

# Smart warehousing

---

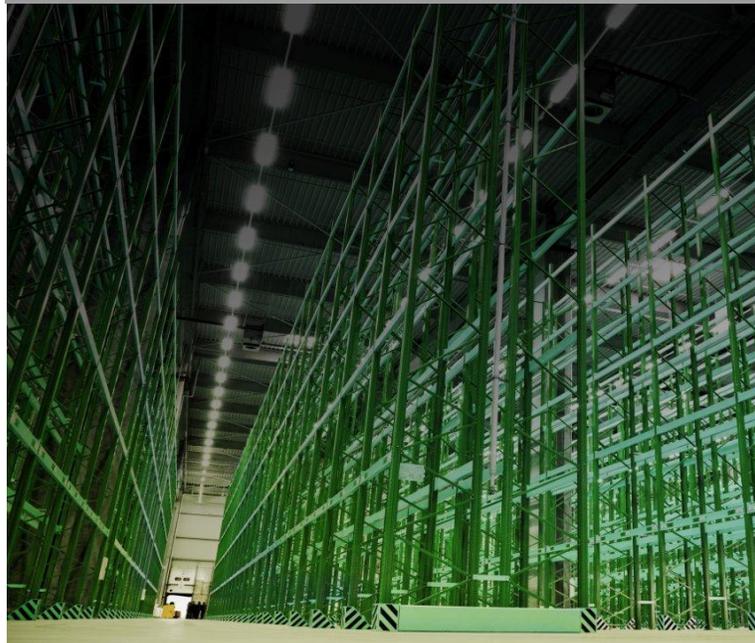
Technologies : future and past



## Supply Chain Management



## Logistics



## Construction Mgt. & Engineering



>50 JAAR  
LOGISTIEKE ERVARING

MULTI DISCIPLINAIR

ONAFHANKELIJK

PROFESSIONEEL



# What is the definition of smart warehousing?

Smart warehousing refers to the **use of advanced technologies** and systems to **optimize warehouse operations** and make them more efficient and effective. It involves the integration of technologies such as robotics, automation, sensors, artificial intelligence (AI), Internet of Things (IoT), and cloud computing into warehouse management systems.

Through the use of smart warehousing, businesses can **improve** inventory management, reduce operating costs, increase productivity and accuracy, and enhance customer service. The technology allows for **real-time** monitoring of inventory levels, tracking of products throughout the supply chain, and **automation of tasks** such as picking, packing, and shipping.

Overall, smart warehousing enables businesses to streamline their operations, increase efficiency, and **respond more quickly to changing** market conditions and customer demands.

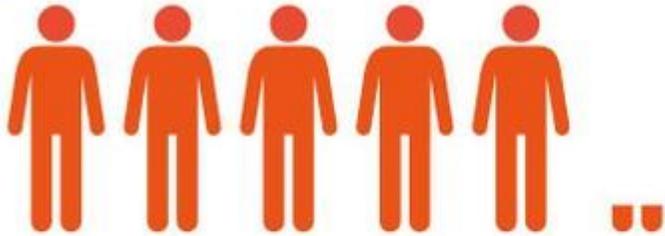
Source: <https://chat.openai.com/chat> ( version 13)



# 1. DRIJVENDE KRACHTEN

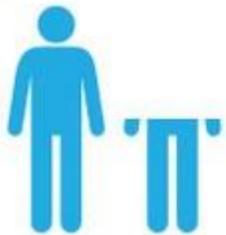
**2017: 38.000 vacatures**

5,3 werkzoekenden  
per vacature

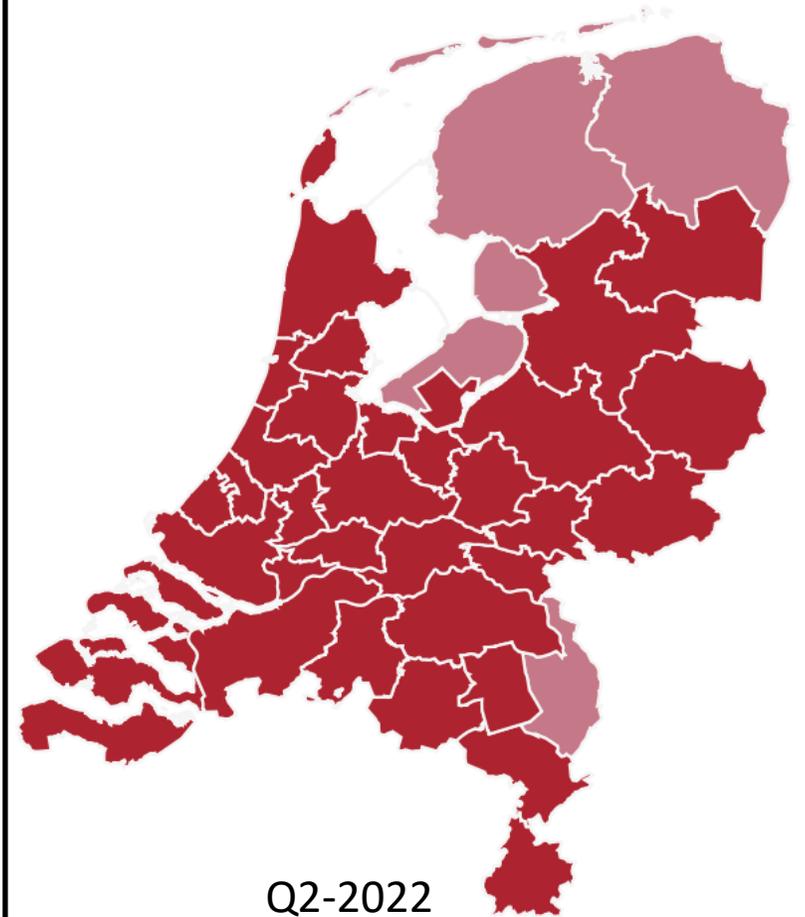
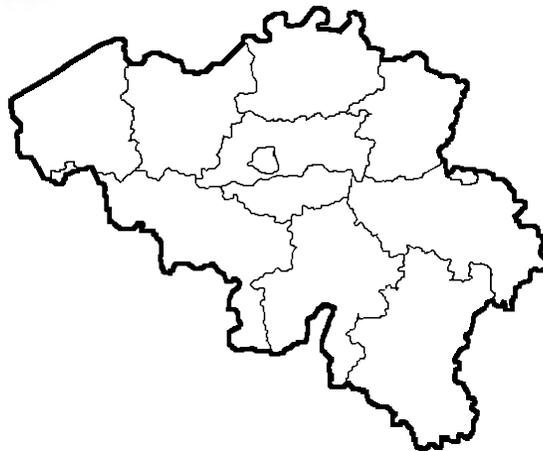


**2022: 87.130 vacatures**

1,6 werkzoekenden  
per vacature



Bron: Unizo

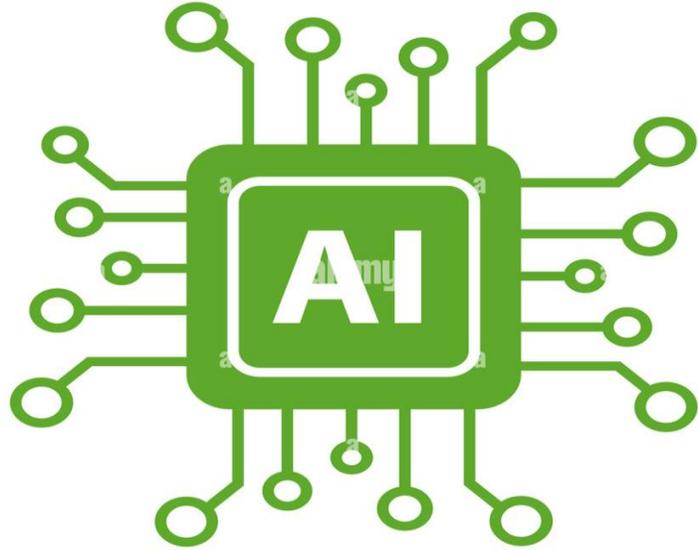


Q2-2022



Onzekerheid leidt tot een vraag naar  
**schaalbare en flexibele**  
logistieke oplossingen



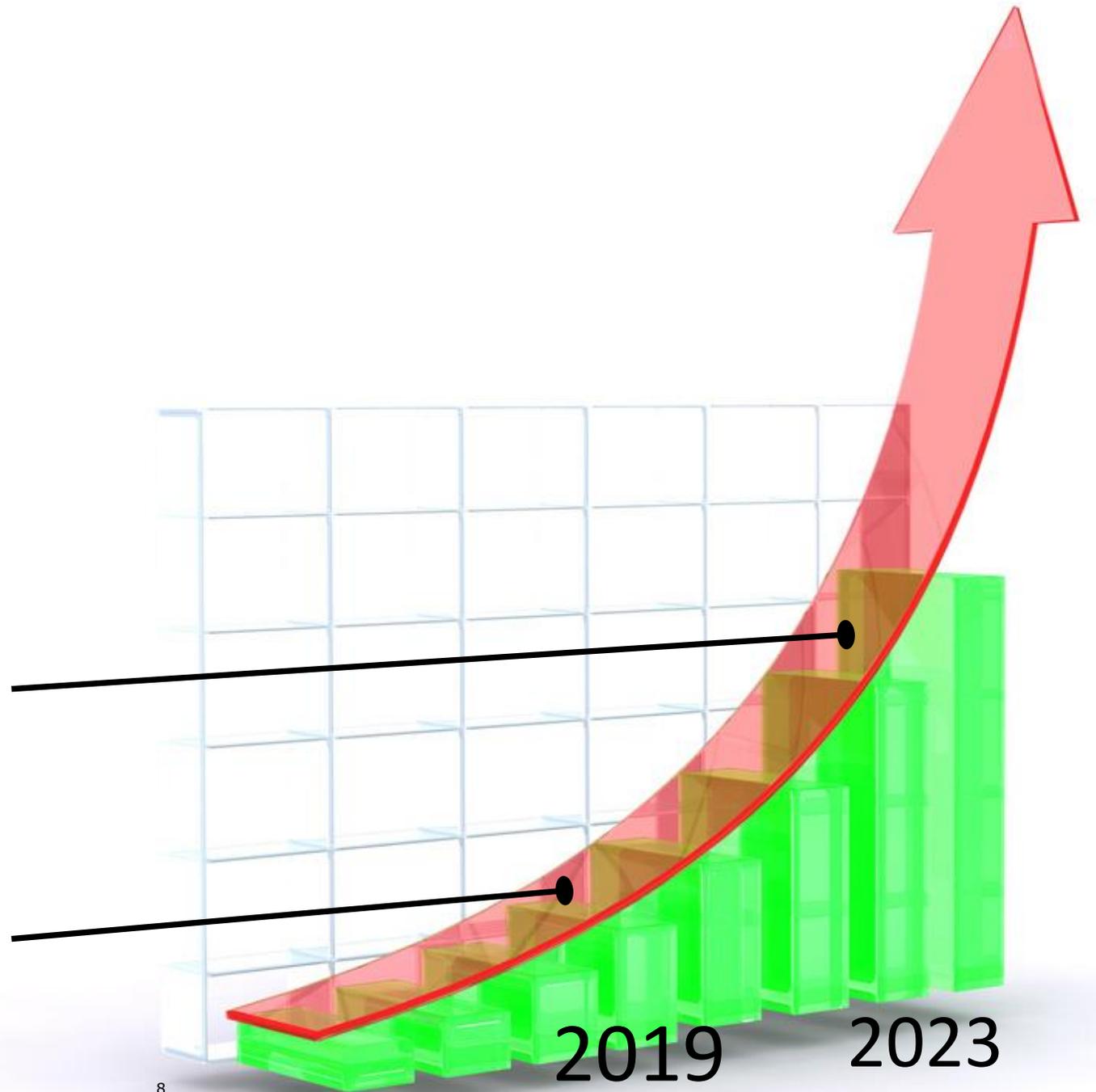


## 200-300 MILLION

jobs expected to be replaced by Artificial intelligence, optionally supported by robotics. [ Goldman Sachs ]

## 1.5 MILLION

jobs expected to be replaced by robots within the next 10 years. [ Roland Berger ]



---

## 2. LOGISTIEKE AUTOMATISERING

---

# DATA & PROCES ANALYZE

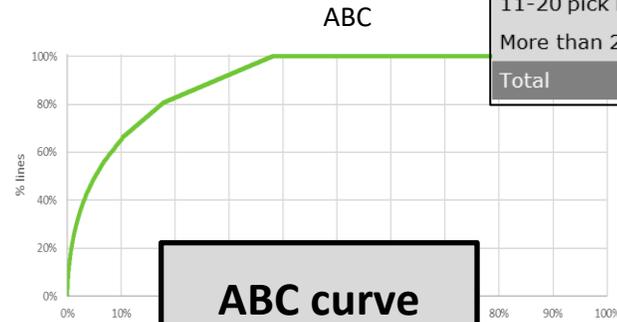
## LOGISTIC DESIGN PROCES

Type  
SKU

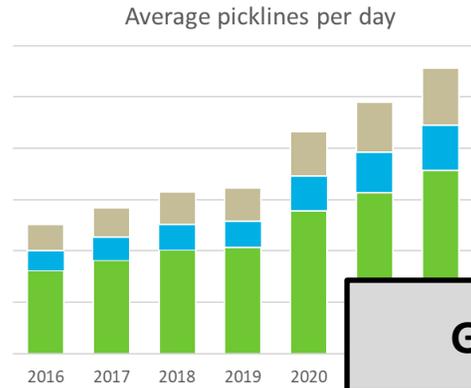


| Pick lines per Order           | Percentage |
|--------------------------------|------------|
| Singles (1 pick line, 1 piece) | 25%        |
| 1 pick lines multiple pieces   | 27%        |
| 2-5 pick lines                 | 14%        |
| 6-10 pick lines                | 8%         |
| 11-20 pick lines               | 11%        |
| More than 20 pick lines        | 11%        |
| Total                          | 100%       |

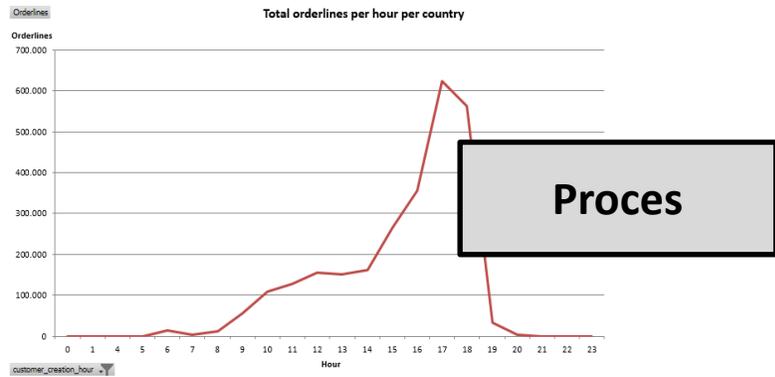
Orderprofiel



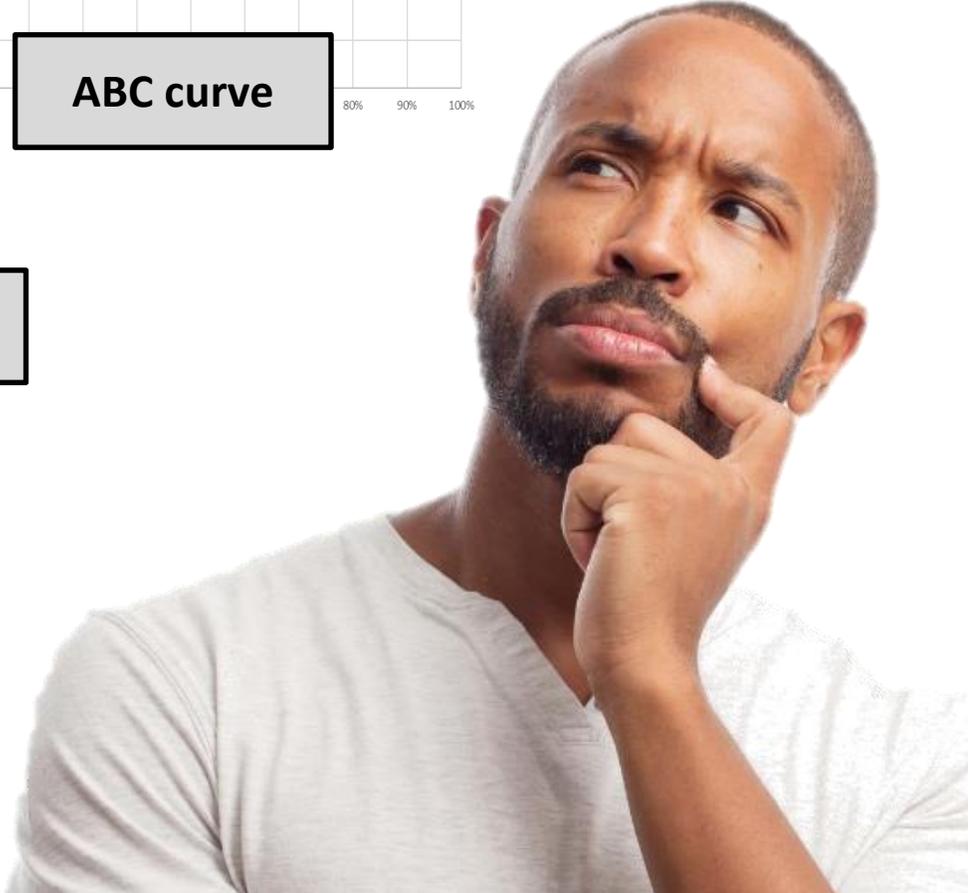
ABC curve



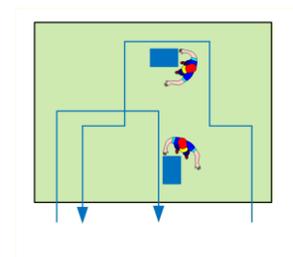
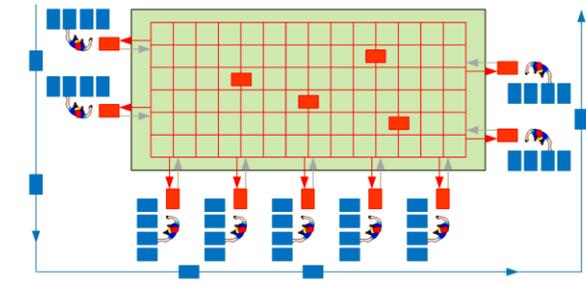
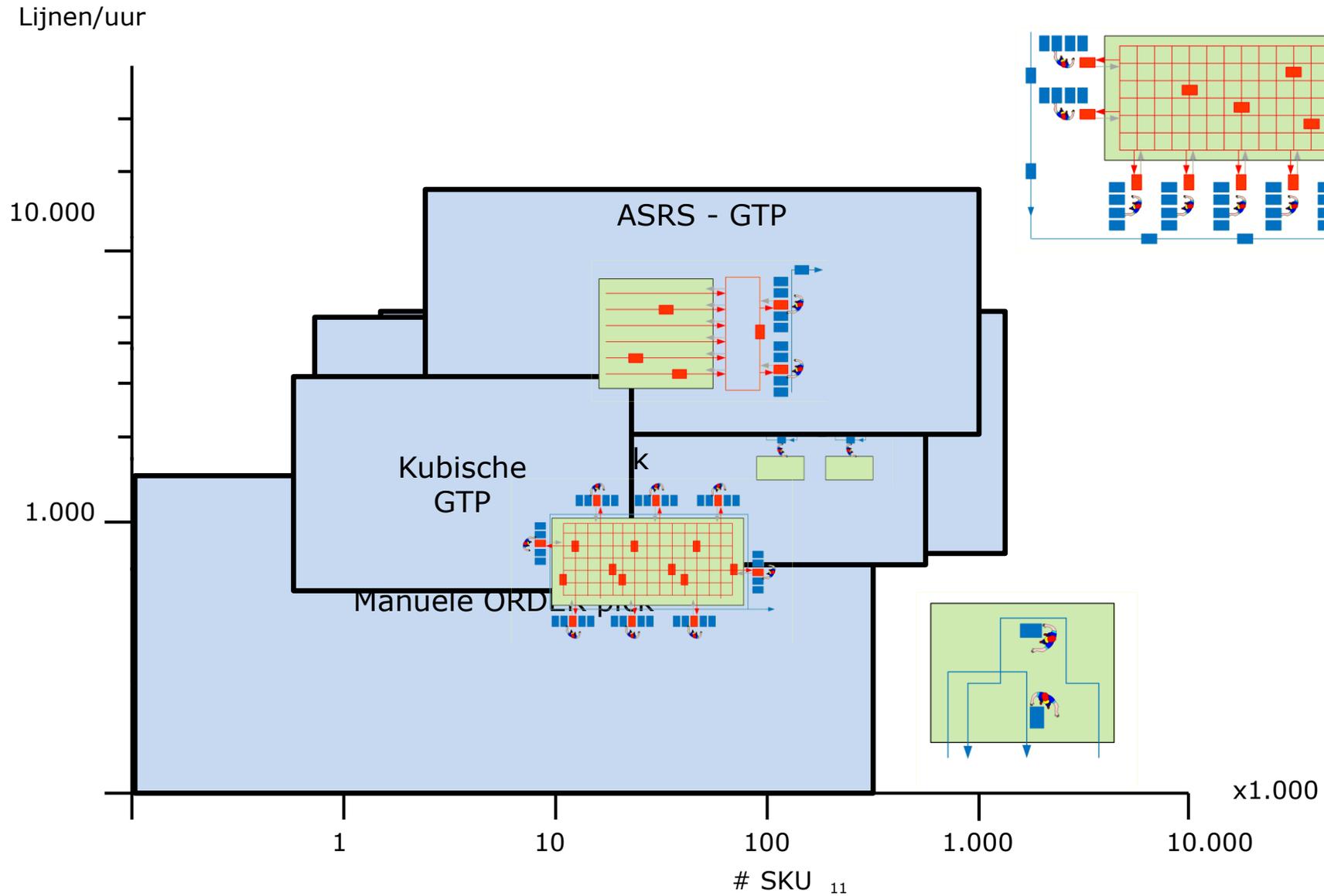
Groei

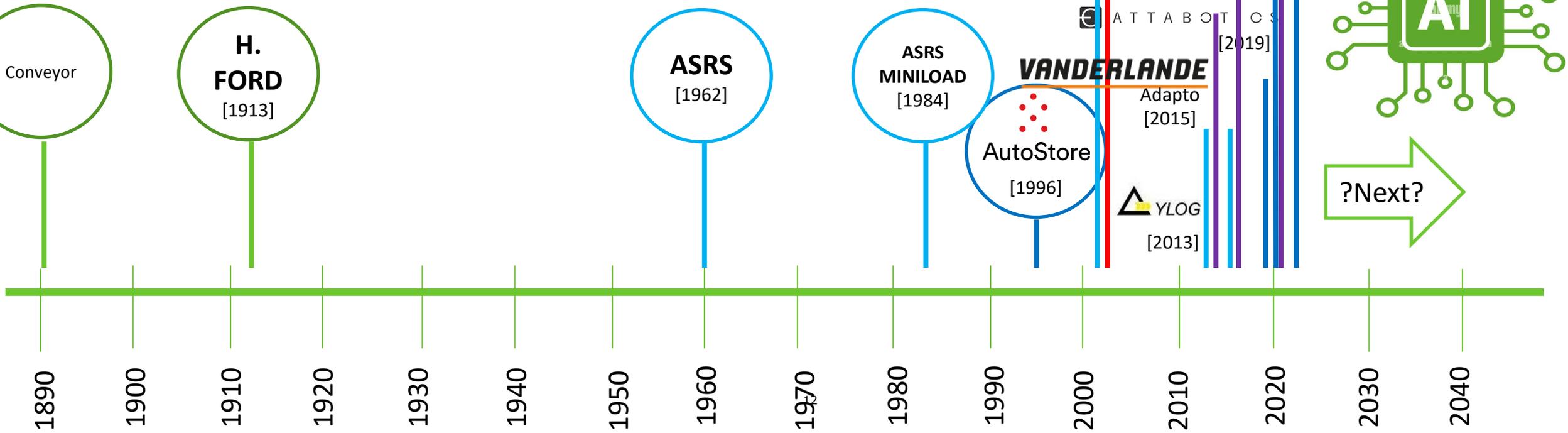


Proces



# Logistieke concepten tot voor "kort"





Intellistore  
[2022]

JUNGHEINRICH  
Powercube  
[2021]

KIVA Systems  
amazon.com  
[2003]  
[2012]

HAIROBOTICS  
[2016]

KNAPP  
[2002]

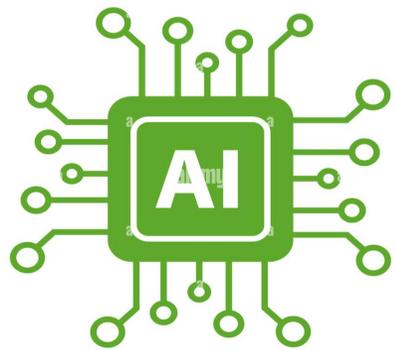
EXOTEC  
[2014]

ATTABOTICS  
[2019]

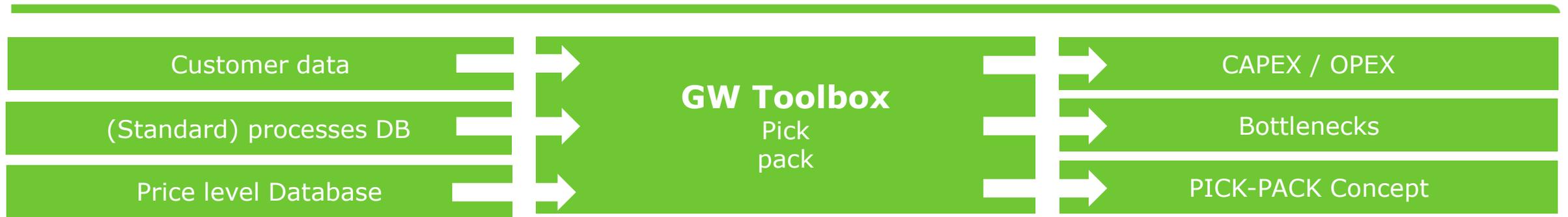
VANDERLANDE  
Adapto  
[2015]

AutoStore  
[1996]

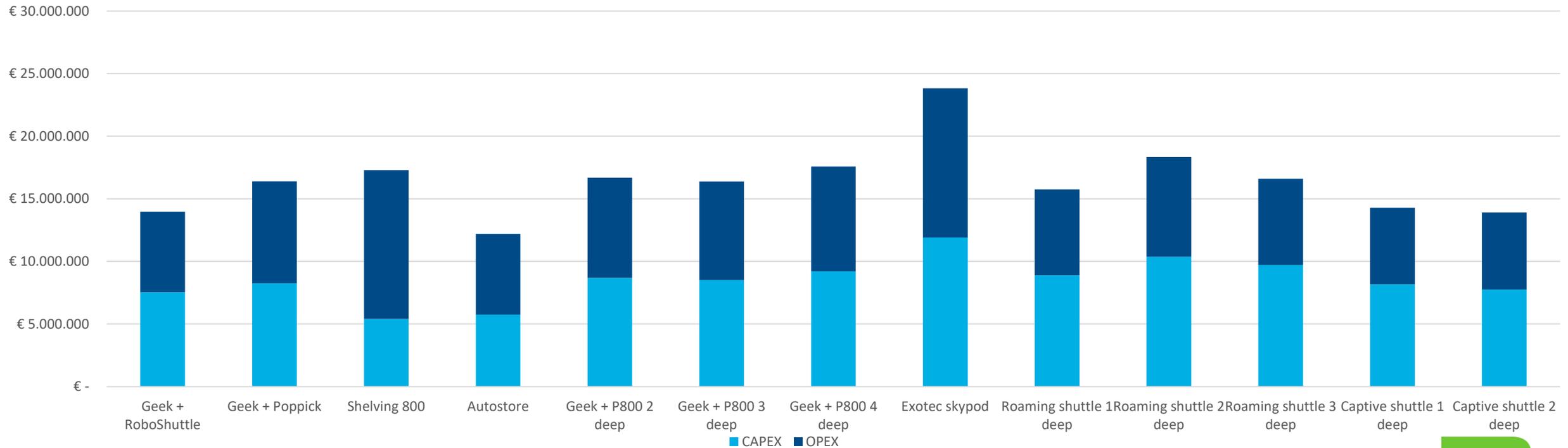
YLOG  
[2013]



# Practical Example Groenewout Toolbox



CAPEX VS OPEX



# 3. Kubische GTP systemen

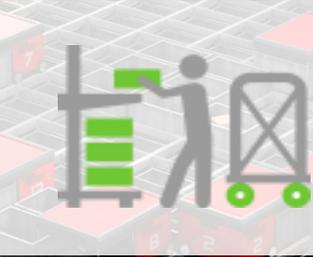


## Which companies supply a cubical goods to person storage system?

There are several companies that supply a cubic goods-to-person storage system, also known as automated storage and retrieval system (ASRS), including:

- 1.AutoStore:** AutoStore is a leading provider of cubic goods-to-person storage systems, offering a flexible and scalable solution that can be adapted to different warehouse sizes and layouts.
- 2.Dematic:** Dematic offers a range of ASRS solutions, including cubic goods-to-person storage systems that use advanced robotics and software to automate warehouse operations.
- 3.Swisslog:** Swisslog offers a range of ASRS solutions, including cubic goods-to-person storage systems that can be integrated with conveyor systems, robotic picking solutions, and other warehouse automation technologies.
- 4.Knapp:** Knapp is a provider of ASRS solutions, including the OSR Shuttle™, a cubic goods-to-person storage system that can handle a wide range of products and order profiles.
- 5.Daifuku:** Daifuku offers a range of ASRS solutions, including the Cube Storage System, a cubic goods-to-person storage system that can be customized to meet specific warehouse needs.

Source: <https://chat.openai.com/chat> ( version 13)



Concept: GTP, Autostore  
Supplier(s) Swisslog, RLS, Dematic, Element, Toyota ILS



<https://www.youtube.com/watch?v=iyVDMp2bL9c>

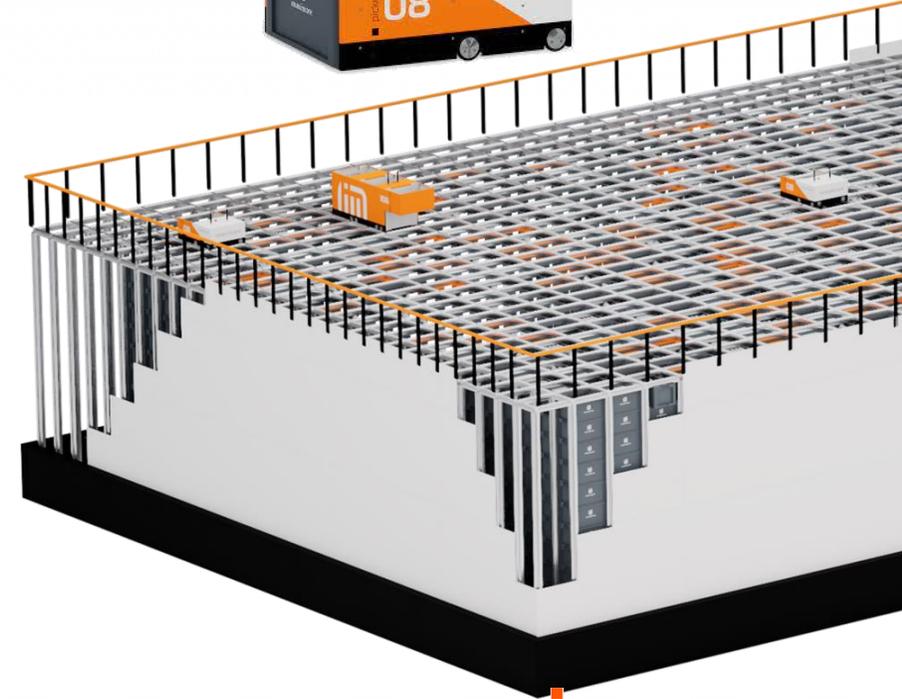
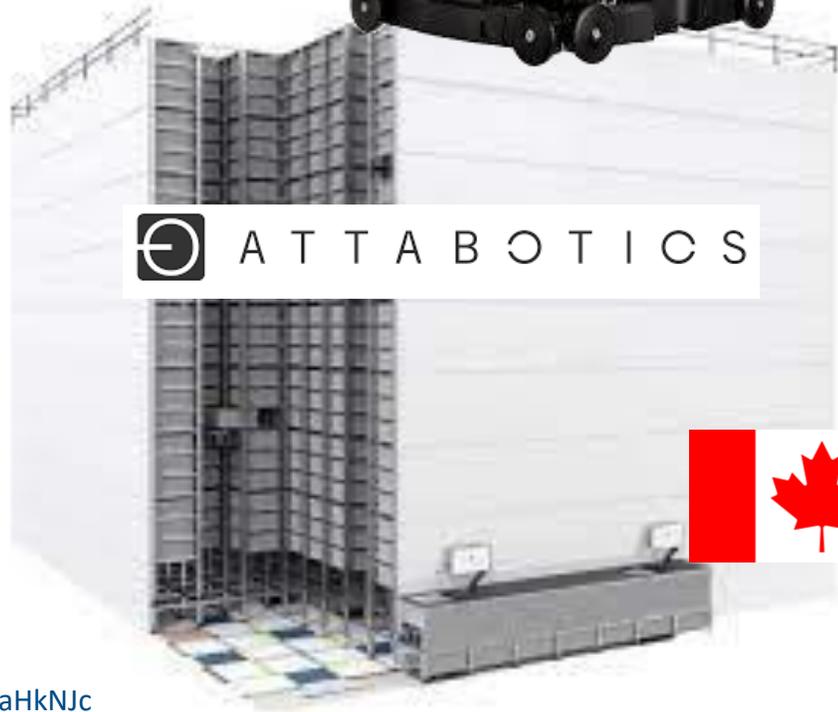
# CUBIC STORAGE SYSTEMS : NEW KIDS IN TOWN

[https://www.youtube.com/watch?v=vl\\_I5OzgN3Q](https://www.youtube.com/watch?v=vl_I5OzgN3Q)

**JUNGHEINRICH**



 ATTABOTICS



**intellistore**



<https://www.youtube.com/watch?v=WLtEBaHkNjC>

<https://www.youtube.com/watch?v=qgXMT76mTSY>



AutoStore



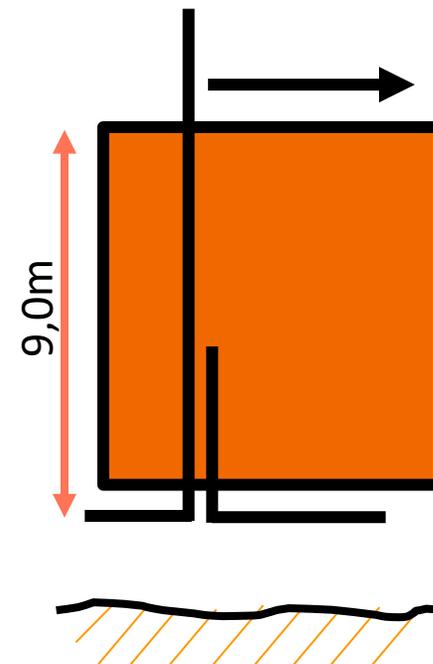
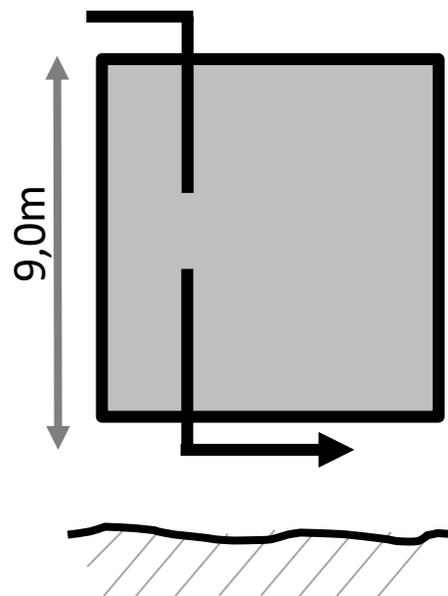
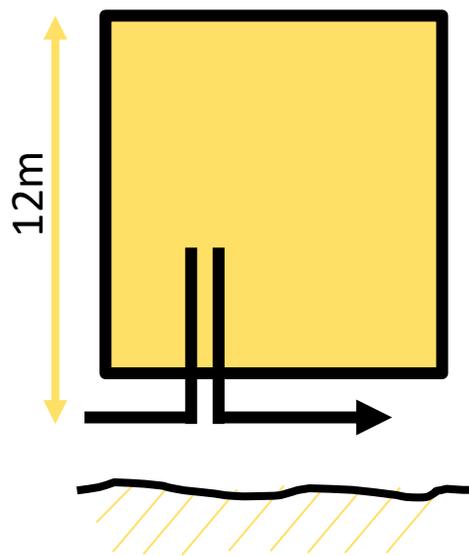
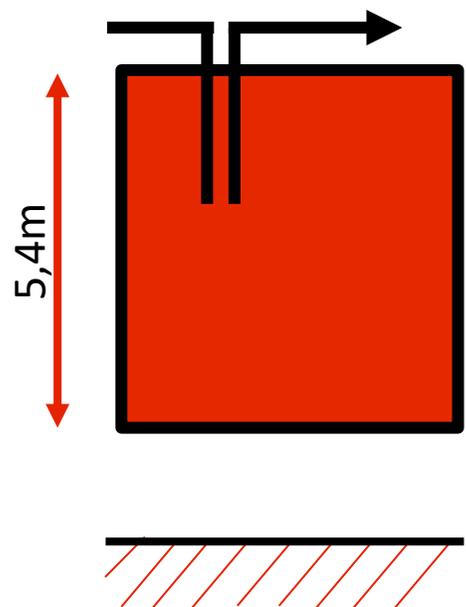
JUNGHEINRICH

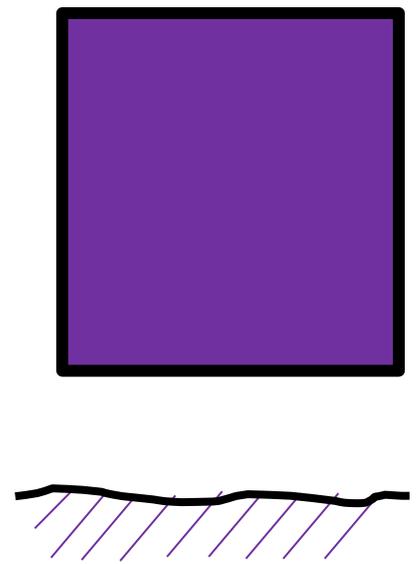
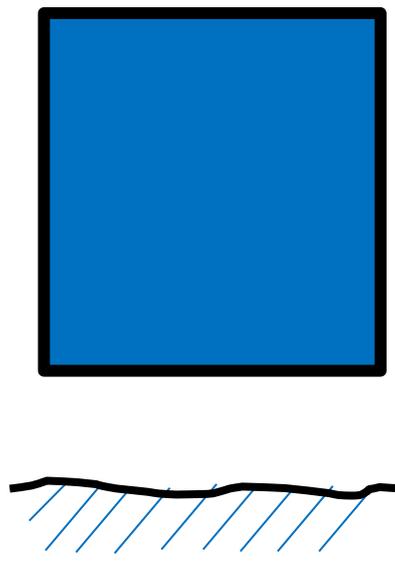
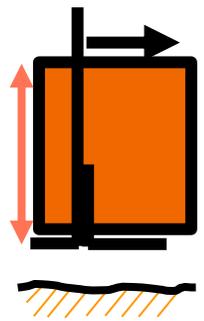
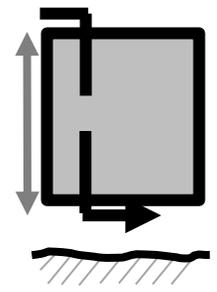
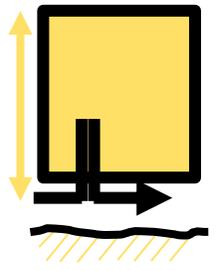
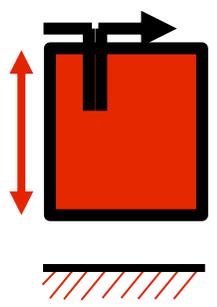


ATTABOTICS



intellistore







|                        |                              |  |  |   |
|------------------------|------------------------------|--|--|---|
| Concept                | Rijden bovenop & graven      | Rijden onderop & graven                                      | Rijden boven en onder Niveau Wissel                                | Pusherunit onder Transport en Buffer boven  |
| Robot                  | 20-25 bph <sup>(2)</sup>     | -  | 30-40 bph  | 75-100 bph<br>"per 3 AMR-set"   |
| Voorraad bak           | 600x400<br>3 hoogtes<br>30kg | 600x400<br>1 hoogte<br>50kg                                  | 600x600<br>1 hoogte<br>50kg  | 600x400<br><i>Multi height</i><br>30kg  |
| Stroom concept         | Loodzuur batterij            | Lithion ion Batterij   | Condensators met "On het fly"laden                                 | Lithium Ion batterij  |
| Max hoogte             | 5,4meter                     | 12 meter   | 9 meter  | 9 meter   |
| Bruto Opslag dichtheid | 3.400 L/m <sup>2</sup>       | 5.900 L/m <sup>2</sup><br>[ 7.200 L/m <sup>2</sup> bij 12m ] | 3.590 L/m <sup>2</sup>   | 5.800 L/m <sup>2</sup> <sup>(1)</sup>   |
| Vloer                  | Supervlak                    | Vlak   | Vlak   | Vlak  |
| USP                    | Proof of concept             | Hoogte 12m<br>2 bakken tegelijk<br>Geen vloeraanpassing      | <b>Bakken uniek bereikbaar</b><br>Snelheid<br>Geen vloeraanpassing | <b>Bakken uniek bereikbaar</b><br>Hoogste opslagdichtheid<br>Geen vloeraanpassing |

(1) : Afhankelijk van vrije hoogte gebouw

(2) : Planner software



FM GLOBAL 8:34





 AutoStore

 JUNGHEINRICH

 ATTABOTICS

 Intellistore

Handling capaciteit



**Ervaring**



**Planning**



Onderhoud en Service



**FM Global 8:34 richtlijn**



Opslagdichtheid



Schaalbaarheid



Bouwkundige randvoorwaarden



**Relatieve onderlinge investering<sup>(1)</sup>**



Concurrerend concept

Cubic

Cubic

ASRS

Cubic

(1) : Subject aan schaalgrootte

## Planning

Contract date : 23-03-2023

Golive: 02-2024

## Scope:

3 robots sets (300 bakken per uur)

3 pickpoints(optie voor een 4<sup>e</sup>)

1 inbound pickpoint

11.310 bakken

Intellistore Control Systeem



# 4. AGV/AMR opslagsystemen





## Which company supplies ASRS solutions based on AMR technology?

There are several companies that supply Automated Storage and Retrieval Systems (ASRS) solutions based on Autonomous Mobile Robots (AMR) technology, including:

1. Fetch Robotics:
2. Geek+ Robotics:
3. Swisslog: /CarryPick,
4. Kiva Systems /Amazon Robotics,
5. GreyOrange

## Do you know also other companies beside these 5?

Yes, there are other companies that offer ASRS solutions based on AMR technology:

6. Quicktron:
7. Locus Robotics:
8. Magazino:
9. Balyo.
10. Scallog:

These companies offer different variations of AMR-based ASRS solutions that are designed to meet the specific needs of their customers.

Source: <https://chat.openai.com/chat> ( version 13)



AGV/AMR : "XL opslag rekken"

[POP-PICK]



Geek+

2022 WINNER  
EUROPEAN  
PRODUCT  
DESIGN  
AWARD  
POPPICK SYSTEM

AGV/AMR : AMR gecombineerd met Lift functie

[Robo-shuttle]

**HAI ROBOTICS**

**Quicktron**

**Geek+**



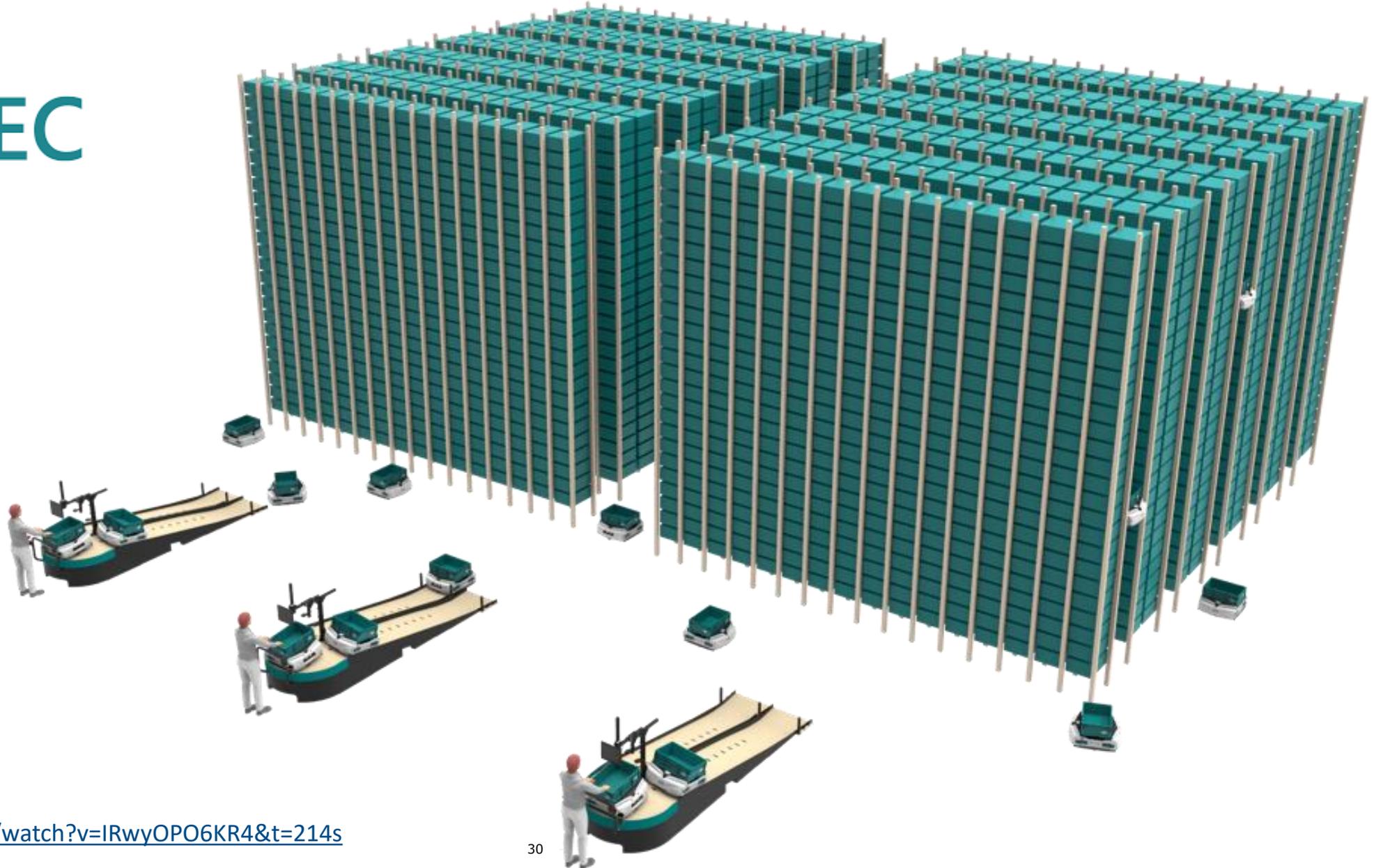
2021 WINNER  
**EUROPEAN  
PRODUCT  
DESIGN  
AWARD**



26-01-2023

# AGV/AMR: AMR met geïntegreerde lift functionaliteit

EXOTEC







| Concept                                    | ASRS  | AMR/AGV  | AMR-HOOG   | AMR-LIFT   | SKYPOD   |
|--|---|--|--|--|--|
| GTP transport cycli                        | per bak   | mobile stellingenkast (+/- 20 totes)                 | mobile stellingenkast XL (60 totes)                        | meerdere bakken  | per bak  |
| Drager concept                             | Bak<br>600x400<br>800x600   | <b>Vrije indeling</b><br>1200x800<br>2m hoog         | Bak<br>600x400   | Bak<br>600x400   | Bak<br>600x400   |
| Opslag concept                             | Vaste stellingen<br><30m  | Mobiele stellingenkasten<br>2m hoog                  | Mobiele stellingenkasten<br>4 meter hoog                   | Vaste stellingen<br><10m                                 | Vaste stellingen<br>< 12m                                |
| Cycli capaciteit <sup>(1)</sup>            | 600-800tph<br>Per gang  | 15-20 racks/hr <sup>(3)</sup>                        | 12-20 racks/hr <sup>(3)</sup>                              | 30-40 tph /AMR <sup>(3)</sup>                            | 25 tph/AMR <sup>(3)</sup>                                |
| <b>Werkstation</b>                         | <b>Meerdere niveau's<br/>0-2 sec bakwisseltijd</b>                      | <b>(Meerdere niveau's)<br/>4-5 sec rekwisseltijd</b> | <b>Grondniveau<br/>0-2 sec bakwisseltijd<sup>(4)</sup></b> | <b>Grondniveau<br/>3 sec bakwisseltijd<sup>(4)</sup></b> | <b>Grondniveau<br/>2 sec bakwisseltijd<sup>(4)</sup></b> |
| <b>Bruto Opslagdichtheid<sup>(2)</sup></b> | <b>3.600 – 4.700 l/m<sup>2</sup><br/>7.200 -- 9.500 l/m<sup>2</sup></b> | <b>700- 1.100 l/m<sup>2</sup></b>                    | <b>2.000 l/m<sup>2</sup></b>                               | <b>2.800 l/m<sup>2</sup></b>                             | <b>3.400 l/m<sup>2</sup></b>                             |
| Vloer                                      | Vlak  | Industrieel  | -  | vlak   | vlak   |
| USP  | Uniek bereikbaar hoogte   | Vrije indeling in kast                               | Reshuffling in de nacht                                    | Uniek bereikbaar   | Uniek bereikbaar   |

(1) : Afhankelijk van oppervlak/ schaalgrootte oplossing

(2) : Exclusief technische ruimtes

(3) : **Begrensd door congestie**

(4) : Bij voldoende bakken uit 1 rek

KNAPP

IT&W  
LIVING LOGISTICS

VANDERLANDE

Geek+  
Quicktron  
GreyOrange  
lowpad



Geek+



HAIROBOTICS

Quicktron

Geek+



| Concept naam                                    | ASRS | AMR/AGV          | AMR-HOOG | AMR-LIFT | EXOTEC |
|---|------|------------------|----------|----------|--------|
| Handling capaciteit                             | 😊😊   | 😞                | 😐        | 😊        | 😊      |
| Ervaring  | 😊    | 😊                | 😞        | 😞        | 😊      |
| Planning  | 😐    | 😊                | 😊        | 😊        | 😊      |
| FM Global 8:34 richtlijn                        | 😐    | 😊                | ?        | 😐        | 😐      |
| Opslagdichtheid                                 | 😊    | 😞😞               | 😐        | 😐        | 😊      |
| Schaalbaarheid                                  | 😞    | 😊                | 😊        | 😐        | 😐      |
| Redundantie                                     | 😐    | 😊                | 😊        | 😊        | 😊      |
| Bouwkundige randvoorwaarden                     | 😞    | 😊                | 😐        | 😐        | 😐      |
| Relatieve onderlinge investering <sup>(1)</sup> | 😞    | 😊 <sup>(2)</sup> | 😐        | 😐        | 😞      |

(1) : Afhankelijk van oppervlak/ schaalgrootte oplossing

(2) : Bij enkellaags



dematic.com/en-us/news/2022/dematic-to-deliver-299-amrs-to-omnichannel-retailer-radial/

1-877-725-7500 Contact Us EN Countries

**DEMATIC** Industries Products Software Service

## Dematic to Deliver 299 AMRs to Omnichannel Retailer Radial

May 31, 2022

[Share](#)

**HEUSENSTAMM, Germany / GRONINGEN (NL)** - Dematic has been awarded a contract to provide warehouse automation for omnichannel retailer Radial Europe, a member of the bpost group. The supplier of intelligent automation technology is to deliver 299 autonomous mobile robots (AMR) to its logistics center in Groningen, Netherlands. The transport robots will take over

[Media Contact](#)



---

## Conveyor

---

0,5 – 3,0 m/s

Vaste opstelling

Vaste Functie per unit

1.5-2.0K€/m

---



---

## AMR/AGV

---

0,5 -2,5 m/s

Flexibele opstelling

Multifunctioneel

15-20K€/stuk

---



Grey Orange Rangers  
[Active Ants, Belgie]

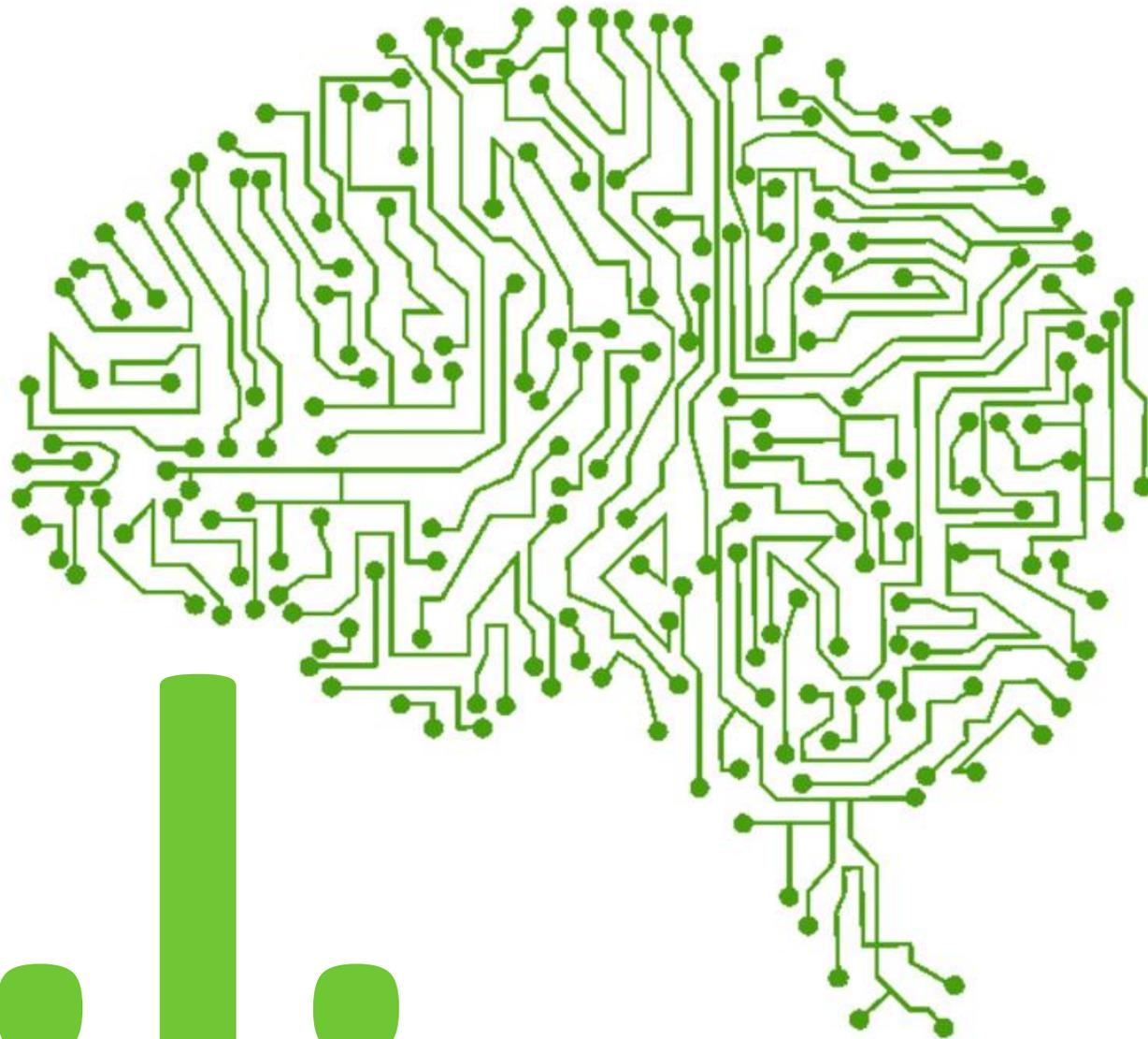


Tompkins Robotics t-Sort  
[Nordstrom, Australie]



# 5. OTHER

**A.i.**



V1



V2



V3



V4



V5



## PROMPT:

***PORTRAIT OF A CUTE AND  
ADORABLE MONKEY SITTING  
ON A COUCH  
HOLDING A SLICE OF  
PEPPERONI PIZZA, LIVING ROOM,  
VIBRANT, PHOTOGRAPHY,  
CANON 5D, 50MM***



## Jack van der Veen: AI in de logistiek: ongekende mogelijkheden maar 'handle with care'

Automatisering & Robotisering **Nieuws** - Peter De Weerd - 5 juni 2023



## Robots en AI kunnen verloop personeel oplossen mits ze juist worden ingezet stelt Gartner

Mens & Werk **Nieuws** - Peter De Weerd - 5 juni 2023



**BlueYonder**  
Fulfill your potential™

Blog Knowledge Center Communities Careers Partners Customer Portal Language

Luminate Platform Industries Solutions Services Events About

# Artificial Intelligence & Machine Learning

Leverage industry-leading artificial intelligence (AI) and machine learning (ML) to make decisions with powerful insights from deep volumes of data.

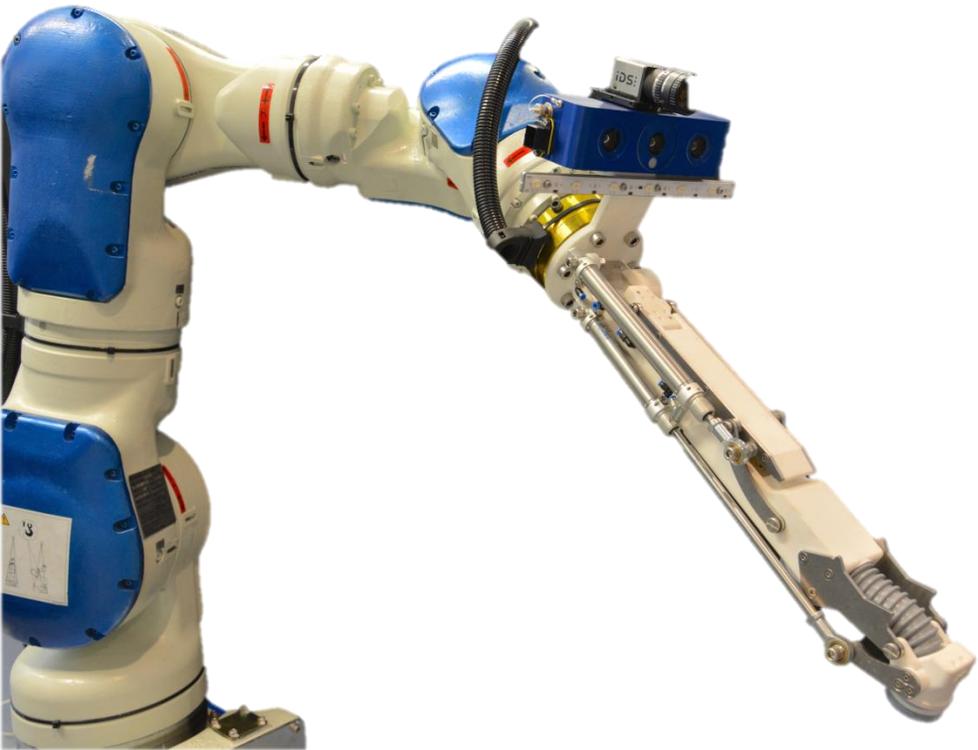
[How It Works](#)

## Customer Benefits

Hey! What can I help with today?

01101 > <10101

Alles bekijken



# Gripper

---



Identification

---

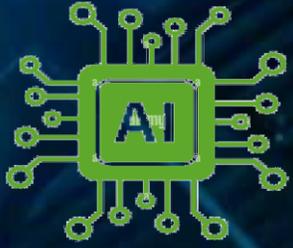


Algoritmes

---

Integration

---



Nieuws - 23 maart 2023 - 09:55

## IKEA laat drones winkelvoorraden tellen



Bezoekers van IKEA's in Nederland, België, Duitsland en nog een paar landen hebben kans dat ze drones door de winkel zien vliegen. Die helpen de winkelmedewerkers door voorraden in de winkels te tellen.

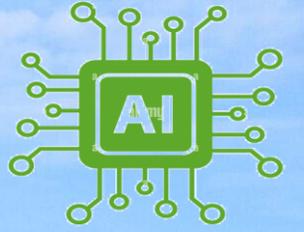
Eigenlijk vliegen ze alleen buiten de openingstijden door de winkels, maar misschien zal een enkele drone toch wat overijverig blijken en per ongeluk propellertjes zijn tonen.

IKEA is bezig vliegende hulptroepen in te voeren in zestien Europese winkels. Het gaat om [honderd drones](#) van het bedrijf [Verity](#) uit Zürich. Dat is gespecialiseerd in het automatiseren in-door inventarismanagement.

Andere klanten zijn DSV, Maersk en Samsung.

De Zwitsers haalden vorige week nog [dertig miljoen](#) euro venture capital op in een ronde die werd geleid door A.P. Moller Holding, het moederbedrijf van rederij Maersk.

De drones vliegen langs de schappen van IKEA en kijken daar hoeveel voorraad er nog op de pallets ligt. Dat scheelt de menselijke collega's van de autonome bots loop- en telwerk. Het Zweedse concern kijkt ook naar drones die artikelen kunnen pakken en picken. Dat komt bijvoorbeeld van pas bij e-commerceorders. Robots verzamelen dan items uit de winkel voor de Click & Collect-balies.



# 5. Samenvatting

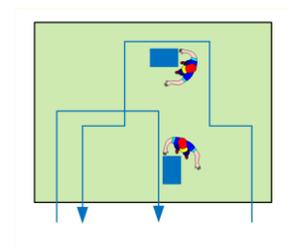
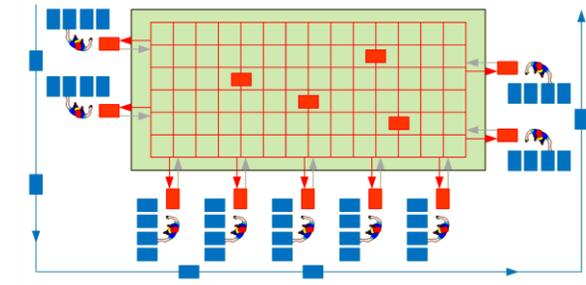
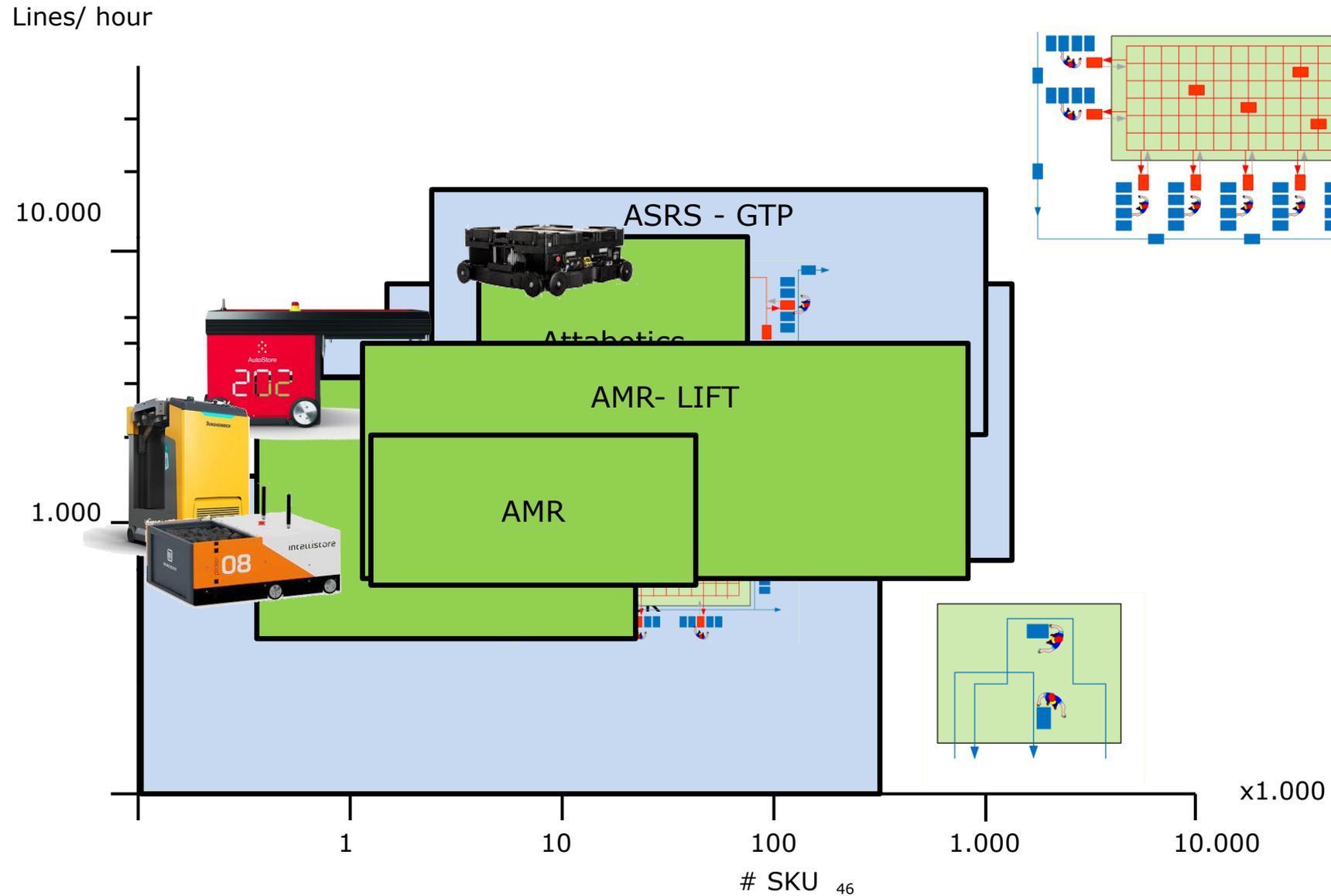


| TECHNOLOGIE                  | ASRS | KUBISCH | AMR | AMR-LIFT | EXOTEC |
|------------------------------|------|---------|-----|----------|--------|
| Handling capaciteit          | 😊😊   | 😐       | 😞   | 😊        | 😊      |
| Operator Productiviteit      | 😊    | 😐       | 😞   | 😊        | 😊      |
| Opslagdichtheid              | 😊😊   | 😊       | 😞   | 😐        | 😊      |
| ABC gevoeligheid             | 😊    | 😞       | 😐   | 😊        | 😊      |
| Schaalbaarheid               | 😞    | 😐       | 😊   | 😐        | 😐      |
| Relatieve onderlinge pricing | 😞    | 😐       | 😊   | 😐        | 😞      |



| TECHNOLOGY                  | ASRS | KUBISCH | AMR | AMR-LIFT | EXOTEC |
|-----------------------------|------|---------|-----|----------|--------|
| Ervaring                    |      |         |     |          |        |
| Planning                    |      |         |     |          |        |
| FM Global richtlijn         |      |         |     |          |        |
| Redundantie                 |      |         |     |          |        |
| Bouwkundige randvoorwaarden |      |         |     |          |        |

# Logistieke concepten vandaag de dag



HAIPICK A42T



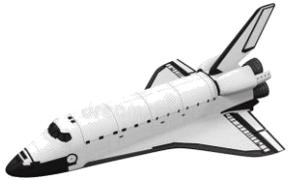
## **KUBISCHE SYSTEMEN**

- Concurrente kubische opslag systemen opereren in dezelfde markt in nagenoeg dezelfde "sweet spot" van huidige marktleider Autostore.
- De nieuwe leveranciers van kubische systemen hebben veel potentie door met name hogere opslagdichtheid



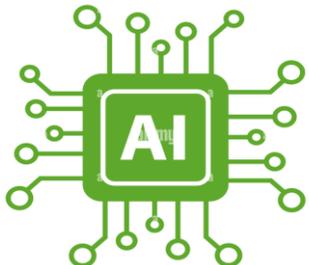
## **AMR SYSTEMEN**

- De AMR technologie met verrijdbare stellingen vraagt een relatief groot oppervlak voor opslag en is daardoor relatief prijzig in huurkosten of kosten om meerlaags te bouwen.
- AMR Technologie door gebruik van de hoogte in nieuwe "AMR-LIFT" concept veel toegankelijker met relatief hoge opslagdichtheid en performance en is daardoor een veelbelovende techniek. De combinatie van goede flexibiliteit en schaalbaarheid past uitstekend in de huidige marktvraag.
- De AMR technologie komt ook meer beschikbaar als alternatieve technologie voor transport en sorteerstromen.



## **ASRS Shuttle systemen**

- Conventionele shuttle systemen blijven gebruikelijk voor projecten met grote schaalgrootte, zeker als de bouwhoogte relatief hoog is ( >12m vrije hoogte)
- "Speciale systemen" ; Attabotics is een kubisch opslag systeem maar concurreert op hoge capaciteitsconcepten en is daardoor meer een concurrent van ASRS shuttle systemen
- "Speciale systemen"; Exotec is een AMR gedreven concept en is qua performance (en investeringsniveau) gelijk aan ASRS shuttle systemen in een conventioneel gebouw (eg 11m vrije hoogte)



## **Artificiële Intelligentie**

- Veel bestaande systemen worden reeds ondersteund door robotica en artificiële intelligentie. Vooral deze AI functionaliteit heeft voor diverse toepassingen de potentie om de logistieke automatisering radicaal te veranderen.



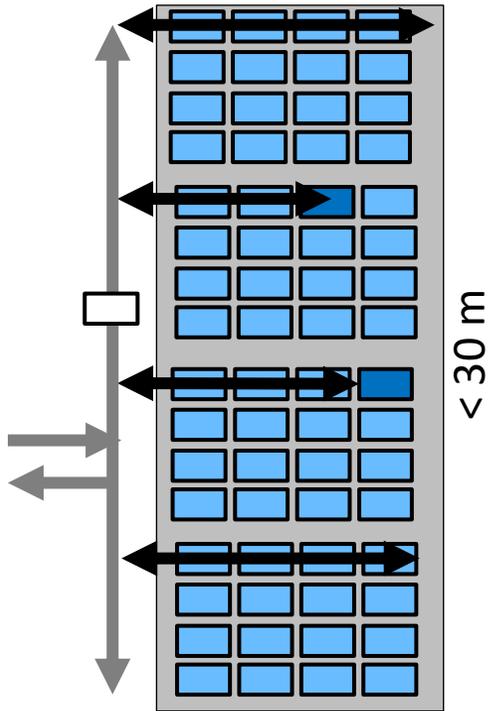
ASRS  
Bak

AMR  
Rek

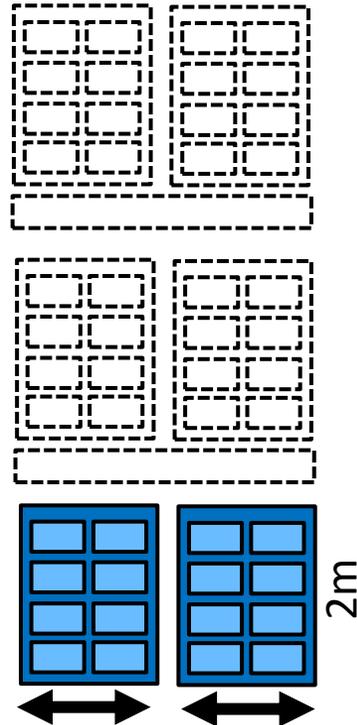
AMR-XL  
XL rek / POPPICK

AMR-LIFT  
(Meerdere) bakken

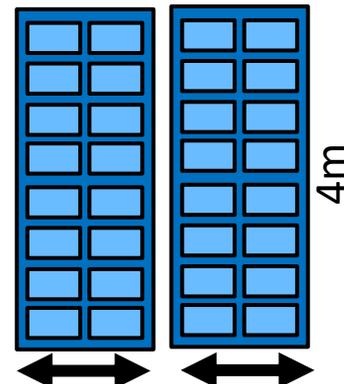
SKYPOD  
bak



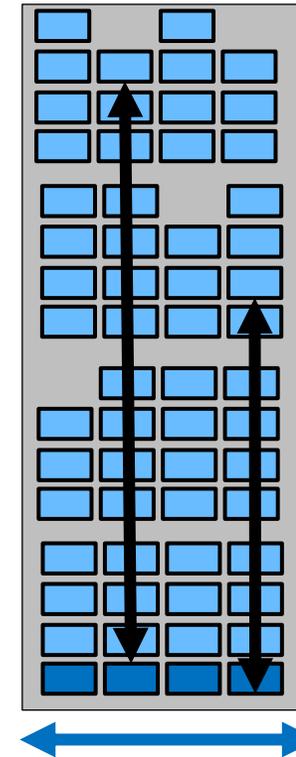
< 30 m



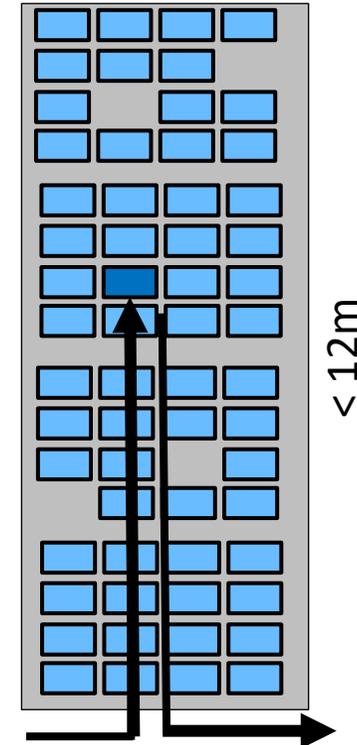
2m



4m



< 10 m



< 12m



**GROENEWOUT**  
Member of EPG

# CONTACT



**Dirk Becks**  
Senior Consultant  
31 6 2124 7702

[becks@groenewout.com](mailto:becks@groenewout.com)