Volume 29, number 1, March 2015

Continuous improvement in construction projects: A concrete example

In February 2010, Groupe Robin inaugurated a 94-room Holiday Inn Express in Saint-Hyacinthe, the first LEED-certified hotel in Canada. In 2012, they decided to build a second one in Vaudreuil. This one, with 133 rooms, is almost identical to the first and also aims for LEED certification. For acheiving, among others, the design of efficient electromechanical systems, the Groupe Robin mandated the services of engineers from Cimaise.

A visit to the Holiday Inn Express in Saint-Hyacinthe was organized to present the needs of the new hotel. Élyse Dufrêne and Erik Duguay, the consulting engineers assigned to the case, identified some malfunctions and suggested that the hotel needed to be recommissioned – and this only three years following its delivery.

Besides presenting the benefits of a systematic evaluation once projects are completed, this article lists the malfunctions identified at the Saint-Hyacinthe Holiday Inn, as well as the measures put in place to correct the situation following the recommissioning process. The article also describes the continuous improvement and optimization measures integrated in the design of the future hotel.

First step: Identify the corrective measures needed

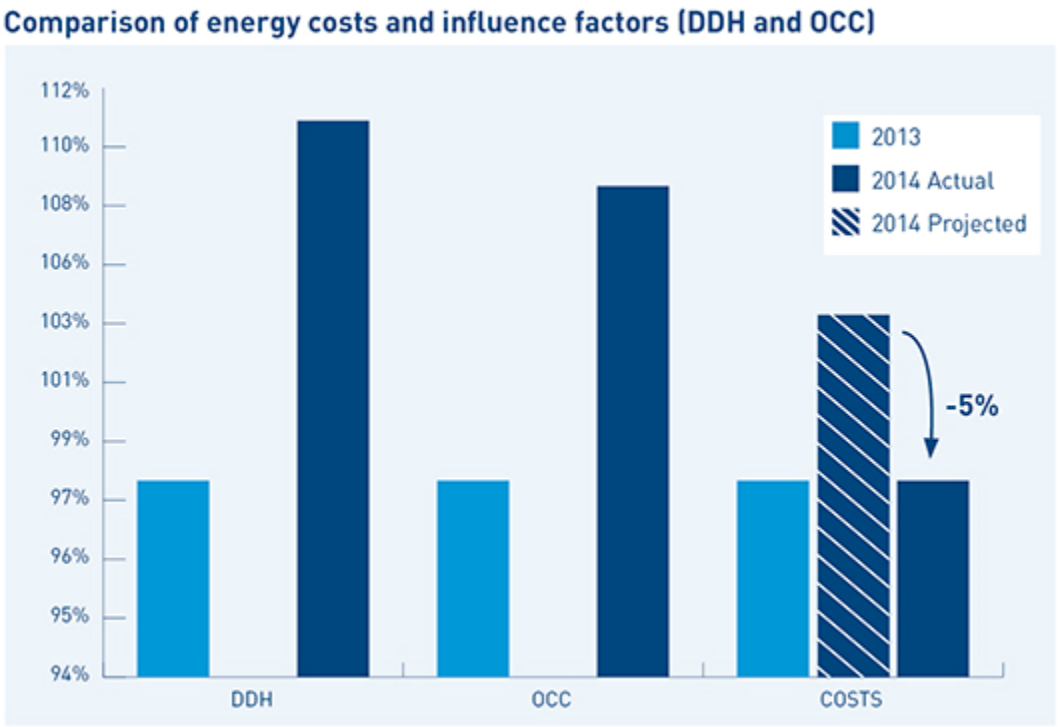
In addition to the issues identified by Groupe Robin at the Saint-Hyacinthe hotel, such as problems with storage space and with the capacity of the domestic hot water and ventilation systems, engineers Dufrêne and Duguay questioned the building's operating costs. In fact, an initial analysis of the hotel's energy bills showed that energy expenses did not correspond to what was forgiven at the phase design. Despite the fact that a load management system had been implemented to optimize the electricity utilization factor and to use natural gas at peak periods, the utilization factor was low, as was the consumption of natural gas (45% on average for the year and natural gas consumption of about 9,000 m³).

The following table shows the principal operational problems, the measures taken by operating personnel and the phases of the recommissioning process.

#	Operations		Recommissioning Process		
	Operational problems	Measures taken by operating personnel	Real sources of problems	Solutions implemented	Impacts on operations
1	Domestic hot water shortage	Adjustment to set-point for boilers	Unsatisfactory installation of equipment, leading to poor layout configuration during construction	Transfer of all DHW heating natural gas boilers	→ Improvement in comfort of occupants → Reduction in complaints → Reduction in operating costs
2	Low electricity utilization factor, resulting in high operating costs	None	Incorrect adjustment of load-shedding system in relation to actual consumption	Adjustment to load-shedding set-point (based on one year's consumption) and to load-shedding equipment	Reduction in operating costs
3	High maintenance costs of fresh air ventilation unit for the rooms	Seasonal replacement of parts	Snow trapped in unit	Addition of higher fresh air vent	Reduction in maintenance costs
4	Condensation around windows in the rooms	Replacement of materials around windows to facilitate maintenance	Shutdown of ventilation unit due to breakdowns	Showing maintenance personnel how to manage the control systems	→ Improvement in comfort of occupants → Reduction in complaints → Reduction in maintenance costs
5	Heating operated by an SCR* during emergency power (generator), producing a heavy cyclic load	None	Incomplete interlocking connections	Interlocking of heaters in emergency mode	Reduction in premature wear of generator and increase in reliability

*SCR-type controller to modulate current supplied to the coil.

The implementation of the solutions proposed in the recommissioning process led to a reduction in energy expenses of 5% in 2014 compared with those initially projected for that year, even though the heating degree days (HDD) and occupancy rate (OCC) were higher in 2014 than in 2013. The savings were generated in large part by the appropriate use of natural gas for heating domestic hot water. The graph below shows these elements.



Second step: Integrate and verify implemented measures in the new hotel based on experience with the first

Based on this information, the measures to be put in place, along with the real needs for the new hotel in Vaudreuil, as described below, were integrated in the design and in the construction, thereby simplifying the electromechanical system and minimizing maintenance constraints.

1. The dual energy hot water production system at the Saint-Hyacinthe hotel was replaced by a totally natural gas system only. Load management is assured by other loads.
2. The HVAC control system is centralized and generates alarms.
3. A solar system to preheat fresh air on the principal unit was added in order to maintain energy performance equivalent to that of the Saint-Hyacinthe hotel (i.e., 37% more efficient than MNECB 1997, according to the LEED energy simulation) and to be eligible for financial assistance for efficient buildings. (A preliminary grant of $52,304 was awarded under Gaz Métro's New Efficient Construction Program.).[1]
4. The capacity of some equipment was optimized through more detailed calculations (e.g., room-by-room calculation of load) and by the validation, with actual percentages, of capacity used at the Saint-Hyacinthe hotel, especially the capacity of the domestic hot water boilers (optimized by 15%) and the electrical input power (optimized at 600 amps rather than 800 amps as per the initial calculation), which helped optimize construction costs.

Also, verification tools, such as the implementation of a measurement and verification plan to be implemented a year following the date of possession, were planned during the design of the Vaudreuil hotel to ensure that the measures put in place will achieve the desired performance.

Introducing a continuous improvement process: The key to success

The Holiday Inn in Vaudreuil is currently under construction and should be completed in May 2015.
The recommissioning process helped underscore the importance of the following elements:

1. Design systems by choosing the right energy for a specific use in order to optimize the building's energy costs and achieve the performance goals;
2. Ensure that the client, the worksite manager, specialized contractors, and those responsible for operations have a good understanding of the design concept so that the systems can be installed and operated at their maximum efficiency;
3. Have an overall vision of the systems and ensure effective coordination with all involved in case corrections are needed in order to target the problem at the source and thus avoid aggravating the situation further.

Having the opportunity to introduce a continuous improvement process in a project is not common practice in the industry. In the case presented in this article, the engineers seized the opportunity to make improvements to the two buildings through continuous improvement, which resulted in an enormous difference in quality for the two projects, as much for the comfort of the occupants and the construction adjustments, as for the optimization of operations.

The performance verification phase at the Vaudreuil hotel, which will be carried out in 2015-2016, will enable comparing construction and operating costs and thus quantify the financial impacts of continuous improvement on the construction of a Holiday Inn Express.

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1 The savings generated by the solar wall installed in the hotel will be studied as part of a new solar preheating program, recently re-authorized by the Régie de l'énergie.

Informa-TECH is a publication of DATECH Group of Gaz Métro offered free of charge. For further information on these topics, contact Marie-Joëlle Lainé, Eng., at 514-598-3507.

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