

AI for SDGs – How Can AI Help Solving Environmental
Challenges?

Japanese – German – French DWIH Tokyo Conference

AI for Smart Buildings

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Outline

- .Some definitions and terminology elements about Smart Building
- .Sources for reducing energy consumption
- .Focus on ***control systems*** and problem statement
- .Towards an architectural model based on AI technologies
- .Conclusion



Definitions and Terminology

.Smart City refers to a city using information and communication technologies (**ICT**) to "improve" the quality of urban services or reduce its costs.

.City "=" collection of buildings

.Intelligent building reacts to events

.*Smart building integrates and accounts for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability not reactivity, at a core...*



Definitions and Terminology

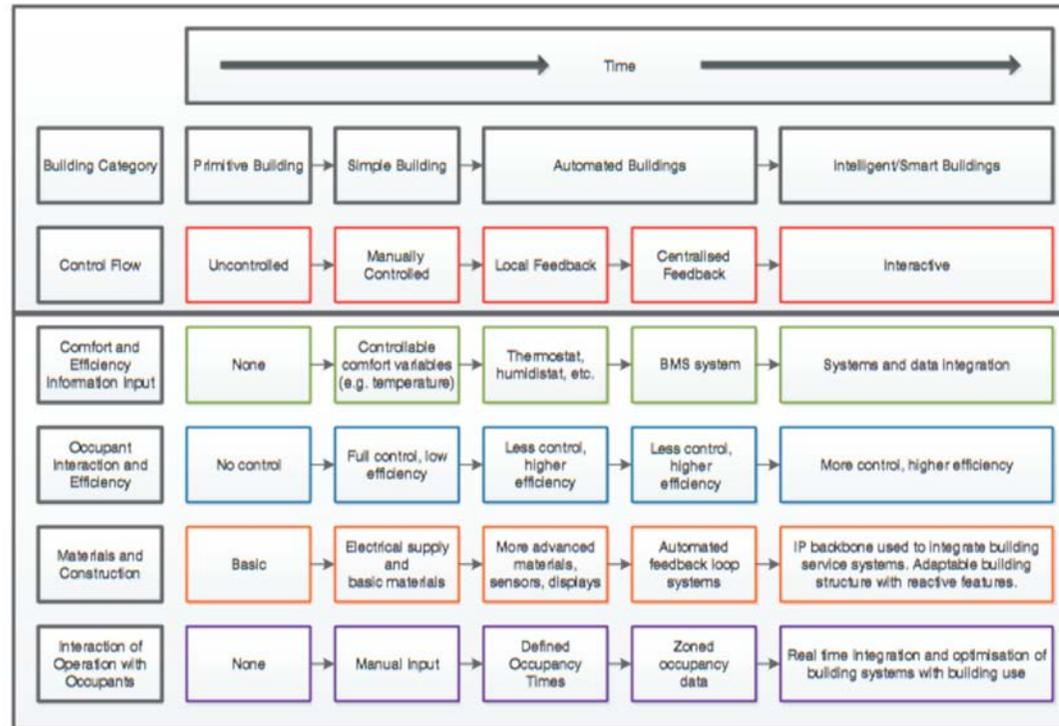
.For a Computer Scientist & Engineer, adaptability and system means a lot → self-* computing → **self-aware computing systems**: (System is a hardware system, software system, or combination, which has components as its structure and observable inter-process communications as its behavior)

1) Learn models capturing knowledge about themselves and their environment (such as their structure, design, state, possible actions, and run-time behavior) on an ongoing basis and

2) Reason using the models (for example predict, analyze, consider, plan) enabling them to act based on their knowledge and reasoning (for example explore, explain, report, suggest, **self-adapt**, or impact their environment)



Definitions and Terminology



From Buckman, Mayfield, Beck, university Sheffield, UK, 2014



Definitions and Terminology

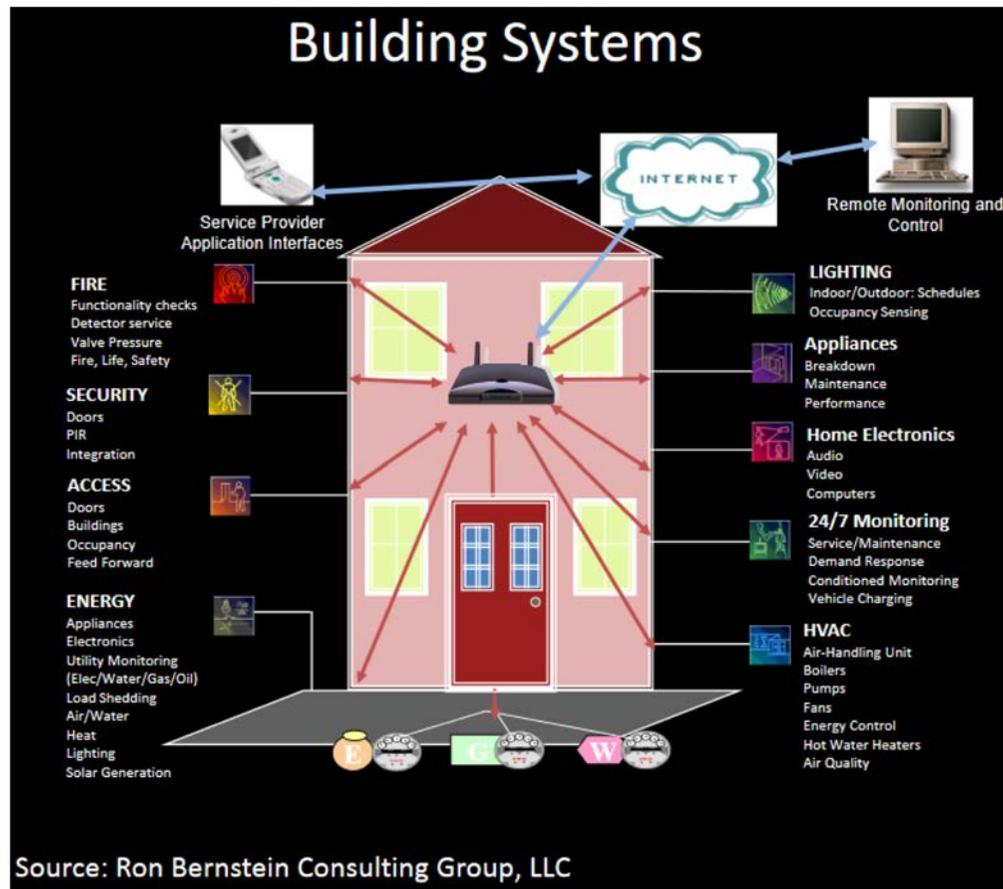
| | Time | | |
|--|--|--|--|
| Building Category | Intelligent Buildings | Smart Buildings | Thinking Buildings |
| Control Flow | Reactive | Adaptive | Predictive |
| Comfort and Efficiency Information Input | Systems and data integration | Enterprise integration and building as a system approach | Undefined/Ambiguous Data |
| Occupant Interaction and Efficiency | More control, higher efficiency | Inherent control, higher efficiency | Predictive control, higher efficiency |
| Materials and Construction | IP backbone used to integrate building service systems | Further integration using middleware, and adaptable building structure with reactive features. | Future technology, control hardware, software and materials |
| Interaction of Operation with Occupants | Ability to react to occupancy data in real time | Building operation defined by and adapted to building occupants | Effective operation based upon predicted use by occupants for a specified function |

From Buckman, Mayfield, Beck, university Sheffield, UK, 2014

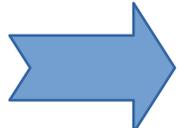
Thinking building: if people may impact the behavior of the system, is it better?



Sources for reducing energy consumption... and many more opportunities



Sources for improving life of residents with “new” connections

- .Different businesses and operations  collective efforts of a team far outweigh those of the individual
- .Improve cost structure: reduce operating costs and increase productivity
- .Reduce risk: enhanced safety and increased uptime
- .People focus brings economic benefits
- .Health and well-being



Control Systems and Problem Statement

.Control System manages, commands, directs, or regulates the behavior of other devices or systems using control loops.

.What are the parts / types of AI useful for a Software System managing a building (an Operating System for the building)?

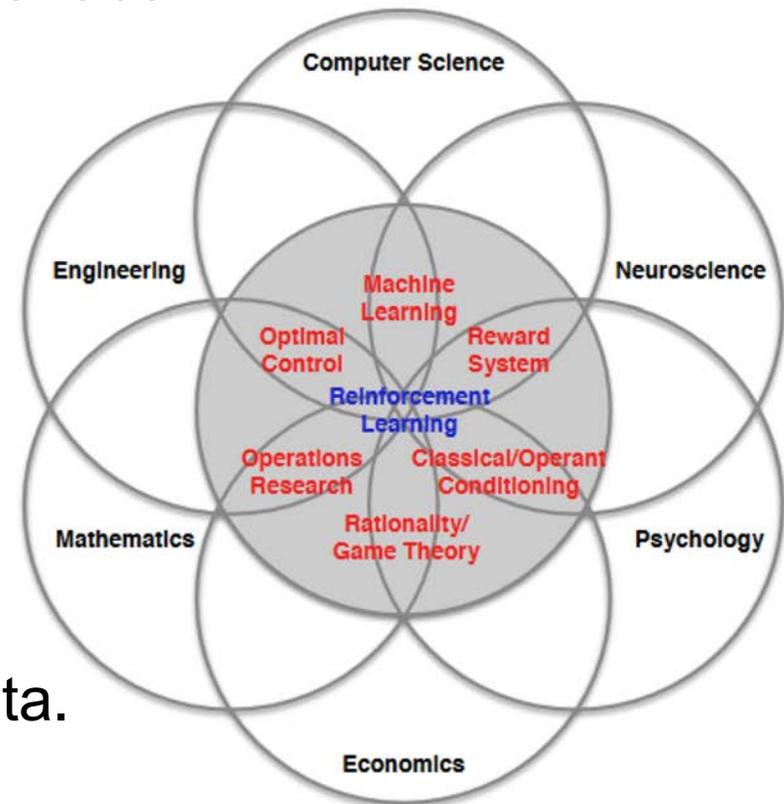
.Many AI candidates. Ex: Machine learning is divided into

- A. Neural networks –
- B. Hybrid neural network –
- C. Recurrent neural network –
- D. Perceptron –
- E. Support Vector Machines (SVM))



Many Faces of Reinforcement Learning

One day the theory should meet the interface layer (inputs set by real inhabitants)

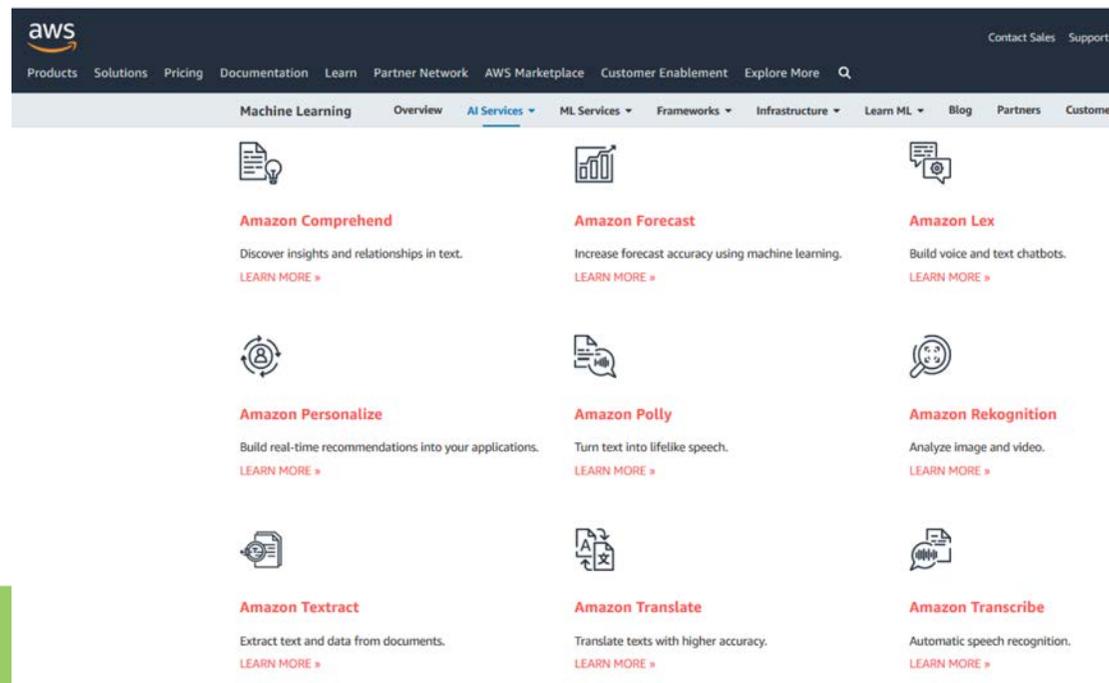


One day the theory should meet the data.
Top down versus Bottom up approach.
Or the two at the same time!



Towards an Architectural Model based on AI Technologies

- The Cloud (a centralized System) can already solve all the problems – See Amazon artificial intelligence services for instance;
- Do we want, do we need Cloud?



Do we absolutely need cloud?

•No, if you decide to make the building as a data center.

•Very clever idea since the rationale is that the building be able to compute, store, analyze. learn. monitor...



Qarnot Computing
R&D Performing SME
<http://www.qarnot-computing.com/>



<https://www.eurostars-eureka.eu/project/id/11017>



And in summer?

- In summer you need hot water;
- No heat. Use smartphones, tablets and all the appliances of inhabitants to solve AI problems (Desktop Grid Computing)



Multi-Level Intermediate Representation Overview

The MLIR project aims to define a common intermediate representation (IR) that will unify the infrastructure required to execute high performance machine learning models in TensorFlow and similar ML frameworks.



Energy balance

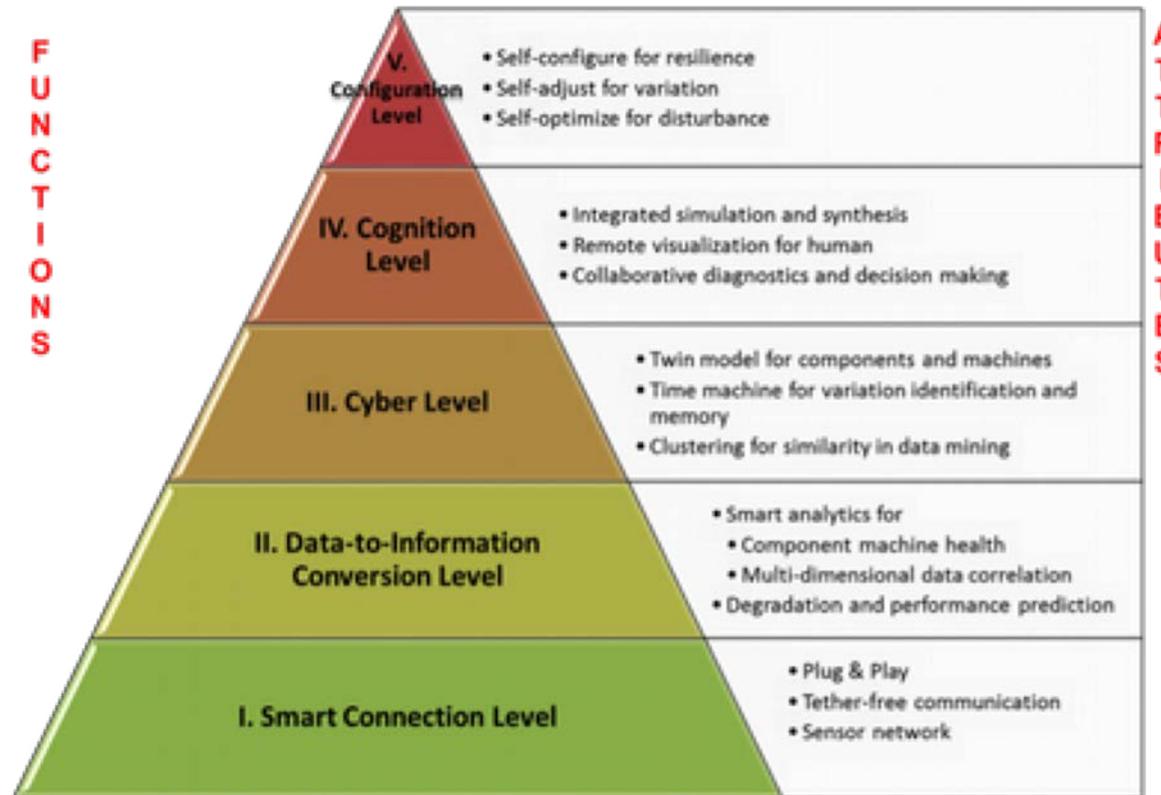
.Cloud: the providers buy dedicated servers (electricity, cooling) + energy cost for data transfers (crossing hubs, switches...)



.The building as a data center: the appliances (heaters, boilers, fridges, washing machines...) have a second life (computing) hence no extra costs + no data transfers since the building stores the data.



Towards an Architectural Model based on AI Technologies

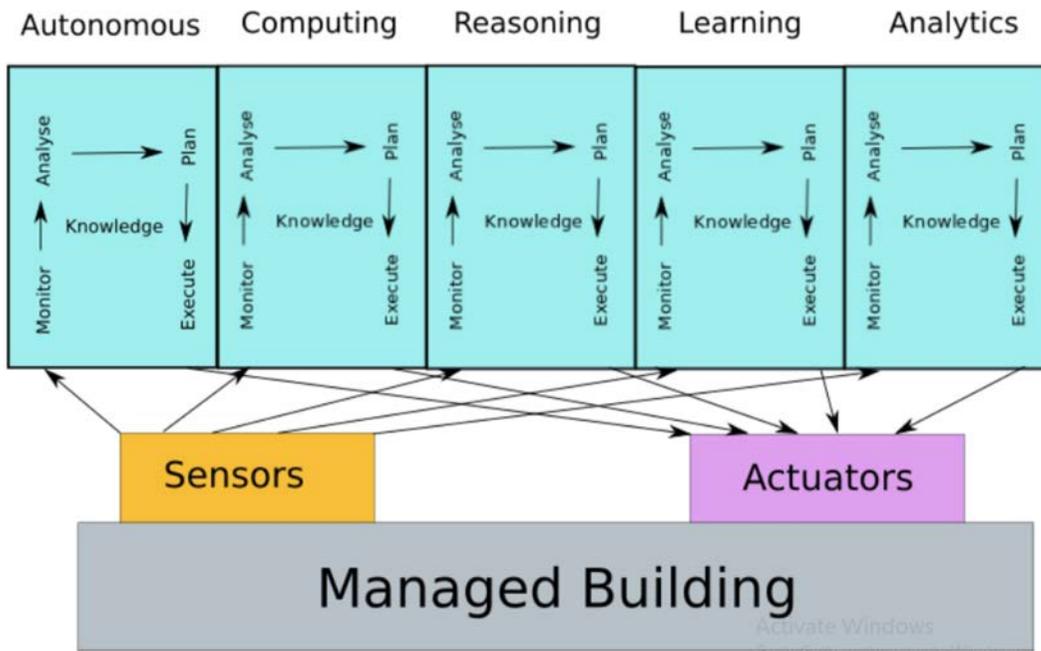
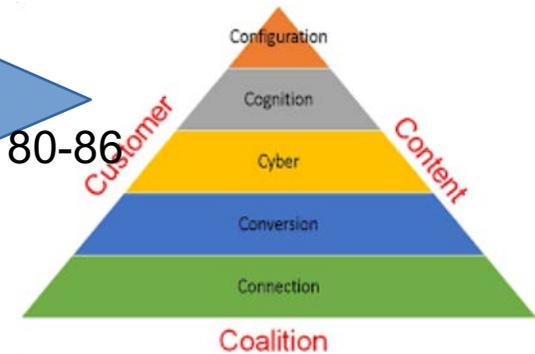
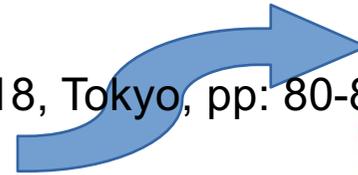


A Cyber-Physical Systems architecture for Industry 4.0-based manufacturing systems
Jay Lee, Behrad Bagheri, Hung-AnKao, Manufacturing Letters
Volume 3, January 2015, Pages 18-23



Towards an Architectural Model based on AI Technologies

Tarek Menouer, Christophe Cérin, Yanik Ngoko:
Efficient scheduling in a smart building. MEDES 2018, Tokyo, pp: 80-86



Activate Windows
Go to Settings to activate Windows.



Demonstrator

•Some research fields control data from the birth to the death: from telescopes until

<http://cdsweb.u-strasbg.fr/index-fr.gml>

•Many research fields are looking for real data!



**Innovative renovation of a public building of higher education –
The Paris 13 IUT of Saint-Denis as a demonstrator**



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Conclusion

- AI + Smart Buildings = Thinking Buildings
- Rationale for doing a research on that topic: improve the living of inhabitants AND energy efficiency of the buildings
- That is to say: AI for big population (and not only AI for the big science)
- Japan, Germany, France, make the building great again!



Merci pour votre attention Vielen Dank für Ihre Aufmerksamkeit ご清聴ありがとうございました

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Products & Services > Building technology > Smart Buildings

Smart buildings

A smart building is an active contributor to the experience and success of its stakeholders. #CreatingPerfectPlaces

住宅・ビル・施設 Week

招待券お申込み

JAPAN BUILD 2018

スマート住宅 EXPO
RENOVATION EXPO

9月大阪、12月東京で開催

住宅・ビル・施設 Week

下記5展で構成

- 建材・住設 EXPO
- 工務店支援 EXPO
- 施設リノベーション EXPO
- AI・スマート住宅 EXPO
- スマートビルディング EXPO

招待券お申込み (無料) >

主催: リード エグジビション ジャパン株式会社