High intelligence Low Tech

Rethinking hospitals

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High intelligence– Low-tech:
Rethinking hospitals

The most modern hospitals have become too complex to manage effectively. It is a paradox of our time: the more we try to control, the more we lose control.

The paradox of complexity is that the more we add, the less effective it becomes

For the past thirty years, the hospital sector has responded to every problem, whether relating to safety, energy, hygiene or comfort, by adding another layer of technology. Proprietary systems, costly redundancies, over-ventilation, oversizing and automated hyper-control were all supposed to improve performance and safety. But often, the opposite has happened.

Technical costs are skyrocketing as a proportion of all investments, and equipment maintenance has become so complex that it exceeds the resources and capabilities of institutions. The feedback is clear: this trend undermines service continuity and permanently increases operating costs. A hospital that is unable to maintain its own systems is not efficient.

This phenomenon is occurring in an increasingly challenging context: structural crises in hospitals, shortages of human and financial resources, accelerating medical innovation, decarbonisation imperatives and increased safety and continuity requirements. Institutions are looking for buildings that are simple, robust and easy to operate. However, they are unable to find them because the entire sector has become accustomed to building differently.

It is time to change our mindset.

Low-tech is a structural response, not a nostalgic one

It is not a step backwards. It is not frugality by default, nor is it a renunciation of performance. Rather, it is a deliberate break with technical one-upmanship, based on the simple conviction that a system we understand, maintain and repair is more efficient in the long term than one we simply endure.

It is based on a few clear principles:
- simple and robust solutions are preferred to sophisticated technical architectures;
- proven technologies whose reliability has been documented over time.
- easy maintenance that is accessible to internal teams at the establishments;
- Passive techniques are favoured, such as natural convection, thermal inertia, shading and cooling islands.
- Optimised networks and equipment, reduced to what is strictly necessary;
- Standards are applied rigorously, but without maximalism, based on a genuine risk analysis.

This approach reduces CAPEX and OPEX simultaneously, improves operational resilience, and reduces dependence on rare skills. A simple hospital breaks down less often, maximises service continuity, repairs itself more quickly, and evolves more easily.

By eliminating anything that does not contribute to care or operations, institutions can return to a sustainable model aligned with their actual resources and restore their investment capacity. This approach also promotes technical sovereignty by reducing reliance on proprietary solutions and mitigating exposure to industrial and geopolitical tensions.

AI is an accelerator of simplicity and the real differentiator for Egis

This is at the heart of our approach. AI does not over-equip hospitals; it enables us to control their simplicity, demonstrate their robustness and guarantee their performance. It renders low-tech scientific, demonstrable and credible. It also gives project owners the confidence they need to move away from overly technical solutions.

At Egis, we use AI in three operational areas that are directly related to efficiency, simplicity and robustness.

1. **Parametric and generative design enables us to explore thousands of scenarios to find the most efficient solution**

Traditional design is based on a limited number of variants. Enhanced by AI, parametric and generative design reverses this model by automatically generating thousands of configurations. It tests variations in orientation, morphology and compactness in parallel, accurately simulates thermal and aerodynamic phenomena and selects the most energy-efficient options according to several simultaneous criteria.

For accommodation or consultation floors, we generate thousands of morphologies by testing orientations, patio dimensions, sun protection, glazing performance, natural lighting levels and occupancy data, precisely optimising the required power. Less power means less equipment and lower costs.

2. **Correct sizing: moving away from the extreme case**

Most hospital facilities are oversized and designed for extreme cases, or according to outdated rules of simultaneity and redundancy. AI enables us to move away from this approach by relying on real data, such as analysis of load curves, hourly profiles, seasonal variance and classification of typical uses...

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3. **Enhanced risk analysis: regaining regulatory courage**

Controlled environment areas, operating theatres, sterile areas and laboratories are too systematically required and operated at the highest level of protection. However, this is not what the standard requires: NFS 90-351 requires a real risk analysis, not an automatic upgrade as a precaution.

AI gives project owners and designers the ability to return to this sober and rational regulatory logic. With its computing power, it models contamination scenarios, simulates the spread of particles and bioaerosols, correlates architecture, human flows and real risks, and generates documented compensatory measures. The requirements formulated respond precisely to the risks identified, without the overinvestment or operational constraints of default hyperprotection..

Proof by facts: Reims University Hospital

The new 58,000 m² surgery building at Reims University Hospital, which houses all of the site's surgical activities, provided an opportunity to put our principles to the test on a large scale.

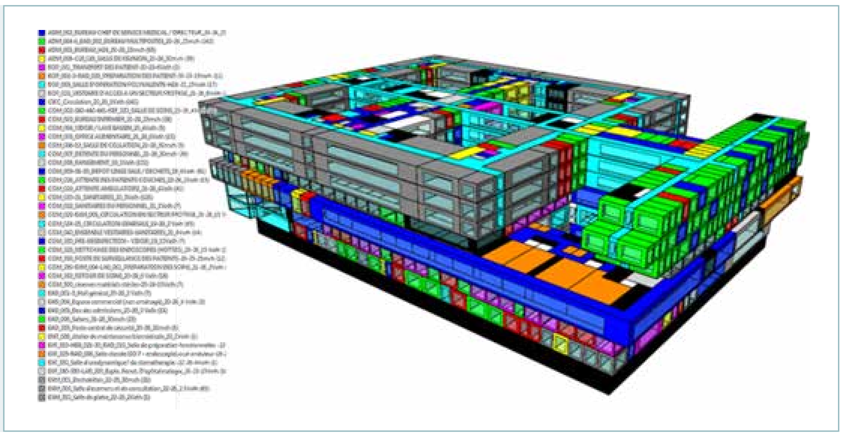
A project of this nature involves considerable air volumes, more than 500,000 m³/h, circulating through four separate networks. In a traditional design, this generates a proliferation of large-section ducts that criss-cross the building, reducing usable space.

Optimisation modelling from the outset

From the initial studies onwards, we modelled the programme requirements, the characteristics of each room, their conditions of use and the geometry of the building envelope using our exclusive Digital Thermal Model (DTM) concept. This method enables precise dimensioning that closely matches actual requirements while optimising the design in terms of energy and the environment.

Producing air where it is needed

Rather than distributing treated air throughout the building, we brought the air treatment installations closer to the rooms that consume the most energy. The air no longer has to circulate; it is produced directly where it is needed. In clean rooms and controlled environments, the air treatment system has been incorporated into the room itself, becoming an integral part of the space, just like the volume or the medical equipment.



This embedded solution reduces ductwork length, decreases technical room surface area and facilitates future changes, such as reconfiguration, change of use and installation of new equipment. It is not a compromise; it outperforms traditional designs in all the criteria that matter.

The result? More than 2 km of ductwork has been eliminated throughout the building compared to a traditional design.

Energy efficiency across the site: energy hub and smart grid

This project forms part of an overall property master plan that combines new builds, renovations, extensions, and significant demolitions. To consolidate requirements across the site, we have implemented an energy hub, the potential of which is being gradually realised according to the phasing. This is combined with thermal storage in the surgery building. Connected to the other CHU buildings via a smart grid, this hub is a decisive lever for energy efficiency across the entire site.

What low-tech means in concrete terms for establishments

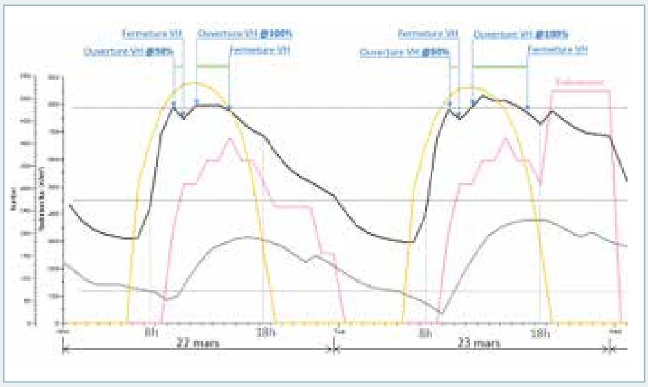
The benefits of this approach are tangible. They can be measured, documented and anticipated.

Less dependence on rare skills

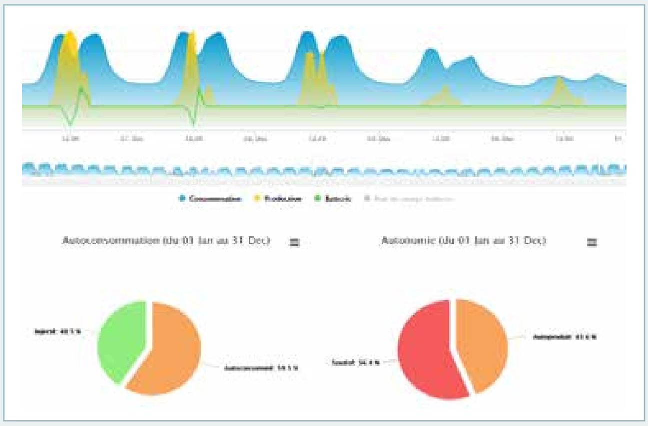
Builders and hospitals struggle to recruit, retain and train technicians who are specialised in complex systems. The simpler the systems are, the more easily they can be built and operated. Low-tech solutions structurally reduce this dependence, which is no longer a marginal issue but a central consideration in institutions' HR strategies.

Greater service continuity

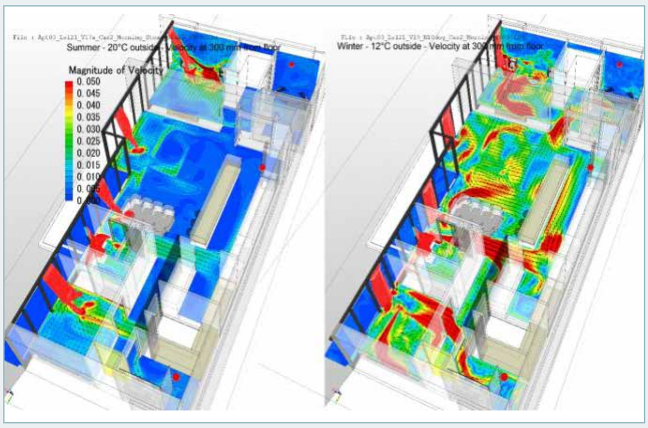
A simple system is more reliable. When it does break down, it can be repaired more quickly by more versatile technicians using more readily available parts. Complex systems are not resilient: often, they are the opposite.



Simulation of natural ventilation control over 48 hours shows that alternating opening regimes (50%/100%) optimise comfort while reducing reliance on mechanical systems.



Production, consumption and storage occur on a daily cycle. Self-consumption reaches 56% and autonomy reaches 42% throughout the year, demonstrating the shared energy hub's potential to reduce the site's energy dependence.



Air velocity fields in the same room in summer (20°C) versus winter (12°C). Seasonal simulations justify adaptive control and prevent oversizing in extreme cases.

Renewed capacity for change

A low-tech building is an adaptable building. By preserving technical space, promoting modular equipment, and limiting the footprint of networks, this approach ensures that the necessary space is available for future medical, organisational, or regulatory changes.

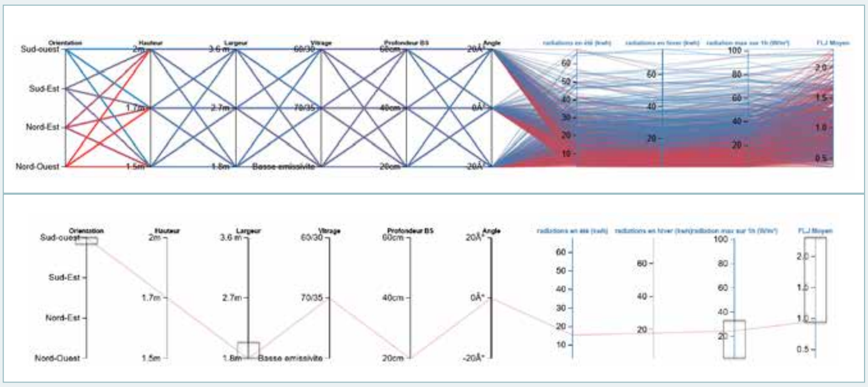
An accelerator for reuse and the circular economy

Low-tech promotes the recovery of materials from buildings undergoing renovation, the modularity of equipment for a second life, and the use of local recovery channels. This circular approach reinforces savings throughout the building's life cycle.

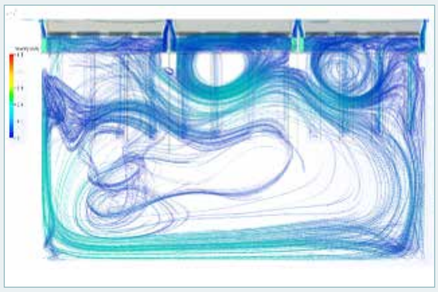
Why Egis and our long-term vision?

For us, low-tech is more than just a conceptual positioning. It is an approach that is firmly grounded in our continuous presence alongside healthcare establishments in France and internationally for over sixty years, covering everything from planning and commissioning to heritage master plans and performance analysis of existing facilities.

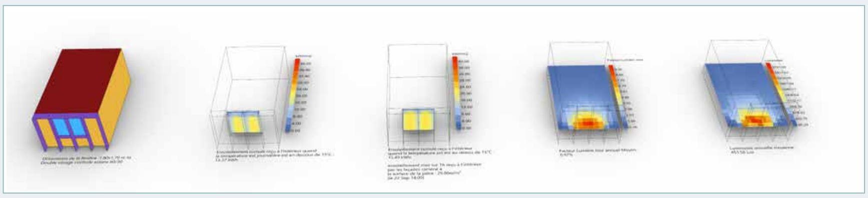
This experience enables us to take a pragmatic approach to each hospital project, considering what is necessary and what is possible. We have been convinced that technical one-upmanship is not the answer; it creates additional problems.



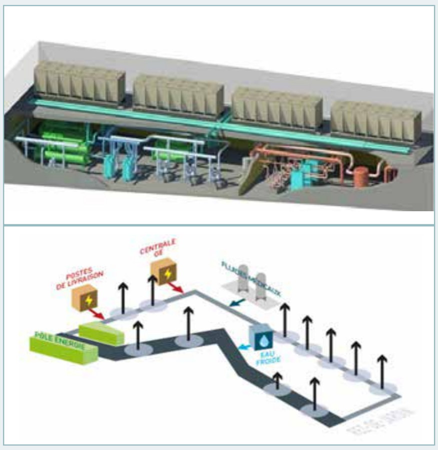
'Parametric design of a typical floor: broad exploration at the top, with several thousand configurations tested simultaneously across all architectural parameters (orientation, dimensions, glazing and solar protection).
Below that, there is a filtering process where only configurations that meet all performance criteria are retained. AI then reduces this to a few optimal solutions, which are validated before detailed design begins.



This is an airflow diagram of a room with a blown ceiling. The flow lines show the coverage of the volume and the absence of dead zones. The simulation demonstrates the efficiency of the air treatment without the need for oversized flow rates.



One space, five simultaneous criteria: envelope geometry, solar gain based on external conditions, natural lighting, and annual luminance. Parametric design evaluates each configuration across all its performance parameters before converging on the most energy-efficient solution.

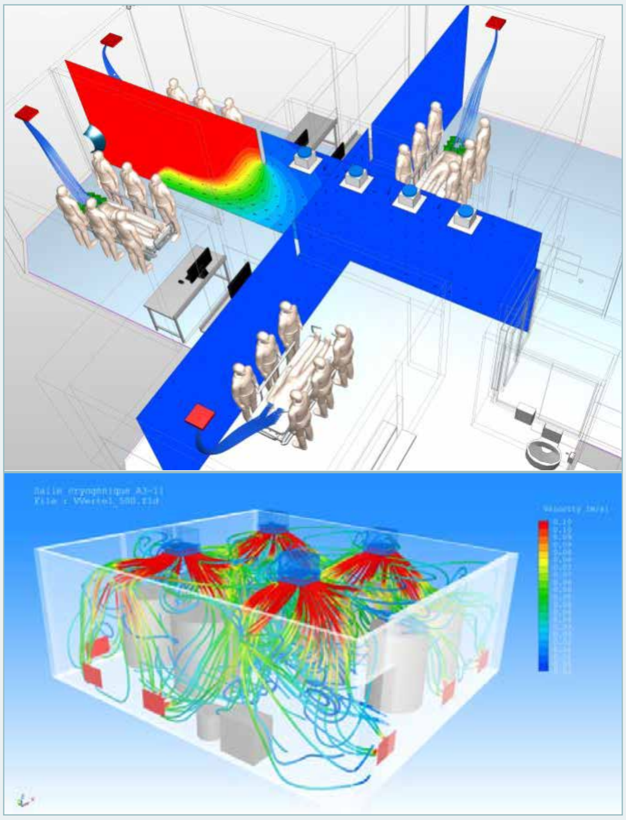


Reims University Hospital's energy and smart grid hub: centralised, phased production (left), connected to all on-site buildings via a smart heating network (right). Rather than multiplying installations, the low-tech principle is applied on a hospital campus scale by pooling them.

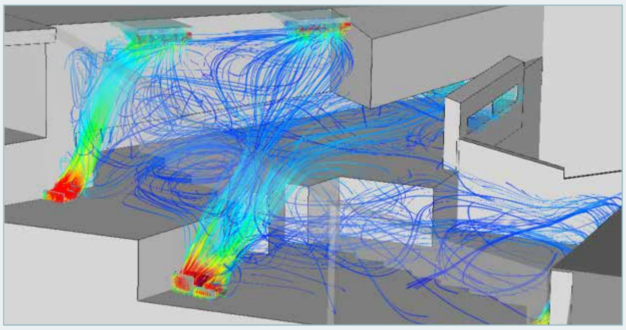
We have placed simplicity at the heart of our choices, our research and development, our employee training and our tools. Our rigorous method is based on accurate needs assessment, targeted and well-positioned facilities, proven techniques, easy-to-maintain equipment, local materials, and environmentally friendly construction processes.

By combining low-tech solutions with artificial intelligence, we are breaking new ground with innovation that is more sober, rational and scientific. AI does not complicate our designs or principles; it substantiates them. It transforms professional intuition into demonstrable arguments and sobriety into documented choices.

The future of hospitals does not lie in one-upmanship, but in the right technology informed by data and a long-term vision. This is how we are building the sober, efficient and sustainable hospitals that professionals and patients need today.



Operating theatre (left) vs cryogenic chamber (right): two controlled environments, two airflow regimes. CFD simulation defines the right level of protection for each room, without systematic over-engineering..



Natural cross ventilation: the building's geometry and the positioning of its openings ensure air renewal without the need for a mechanical system. In effect, the building acts as its own ventilation system.

IMAGINE. CREATE. ACHIEVE. *a sustainable future*

Egis is a major international player active in architecture, consulting, construction engineering and operation and mobility services. We create and operate intelligent infrastructures and buildings that respond to the climate emergency and contribute to more balanced, sustainable and resilient territorial development.

Our 22,000 employees work in over 70 countries, using their expertise to develop cutting-edge innovations and solutions and make them available to our clients.

Through our wide range of activities, we are a key player in the collective organisation of society and the living environment of citizens all over the world.

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