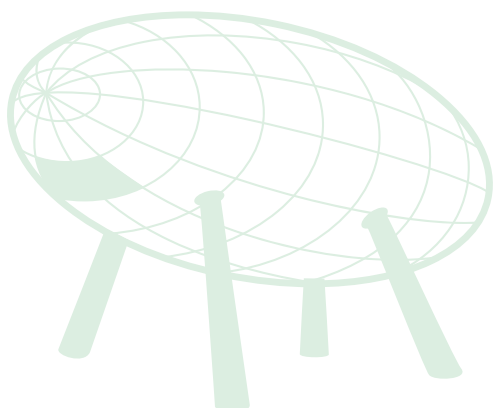
Mr Albert Wong

Mr Albert Wong, CEO of Hong Kong Science & Technology Parks Corporation (HKSTP) delivered opening remarks.

Mr Wong welcomed everyone to the 1st “Innovation and Green Building Conference”, co-organized with Hong Kong Green Building Council to promote innovation and technology for intelligent buildings, as part of the HKSAR Government’s Smart City Blueprint in Smart Environment.

He expressed the challenges of Science Park in transforming itself to be an Innovative and Green Campus and sincerely invited the audience to offer solutions for trial in Science Park and push the boundaries of the technological advancement for smart buildings, especially in AI and Big Data application.

Mr Wong also mentioned the importance of Green Technology Cluster development in Science Park where Smart & Intelligent Building is one of the key focus in their eco-system. He expected that the conference should be a fruitful one and could facilitate knowledge exchange for different stakeholders throughout the event.



EMSD empowers innovation



Ir Alfred Sit

Ir Alfred Sit, Director of Electrical and Mechanical Services Department (EMSD), HKSAR Government, and Guest-of-Honor, delivered a keynote speech.

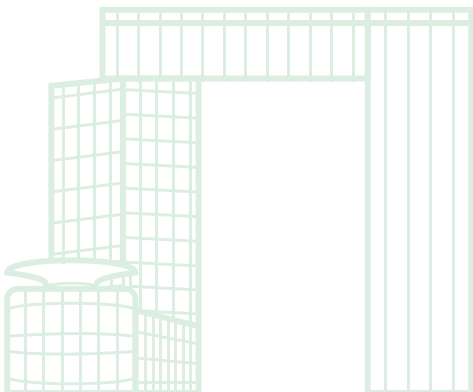
Ir Sit firstly expressed his full affirmation and appreciation on the work of HKSTP and HKGBC in driving the innovation and technology (I&T) of smart buildings through the conference.

He further said that Hong Kong had experienced the most intense Super Typhoon Mangkhut in 2018 and recorded the hottest Lunar New Year for two days in 2019 according to the Hong Kong Observatory. The message for us to step up action against climate change is obvious.

Over the past years, EMSD has accorded great importance to energy saving. Hong Kong's energy intensity has dropped by 28% between 2005 and 2016. Although the city is the champion among all APEC economies in this respect, they shall not be complacent. While Hong Kong is facing the challenge of achieving further energy saving solely with technologies available in the market, innovation and technology (I&T) can help us cope with that.

Ir Sit further elaborated on how EMSD acts as facilitator for technology trials and promotes I&T solutions for Hong Kong in the future. He further illustrated that innovation does not necessarily need to be rocket science. Any new ideas which involve out-of-the-box thinking and can meet people's needs are innovative. The power-free washing machine designed by a ten-year-old student in India to tackle the challenge of unreliable and unaffordable electricity supply is a good example.

He further explained that the Government will continue to put resources in enhancing the energy efficiency of buildings. An example is the web-based E&M InnoPortal of EMSD, which aims to match I&T wishes of users with I&T solutions of local universities and start-ups. They believe that everyone should join hands to embrace I&T and make concerted efforts to combat climate change for a sustainable future.



AI brings leap change in building systems



Dr Tian Peng Wei

Dr Tian Peng Wei, Head of Research Group, Siemens Corporate Technology China, gave a speech on “Industrial Artificial Intelligence & Smart Building”.

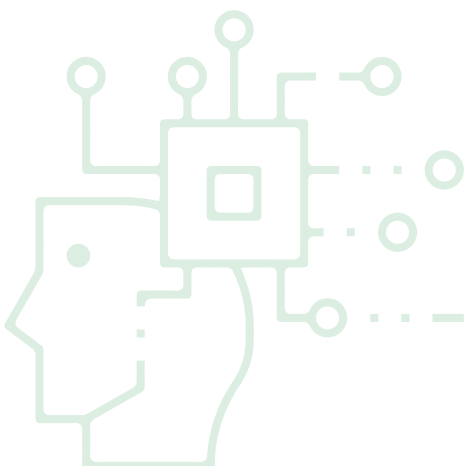
Dr Tian illustrated that how AI technology can apply to different industrial verticals, especially in Smart Building where Chiller Plant controls, anomaly detection of the system and remote equipment diagnostics application were discussed.

He expressed in detail that Artificial Intelligence (AI) has been impacting both consumer and industrial areas, including smart building. Three (3) applied AI topics which will bring tangible impact: learning to identify, adapt and interact were widely discussed.

Learning to identify is a task of generalizing from labeled training data points and supporting prediction topics in buildings, like anomaly detection for chiller plants, in which, both cross-sensor and time-series status of specific sensors need to be considered. The encoder-decoder neural network solution could well model the problem and recognize anomaly patterns proactively.

Learning to adapt is a task of acting in a context to maximize rewards and supporting optimization topics in buildings, like electricity consumption reduction of HVAC which accounts for most electricity bill charge of buildings in Hong Kong. The dynamics of whole HVAC together with environmental factors and energy consumption could be quantitatively modeled by machine learning rather than human beings. Afterwards, decision theory could identify most energy-efficient setup.

Learning to interact is a task of reasoning on existing knowledge to build hypothesis and supporting knowledge management topics in buildings, like diagnostics for facility maintenance with root cause and resolution identified. The historic maintenance tickets could be used to build a knowledge base for phenomena-oriented reasoning, like a type of “Traditional Chinese medicine” diagnostics. Combined with historical sensor data-driven and quantitatively measurement-based “Western medicine” diagnostics, the approach has proved its effectiveness.



Machine learning a boon for chiller plant savings



Ir Dave Chan

Ir Dave Chan, Director of ATAL, delivered a talk on “Dynamic Chiller Plant Optimization Using Physics-guided Machine Learning Approach” detailing their new approach of modelling the AI machine for Chiller Plant Controls.

Ir Chan illustrated that in order to provide an effective dynamic optimization control system for Chiller Plant, it should be built via Machine Learning (ML) and governed by the physical principles in Physics-guided Machine Learning (PGML) approach. This combined approach provides a basis towards self-adaptive controls while ensuring physically consistence and interpretable results.

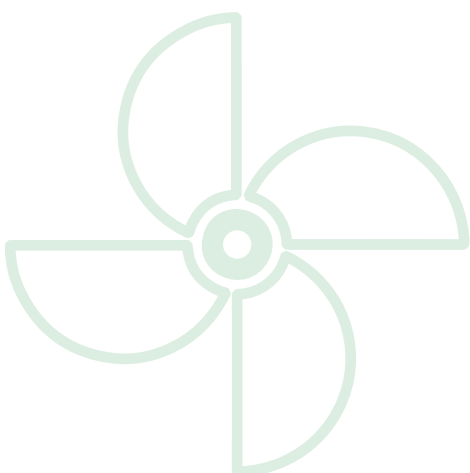
This hybrid blend of physics and ML approach reveals the actual performance of individual chiller plant equipment, including chillers, pumps and cooling towers.

By utilizing the recorded data, the representative models for real-time plant optimization can be developed to achieve overall optimal operation. The ML-based cooling load model is developed to forecast cooling load of daily patterns in consecutive days. With the predicted cooling load, the system control stability can be further enhanced to prevent hunting of the chiller plant.

Also, sensor fault detection is an essential function of the FDD algorithm because optimization and energy analytics rely on properly functioning sensors to provide actual system performance. Without reliable sensors, the system will no longer be able to identify any abnormal operation and cannot actually optimize chiller plant performance. He also demonstrated the importance for system to detect, validate and remove data bias which will greatly improve the system performance based on their solid implementation experience.

The data-driven approach adopted in the design of the system allows users to detect and evaluate the severity of sensor biases, if any, automatically by using a least square curve fitting method. The principle is based on the conservation of energy and mass.

Buildings can achieve up to 30% energy savings on chiller plant operations with the use of the said platform, depending on the building types and the buildings’ current energy performance.



AI creates synergy in green building



Ir Conrad Wong

Ir Conrad Wong, Vice Chairman of Yau Lee Holdings Limited, presented “How can AI improve design and manage Green Building”. Two types of AI approach, namely Rule based and Machine Learning had been widely discussed.

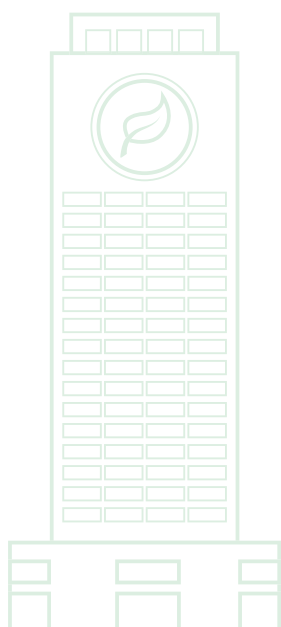
Ir Wong said that according to the Hong Kong Green Building Council (HKGBC), green building is a practice of reducing the environmental impact of buildings and enhancing the health and well-being of building occupants.

One of the main strategies is to optimize the efficient use of energy, water, and other resources. Current practices include using the Building Environment Assessment Method (BEAM) tool to reduce the environmental impact of buildings while maintaining and improving the quality of the built environment and users’ satisfaction. Such BEAM tool usually contains rules for utilizing Building Information (BIM) information, thus cutting down the assessment time to evaluate green building management strategies.

Other practices include adopting Artificial Intelligence (AI) energy optimization solutions designed to optimize the energy consumption of the central air-conditioning system without reducing thermal comfort. That kind of AI solution is usually a rule-based system with formula and control procedure embedded, like an experienced building service engineer fulfilling his duties. However, drawbacks for rule-based AI system include partial system optimization and no consideration of system deteriorating issues.

The evolvement of AI machine learning helps to improve self-learning capability. For example, Artificial Neural Network (ANN) is a data-driven modelling technique that aims to learn system knowledge. Its self-learning capability helps to keep up-to-date and cater for system deterioration.

Despite the AI machine learning solution having its own drawbacks (e.g. the size and quality of data pool), it is believed that a hybrid of AI techniques will create a synergy effect to improve the design and management of the green building.



Data makes the difference for plant control



Dr David Chan

Dr David Chan, Director of Negawatt Utility Limited, talked about “Cloud computing with Artificial Intelligence in Energy and Management Optimization for Air Conditioning System”.

To achieve better result from retro-commissioning, Dr Chan widely discussed how a cloud platform with AI and big data analysis could deliver a sustainable result for an effective plant operation.

Dr Chan stressed that the capability of correlation of all information in the building, from daily operating manuals to automatic data collection from different types of IoT devices & BMS system, on to an integrated secured cloud platform is critical for retro-commissioning.

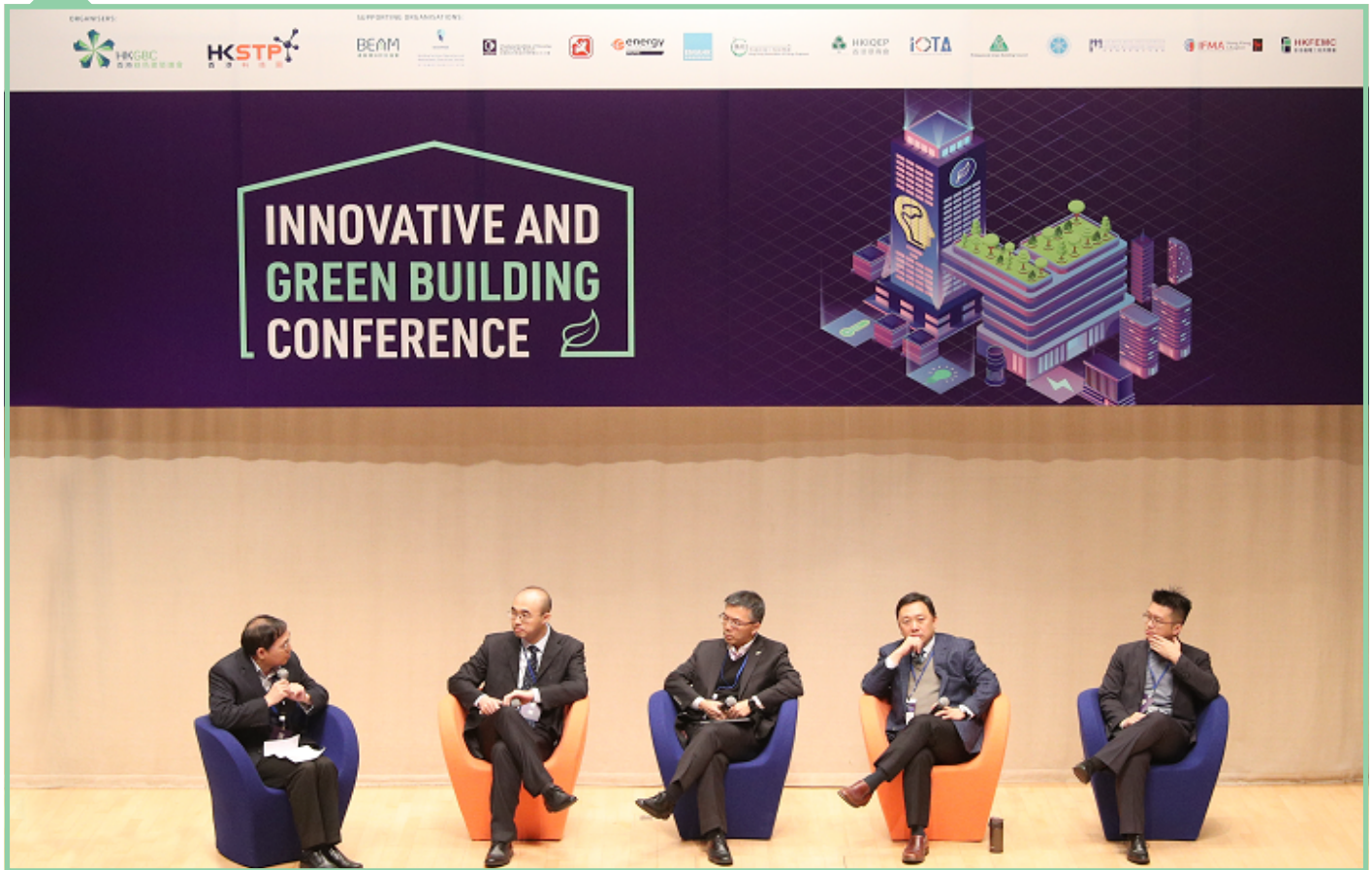
Data collected are generally separated into three kinds, the indoor (indoor environment, indoor occupants etc), the outdoor (Climatic condition) and AC Plant (Chiller, Cooling Tower etc). The AI Solution currently is capable to explore all possible way to achieve highest energy reduction while not sacrificing the comfort of indoor occupants through fast data cluster crunching and trending technique. Different suggestions can be provided to building owners whom will incorporate the suggestions into building operation. The suggestions should be simple to follow, and easy to tune without any adverse impact.

In future, AI platforms should be able to manage more data to grow with self-learning technique to achieve even more energy saving. The platform shall also continue to develop more features, ensuring the system be more user-friendly and effective in identifying energy saving solutions, making buildings smarter and raising its level of sustainability.

Based on his experience, apply these techniques in an already very efficient chiller plant, and an additional 10% energy saving can be achieved. The savings created by the platform from energy reduction will pay off the platform itself with extra savings.



Panel Discussion



The way forward towards AI for HVAC systems

Before the lunch break, a panel discussion was moderated by Prof. S W Wang, Chair Professor of Building Services Engineering of The Hong Kong Polytechnic University with morning session speakers. The topic was “Way Forward towards AI for HVAC Systems”.

There was a vigorous discussion on the challenges of using Cloud-based platforms.

They also mentioned about Internet of Things (IoT) which has brought a huge transformation in current Building Management System (BMS) Industry. In future, the degree of using Cloud and cybersecurity should carefully be determined and enhanced.

AI makes predictive maintenance effective



Ir Dr Peter W.T. Tse

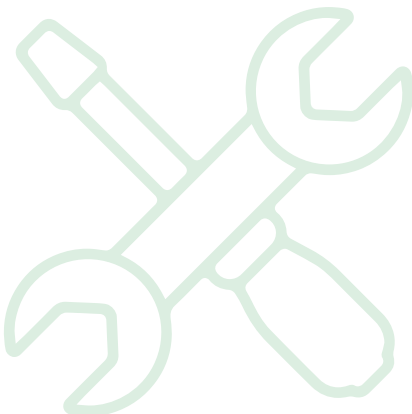
Right after the lunch break, Ir Dr Peter W.T. Tse, Director of the Smart Engineering Asset Management Laboratory of City University of Hong Kong delivered a keynote speech on “Smart and Predictive Maintenance for Critical Machines”.

Ir Dr Tse said that critical and heavy-duty machines are expensive to replace and breakdown may lead to tremendous costs and environmental loss, especially in public utility services. A proper health management system for machines must have sophisticated fault diagnosis and prognosis systems.

Ir Dr Tse shared his experience on how to design an intelligent and fully automatic system for critical machine fault diagnosis and prognosis. The system can smartly identify invalid data collected from a machine during its operation on-site, and then perform a diagnosis to the machine to determine its current health status.

Once the machine has been determined defective, then the system will intelligently predict the Remaining Useful Life (RUL) of the deteriorating machine. It is designed based on sophisticated artificial intelligent (AI) algorithms embedded with industry domain knowledge and implemented through virtual instruments.

It has been well tested in slurry pumps that are widely used in mining industry and sewage services. It can be modified and then applied to other types of building machines such as reciprocating machines, engines, and chillers. The expected results are the minimization of production downtime, a dramatic decrease in maintenance costs and the avoidance of human casualties.



Perfect pairing between BIM and IoT



Mr Terence Lo

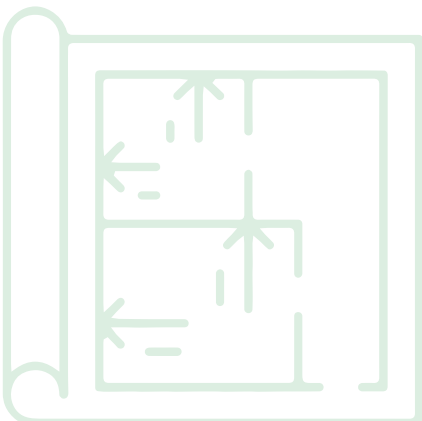
Mr Terence Lo, Solution Manager of Planon Hong Kong Limited talked about “Future Buildings: Smarter than before”. Mr Lo explained how to integrate the BIM and IoT technology in Building operation so as to make it smarter.

He described that Building Information modeling (BIM) is a 3D model tool for architecture, engineering, and construction industries to design, build and operate the building in a more efficient way.

In addition to 3D visualization, another beautiful thing of BIM is the capability of storing information in a model. Keeping details of a building in an organized way is a foundation for a smart building.

Internet of Things (IoT) is a network of sensors to monitor the internal state and external environment. IoT is not just about connecting sensors, the real value is using the sensor data to understand the condition of a building and thus creating new types of interactions for smart building put into practice.

Mr Lo further explained that such integration between BIM and IoT can allow them to interact with each other as one platform for connecting people, environment, systems, and operations. Solid experience with video to demonstrate the real operation of combing these technologies in government buildings has been illustrated. In general, energy consumption and carbon footprint can be reduced up to 10% and efficiency in operation can gain up to 20% with such systems in place.



AI delivers greater user satisfaction



Dr James Huang

Dr James Huang, Chairman, CTO and Co-Founder of DataInsights Limited had a talk on “Trends of Intelligent Transformation in Smart and Green Building”.

Dr Huang illustrated how to implement an AI-based predictive analytics model with clients.

Dr Huang said that recent significant advances in the technologies of AI, Blockchain, IoT, ICT, CPS, VR/AR/MR have been enabling smart transformations of every aspect of human society.

Leading applications include AI-based building controls for lighting, HVAC, energy management, elevator maintenance, access management, occupant tracking, occupant comfort aiming to reduce operational costs, enhance tenant experience and improve productivity or quality of living.

From their experience, personnel tracking using facial and behavioral recognition algorithms by which patrol trajectory or compliance issues of security guards can be easily searched and played back.

Applications such as advanced lighting and air conditioning control in smart hotels and homestays or dimming or turning on/off lights or changing room temperatures by hand gestures and voice commands could be applied.

In another domain, IoT, blockchain and artificial intelligence techniques to manage and analyze data from integral sensors which monitor both environmental and occupant conditions (temperature and humidity) to improve home-based elderly care can be developed. Industrial and residential parks are also using remote monitoring and analysis solutions to manage remote metering and parking lots via NB-IoT or Lora.

It is a co-creation methodology between the AI solutions provider and domain experts from the customer. Solid successful examples from different industries were demonstrated which shows how broad and deep AI applications in people’s daily life could be.



Automation equals building optimization



Ir Calvin Tang

Mr Calvin Tang, Senior Key Account Manager, End User Business – Hong Kong of Schneider Electric delivered a topic on “Building Re-invented – Digital Transformation for Optimizing Building Energy, Reducing Operational Cost and Enhancing Comfort”.

Mr Tang mentioned about how to make use of these data to optimizing building energy, reducing operation cost and enhancing comfort in leveraging the Internet of Things (IoT).

He also illustrated how to use different set of data trend to determine the abnormality of equipment performance, such as leaking chilled water valve where the system could provide a clear priority list for the operator to fix fault equipment which in turn will enhance energy and maintenance efficiency.

In addition, mobile APPS and analysis software have become more of a trend with user friendly interfaces. Proper investment in data analytical platforms, not only in the point of view of sustainability, can save energy, but also can perform preventative maintenance and manpower optimization. Solid experience and results of those systems was been shared.



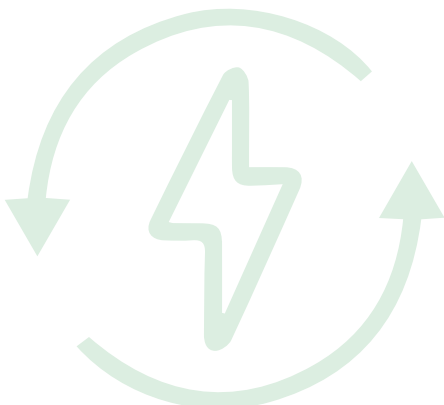
Retail revolution through IoT and Big Data



Mr Alan Seigrist

Mr Alan Seigrist, CFO and Head of Strategy for Energybox Limited presented “The Role of IoT & Big Data in Automating Facilities and Retail Businesses”. Mr. Seigrist discussed that the best way to release the power of data is to engage the end user with information that changes behaviour automatically to achieve desired outcomes.

With the advancement of IoT platforms coupled with A.I. and big data analytic engines, companies are now empowered to automatically make decisions which in turn can massively improve operational and energy efficiency. They have applied this technology over 700 projects around the world.



Optimized controls need integrated systems



Ir Gary Chuk

Ir Gary Chuk, Director, Building Controls and Integrated Solutions, North Asia of Carrier Hong Kong Limited talked about “Intelligent Building Management Systems Today and Tomorrow”.

Ir Chuk illustrated various way to optimize the chiller plant controls. He pointed out that much research and development has been done to improve the operating efficiency of HVAC systems, including higher efficiency chillers, pumps, fans and more optimized system controls.

He also discussed the advances in energy efficient HVAC controls and the benefits in adopting different control strategies, such as cloud based energy management system, the application of automated fault detection and diagnosis in achieving higher energy efficiency in buildings. He said that over 350 automated fault detection and diagnosis expert rules have been developed and readily deployed to various airside applications. From their experience, central chiller plant efficiency can be generally improved in the range of 8-15% by measures depending on the plant configuration.

He also strongly emphasized that with the integrated systems with more data from the buildings, data analytics and expert rule based technologies can be applied to provide more optimized controls on HVAC systems for further enhancing energy efficiency while at the same time improving indoor environmental quality.



BASs paring with IoT brings buildings transformation



Dr Linda Xiao

Dr Linda Fu Xiao, Associate Professor, Department of Building Services Engineering of The Hong Kong Polytechnic University delivered a speech about “Big Data Analytics for Smart Buildings and Applications”.

Big data is transforming the world including buildings. Dr Xiao shared their past experience on how to develop prediction models as well as optimal control and fault diagnosis strategies for smart buildings based on big building operation data.

While modern IT technologies adopted in Building Automation Systems (BASs) make buildings smarter, they also provide a tremendous amount of real-time building operation data. A seamless integration of BASs with massive IoT devices in future smart buildings will bring more explosive growth in building operation data.

Dr Xiao also stressed that effective use of big building operation data has become a challenge and an opportunity for smart buildings facing the increasing requirements of sustainability and intelligence.

Data mining and machine learning techniques have been adopted to discover novel data-driven knowledge from big building data, such as predictive models, association rules, clusters and frequent patterns, which are valuable complements to domain knowledge in the building industry. Although advanced big data analytics are constantly emerging, the potential in analyzing high-complexity and low-quality big building operation data has not yet been fully exploited. Dr Xiao had introduced a generic Framework of doing big data analysis for smart buildings. Some application examples using AI technologies had been illustrated.

Big data is driving innovations in smart buildings, which will bring powerful innovative data analysis, control and optimization tools for next generation BASs to automatically deal with increasingly complicated disturbances and interactions among buildings, environment, occupants and smart grids.



Insights through data realization



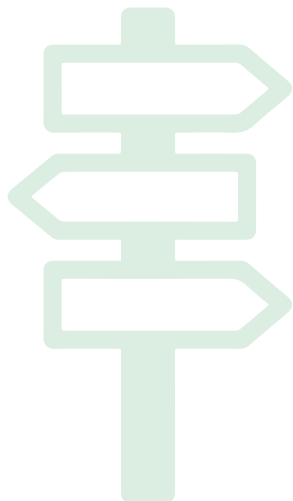
Ir Cary Chan

Ir Cary Chan, Executive Director of Hong Kong Green Building Council delivered a closing remarks.

Ir Chan said that there is a huge transformation on how to obtain data and doing analysis from the old days when compare with the current practice.

With all the development in IoT, AI and big data analytic technologies, it is easier for engineer to obtain useful information and making sensible decisions which is vital to run a building in a more sustainable way.

He saw great opportunities for retro-fitting or replacement of those BMS in existing buildings that are not compatible with those of the latest generations. The market is still searching for the best options for upgrading their systems and exploring what information is of value for managing their facilities and assets. He was glad to have such good learning from the conference.





*Group Photo for Conference Speakers,
Organizing Committee members and Guest of Honors*

Back Row (from left to right): Ir Gary Chuk, Carrier; Mr Alan Seigrist, Energybox; Prof S W Wang, HK PolyU; Dr Tian Peng Wei, Siemens; Ir Dave Chan, ATAL; Ir Conrad Wong, Yau Lee; Dr David Chan, Negawatt; Mr Terence Lo, Planon; Dr James Huang, DataInsight.

Front Row (from left to right): Dr Linda Xiao, HK PolyU; Ir Thomas Chan, HKSTP; Mr Oscar Wong, HKSTP; Mr George Tee, HKSTP; Mr Albert Wong, HKSTP; Mr Alfred Sit, EMSD; Ir Cary Chan, HKGBC; Dr Benny Chow, HKGBC; Ms Margaret Kam, HKGBC; Ir Dr Peter Tse, CityU HK; Ir Calvin Tang, Schneider Electric.

Acknowledgements

Innovation and Green Building Conference

By

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Dr Tian Peng Wei, Head of Research Group, Siemens Corporate Technology China

Ir Dave Chan, Director of Information, Communications & Building Technologies, ATAL Building Services Engineering Limited

Ir Conrad Wong, BBS, JP, Vice Chairman, Yau Lee Holdings Limited

Dr David Chan, Director, Negawatt Utility Limited

Prof. S W Wang, Chair Professor of Building Services Engineering, Department of Building Services Engineering, The Hong Kong Polytechnic University

Ir Dr Peter W.T. Tse, Director of the Smart Engineering Asset Management Laboratory, City University of Hong Kong

Mr Terence Lo, Solution Manager, Planon Hong Kong Limited

Dr James Huang, Chairman, CTO and Co-Founder, DataInsight Limited

Ir Calvin Tang, Senior Key Account Manager, End User Business - Hong Kong, Schneider Electric

Mr Alan Seigrist, CFO, EnergyBox Limited

Ir Gary Chuk, Director, Building Controls and Integrated Solutions, North Asia, Carrier Hong Kong Limited

Dr Linda Xiao, Associate Professor, Department of Building Services Engineering, The Hong Kong Polytechnic University



**Discover more about the Green Technology Cluster
at Hong Kong Science Park**

For enquiries, please contact:

Ir Thomas Chan

Senior Manager, Green Technology Cluster

☎ +852 2629 6851 ✉ thomas.chan@hkstp.org
