

The University Hospital of Tomorrow

Come along on one of Sweden's most exciting construction projects!

SKANSKA



Stockholms läns
landsting

Stockholm County Council

May 2013

DESIGN: KAMIS.SE

We are the university hospital of tomorrow

New Karolinska Solna (NKS) is the project name for the state-of-the-art hospital under construction at the Karolinska University Hospital in Solna. Highly specialized healthcare will be provided alongside research and training of the very highest quality.

NKS will be a hospital that provides a faster response and improved patient safety and a “patient always first” vision. Individual rooms for in-patients allow a sharper focus on and world-class care for the severely ill.

The customer is the Stockholm County Council. The project company Swedish Hospital Partners is responsible for the design, construction, financing, operation and maintenance until the year 2040. The design-build contractor is Skanska, which is constructing the hospital, and the operational and services provider is Coor Service Management. NKS is scheduled to receive its first patient in 2016 and be completely finished in 2017.

A unique project in every way

NKS is both Stockholm County Council’s and Skanska’s single largest project ever - a state-of-the-art hospital with stringent environmental requirements during construction and future operation. Thus Skanska has brought together its leading specialists in this area from around the world to carry out this project. The Stockholm County Council’s professional staff in various categories visited 20 leading hospitals around the world to gather the best ideas in design, organization and work methods. That set the bar high and attracted extensive international interest in both the building process and the future hospital itself.

NKS is being built according to the rules for achieving Gold certification in the Sweden Green Building “Miljöbyggnad” system, requiring sustainable solutions implemented in all stages. The finished hospital will be one of the first university hospitals in the world to be certified according to the Leadership in Energy and Environmental Design (LEED) requirements of the U.S. Green Building Council. New Karolinska Solna will bring Sweden and Stockholm not only a new cutting-edge university hospital and landmark but also a unique environment for world-class medical research.



New Karolinska Solna 2010

A showroom has been set up to provide more information on the NKS project. It receives visitors from around the globe.

Sweden's largest array of on-site cabins for project offices, trades workers and subcontractors. At the project's peak 1,800 people will be working on the construction site.

The new hospital will contain approximately 8,000 rooms, including:

- 36 operating theatres
- 8 radiation units
- 168 examination rooms
- A research lab
- Classrooms

Total gross area will be approximately 320,000 m², including a patient hotel. Up to 12 floors, including 1-2 basement levels with parking, changing rooms, logistics area and goods receiving.

Customer: Stockholm County Council
Builder: Skanska
Architect: WTT - White Tengbom Team
Service partner: Coor Service Management
Construction cost: SEK 14.5 billion
Construction: 2010–2017

One gigantic project made up of many sizable subprojects

The New Karolinska Solna is a vast undertaking, so it has been broken down into several subprojects. Even so, each stage is on a huge scale.

Work in all sections is underway at the same time, within one and the same area – an area that is also already hosting a fully operational university hospital.

It all comes down to project planning

The unique conditions of this project set it apart from other hospital projects and present new challenges to the project organization. The high standards of the project's technical installations require extremely accurate planning. In addition, project planning is being done in parallel with construction, making it even more important for the deadlines that are set to be met. Thus cooperation, coordination and planning are fundamental to project execution.

New Karolinska Solna 2012

Technology building

The technology building is a coordination center for technology and provides energy to the entire hospital. This is also where shipments are handled, for deliveries to and from the hospital. To be completed in 2014.

Radiation building

To be completed in 2016.

Hospital part 1

The first part of the hospital will be completed in 2016.

Parking garage

The parking garage was inaugurated in December 2012 and has 818 parking spaces, 75 equipped with charging stations for electric cars.

Research building

The research building is home to lab areas, training facilities and lecture and conference halls. To be completed in 2016.

Hospital part 2

To be completed in 2017.

Patient hotel

Accommodation for patients who need to stay close to their care provider. To be completed in 2016.

NKS – Driving the development of Hagastaden life science city

The Stockholm County Council and Skanska are working together to make the New Karolinska Solna a reality, with a common starting point: that everything to be created, built and organized within the framework of the project is based on the patient's perspective.

Project goals

A number of project goals guide all planning and construction of the new hospital. These include:

- Healthcare, research and education shall be integrated to such an extent that they efficiently support the development and dissemination of knowledge for the treatment of severely ill and injured patients.
- The project shall create attractive and humane environments of high architectural value, within and around the hospital.
- Healthcare and support processes shall be made more efficient, and the utilization of resources shall be optimized.
- The project shall work as much as possible with generally applicable solutions permitting continuous operational development.
- The hospital and its activities shall be assigned an explicit high-priority role in the city.
- The project shall work on all levels from the point of view of sustainability.



THE HOSPITAL IN THE CITY

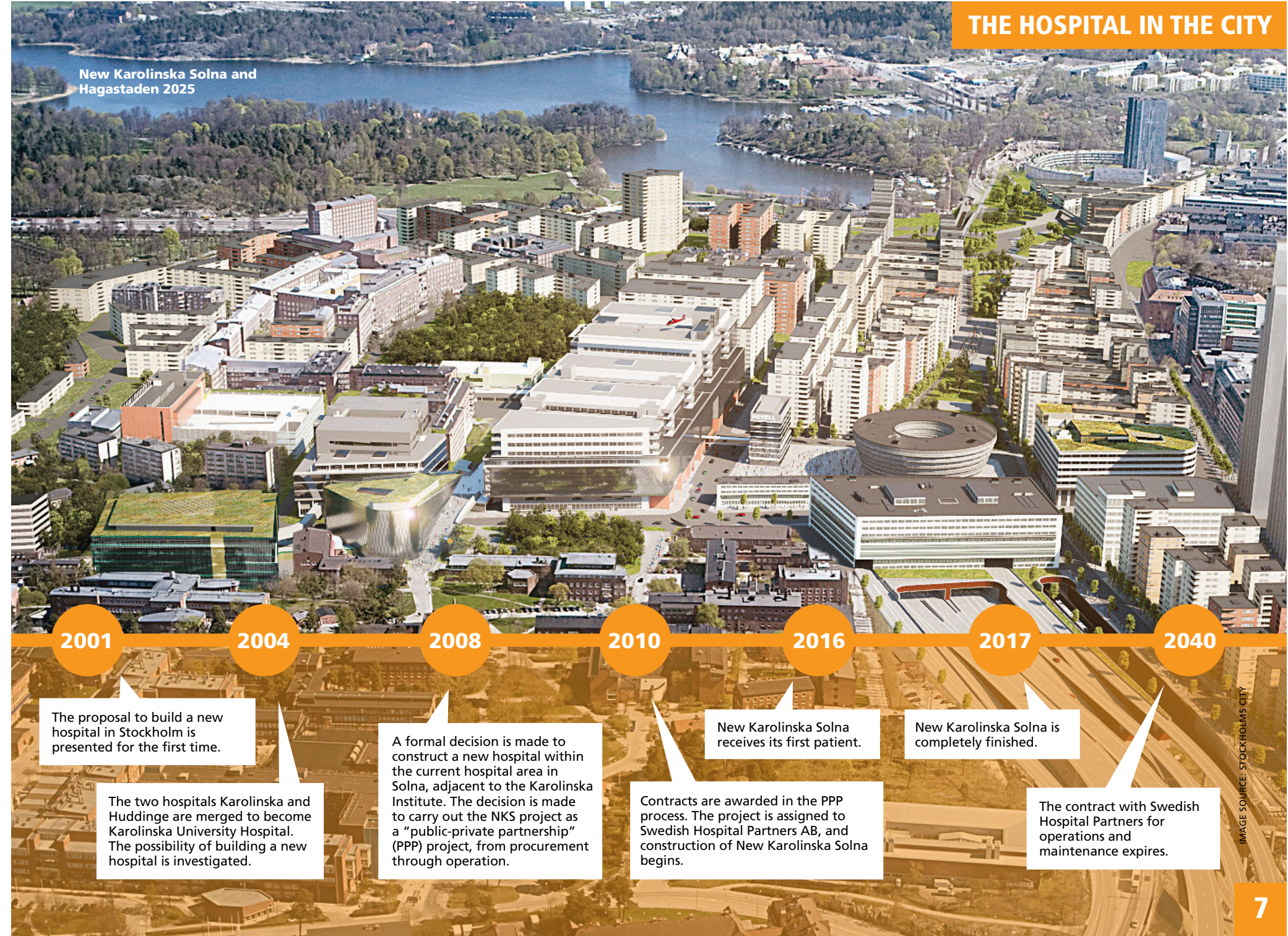


IMAGE SOURCE: STOCKHOLMS CITY



The hospital setting harmonizes with the interiors and is designed to maximize the healthcare experience.



Advanced equipment sometimes weighs up to 3 tons.



Different building sections have different color themes.



All inpatient rooms are private rooms with space for family members to spend the night.

Design solutions with a focus on function and good logistics

New Karolinska Solna is a high-tech hospital, designed for optimal clinical functionality. A streamlined logistical flow and faster response to patient needs will enhance the hospital experience.

For this reason, a clinical design that separates the various flows was chosen, drawing lines between outpatient/inpatient care, day/night care, adult/pediatric care and emergency/planned care. Attention has also been paid to make sure that closely related functions are located near one another in the healthcare building. For example, intensive care and X-ray are located close to one another.

Adaptability for future needs

The clinical design also makes it possible, on most floors in the NKS buildings, to provide current and future forms of specialized medical care, training and research without major renovations.

The Stockholm County Council is responsible for purchasing and installing the medical equipment, while it is Skanska's task to prepare for the installation of this

equipment. However, construction planning takes place before equipment is selected. Everything from dimensions and weight, to vibrations and heat generation must be taken into account. The hospital must also be flexible to accommodate the replacement of medical equipment, which has a shorter life cycle than the hospital structures. This eventuality has also been addressed by making it possible to open up the façade to replace heavy and bulky equipment.

Flexibility and universality have been key concepts in the planning and design of NKS, and these buildings and their facilities are well prepared for future activities.

A welcoming hospital

Light, space and a good indoor climate are obvious qualities for a project such as NKS. But emphasis has also been placed on the physical experience of visitors to the hospital. The choice of colors and materials, color schemes, décor and signage are all important components in creating a functional and pleasant environment for patients, visitors and personnel alike. A comprehensive art program has also been developed for aesthetic presentation.

The helipad can accommodate two helicopters. Elevators provide quick access to the trauma department on level 5.





“Thanks to the PPP model we’ve followed, the Stockholm County Council can focus completely on providing care, because we are managing construction and operations until 2040,” says Ulf Noréhn, CEO of Swedish Hospital Partners.

A pioneering model for infrastructure

The design, construction, financing and operation of New Karolinska Solna were procured according to the public-private partnership (PPP) model. PPP is new to Sweden but has been successfully employed in many other countries.

One characteristic of PPP is that the contractor bears a large part of the risk related to project execution, which has been a requirement from the Stockholm County Council. This model generally means that the customer does not pay for anything until the hospital is up and running, which is unique to the PPP model. Instead, a yearly fee is paid until the customer takes over the operations.

In the case of the New Karolinska Solna, though, the County Council has chosen to co-finance the project during the construction period through ongoing monthly payments as well as milestone payments when the various phases are completed and put into operation. The purpose of this is to reduce financing costs. The County Council is co-financing a total of nearly half the construction costs, while the remaining investment is financed by the private sector through equity capital and bank loans. After

completion of the final phase, the County Council will pay a pre-determined amount monthly until 2040, at which point the County Council itself will assume operation. There is also an option for extension of the agreement all the way to 2055. Having such long contract periods for an operating agreement provides major advantages in terms of predictability and is unique in Sweden.

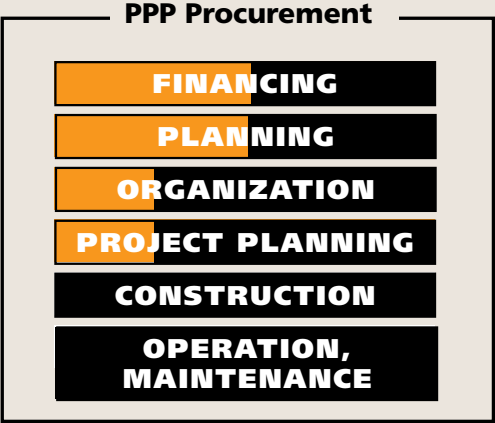
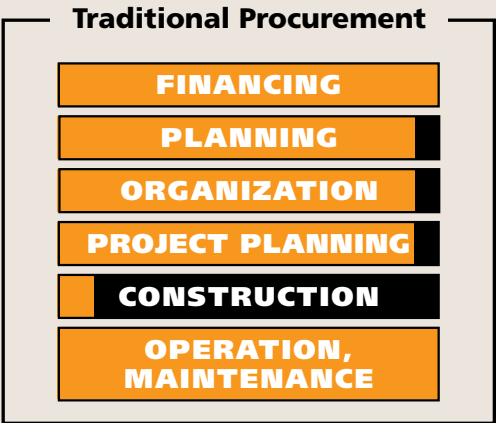
A smart, turnkey “package”

Swedish Hospital Partners (SHP) is the party that signed the agreement with the Stockholm County Council. SHP is owned by Skanska Infrastructure Development and the British investment fund Innisfree. Thanks to the PPP process, SHP can deliver a cutting-edge, turnkey hospital, while the County Council can focus entirely on providing healthcare and conducting research at the highest international level.



On September 3, 2010, the “groundbreaking” ceremony for the New Karolinska Solna took place. Sweden’s Crown Princess Victoria detonated a charge and wished NKS the best of luck.

- = Customer responsibility
- = Contractor responsibility



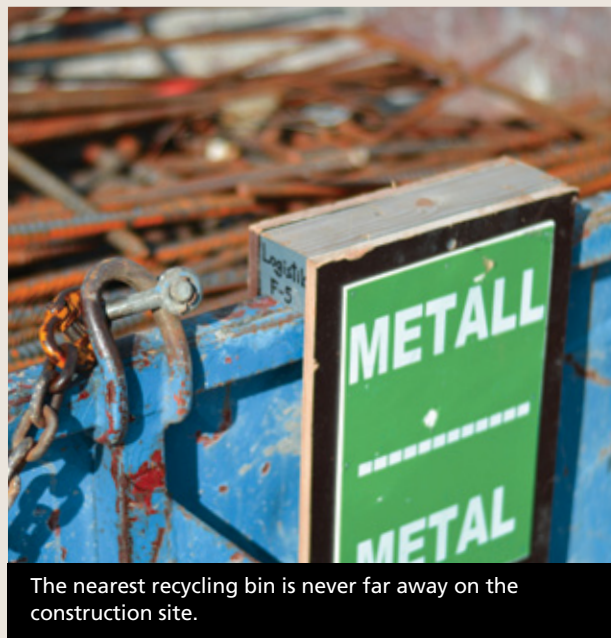
The County Council has set comprehensive functional and environmental requirements and tasked SHP to design, build and co-finance the hospital in conformance with those demands, also being responsible for running the property, from technical operations, to services such as reception, caretaking, cleaning and laundry. Thus, SHP is the project manager and has contracted Skanska for project planning and construction, while Coor Service Management will be handling property operations and services. This model has meant a unique opportunity for everyone involved to help shape the design and project planning. This has made it possible to optimize logistic flows and create smart solutions from the very beginning.

Security for the customer

In the PPP model, the Stockholm County Council owns the property but has entrusted operation and maintenance to SHP during the contract period. This gives the Stockholm County Council total cost control until 2040. At that time, the property must be in as-new condition, without any need for repairs or major maintenance. The long-term operating agreement ensures that everything will be constructed with the highest possible quality and that systems and materials are selected based on a long-term perspective with respect to the environment and costs over the entire life cycle of the project. No unforeseen expenses resulting from delays during construction will be charged, because SHP is fully responsible for such.



The construction site is classified as a “Green Site,” with sustainable solutions at all stages.



The nearest recycling bin is never far away on the construction site.

A green hospital

The Stockholm County Council is on the absolute cutting edge when it comes to high-level environmental requirements, and right from the start the goal was to create one of the world’s most sustainable university hospitals. Skanska is building and certifying the New Karolinska Solna according to the Swedish third-party certification Miljöbyggnad and aiming for Gold.

But Skanska has decided to go even further than that. Once it is complete, NKS will also be one of the first hospitals in Europe to meet the tough environmental requirements for the international LEED Gold certification in line with Skanska’s ambition to become the world’s greenest construction company. The actual construction site is also classified according to Skanska’s own “Green Site” system, whose purpose is to create a greener worksite during construction.

Environmental thinking at all levels

The County Council’s environmental requirements for the project include eight strategic areas: energy efficiency, climate-neutral solutions, environmental impact, indoor climate, third-party certification, transport, waste management and materials management. Most projects usually focus on just a few of these areas, but NKS will be covering all of them.

This means specifications for nearly everything. From transportation – where the demands include choice of fuel, coordinated goods delivery, fuel-efficient driving and the like – to the selection of materials – such that the materials used must be low-consumption during construction and during the entire lifetime of the hospital.

Materials must also be tried and tested and based on renewable or recyclable raw materials. For this reason, all materials in the buildings are approved and documented according to the Swedish environmental evaluation of building products (Byggsvarubedomningen). During construction, as much as possible is re-used, sorted and recycled. The goal is to send zero building materials to landfills by 2015.



The concrete plant established on the construction site provides the project with concrete and reduces the number of trips by a total of 20,000.

Environmentally friendly operations

Operation of the hospital must also live up to high environmental standards, from the detail level to overarching operations as a whole.

Energy will be supplied through a combination of district heating and cooling, a dedicated large geothermal plant and recycled energy from ventilation exhaust. The geothermal plant alone will satisfy 65 percent of the hospital’s demand for heating and cooling. As a result, the need for purchased energy will be 40 percent below the maximum in building norms for purchased energy, and the electricity used in the new hospital will come from renewable energy

sources to the greatest extent possible. Another interesting detail is the use of green roofs, which insulate against cold and retain surface water, while adding green space to the site.

Good conditions for green traffic

Environmental thinking also applies to traffic to and from the hospital. For example, bicyclists will have many good possibilities, including bicycle rooms for staff. In addition, 10 percent of all parking spaces will be equipped with charging stations for electric cars.

Environmental thinking

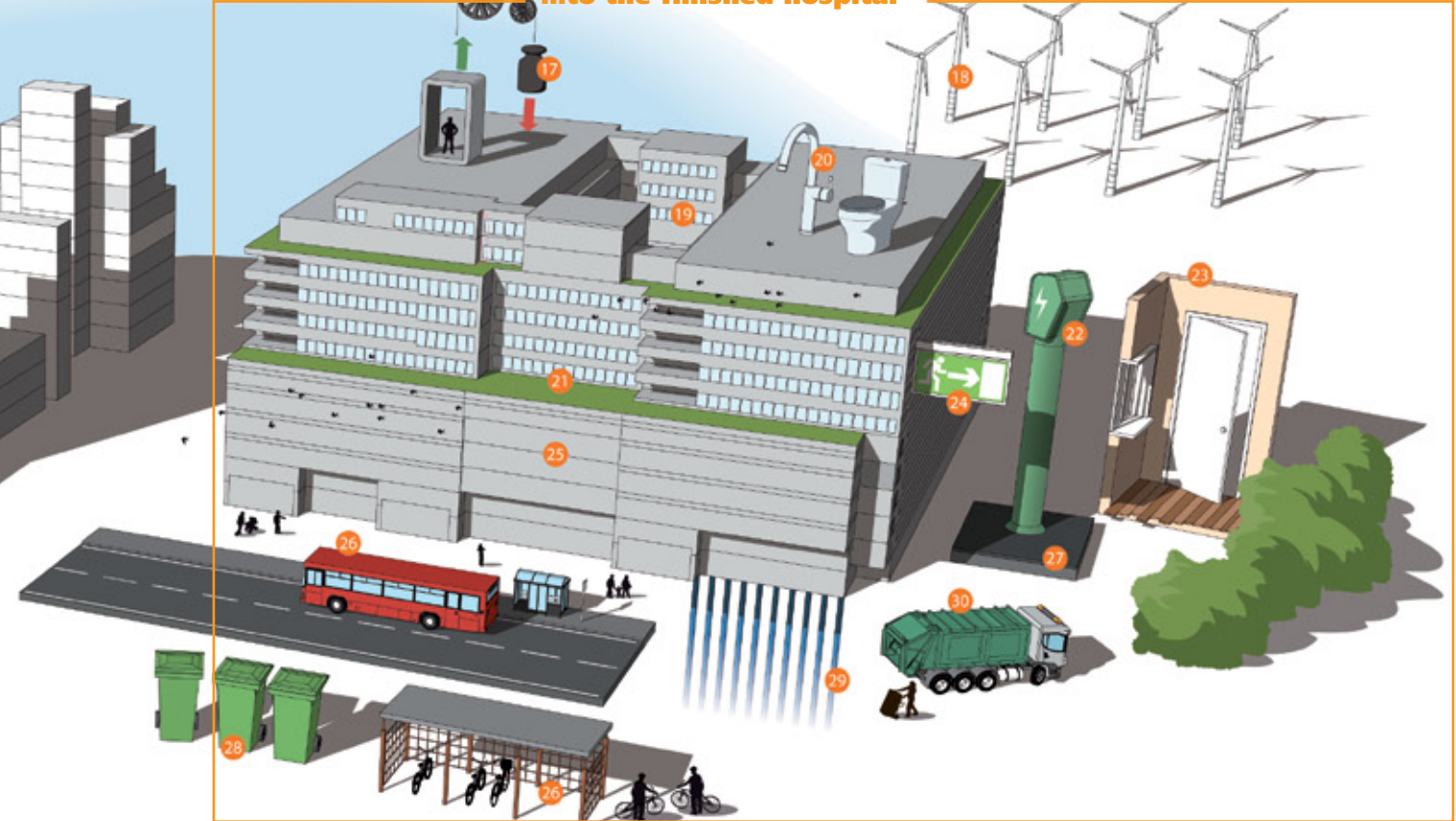
During construction...



A part of
our
Green
Initiative
SKANSKA

- 1 Cranes that are frequency controlled instead of friction-controlled to save energy.
- 2 The sediment unit treats water from the construction site before it is released.
- 3 The on-site concrete plant will reduce the number of trips by 20,000 the first three years.
- 4 A watertight foundation helps reduce the risk of radon inside the buildings.
- 5 Skanska's and subcontractors' heavy machinery and vehicle operators are trained in ecodriving. The equipment meets Euro II standards for exhausts at a minimum, heavy vehicles fulfill requirements for Stockholm "environmental zone." Fuel consists of 6.5% renewable raw materials.
- 6 Correct storage and documentation of chemicals on the building site reduce the risk of spills and improper handling.
- 7 Ecolabeled ingredients for break rooms and conference rooms.
- 8 Mercury-free low-energy bulbs, timer-controlled to reduce energy consumption.
- 9 Heat pumps in the cabins save energy.
- 10 Only ecolabeled kitchen, hygiene and cleaning chemicals are used.
- 11 Staff bicycles and information on public transport to promote transportation to and from the workplace.
- 12 All waste is weighed on-site for tracking. Many modules, such as bathrooms, are pre-fabricated to reduce waste.
- 13 Environmental engineers provide support in project planning, purchasing and production. Skanska also uses electronic drawings, which saves paper.
- 14 Deliveries planned carefully to reduce impact on local traffic and reduce exhaust emissions.
- 15 One goal is to increase the percentage of building waste that can be recycled. The goal is to send 0% to landfills.

...to the finished hospital



- 16 Certification under LEED, "Sweden's Miljöbyggnad" and Skanska's "green leaf" for a green construction site.
- 17 Elevators recycle energy when they are going down.
- 18 Purchased electricity must consist of at least 20% renewable energy from wind power.
- 19 High air quality and occupant-adapted airflow.
- 20 Water-saving taps and toilets. The taps are specially manufactured and contain less lead.
- 21 Green roofs provide biological diversity and collect water.
- 22 Charging stations for electric cars are provided at 10% of all parking spaces.
- 23 All materials assessed under the Swedish environmental evaluation of building products (Byggarbetsvärderingen). Priority given to locally produced, recycled and low-emission materials, as well as FSC-certified wood.
- 24 Energy-efficient LED lighting in public areas and emergency exit signage.
- 25 Energy-efficient windows and façade cladding. Transmission of daylight via atriums.
- 26 Close access to public transport. Bicycle racks and bicycle rooms to promote bicycle use.
- 27 Environmentally friendly asphalt in parking garage in which part of the bitumen has been replaced by wax, which is renewable.
- 28 Sorting of waste into more than 30 fractions.
- 29 Geothermal energy plant, heating and cooling storage in drill holes more than 220 meters deep.
- 30 All food waste is collected and sent to the Stockholm County Council's biogas plant. The hospital's main kitchen will have several food waste grinders to help produce biogas for the County's buses and cars.

Proactive health & safety work

Skanska has a zero-accident vision, and the company’s ambition is always to be one step ahead when it comes to health and safety work – with the goal of holding a world-leading position. This is one more area in which New Karolinska Solna stands out as a unique project where standards are also set as to how the construction industry’s safety work should be carried out.

With many different processes and a large number of trades workers and subcontractors in constant movement on the construction site, health and safety must be given the absolute highest priority. Careful risk analysis, strictly set routines, detailed work descriptions and immediate action against unsafe working conditions are self-evident for everyone involved in proactive safety work.

Knowledge helps boost safety

The foundation for health and safety work is to increase everyone’s awareness of their own health and safety and that of others and to respect the guidelines in place. Clear rules and health and safety routines have been drawn up for the

construction site, and everyone present on the site must be familiar with these routines and regularly participate in relevant safety and rescue training. The same health and safety guidelines apply for both employees and subcontractors throughout the project. Health and safety work is carefully documented, and continual assessment and review of daily tasks help provide a clear image of how the work rules are being complied with in practical terms. It also follows that good health and safety performance should always be acknowledged. Planning and follow-up take place on a continual basis through health and safety meetings at all levels.



Personal safety equipment is evaluated and upgraded continually.



Action against unsafe working conditions is automatic to everyone involved in proactive health and safety work.



Training in occupational health and safety is held to prevent accidents.

Challenges beyond the ordinary

A project as involved as New Karolinska Solna sets the bar high when it comes to logistics. Specific circumstances prevail on every construction site, but there is much more to account for in this case, requiring planning down to the smallest detail. It is not just the size and complexity of the project that affect logistics work. Traffic, noise and vibrations must not be allowed to disrupt activity going on around the clock in the nearby Karolinska University Hospital and Karolinska Institute.

Numerous ambulances and ambulance helicopters arrive at the site every day while construction is underway. The construction project must not block roads or airspace connected to the hospital, which might otherwise force changes to helicopter flight paths. Nearby there are both

residential areas and several other ongoing construction projects, something which means further considerations and restrictions with respect to use of roads. For safety reasons, there are special traffic guards at the gates of the construction site to guide drivers and pedestrians.

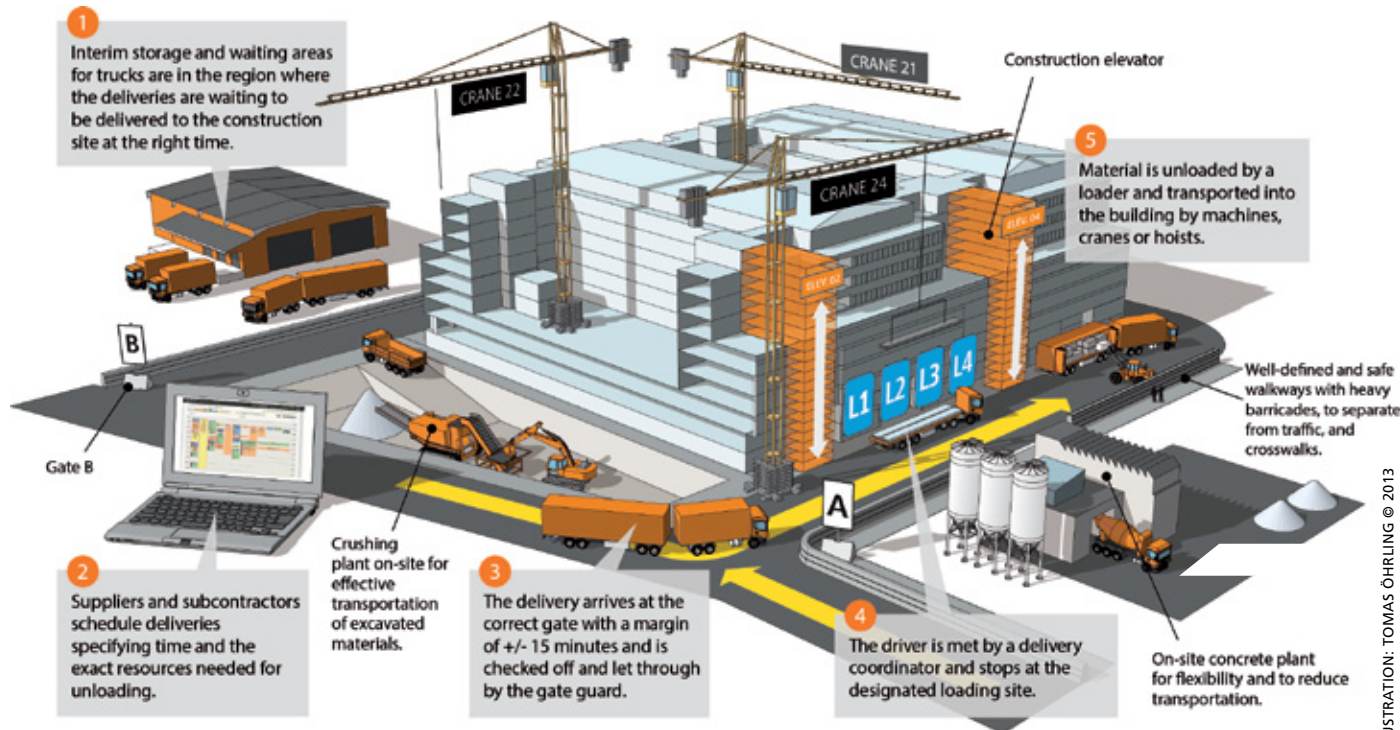


ILLUSTRATION: TOMAS ÖHRLING © 2013



New Karolinska Solna is being constructed in close proximity to ongoing activity at Karolinska University Hospital, putting extra demands on logistics flows.



A number of food service stations are found on the worksite to provide everyone involved in the project with food.

Planning down to the smallest detail

The scope of the project and the fact that there is limited storage area on the actual construction site also entail extensive transportation. The complicated logistics around the construction site necessitate a plan for every delivery. A clear “just-in-time” booking system ensures that deliveries arrive at precisely the right time and place without creating obstacles for other deliveries or surrounding activity. To further facilitate transportation, there are limited short stay waiting areas nearby, and interim storage and holding facilities around the region have also been established for project suppliers.

Smart solutions to reduce transportation

Our proactive work in coordination and planning also helps minimize the number of trips to and from the construction site. For example, a local concrete plant was set up at the beginning of the project. By manufacturing concrete on-site, the number of trips in the first three years has been reduced by more than 20,000 deliveries, which is good for the environment and from a logistics viewpoint. The expanded use of prefab modules, such as bathrooms, also helps significantly reduce transport.



Prefabricated sanitary rooms are delivered as boxes.



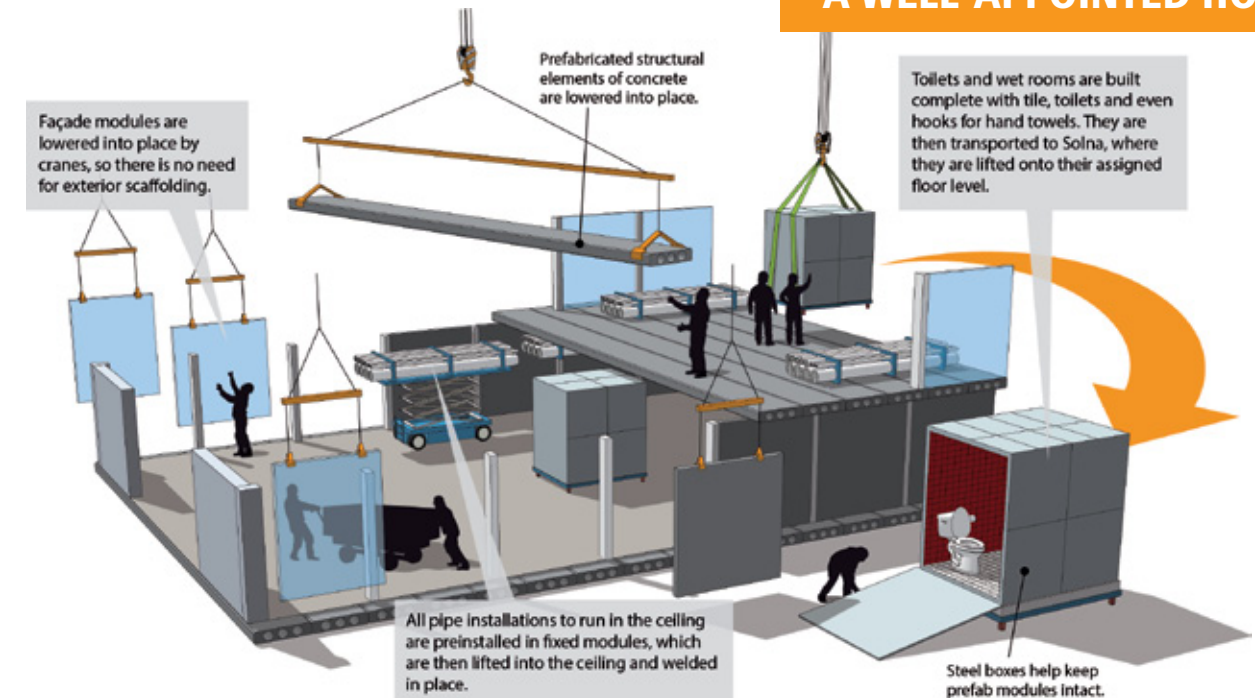
The modules, lifted into place using cranes, are sealed until they are put into use.



Cranes lower the modules through the roof.



The sanitary rooms are complete and ready to be used.



A well-appointed hospital

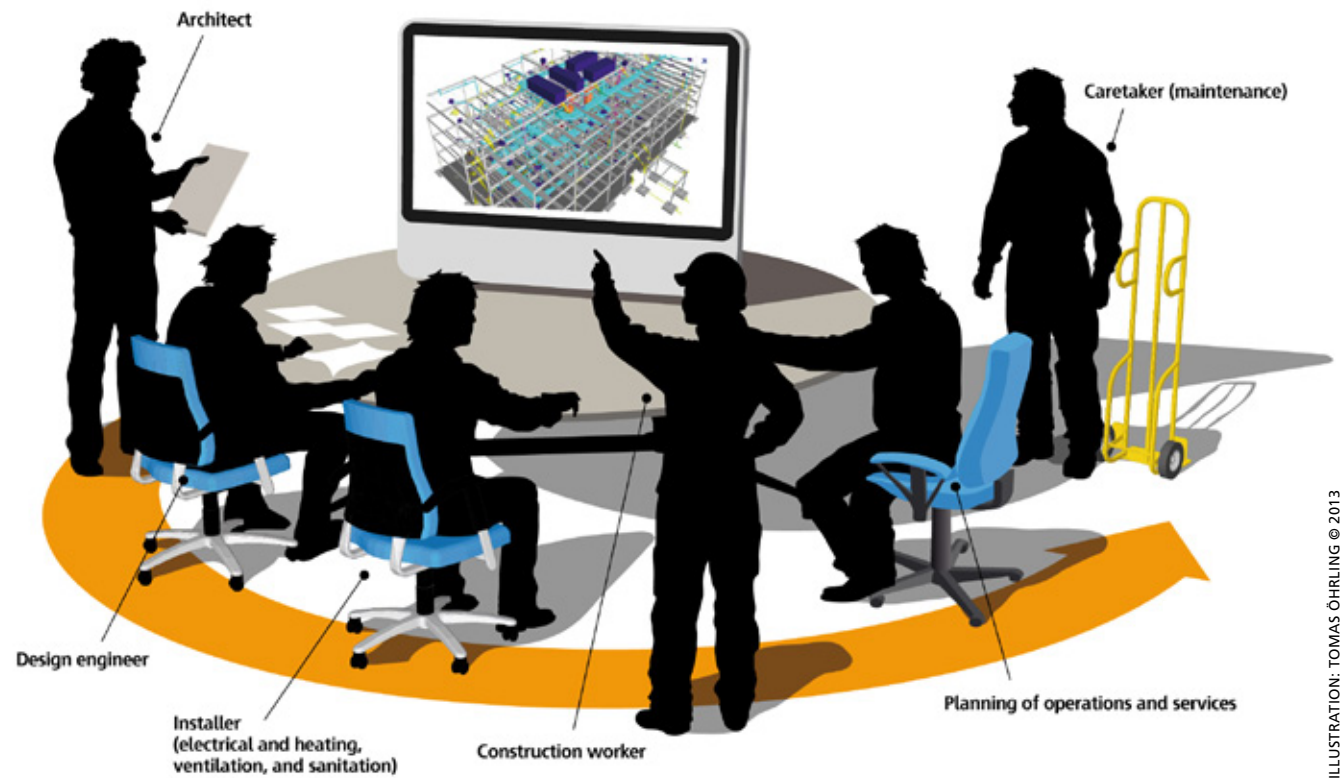
The hospital's design is based entirely on the clinical and functional requirements set by the Stockholm County Council. Skanska has used these as the basis for developing solutions that were then approved by the County Council's experts and healthcare specialists. Ensuring patient safety has been given the highest priority, so people representing the various professional categories that will work at the hospital were given the chance to provide input.

Form follows function

The location and clinical design of various care functions were determined based on the need for integration and flow and optimized with respect to the activity that will be carried out – everything from the size and location of the room, to ease of cleaning and color selection. To facilitate this work, the architects developed prototypes for outpatient clinic rooms, inpatient rooms, operating rooms, laboratory medicine, radiology/imaging and radiotherapy – each optimized for its specific function. A number of these prototype rooms together form a functional unit, and a number of functional units make up one floor.

Modules provide major advantages

The project also makes extensive use of prefabricated modules, which significantly facilitates construction work and reduces the number of deliveries during construction. Producing the modules in a secure factory environment also guarantees higher quality in the end product than building them on-site would. The modules enable a high degree of flexibility in optimization. For example, the sanitary rooms of the hospital are completely prefabricated in a factory and delivered in sealed boxes that can then be smoothly lifted into their proper place – simply plug and play.



A model of clarity

The New Karolinska Solna project employs a method of designing and constructing buildings entirely in 3D, which presents information about all the attributes of every object included. This is known as Building Information Modeling (BIM).

For NKS, BIM has virtually been the prerequisite for success for building in such a strict timeframe. BIM will also serve as a tool for the complex future operation of the hospital.

A simpler way to build

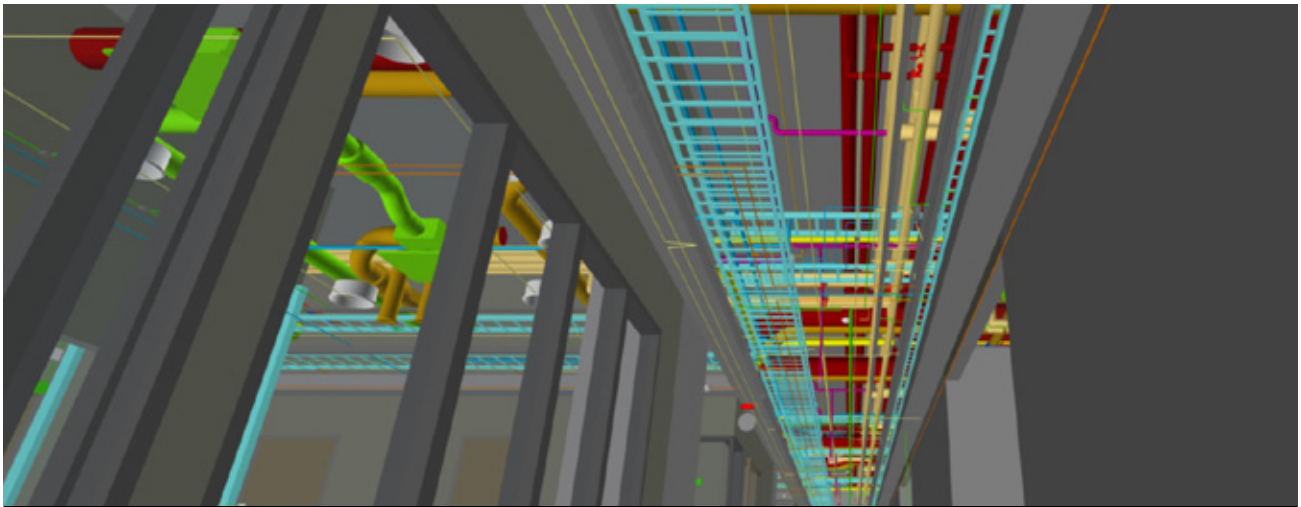
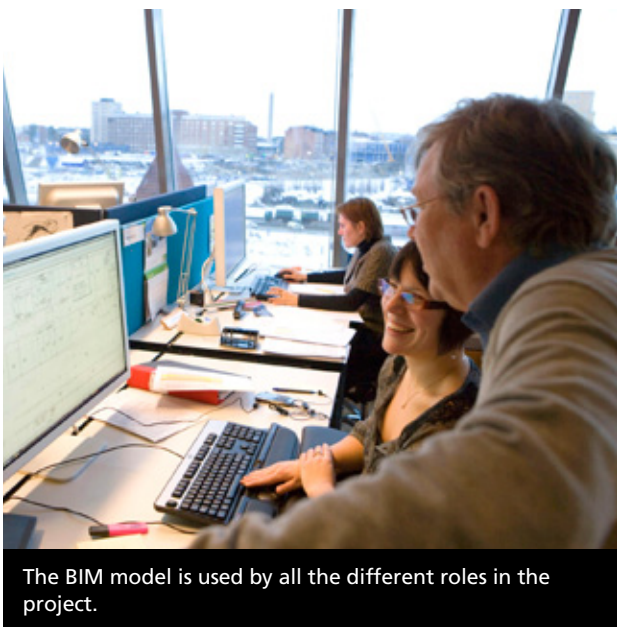
For NKS, BIM provides necessary communications support in the building process and a means of gathering all information on the parts of the building in one place. Everyone involved – from design engineers to electricians, from

heating, ventilation and sanitation specialists to purchasing managers – are working according to one and the same model of the project.

By working in a common model, everyone designing the various parts of the building can see how their section fits into the building as a whole. The building sections are then “dressed” with information on their attributes, turning the model into a well-organized information hub. Simply put: BIM serves as an unbroken chain of information that allows everyone to work towards a clear and common goal.

BIM in daily operations

BIM makes it possible to create a visual image of the project that links information down to the very smallest details. This creates opportunities to manage the complex building not only in production, but also during operation. Thanks to BIM, there is a system that provides the administrator with a clear overview and understanding of the installation. For example, information that the model provides on floor space facilitates planning of cleaning and other hospital upkeep. If a lamp breaks, the model will show not only what type of lamp it is, but also whether a ladder will be necessary to replace it. It is also possible to draw conclusions on the priority of measures. Naturally, it is more important that everything functions optimally in an operating theatre than in a break room. Thus information saved in BIM can be at least as important for future operation as it is in construction. Through BIM, the information can be reused throughout the lifecycle of the building. BIM also provides major advantages from an environmental perspective, as it is an excellent tool for conducting accurate energy analyses.



An example of how the BIM model might look: Even the smallest detail in the project is described in the model.