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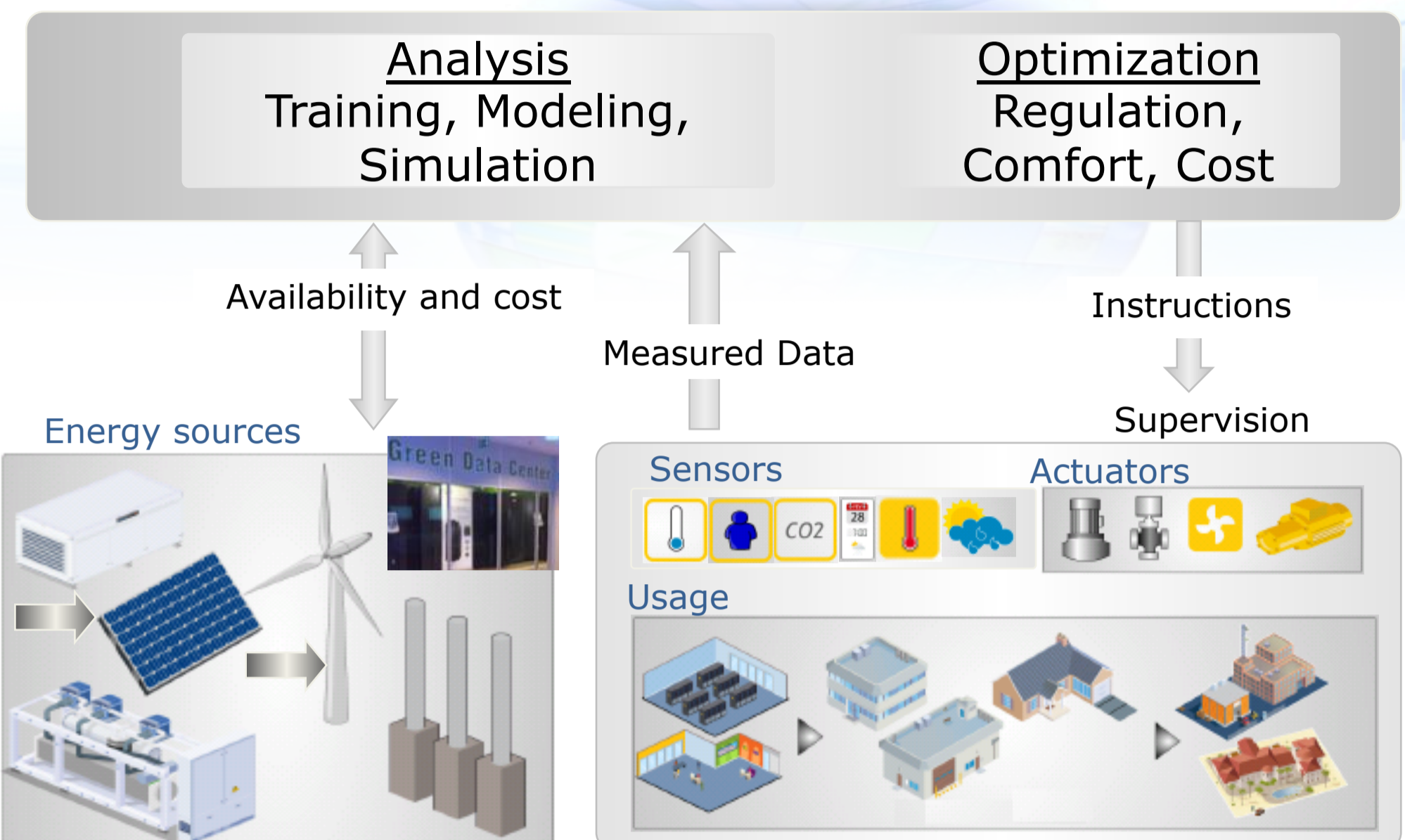
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Interactive Visualization of Heterogeneous Data for Energy Efficiency of Buildings

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INTRODUCTION

Currently, data from building sensors are managed by Building Management Systems (BMS), which can only be used to adjust building parameters or to provide feedback to the system manager. The user cannot modify the predefined rules to improve his comfort, the energy consumption or to update the building model. The RIDER green box is conceived to understand, anticipate and react to various situations with specific adapted predictive models. **RIDER aims to optimize buildings energy consumption while improving people comfort.** Indeed, a building is as a "living" entity, constantly evolving. For example, topology of rooms change over time, mainly through internal walls modifications. Therefore, it is interesting to RIDER to not only present data but also recover user knowledge about the building.



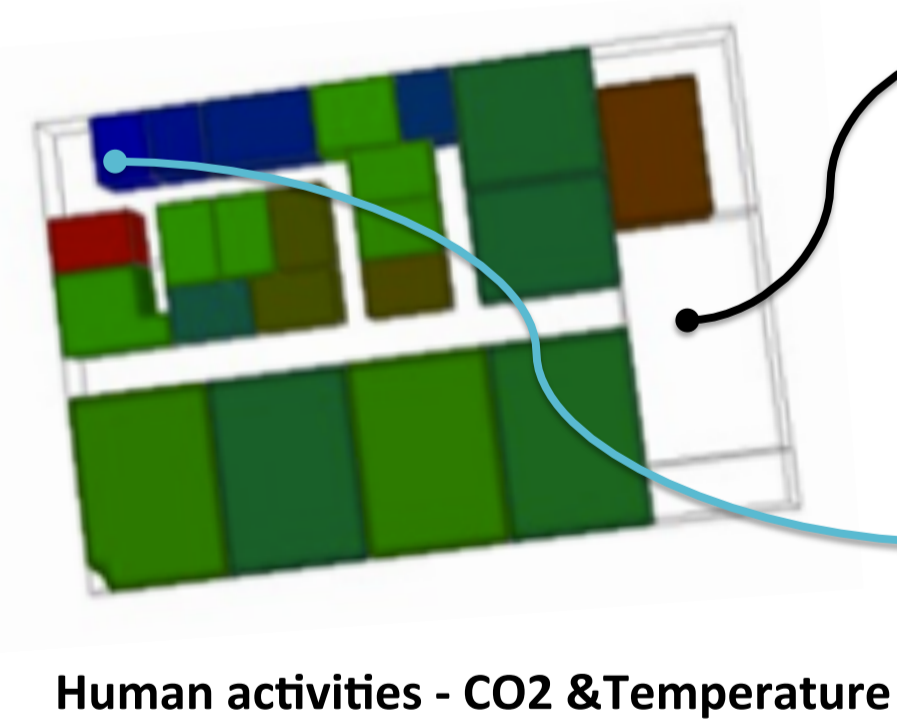
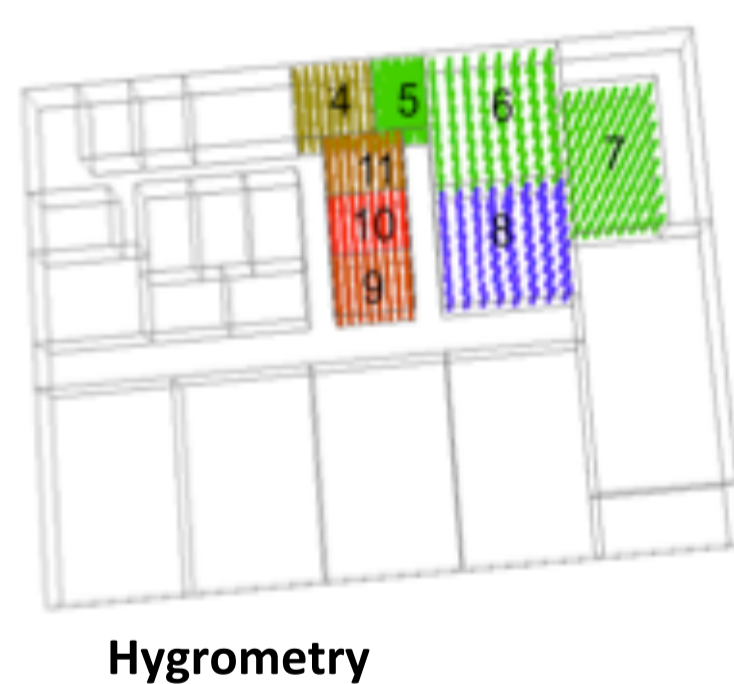
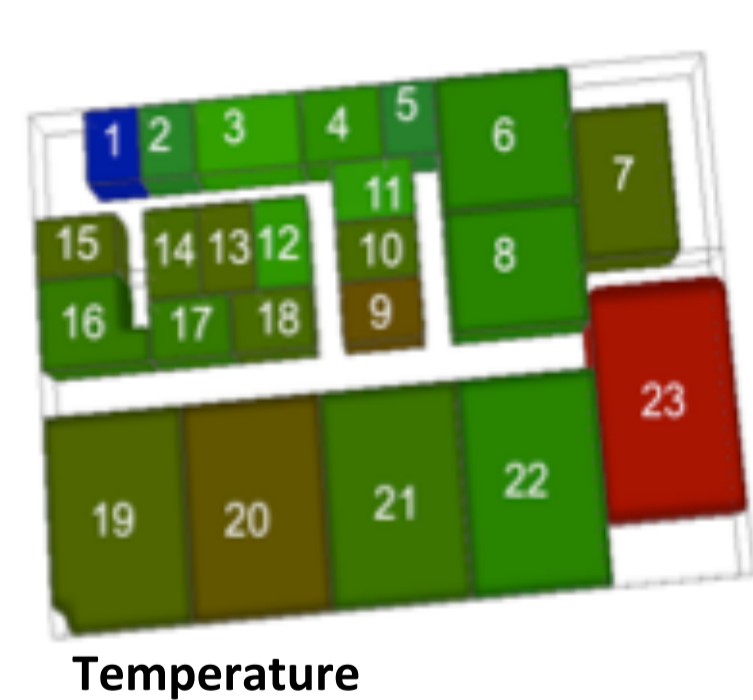
INTERACTIVE MULTI-DIMENSIONAL VISUALIZATION OF BUILDING DATA

2D/3D interactive visualizations improve perception and understanding of data [Card et al., 1999]. Visualization allows users to detect anomalies, identify trends, perform some diagnostics and explore intuitively the information. With these purposes in mind, our visualization module provides:

- Interactive multi-dimensional visualization techniques to deal with several types of sensors, working at different frequencies: CO₂, temperature, pressure, humidity, etc.
- Commonly used visualization methods found in BMS [Hao et al., 2010], including curves, graphs, radar charts, scatterplots and parallel coordinates.
- 3D visualization of room using a particle system [Alexa et al., 2003].

The user interacts with the system using traditional techniques (selection, zooming, panning) and can annotate views to keep track of his analyzes. This information will then be used to update the RIDER building model.

Our module allows users to visually explore and compare data from multiple views to easily identify hot/cold regions and airflows, to get insight into sensors and furniture actual positions and to better understand human activity as shown in figures below. These images depicted measurements for a set of 23 rooms (offices and meeting rooms) of IBM Montpellier. This information may help to optimize sensors configuration, to improve room layout and to take into account room occupation in order to enhance RIDER rules (e.g. to lower the temperature of empty meeting rooms).



A corridor : hot region, not constant human presence >> Misplaced sensor!

An office : cold region, not constant human presence >> People have moved!

CONCLUSIONS

Nowadays, energy saving has become a crucial issue. The buildings where we work and live has been identified as a major source of energy consumption. The visualization module we have implemented for the RIDER project shows that visual analysis can allow users to better understand data and be aware about their energy consumption. RIDER is a work in progress. In the near future, we must integrate data coming from the user comfort model and from an accurate physical model of the building.

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ABSTRACT

Since 1997, Kyoto protocol has highlighted the importance of a rational usage of energy. France and the EU have fixed several objectives concerning reduction of energy consumption and of greenhouse gas emission, and use of renewable energies. The main goal of the RIDER project (Research for IT Driven Energy Efficiency), is to develop an ICT-based smart platform for multiscale and multistandard energy management of buildings. In particular, the visualization component aims to provide users with a better insight of their energy usage by visually detecting trends or gaps. Users can also provide information to update and improve RIDER model, which can help them to become aware of their energy consumption.