



Hospitaller og logistik

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# Hvem er vi og hvad laver vi?

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Vi er en gruppe af specialister der tilbyder et bredt udvalg kompetencer indenfor logistik, supply chain og automatisering

Fra koncept, udvikling eller optimering af interne logistiske løsninger til forbedring af hele forsyningskæden fra leverandør til patient

Dermed tilbyder vi en bred vifte af logistisk rådgivning, der understøtter specifikke behov

Tværfaglighed frembringer nye idéer og metoder, der kan bidrage til at optimere drift og forbedre patientoplevelsen



# Så hvorfor er logistik så interessant?

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Logistik er...

- Alle former for planlægning
- Flow og transport af varer og personer
- Produktions-, lager- og driftsstyring
- Arbejdsprocesser eller services
- Overførsel og udveksling af information





# Hospitalernes udfordringer...

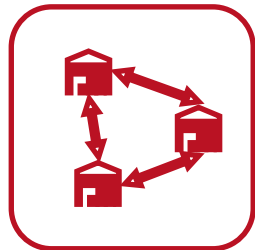
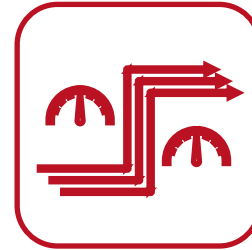
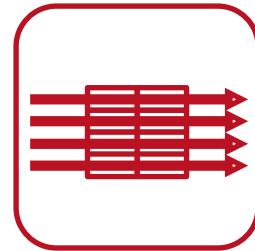
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- Hospitaler arbejder med budgetter og ressourcer der begrænser evnen til at investere i ny teknologi
- Hospitaler er "for politiske" og kommercielt uinteressante for mange industrielle leverandører
- Fokus på "unikke lokale løsninger" gør det svært at implementere standardiseringer
- "Mangfoldigheden" af teknologier og systemer der bruges i hospitaler, skaber kompatibilitetsproblemer
- Konstante ændringer i regler, politikker og forskrifter gør det svært at "holde trit"
- Patientpleje og sikkerhed konflikter med målet om at forbedre effektiviteten og reducere omkostninger



# Men hvad kan opnås og undgås ved at prioritere logistik?

- Forbedring af synlighed i driften gennem viden og data.
- Strømlining af processer, en konstant læring og anvendelse af standardisering
- At tilsikre at have de rette produkter og varer på rette pladser til den rette tid
- At finde de optimale ruter, transporttyper, transportører og metodikker



- Fjerner usikkerhed og overkompensation ved det manglende overblik
- Faktuelt at nedbringe forsinkelser og kvalitetsproblemer i drift og patientpleje
- At fjerne ”støj” og rod som følge af manglende eller dårlig forecasting
- At vide at daglige driftsforstyrrelser og uforudsete hændelser er løst

# Hvad kunne disse problemer være?

- **Ustruktureret Affaldshåndtering:** Ineffektiv affaldshåndtering udgør både operationelle og miljømæssige risici.
- **Manglende Dataindsigt og "blind spots":** Utilstrækkelig overvågnings-løsninger eller "viden om".
- **Hygiejnerisici i løsninger:** Hygiejneudfordringer i relation til opbevaring, transport og personalestrøm kan kompromittere patient-sikkerheden.
- **Ineffektiv udnyttelse af arealer:** Dårligt layout fører til suboptimale løsninger og ditto pladsudnyttelse.
- **Utilstrækkelig lagerstyring:** Over- eller underbeholdning af kritiske instrumenter, forbrugsvarer, medicin og andre varer.
- **Omkostningsoverskridelser:** Uudnyttede omkostningsbesparende muligheder i forsyningskæden, forværrer driftsøkonomi.
- **Operationelle flaskehalse:** Manglende prioritering af operationel kontinuitet kan resultere (kaotisk) fordeling af varer og forsyninger.
- **Svingende Ressourcebelastninger:** Manglende forståelse for automation lægger unødigt arbejdsbyrde på personale.
- **Iboende Sikkerhedsrisici:** Utilstrækkelig opmærksomhed på varesikkerhed og hygiejne udgør en sundhedsrisici
- **Sub-optimering af processer:** Kortsigtet og begrænset fokus på løsninger, resultere ofte i ineffektiv drift
- **Systemuoverensstemmelser:** Manglende integrationer og HMI-løsninger skaber misforhold mellem teknologi og personale
- **Teknologisk stagnation:** Forsømmelse af teknologisk udvikling betyder mindre effektivitet og øgede driftsomkostningerne.
- **Manglende test og ibrugtagning:** Manglende testning og ibrugtagning fører til operationelle risici, forsinkelse og manglende overholdelse af standarder.
- **Utilstrækkelig anvendelse af "Reverse Logistics":** U hensigtsmæssige ophobninger af varer, driftsforstyrrelser og uhensigtsmæssige indkøb og kassationer

## Hvad er så relevant at huske i logistikprojekter?

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1. Er *målsætning(er)* definerede, klare og konkrete ?
2. Er *nuværende* situation(er) og udfordring(er) kendte ?
3. Er *fremtidig* situation(er) beskrevet og definerede ?
4. Er *målinger*, der skal sikre ovenstående blevet fastlagt ?
5. Er *stakeholder(e)* identificeret og involveret ?
6. Er *layoutet*, hvori fremtiden skal være udspilles fundet ?
7. Er *teknologi(er)*, der ønskes anvendt blevet valgt ?
8. Er *omkostningsniveauer* afstemt og aftalt ?
9. Er *risikohåndtering* noget der ligger en metodik for ?
10. Er *tidshorizonten* for projekterne afstemte og realistiske ?





## Hvad man skal være opmærksom på undervejs?

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1. Der er (aldrig) et “quick fix” og slet ikke alt på én gang
2. Husk at få involveret stakeholders og ambassadører
3. Monitorering og kommuniker resultatet undervejs
4. Prioriter tilstrækkelig planlægning – og juster undervejs
5. Risk Management - også som kommunikation
6. Stærk projektledelse og Top Management
7. Ressourcer? Er de til stede? Er de motiverede?
8. Pas på besparelser-paradigmet (Proces vs. byggeri)
9. Hav det brede og langsigtede overblik
10. Start småt, priorité simpelt frem for avanceret.





## Hvorfor går det så galt (Altså for de andre)?

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1. For ensidigt fokus på løsningen frem for behovet
2. Sindrige specialløsninger frem for standarder
3. Fejlberegning af tid, indsats og ressourcer
4. 70/30-reglen: Organisation vs teknologi
5. Urealistiske forventninger om fordele og ROI
6. Manglende ledelsesmæssig opbakning og synlighed
7. Mangelfulde kravspecifikationer og teknisk forståelse
8. Organisatorisk modstand mod forandring
9. Utilstrækkelig træning og uddannelse af brugere
10. Spontane omkostningsbesparelser undervejs ... og ikke mindst...
11. Udskydelse af problemerne til "driften"



# Et bud på fremtiden?

**Der kommer meget mere digitalisering!**

- **Sporing** giver data på processer kan hjælpe med at optimere hospitals driftsbeslutninger
- **IoT-teknologi** binder processer sammen og forbedre effektivitet på alle fronter
- **3D-print** til brug for skræddersyede medicinske enheder der kan produceres lokalt, hurtigt og omkostningseffektivt
- **Lagerintegrationer** på tværs af hospitaler og funktioner, kan tilsikre optimal udnyttelse af ressourcer







## Hvad med AI?

**AI og Machine Learning rummer et enormt potentiale!**

- **Forbedring** af prognoser, optimering af lagerbeholdninger baseret på købs- og brugshistorik
- **Automatiseret håndteringen** af udløbne og tilbagekaldte produkter hvormed lagerbeholdning kan justeres og indkøb forbedres
- **Avanceret fremtidsplanlægning** med aktuel viden om nuværende og kommende patienter, kan alle forsyningsprocesser planlægges ud i fremtiden
- **Dynamisk re-konsolidering** og ressourceplanlægning på et væld af parametre fra sæsonudsving til leverandørvalg.

# Anbefalinger

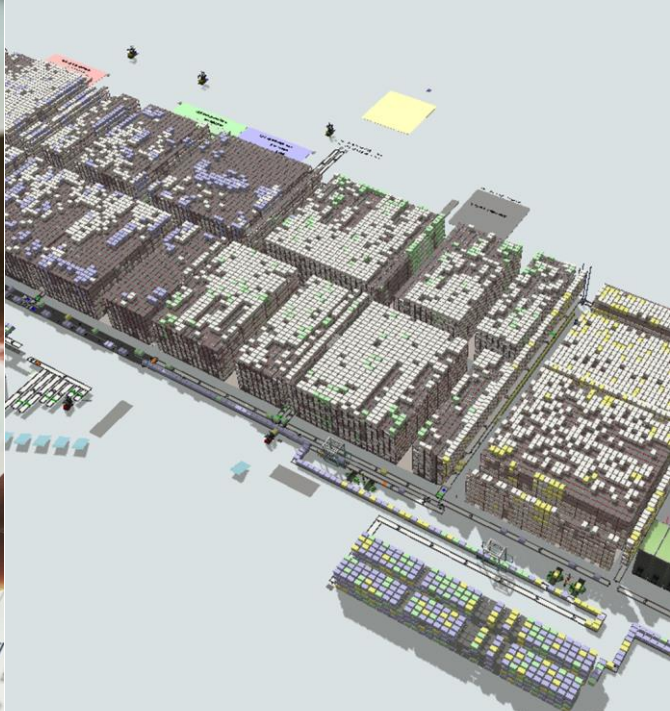
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Et årti med store hospitalsinvesteringer har kostet politisk men også økonomisk.

- Fokuser mindre på store og dyre hardwareløsninger, men se på egne processer
- Prioritér dataopsamling og –integrationer gennem udvidet sporing og IoT
- Undersøg stordriftsfordele i lager og logistik og ryd op i "varianter" og lokale løsninger
- Begynd at anvende AI og Machine Learning i planlægning og prognosticering
- Simplificer og lær af tidligere projekters fejl









# REFERENCER

## Designing advanced logistics solutions

### **Rigshospitalet - Børneriget**

The project involves the construction of a new hospital building at Rigshospitalet, which will accommodate children, young people, expectant mothers, and their families.

The design contributes to creating an **integrated, future-proof**, and functional structure that can easily adapt to the changing needs of the clinic operations over the years.

Among other things, the project includes **advanced logistics** solutions e.g. AMR/AGV designed to create optimized flows and logistical connections.

NIRAS is the sole engineering consultant on the project and is therefore responsible for all engineering disciplines, including **logistics consultancy** which makes NIRAS a key player in the development and implementation of the intralogistics deliveries at the hospital.

The logistics system at the children's hospital are integrated with Rigshospitalet's automatic goods receipt and automatic sterilization center, which is also designed by NIRAS.





Designing and implementing 2 complete CSSD's

## **Rigshospitalet and Herlev Hospital**

As the front-runner, the Capital Region of Denmark (Region Hovedstaden) initiated the construction of two new and complete Central Sterile Services Department (CSSD) for the reprocessing of surgical instruments used across the region's hospitals.

The primary motivation behind this decision was to enhance the quality of sterilisation, boost productivity across the sterilisation process and improve the working environment for staff

NIRAS served as the overarching consultant for the entire construction and installation project, contributing with:

- **Analysis and Planning:**
- **Tender Process**
- **Integration**
- **Simulation**
- **Design & Implementation**





## Providing Regional CSSD & Goods terminal

### **Rigshospitalet**

As part of Region Hovedstadens endeavor to enhance the logistical capacities, a state-of-the-art centralized goods receiving facility was established at Rigshospital, equipped with cutting-edge logistical amenities.

A standout feature of the goods receiving project is its high degree of automation. The initiative seamlessly integrated robots, automated storage systems, transport systems, and AGVs to minimize manual labor and maximize efficiency, particularly in relation to heavy lifting and transport tasks.

NIRAS played a pivotal role in the project's fruition, from in-depth analyses to determine the necessities for the new goods receiving facility to drafting tender documents and overseeing the procurement process.

Moreover, we ensured a smooth integration between equipment and the building infrastructure, while also taking charge of detailed design, implementation, and assembly management, emphasizing their comprehensive and value-driven approach.





# Ensuring Gødstrup's AGV Integration.

## **Gødstrup Hospital**

This project aimed to establish an efficient and reliable transportation system at Hospitalet Gødstrup. The scope of the project extended to creating a harmonious interaction between the new automatic systems and personnel.

### **Services Provided:**

- **Analysis and Dimensioning:** A thorough analysis was conducted to determine the needs and requirements.
- **Automated Guided Vehicle (AGV) System:** Implementation of a fully automated AGV system.
- **System and Building Integrations:** Integration of the new system into the existing building infrastructure.
- **Tender Material and Process:** Tender material and the overall tender process, making sure all legal and technical requirements were met.
- **Supplier Negotiation:** We also undertook the responsibility of supplier negotiation, ensuring the best deal and quality.



# CSSD Logistics by AGV

## Gødstrup Hospital

For Gødstrup Hospital, we provided an efficient and reliable logistics and transportation solution between the warehouse, sterile central, and operation ward. The project involved fostering a productive interaction between the new automated systems and the employees.

### Services Provided:

- **Analysis of Existing Handling Systems and Procedures:** We conducted a comprehensive analysis of the present handling systems and procedures to identify potential areas of improvement.
- **AGV System Integration:** The solution we provided was fully integrated into the Automated Guided Vehicle (AGV) system, enhancing the efficiency and reliability of logistics and transportation.
- **Improvement of Supporting IT Systems:** We also worked on enhancing the supporting IT systems to ensure seamless operation and integration with the AGV system.





# AGV Feasibility Study

## **Bispebjerg Hospital**

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In the new construction phase at Bispebjerg Hospital, our team designed an advanced automated transport system tailored for the efficient transportation of various goods.

A pivotal aspect of this undertaking was the successful integration of a new dispatch and reception area with the existing Automated Guided Vehicle System (AGV/AMR). This integration was also extended to align with key building structures, including elevators, and critical safety systems like fire alarms.

The project's foundation was set by meticulously determining the dimensions for the future transport system, factoring in specific quantities, time constraints, and space requirements. Based on this comprehensive assessment, we then designed the AGV transport system.

Upon completing the design phase, we compiled a detailed CAPEX statement to offer clarity on the project's financial dimensions.





## Automated storage for sterile items

### **Landssjúkrahúsið (National Hospital of the Faroe Islands)**

In a partnership with Selmar Nielsen arkitektur, we tackled logistical issues for a new Faroe Islands ward, particularly a non-standard four-story storage automaton.

As engineering consultants, we crafted tailored solutions:

- **Efficient Storage:** We introduced vertical lift storage on each floor and distinguished sterile from non-sterile items, ensuring operational efficiency and hygiene compliance.
- **Automated Systems:** We implemented an automatic *bed washing* system and a waste sorting mechanism, promoting sustainability.
- **Holistic Logistics:** Beyond storage, we set up a basement *feeding system* next to sterile storage, optimized goods handling, and documented requirements, fortifying Landsverk Hospital's operations.



# AGV Simulation

## **Norsk Radium - Rikshospitalet**

For Rikshospitalet's (Norsk Radium Hospital, NRH) expansion in Oslo, we provided AGV and supply chain simulation.

Our objective was to define the supply chain assumptions for the hospital's designers and to project the required loading/unloading zones, AGVs, elevators, and AGV logistics staff for both the current facility and its expansions. Key deliverables included:

- **Supply Chain Assumptions:** We articulated and validated the hospital's supply chain design assumptions.
- **AGV Logistics:** Comprehensive simulations determined resource needs for AGV logistics in both the existing hospital and expansion
- **Resource Estimation:** Our simulations detailed the required staffing and other resources.
- **Deliverable:** Estimations of AGV numbers and sizes for given distribution patterns, as well as projected service levels.





Projecting an AGV system for

## **Drammen Hospital, Norge**

The new Drammen hospital partnered with NIRAS for an advanced logistical solution. NIRAS designed a custom **AGV system** (Automated Guided Vehicle) for efficient goods distribution and return throughout the hospital.

A unique bed management and centralized **bed washing** system was introduced.

The AGV also *managed the loading/unloading of goods* from trucks, facilitating transport with external suppliers.

Additionally, NIRAS prepared **tendering materials** for the AGV system.

### **Deliverables:**

- **Custom AGV design**
- **Goods receipt integration**
- **Centralized bed washing**
- **Tendering materials preparation.**



# Designing future supply structure

## Helse Midt, Norway

To optimize hospital logistics in Region Helse Midt, Norway, NIRAS was consulted to centralize previously individual hospital warehouses.

These hospitals faced logistical issues from multiple suppliers.

With Helse Midt, NIRAS analyzed the **benefits and challenges** of centralization, studying goods consumption to recommend product standardization.

They also outlined future warehouse and hospital supply processes. From this, the warehouse's dimensions were set, and a detailed CAPEX was prepared, leading to a successful centralized warehouse setup after approval from the political system.

### Deliverables Capex Deliverables:

- Centralization of hospital warehouses
- Product standardization
- CAPEX preparation
- Warehouse establishment success.





# AGV-simulation

## **Nyt Sykehus Aker, Norway**

For the New Sykehus Aker construction, NIRAS used digital simulations to confirm the proposed Automated Guided Vehicles (AGV) logistics plan.

### **Key deliverables included:**

- **Hypothesis Validation:** We verified assumptions about goods supply, such as AGV numbers, VDS space, operating hours, and the potential use of existing tunnels for AGV transport in the NRH project.
- **Bottleneck Analysis:** Our simulation identified potential bottlenecks, highlighting areas that might hinder the smooth operation of AGVs.
- **Service Level and Resource Review:** We ascertained the service level, required AGV numbers, and the adequacy of space in VDS, A/M rooms, and tunnels. This was vital for the successful logistics strategy of the New Sykehus Aker.

Through our consultancy, the hospital refined its AGV logistics plan, enhancing operational efficiency.



## Automated Bed Storage

### **Helse Stavanger, Norway**

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Establishing four bed automata in the new hospital was vital for future logistics processes.

In modern hospitals, beds undergo centralized cleaning after each use and must afterwards be stored safe and clean.

The storage facility transport and store clean and used beds between patient rooms and the basement cleaning location, eliminating the need for beds in hallways.

Beyond infrastructure, we outlined **work processes** and tackled challenges like locking bed wheels and ensuring level access to the automaton's pull-out shelves.

The hospital also envisions using AGVs for bed transport, with NIRAS providing key advice on this aspect.





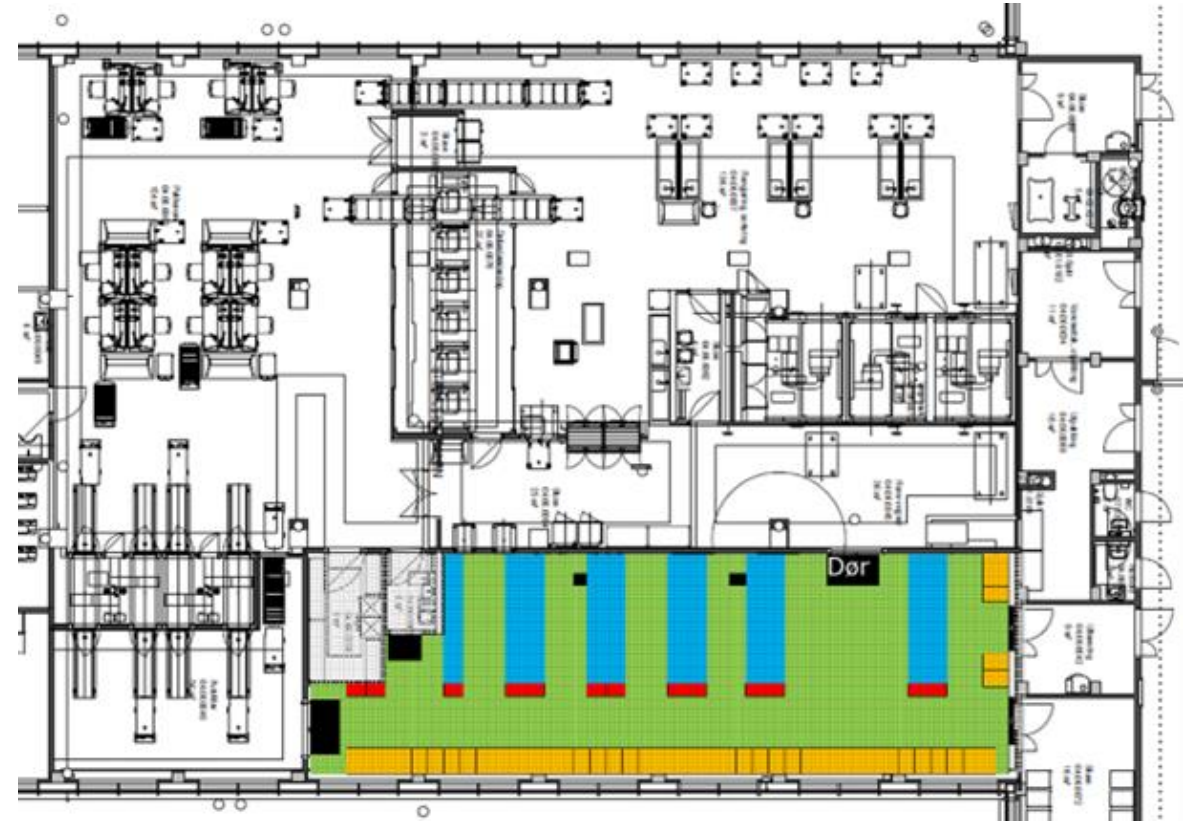
# Complete CSSD

## Helse Stavanger, Norway

For Stavanger University Hospital, we designed a new sterile unit in their new hospital, optimized space use and minimized contamination risk. We established numerous automatic logistics systems, introduced Autonomous Mobile Robots (AMR), and an automatic logistics facility

### Services Provided:

- **Layout Design:** We designed the sterile unit layout, optimized for space and minimizing contamination risk.
- **Collaboration with Hospital Staff:** Ensure alignment of layout design with needs.
- **Process Design:** We designed the processes for the automatic logistics system, ensuring smooth operations.
- **Flow Simulation:** We simulated work and equipment flow for process optimization.
- **Bed Flow and Simulation:** We simulated hospital bed flow (clean and unclean), ensuring smooth logistics.
- **Logistics Systems Design:** We supervised the design and dimensioning of automatic logistics systems, including AMR.



# Designing multiple automatic logistics systems

## **Helse Stavanger, Norway**

For the newly constructed Stavanger University Hospital, NIRAS undertook the pivotal role of defining the concept and designing the automatic logistics systems.

These systems were entrusted with the distribution of a wide array of goods – from consumables, food, linen, and clothing to medicine, laundry bins, surgical instruments, waste, and samples.

The process initiated at the goods reception. From there, automated transport systems, primarily powered by **AGV's** (Automated Guided Vehicles), managed the distribution to the respective departments.

They also oversaw the return transport of empty carts and returned goods, encompassing elevator transport as well.

**Consumables efficiently stored in VLS's** (Vertical Lift Storage) where the refill process was also automated. A noteworthy facet of this project was the meticulous coordination between automated systems and human personnel, ensuring harmonious operations.

Additionally a **storage facility for empty beds** – both clean and unclean – were intelligently stored in a specialized VLS.







Tak for opmærksomheden

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