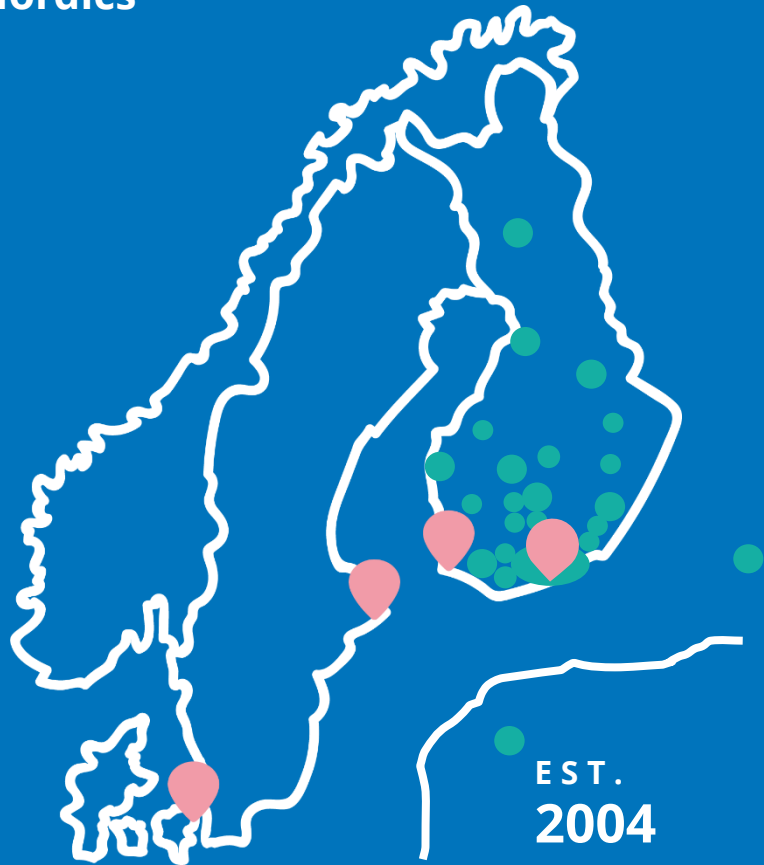


Intelligent hospitals

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14.11.2022

The leading social and healthcare advisory and solutions company in the Nordics

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Over 200 social and healthcare industry experts



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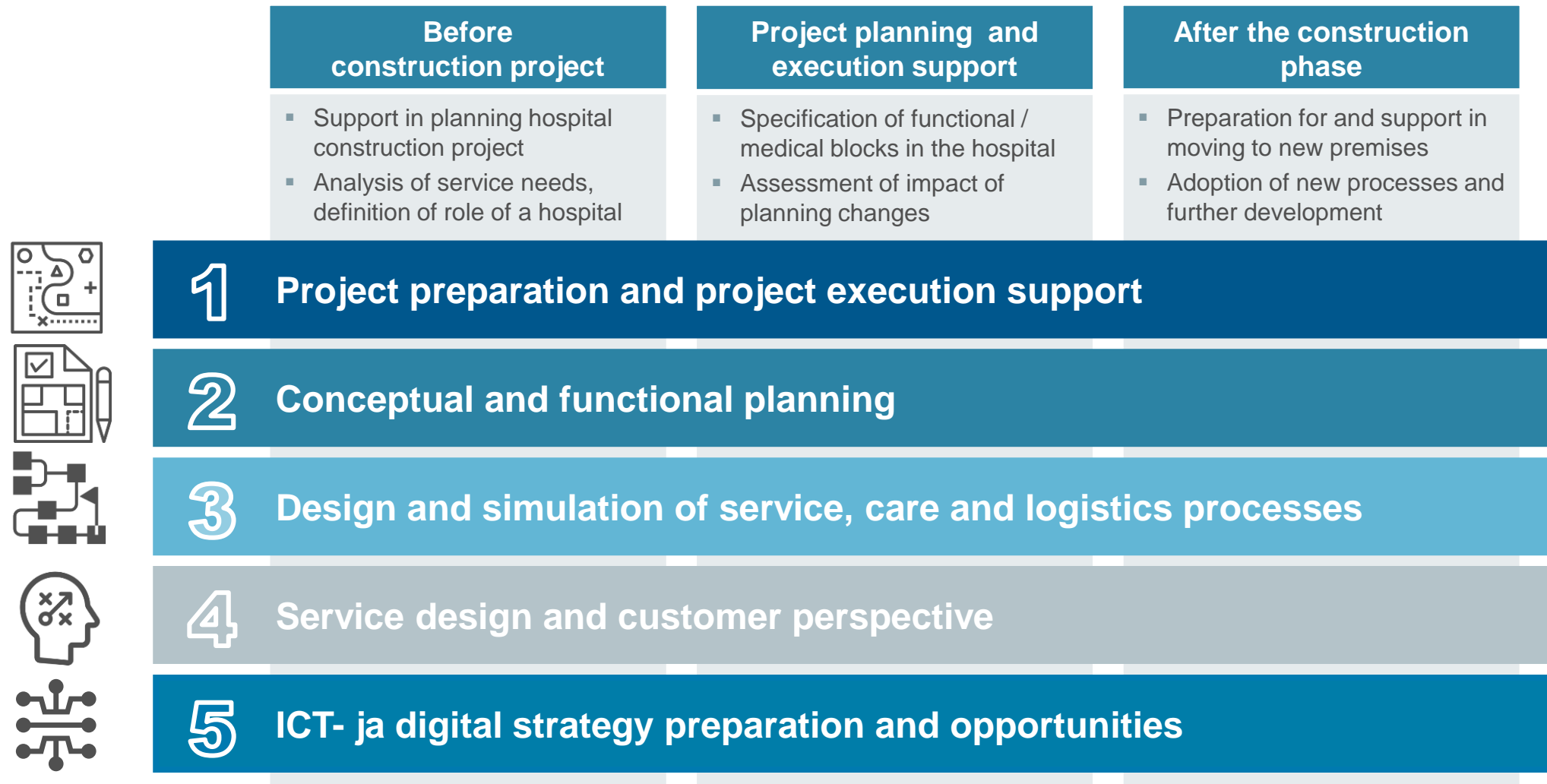
Strategic focus on value-based social and healthcare

Official ICHOM partner since 2018



NHG experience helps in the entire life cycle of a construction project - from needs assessment to post-commissioning development

The best opportunity to impact costs and functionality of facilities is during the planning phase





Jouko Kuisma

Master of Arts in Computational Linguistics, Univ. of Helsinki, grad. 2006

25+ years in ICT business

20+ years in healthcare

Specialist in “smart hospital” design

Consulting mainly in hospital projects, roles include
strategy facilitator, project manager, architect,
procurement specialist

Led Salivirta&Partners 2014-

Salivirta merged into Nordic Healthcare Group in 2022

Today Vice President, Digital transformation @NHG

<https://www.linkedin.com/in/joukokuisma/>



Järvenpää social and health centre "JUST"
(completed in 2017)



Kainuu Central Hospital, Kajaani
(completed in 2021)

some projects i have been involved with in 2014-2022



Oulu University hospital
OYS 2030 future hospital



Kanta-Häme Central Hospital
"ASSI", Hämeenlinna, build started in 2021

Definition of a hospital?

Hospital is a purpose-built building which promises to deliver its patients better health and heal their diseases. A general hospital usually provides a range of services, including:

- Emergency department for treatment of acute patients
- Outpatient departments, "clinics"
- Surgical wards
- Diagnostic departments, including medical imaging and clinical laboratory
- Patient wards for providing overnight care

A specialized hospital is focused on providing certain type of services, e.g. may only provide outpatient appointments or day surgery

Hospitals in Finland

- 21 hospital districts which maintain general hospitals
- The population base of a district range from under 50000 (Eastern Carelia, Savonlinna) to more than 1,5 million (Helsinki and Uusimaa hospital district)
- Each hospital district runs at least one general hospital. HUS has 18!
- The goal has been to centralize hospital care where ever possible

- The Finnish legislation is used to enforce the development
 - From 2023 on, there will be 21 healthcare and welfare regions (+Helsinki and Åland)

- Most of the smaller regional general hospitals and primary care run hospitals are dated
 - The new regions will probably continue with consolidation of smaller units

- The borderline between “proper hospitals” and other healthcare facilities is blurring

Hospitals globally

- In developed countries, there are surprisingly many variations on how secondary (hospital) care is organized
 - Government, local government, trusts, insurance companies, private enterprises...
- The way hospital care is provided is fairly similar
 - Length of stay can be wildly different depending on standard care procedures
- In developing countries, the situation is completely different
- The “best practices” are pretty applicable everywhere

All health care facilities are not hospitals

JUST in Järvenpää

Completed in 2017

62 M€ project

Has most of the functions of a small general hospital, except for surgical operation theaters

JUST is one of the most "intelligent" health care buildings in use in Finland today. But it is not formally a hospital



A major rebuild is going on

- A boom in hospital construction in 1960's and 70's, most general hospitals are from that era
- The structure and layout of the buildings do not meet the needs of today's hospital care
- Technology-wise, the buildings are very outdated
- Most of the old hospitals will be completely replaced with new
- An estimated of 5 billion € will be spent on hospital construction in Finland in 2010'-20's
 - Investments are perhaps half-way right now
- Smaller regional hospitals will mostly move into total newbuilds
- Larger University hospitals (Helsinki, Turku, Tampere, Kuopio, Oulu) are rebuilding their campuses in smaller steps
- There were virtually no hospitals built from late 1980's until mid 2000's in Finland!

Entering the 21st century

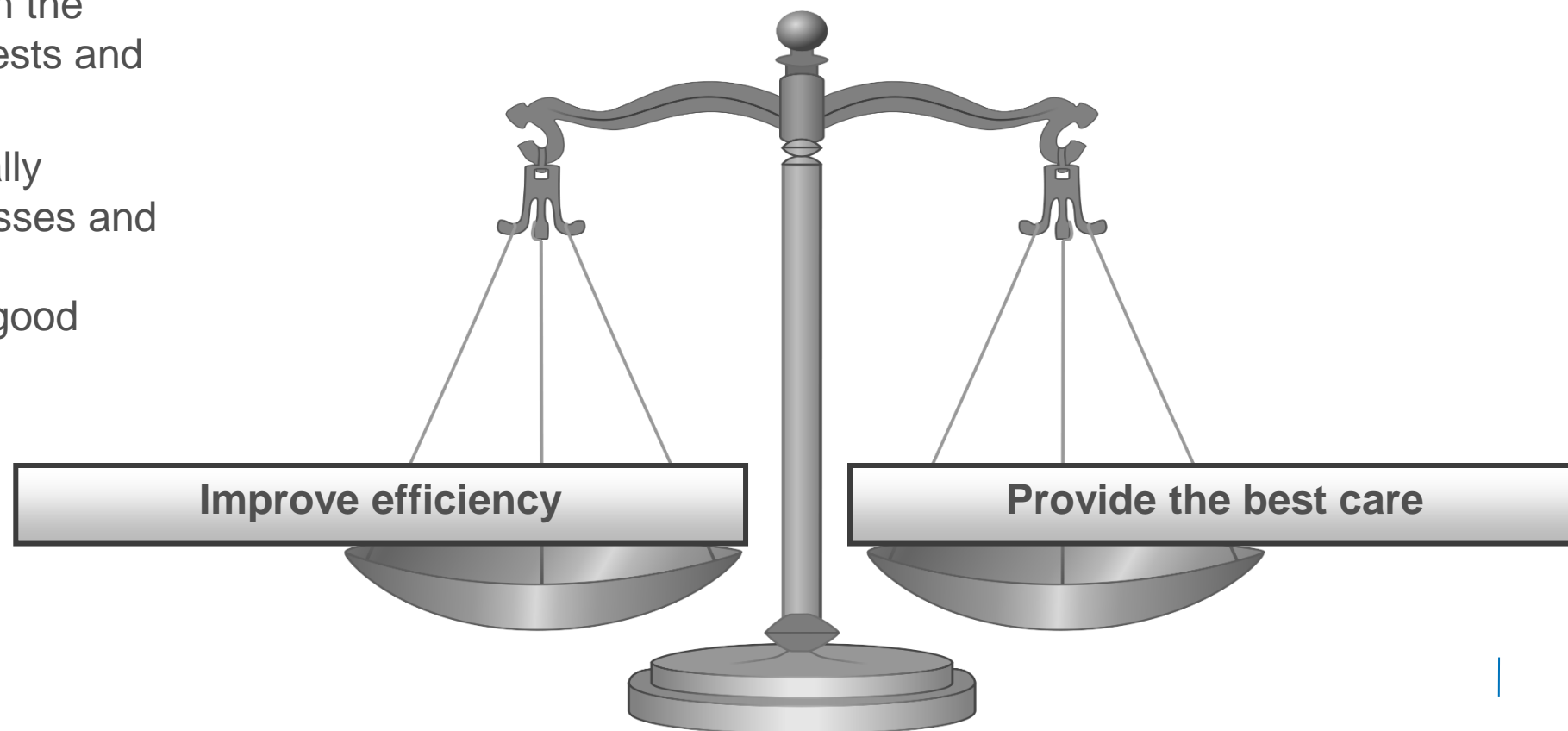
- Old hospital buildings now longer meet the needs of today's healthcare
- Hospital services are being centralized
- Even more specialized treatments are introduced, setting new requirements on premises
- Old facilities are abandoned, new larger units are being built
- Examples:
 - Odense University Hospital - Largest in Denmark, 11000 employees, 1038 beds, complete new build, finished by 2022
 - The New Karolinska University Hospital - Largest in Sweden, 15000 employees, 1340 beds, was finished in 2018
 - Oulu university hospital: about 900 beds: a complete new build in phases, finished by ~2030
- A 1000+ bed hospital is huge by world standards
- The hospitals in the Nordic countries are among the largest in Europe (and the world)

What is an intelligent hospital?

Heikki Korvenranta, MD, project director of TYKS T-hospital, put it this way:

An intelligent "future hospital":

- Is a facility designed with the patients, their best interests and optimal care in mind
- Is a facility which optimally supports the care processes and therefore enables the organization to provide good care
- Is logistically efficient



The mission?

An ideal hospital shall provide:

- Health benefits: in form of less complications, quicker recovery and earlier discharge
- Financial benefits: in form of more efficient operations, less waste and quicker turn-around times

The hospital itself is just one part of the continuum of care:

- The role of prevention of disease and promotion of well-being is critical
- More and more services could and should be provided remotely
 - in Kanta-Häme, the goal is to convert 40% of appointments to virtual meetings
- The concept of "hospital without walls" - not literally though!

Still, the hospital buildings are here to stay and new need to be built

What is an intelligent hospital?

Often called *smart hospital* as well

JOUKO'S LIST OF 8 NON-ACADEMIC CRITERIA

#1: It is up to 30% smaller than the old hospital(s)

The building can be massive, but the functions consolidated into it had greater amount of m²

Often several outdated facilities are being consolidated into one

Kalnes, Helse Sør-Öst, Norway, was built in 2015. It is literally "in the middle of nowhere" yet by a motorway. Several hospital sites in nearby towns were consolidated into one site



Photo (c) Moss-Avis

Production planning system

- The building blocks of hospital IT are *electronic patient administration system (PAS)* and *electronic patient record system(s) (EPR)*. Quite often, these two are in a same system
- Many hospitals lack a proper *production planning* or *enterprise resource planning system*



- In most new building projects, it is a prerequisite that the move-in is only possible if such a system is in place
- Too many hospital production planning system implementations have recently failed

(c) Getinge Cetrea



Self-service kiosks -
arrival registration



Queuing / waiting room info displays

Room reservation and call-in displays



Photos (c) Axel Health

AN INTELLIGENT HOSPITAL IS
MORE COMPACT THAN ITS PREDECESSORS
AND DESIGNED FOR EFFICIENT OPERATIONS

*In order to manage in the new, more compact premises,
there must be a way to reach higher utilization rate of premises,
equipment and staff*

The goal is to not keep the patients waiting

#2: Form follows function – sculpted for its purpose

- Back in the 50's to 70's, the central hospitals all had a tall tower building
- Patient wards were located in the tower
- The wards - encompassing the floors and wings - were each dedicated to a certain clinical speciality



North Carelia central hospital, Joensuu (built 1953)
Photo (c) junafani / wikimedia commons

#2: Form follows function – sculpted for its purpose

- Patient rooms were typically 4-bed rooms with no privacy and no private facilities



Kymenlaakson keskussairaala, Kotka (built 1967)
Photo (c) IA / Wikimedia commons

#2: Form follows function – sculpted for its purpose

- Outpatient clinics, surgical operating rooms and supporting functions were often located in low, 1-3 floor tall adjacent buildings/wings on the side of the tower building
- Meilahti “Hilton” was renovated in 2014 – many think it should not have been done



HUS Meilahti, Helsinki (built 1965)
Photo (c) Tomisti / wikimedia commons

Design brief for the intelligent hospital has changed

- Boxy buildings are efficient
- Compact horizontal dimensions mean short walking and transportation distances
- Floors on top of another can be utilized effectively by using logistics automation, e.g. lifts, and vertical automated storage and retrieval systems



Kardex vertical storage in Kajaani hospital

Design brief for the intelligent hospital has changed

- In order to save labour and to cut turnaround times, relatively simple automated logistics systems can make a big difference



Tempus automated laboratory sample transport system in Kajaani hospital

AN INTELLIGENT HOSPITAL IS
FUNCTIONAL AND THIS
OFTEN MEANS A BORING BOXY SHAPE

*Different logistics automation solutions are
gaining popularity*

#3: If not boxy, the building has an E shape

It is considered "common wisdom" that a pleasant environment will contribute to better healing of patients

There are many ideas how to put this into practise. Most commonly:

- Patient rooms are for a single patient - peace and quiet - not too social
- En suite bathrooms - to avoid spread of bacteria and infections
- Wards are no longer dedicated for the disciplines - you may have patients with very different conditions and needs on same floor
- Natural light and outside views contribute to healing

This is why the patient wards need a lot of exterior wall space: enter the E-shaped buildings!

Challenges of wing layout and single person rooms

Espoo hospital is a primary-care run facility with inpatient wards and an outpatient clinic

It was one of the first hospitals in Finland with single occupancy rooms mainly for elderly patients

The staff has complained about long walks and inability to supervise the patients residing in the privacy of their rooms



Espoo city hospital, Espoo
70 000 m²
Finished in 2016

Solution? Intelligent nurse call and RTLS



(c) 9Solutions

Some features of an intelligent nurse call



Patient call button

- Regular nurse call
- Pre-defined requests
- Adjustment of lights and blinds



(c) 9Solutions

Nurse's mobile

- Patients' calls
- Door intercom
- Colleagues' requests for assistance
- Automated alarms
- Ordering of patient transports, cleaning...

RTLS

Real time location system
- i.e. Indoor positioning system

Helps to track whereabouts of assets
and staff anywhere within the building

Enables lots of automation



(c) Stanley Aeroscout

AN INTELLIGENT HOSPITAL PROVIDES ITS PATIENTS
WITH LOTS OF NATURAL LIGHT AND A GREAT VIEW

*New technologies are needed in order for the staff
to manage in the labyrinth of patient wards*

#4: An intelligent hospital is a social place

The Nova hospital in Jyväskylä was among the first to utilize a "back office" concept, where no-one has an own office any more

According to K-SSHP, their outpatient clinic rooms are utilized at 40%. Goal is to raise it to 70-80%

Patients are met in the clinic rooms

The "office work" is done in back office areas, where desks are "clean desks": you can pick a free seat anywhere

This is a common in a modern office but new for the hospitals!



Photo (c) KSSHP

Nova hospital, Keski-Suomi health care district, Jyväskylä
100 000 m². 411 M€
368 beds, 24 operating theatres
Completed in 2021

#4: An intelligent hospital is a social place

Kainuu hospital in Kajaani was the first to launch the "back office" concept with occupancy sensors



Photo (c) Mimmi Nietula YLE
46 000 m²
153M€
Ca. 300 beds

Where would I sit today?



Photo (c) Haltian / Emphatic building

AN INTELLIGENT HOSPITAL IS A SOCIAL PLACE

...and this will surely take some getting used to

#5: Intelligent hospital is carefully planned

Building Information Modeling (BIM)

- an intelligent 3D model-based process
- gives architecture, engineering, and construction professionals the tools to more efficiently plan, design, construct, and manage buildings and infrastructure

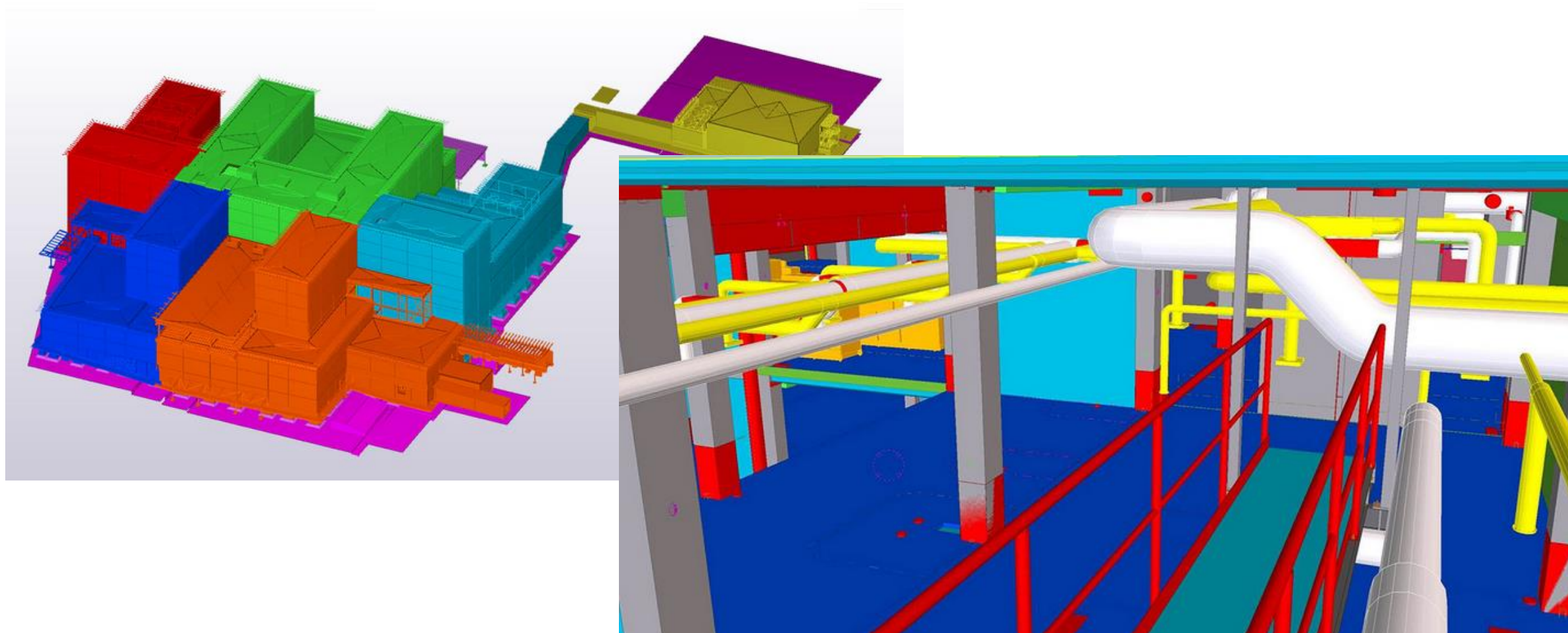
If carried out to the most detailed level, the BIM will know the placement and purpose of every single pipe and wire within the building

In practice, we're not quite there



Kainuu hospital was been recognized for its use of BIM (Building information modelling)

BIM



Kainuu hospital

Other emerging trends in hospital design

Virtual modelling

To ensure the functionality of floor plans, rooms and furnishings, the concepts are tested using Cave automated virtual environment (CAVE) - kind of "Business VR"

Adaptability during the lifespan

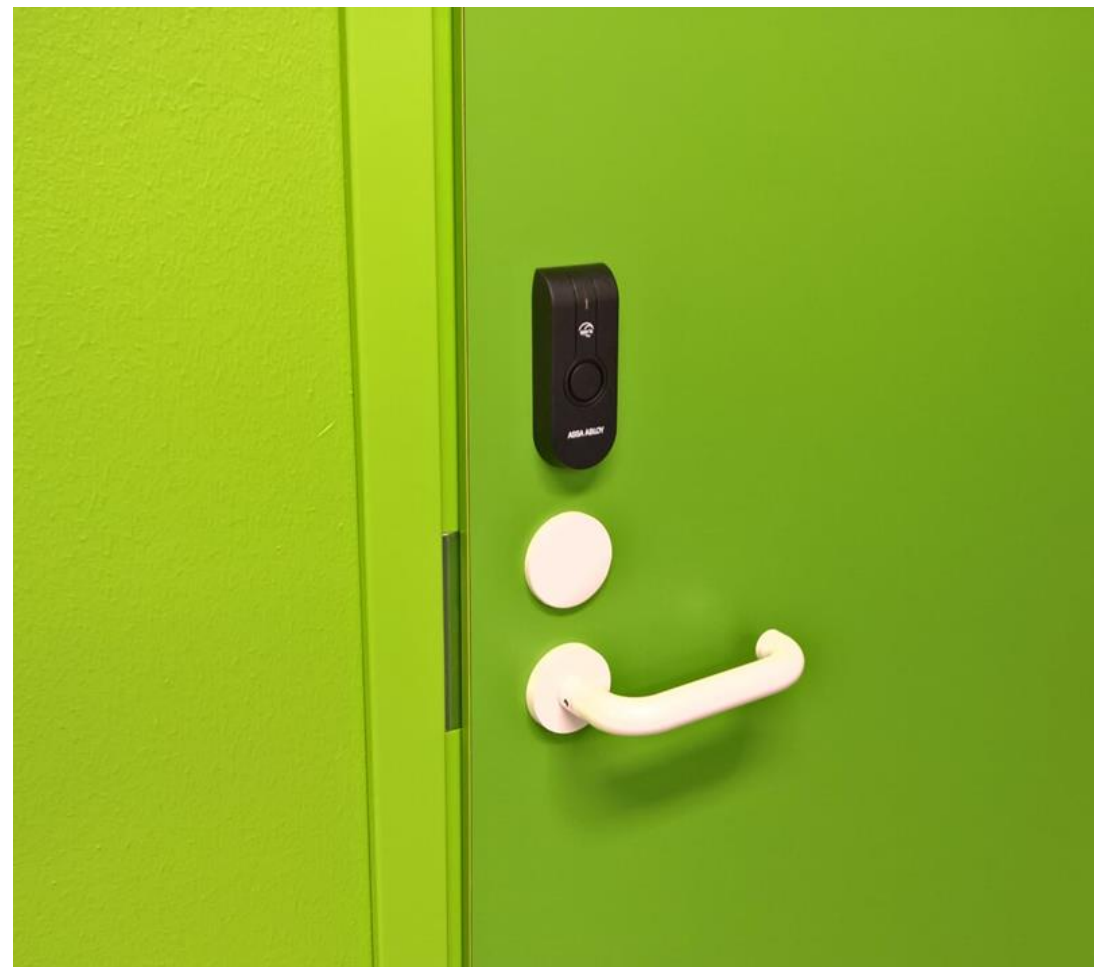
During the 50+ years lifespan of a hospital, the functions inside will change many times. Therefore most of the internal walls are lightweight walls made of plasterboard. In Finland we call this "muuntojoustavuus", would that be adaptability?

AN INTELLIGENT HOSPITAL IS CAREFULLY PLANNED
AND ADAPTABLE TO FUTURE CHANGES

#6: Intelligent hospital is locked up

No more "open doors policy": an intelligent hospital provides its employees and visitors a higher level of security

Wireless systems are used to complement traditional wired access control to enable "keyless" access everywhere



Abloy Aperio access control in JUST, Järvenpää

AN INTELLIGENT HOSPITAL IS LOCKED UP INSTEAD OF HAVING AN OPEN-DOORS POLICY

*It has extensive electronic access control which is complemented
with other security systems such as
RTLS based personal security and extensive camera surveillance*

#7: An intelligent hospital relies on its data networks

Thousands and thousands of twisted pair network nodes are scattered around the building. They are utilized to connect virtually all "intelligent" systems to the network backbone

Fiber-optic networking is used in the trunk network between switches. Fiber cabling to endpoints (workstations) is not being built in large scale

Building automation is used extensively. It is more and more IP based, but still partly separate e.g. DALI bus

These networks form critical "blood vessels" of an intelligent hospital



Kainuu hospital

The power must never go out

The uninterrupted power supply of the whole hospital must be guaranteed.

- UPS (battery)
- RUPS (rotary UPS)
- Heavy-grade diesel generators



Image: Cisco

AN INTELLIGENT HOSPITAL DOES NOT TOLERATE POWER OR NETWORK OUTAGES

The life-supporting medical devices have their internal backup power for short outages but the other systems do not have much tolerance

#8: Intelligent hospital is energy-efficient

Requirements for hospital HVAC are very demanding. Kainuu hospital, despite being a fairly small one, has 70 HVAC units

Nearly the whole 4th floor of the building is dedicated for technical building systems

In a hospital, there is a year-round need both for efficient heating and effective cooling. Heat pumps can be used to improve energy efficiency

In Kajaani, for example, residual heat is recovered from sewage water by using heat pumps. During summer, cooling is charged into a 300 cubic-m sprinkler water pool



Kainuu hospital

AN INTELLIGENT HOSPITAL IS ENERGY EFFICIENT

*Novel energy saving techniques are being used.
There is a good potential for big savings in a building which
has a constant, concurrent need both for heat and cooling*

Conclusion: what makes an intelligent hospital?

Jouko's 8 non-academic criteria: an intelligent hospital:

#1: IS MORE COMPACT THAN ITS PREDECESSORS

#2: IS FUNCTIONAL AND THIS OFTEN MEANS A BORING BOXY SHAPE

#3: PROVIDES ITS PATIENTS WITH LOTS OF NATURAL LIGHT AND A GREAT VIEW

#4: IS A SOCIAL PLACE

#5: IS CAREFULLY PLANNED AND ADAPTABLE TO FUTURE CHANGES

#6: IS LOCKED UP INSTEAD OF HAVING AN OPEN DOORS POLICY

#7: DOES NOT TOLERATE POWER OR NETWORK OUTAGES

#8: IS ENERGY EFFICIENT

Then, how to build one?

- Must have a clear strategy: what is the purpose of the new building? What kind of operations will be performed there? How much do we know about the processes of future care?
- Must have a sufficient budget: the "intelligent" systems will eat up to 10-15% of total hospital investment but will save in the long run
- Must co-operate: "intelligent" systems spread over discipline borders: operational planning, architecture and technical design, electrical design, security systems, communication systems, it-systems, logistics, building technology – all must work together
- Must have a coherent vision and design of the whole: enterprise architecture (EA) is a way of describing and managing some of it

Must's and must not's

- Only implement technology which serves a purpose
- There should be a coherent technical architecture and clear roles defined between subsystems
- Avoid overlapping technologies as this will add to cost and complexity
- Ensure adaptability and compatibility, use "open standards" where ever possible
 - Is not "one stop shopping", at least not in a hospital context
- Division of responsibilities in implementation phase
 - Which systems shall be delivered as part of the building - which are to be brought in by the customer?
 - Challenges of public procurement
- Ensure proper support and maintenance for the lifespan of the systems
 - Unforeseen complexity and needs for IT skills may come as a surprise to end-user's technicians



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