



Workshop 4

Robotisering en de gevolgen voor fysieke belasting

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Bijeenkomst duurzaam fysiek werk
Leren en innoveren

op weg naar duurzame **inzetbaarheid**



Tools & Toys

Jobs & Joys

World Wide

The collage displays the following websites:

- IFR International Federation of Robotics**: Shows a robotic arm in a manufacturing setting.
- rbr robotics business review**: Features a search bar and news categories like News, Industries, Finance, Research, Webcasts, RBR50, Events, Groups, and Companies.
- IEEE SPECTRUM**: Promotes "More Speed, Less Clicks" and includes links for Engineering Topics, Special Reports, Blogs, Multimedia, The Magazine, Professional Resources, and Search.
- RIA Robotic Industries Association**: Includes sections for RIA & YOU, ROBOTIC RESOURCES, UPCOMING EVENTS, SAFETY, INTEGRATOR CERTIFICATION, and BECOME A MEMBER.
- Online Browsing Platform (OBP)**: Displays a search interface for ISO 8373:2012(en) and the title "ISO 8373:2012(en) Robots and robotic devices — Vocabulary".
- SPARC The Partnership for Robotics in Europe**: Features a colorful geometric logo and the text "The Partnership for Robotics in Europe".

The Netherlands

The collage displays the following websites:

- ROBONED**: Shows a robotic arm and the ROBONED logo.
- TU Delft**: Features the TU Delft logo and the TU DELFT ROBOTICS INSTITUTE NEWS section.
- DELFT ROBOTICS**: Includes the DELFT ROBOTICS logo and the tagline "intelligence at work".
- UNIVERSITEIT TWENTE**: Shows the RAM Robotics and Mechatronics logo and the WELCOME TO ROBOTICS AND MECHATRONICS page.

Additional visible elements include a LEO CENTER FOR SERVICE ROBOTICS page and a TU/e Technische Universiteit Eindhoven University of Technology page under the heading "Robotics Research".

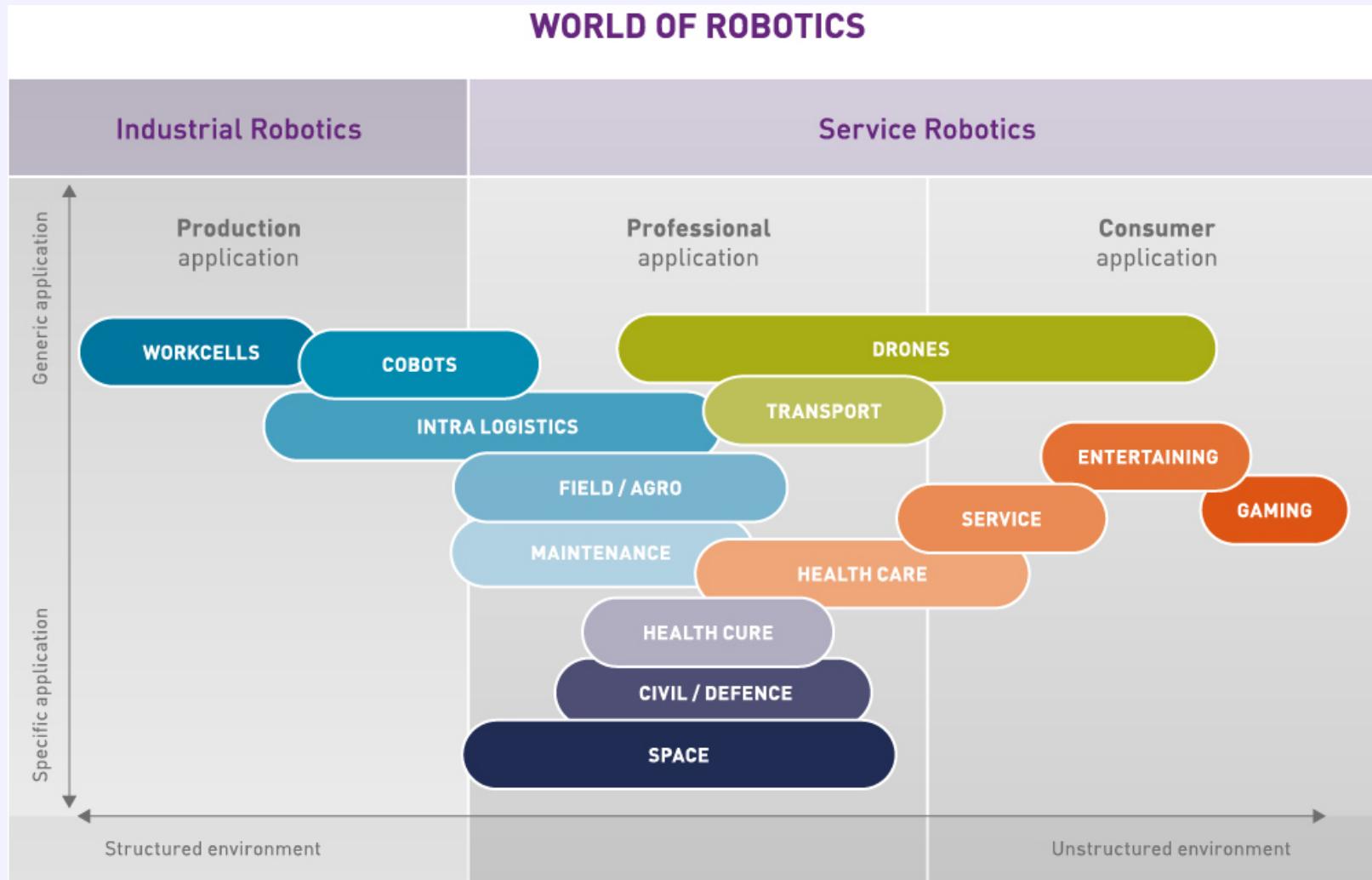
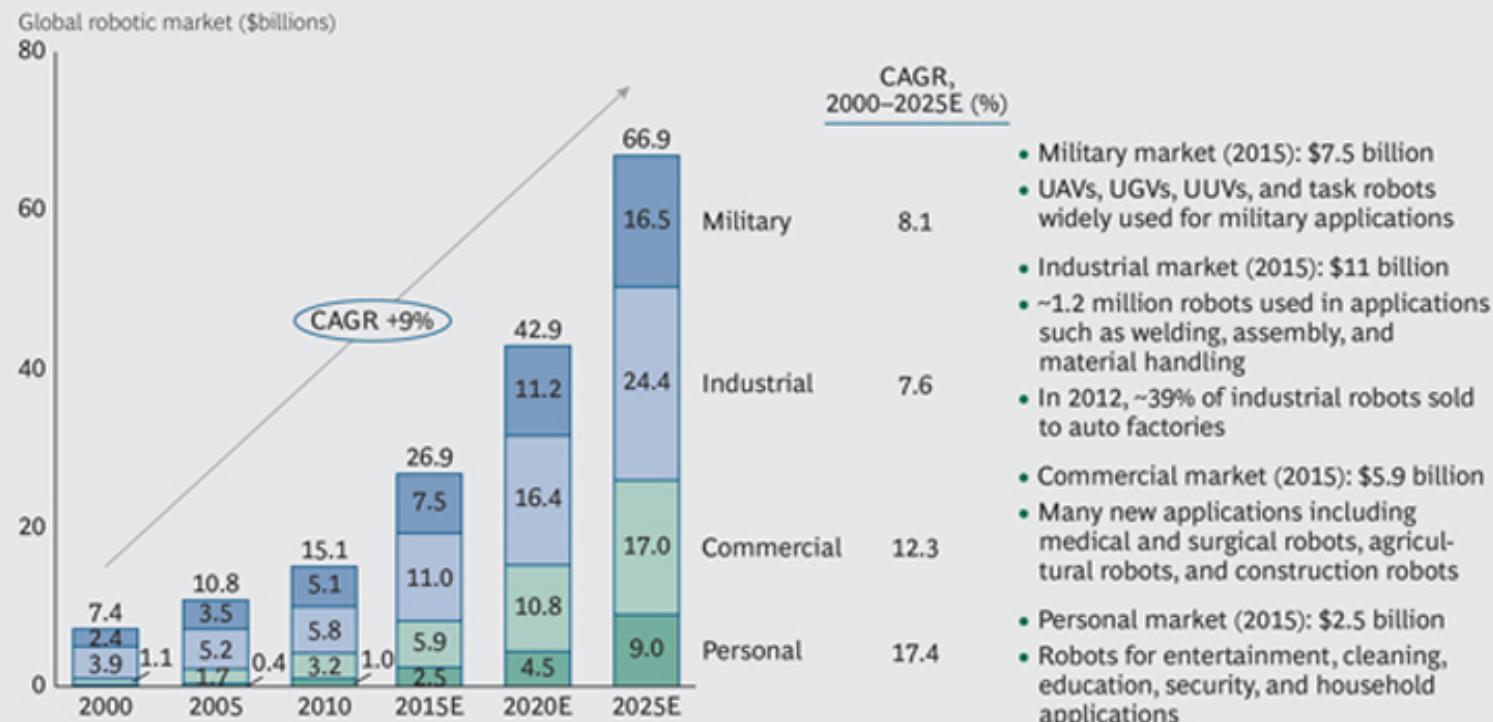


EXHIBIT 1 | Worldwide Spending on Robotics Is Expected to Reach \$67 Billion by 2025

Sources: International Federation of Robotics, Japan Robot Association; Japan Ministry of Economy, Trade & Industry; euRobotics; company filings; BCG analysis.

Note: UAV = unmanned aerial vehicle; UGV = unmanned ground vehicle; UUV = unmanned underwater vehicle. Estimates do not include the cost of engineering, maintenance, training, or peripherals.

Source: Boston Consulting Group 2014

Characteristics

- Around for over
- Types & sizes
- 75% of the market
e.g. Yaskawa
- Average price HW
- Minimum pricing
- Robot density NL low
- Market Benelux
- NL about

Data irf.org

40 years
6DOF / SCARA / DELTA
Big 4 (AFKY)
24.000 units/yr
\$ 50K/unit
\$ 20K (SCARA)
93 robots/10K FTE
1900 units/yr;
800 units/yr



Trends

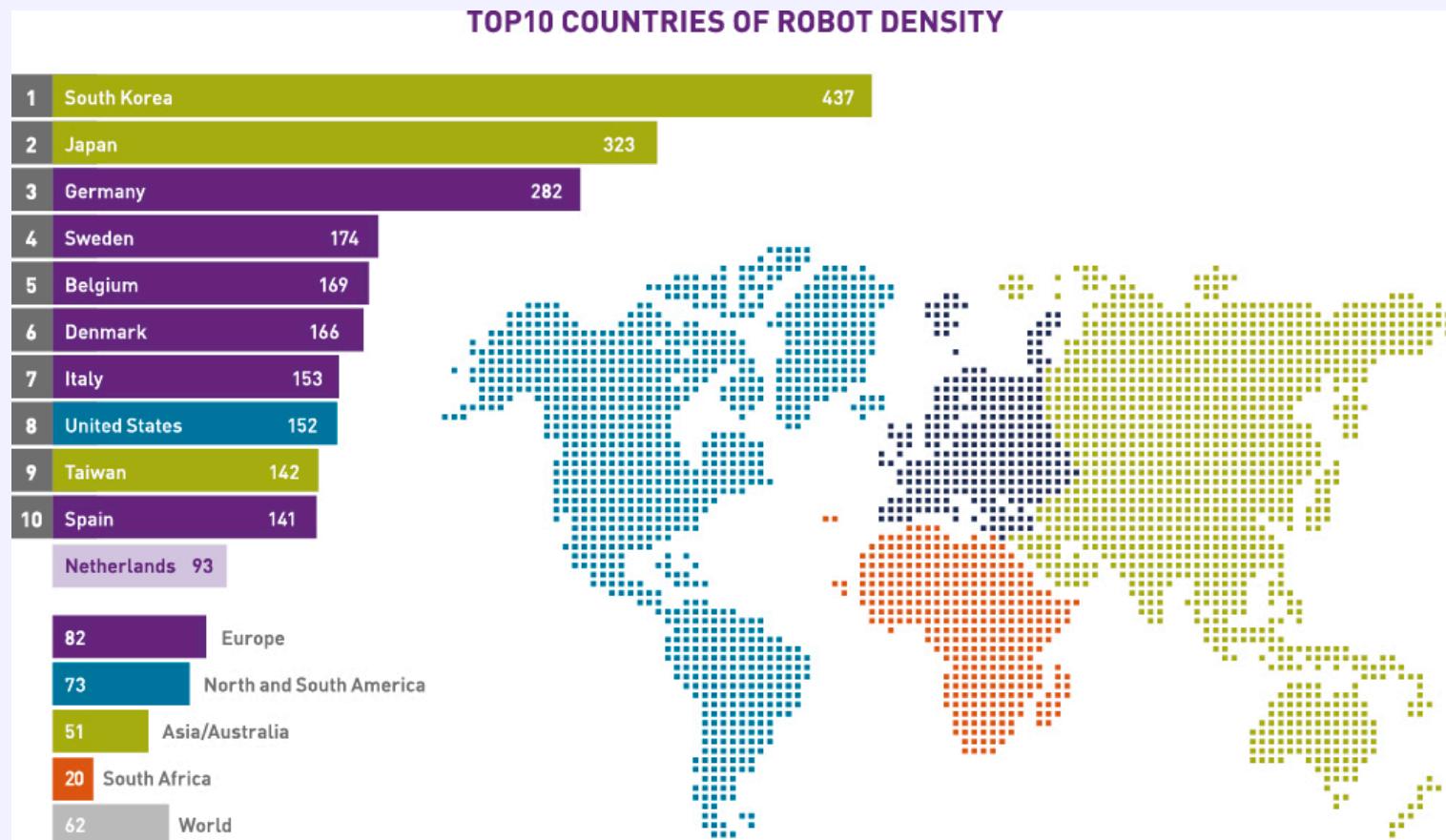
- Focus on **TCO and Productivity**
Payload, Accuracy, Speed and Reliability
- Enhanced SW and control
- Random Order Picking
- Mobile robots on AGV
- Automated warehouse & logistics
- Automated work cells

And many others
whereas:

Adept, Cloos, Comau, Epson,
Denso, Hyundai, Kawasaki,
Mitsubishi, Nachi, Electric,
Panasonic, Reis, Schunk,
Staubli, Toshiba, Yamaha,

Foremost Japanese and German
Billion dollar companies....





Source: IFR World Robotics 2014; Robot density per 10.000 operators in production

Drivers

- Automate Dull, Dirty, Dangerous applications
- Industry 4.0 / Smart Industry
- Human – Machine Collaboration
- Flexibility due to decline Product Life Cycle
- New and affordable HW/SW technology & materials

China/Asia growing 40%



中国最大的机器人产业化基地

新闻资讯 [新闻] 新松公司北方区域总部落户青岛 [2014/7/25]

| 公司新闻 | 行业新闻 | 媒体关注 |

工业机器人
30年技术积累
12年工程应用

并联机器人
高性能 高效率
高性价比

AGV自动导引车
民族品牌 国际品质

智能仓储物流
物流设备顶级供应商

自动化成套设备
研发与应用的权威机构

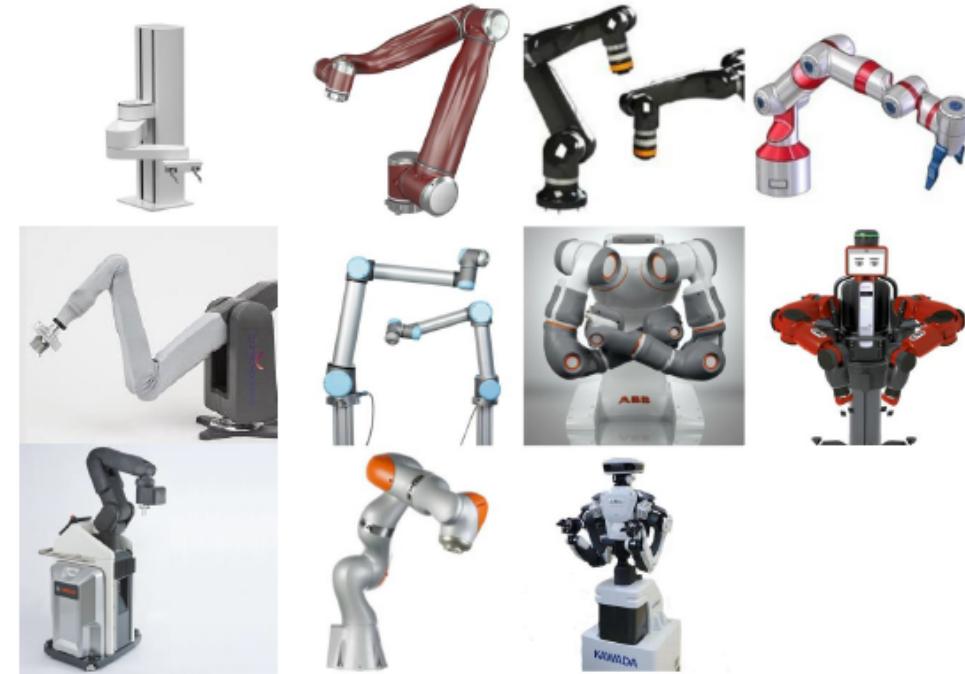
煤焦化制样机
全自动化操作
提升企业形象

China's Industrial Robot Boom Amazes Experts

Robots prime acquisition as China's new factories arise
By Tom Green



PRob – ROBERTA – SPEEDY-10 – BAXTER
ABB YUMI – KUKA IIWA – UNIVERSAL ROBOTS
PF 400 – NEXTAGE – APAS – BIOROB



New in industry, especially for SME:

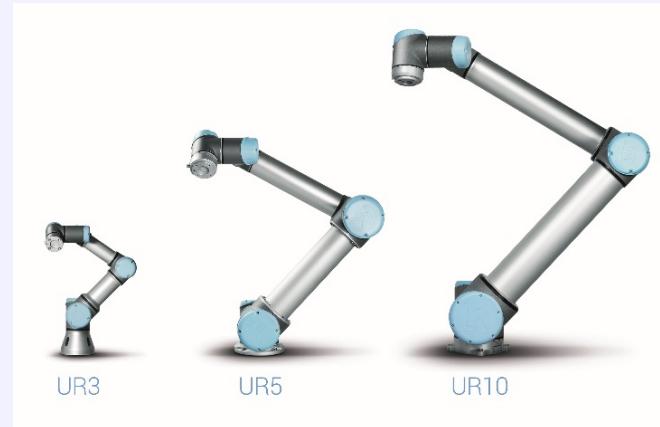
- Low cost
- Easy and fast programmable
- Safe operation

PART4You Audi



Universal Robotics, Denmark

- 2005 Started company
- 2009 Product on the market
- 2014 Sold 4.000 units total,
Revenue \$100M
- 2015 new UR3
- Target sales 4.000 pc
- 2017 Target Revenue \$200M



Rethink Robotics, USA

- Baxter
- Sawyer (new 2015)
- Strong investments and marketing



Universal Robots



Van Wees Waalwijk Mobiele robot

De mobiele robot is een door Van Wees Waalwijk ontwikkeld concept. Deze robot kan gezien worden als een flexibele werknemer, aangezien hij op meerdere plekken inzetbaar is, eenvoudig te programmeren en er geen hekwerk voor vereist is. Door deze multifunctionaliteit kan hij optimaal benut worden en wordt de 'return on investment' sterk vergroot!

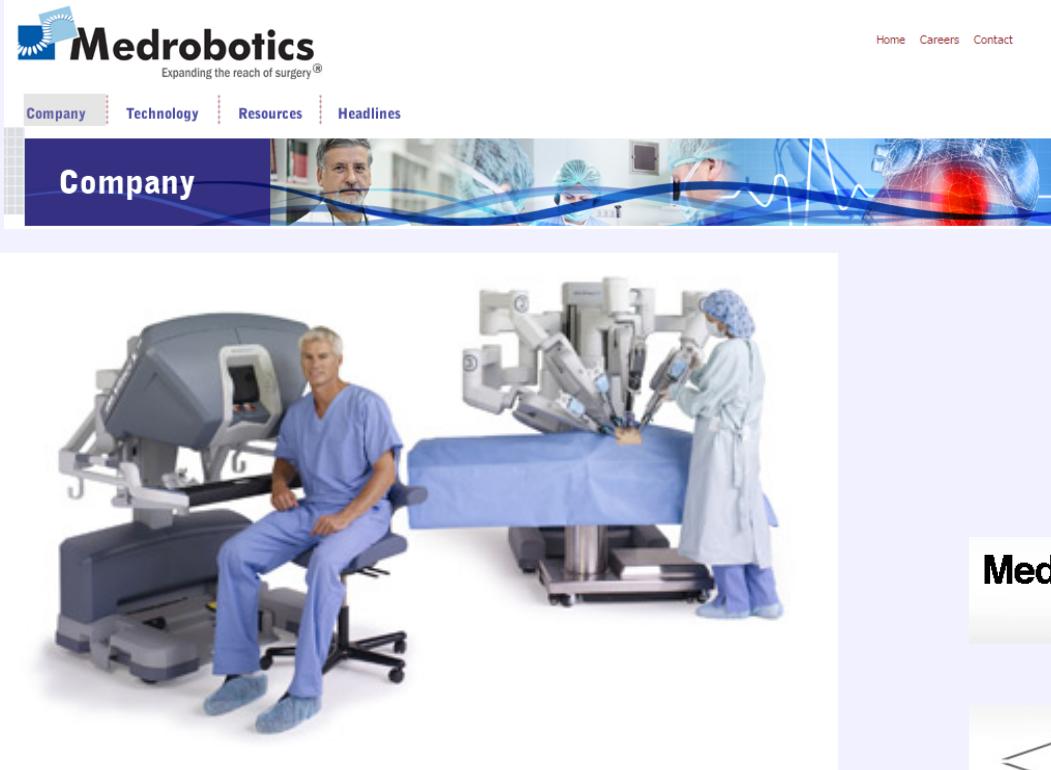
- [Terug naar overzicht](#)



 Uw full-service partner

Basic Principles

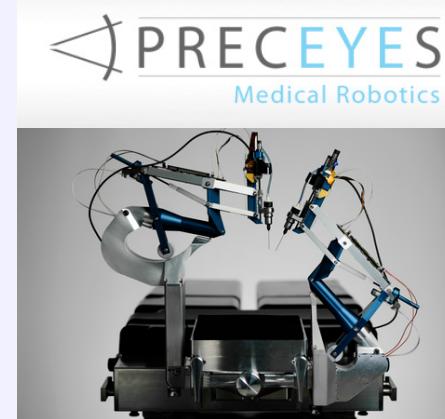
- Move Robot to work location, not work to robot cell
- Small footprint. Fit within existing shop-floor layout
- Programming/teaching by operator



- Tele-operation
- Micro surgery
- Minimal invasive
- Endoscopy



Medical Robotic
Technologies



- Service Robots
- Telepresence
- Exoskeleton
- Rehabilitation

REMOTE PRESENCE DEVICES







Agribotix
Actionable Intelligence for Precision Agriculture

AGRIBOTIX FARM & DATA SERVICES DRONES PRICING STORE BLOG SUPPORT CONNECT ABOUT

Agribotix
Drones & Data Services for Precision Agriculture

Aeronautics

Aerialtronics

Ontdek de nieuwe Altura Zenith
Een onwaarschijnlijk verbluffend luchtaanval systeem

Productivity driven

- Harvesting
- Milking
- Packing
- Processing
- Picking
- Handling

A collage of images illustrating various agricultural robotics applications:

- The top section shows a red and black 'Sweeper' robot harvesting red bell peppers from plants, with a blue tray filled with harvested peppers below it. Logos for the 'SEVENTH FRAMEWORK PROGRAMME' and the European Union are visible above the image.
- The middle section features four smaller images: a close-up of a robotic gripper on a plant, a blue tractor harvesting fruit in a field, a green robot arm inside a greenhouse, and a yellow robotic arm in an outdoor orchard.
- The bottom section displays five small images showing target object detection: red bell peppers highlighted in blue, a forest scene with colored lines indicating paths or targets, vertical colored lines (blue, green, orange, red) on a white background, bunches of dark grapes highlighted in green, and a vineyard with colored overlays (green, pink, purple) indicating specific areas of interest.

For target object detection much work is done on [sensing](#) and [intelligent sensor fusion and learning algorithms](#).

Supporting and assisting in harsh labor and unstructured environment

ALSTOM
Inspection Robotics

petrobot

Company | Innovation | Industries | Services | Products

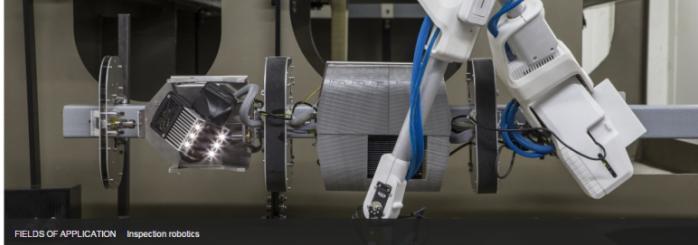


ROBOSHIP

PARTICIPATING MEMBER(S) LEO IMOTEC / Universiteit Twente, Robotics and Mechatronics

START DATE 1-1-2012 BUDGET € 1.700.000

TYPE OF FUNDING INTERREG IVA



FIELDS OF APPLICATION Inspection robotics

NATIONAL ROBOTICS
NREC
ENGINEERING CENTER **Sensabot**
Mobile robotic sensor system



Welkom ▾ Nieuws ▾ MVP ▾ Ki<

[Kennis- en Innovatie Centrum ::]

Ontwikkelen coating robot



Het ontwikkelen van een coating robot door een automatisch systeem te creëren dat een aanmerkelijke bijdrage zal leveren aan veilig en doelmatig reinigen van grote oppervlaktes.

Voor meer informatie bekijk de

[Projectposter Coating Robot](#)

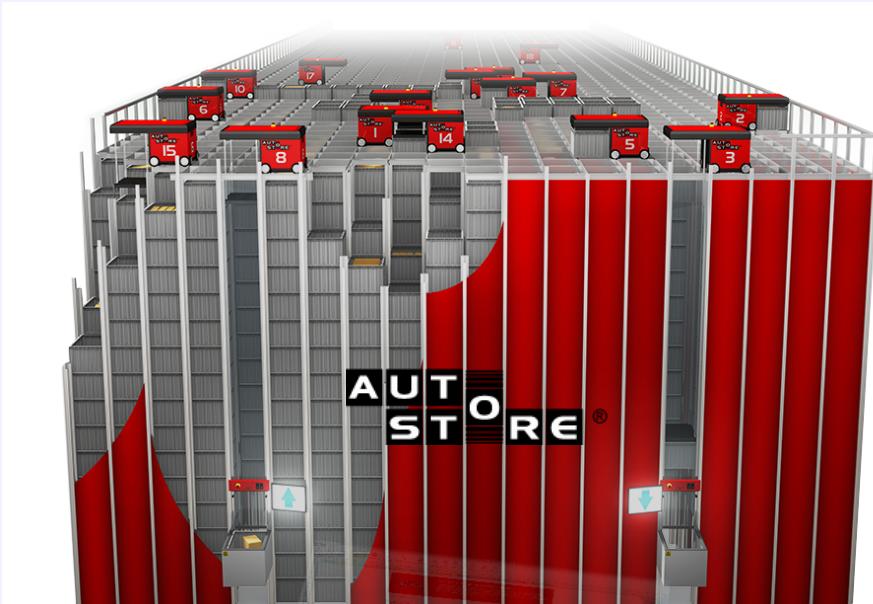


PIRATE

PARTICIPATING MEMBER(S) LEO Universiteit Twente, Robotics and Mechatronics

START DATE 1-1-2006 TYPE OF FUNDING FP7





- Drones
- Paro
- Nao and Pepper
- Jibo

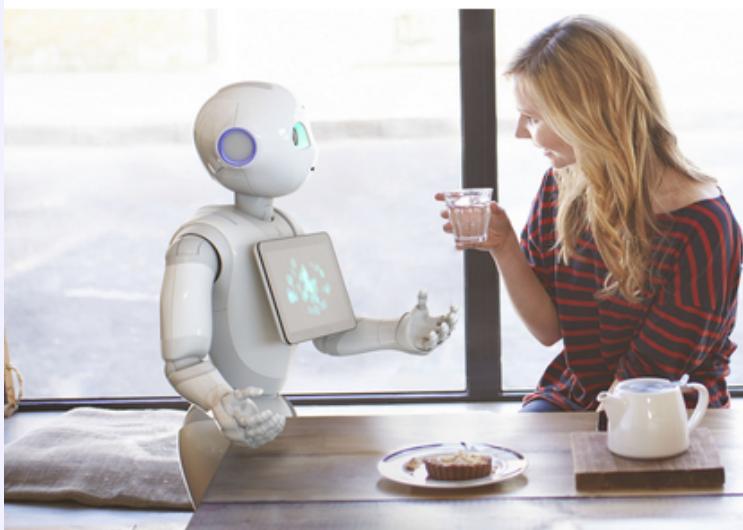
jibo



Meet JIBO, The World's First Family Robot

We are no longer accepting pre-orders and are focused on getting the first shipment of JIBOs to our early adopters who supported our crowdfunding campaign.

Sign up so we can let you know when now!



PLANÈTE ROBOTS

LE MAGAZINE DE LA ROBOTIQUE ET DES NOUVELLES TECHNOLOGIES DU FUTUR

LE MAGAZINE PLANÈTE ROBOTS • ACTUALITÉ • AGENDA ROBOTIQUE • STAGES / EMPLOIS ROBOTIQUES • FORUM PLANÈTE ROBOTS

Recherche



Huishoudrobot



Robotdieren



Speelgoedrobot



Drones



Service robots



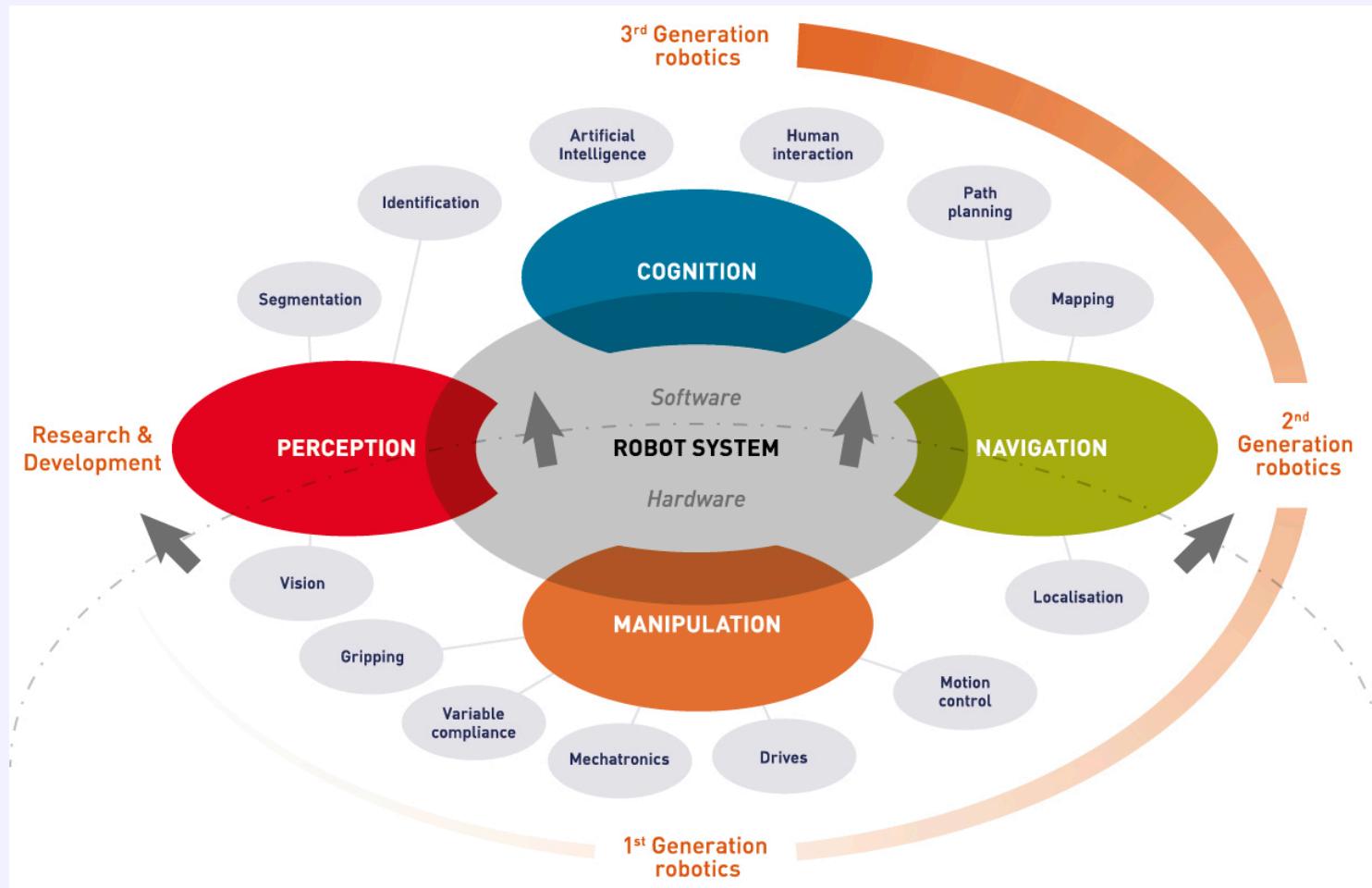
Zorgrobot





Vacuum and Cleaning mass consumer market

- More then 15 brands world wide (*iRobot, Philips, Samsung, Siemens, etc.*)
- More then tens of millions sold



Trends

- Affordable 3D vision and sensing technology available from gaming industry
- Open software platform ROS increased potential
- Affordable HW solutions

Challenges

- Perception, Navigation and Cognition
- System integration
- SW & HW limitations
- Fully **addressing application needs:**
simplicity, costs, reliability, productivity, flexibility, acceptance, safety, TCO

Darpa Challenge

<https://www.youtube.com/watch?v=fQ6b5Wm5Glw>

ROS



Boston Dynamics

<https://www.youtube.com/watch?v=M8YjvHYbZ9w>

CO-BOTS GEVEN MEDEWERKERS UITDAGENDER EN MEER GEVARIEERD WERK.

- *OMDAT MEDEWERKERS CO-BOTS TAKEN KUNNEN LEREN (INTERACTIE)*
- *CO-BOTS REPETITIEVE TAKEN UIT HANDEN NEMEN*



**ER ZIJN GEEN NADELEN VAN CO-BOTS VOOR DE
FYSIEKE BELASTING VAN MEDEWERKER EN ERGONOMIE
VAN DE WERKPLEK.**



**CO-BOTS KUNNEN ALLEEN VEILIG NAAST MENSEN
WERKEN ALS ZE LANGZAMER BEWEGEN DAN MENSEN
EN DUS ZIJN ZE NIET PRODUCTIEF GENOEG IN DE
SAMENWERKING MET MENSEN.
→ KIES MENSEN IPV CO-BOTS**



**SOCIALE WERKPLAATSEN KUNNEN INGEWIKKELDERE
PRODUCTIE AAN DOOR DE SAMEN WERKING VAN CO-
BOTS MET MENSEN MET EEN HANDICAP.**



EXOSKELETONS

What is an exoskeleton?

- › Mechanical structure
- › External to the body
- › Wearable
- › Enhance power of a person
- › Human is in charge...

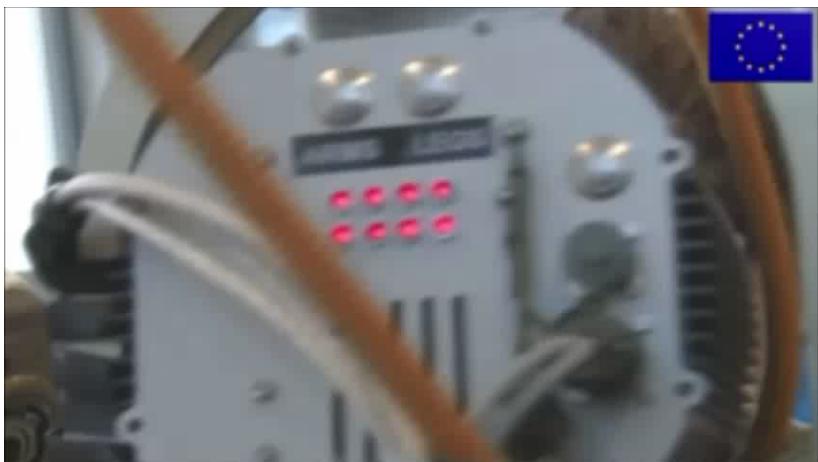


Variations in..

- › Power supply: passive or active
- › Size: full body, lower body, upper body



EXAMPLES



POTENTIAL BENEFIT

large variation in activities and/or products to be handled is large

human tasks are too difficult or too expensive to automate

worker is mobile and has to handle loads on many different locations

cranes or balancers are not feasible or effective

exoskeletons, augmenting power to the human body while keeping human flexibility may increase business performance (flexibility, productivity) and promote health



CHALLENGES

- › Benefits are unclear (from health and productivity perspective)
- › Risk of non-acceptance is high
 - › Usability
 - › Discomfort (anthropometry fit, pressure points, climate)
 - › Safety
- › Technical issues
 - › Hindrance of fast and smooth movements
 - › Weight / power source for complete work shifts
 - › Size of device
- › Missing standards for exoskeletons in industry
 - › ISO 13482 on personal care robot safety (not about industry...) (TC 184)
 - › ISO 10218-1 en -2 on industrial robot safety (not about exo-skeletons...)

RUNNING PROJECT: EU ROBO-MATE

Intelligent exoskeleton based on human robot interaction for manipulation of heavy goods in Europe - Large-scale Integrating EU project (GA 608979)



ZHAW
CENTRO RICERCHE FIAT
INDRA SAS
IIT
TNO
UNIVERSITY LIMERICK
MRK
FRAUNHOFER IAO
COMPÀ
ROPARDO
ACCELOPMENT



JOINT INNOVATION CENTER *INTERACTION ROBOTS*

TU Twente & TNO

- › Samenbrengen van kennis
- › Versnellen van innovatieve robotica applicaties
- › Creëren van partnerships
- › Strategic and operational continuity
- › Aanbieden hele waarde keten

WEARABLE ROBOTS STELLINGEN

STELLINGEN:

- › Een wearable robot helpt de mens om het maximale uit zichzelf te halen. Optimale belasting van deelsystemen.
- › Een wearable robot stelt meer mensen in staat zwaar werk uit te voeren.
- › Wearable robot is een persoonlijk beschermingsmiddel (Mag alleen worden toegepast als alle andere maatregelen niet mogelijk zijn)
- › Er moet een grens gesteld worden aan de gebruiksduur van een wearable robot om afname van getraindheid te voorkomen.

- › User intention is niet door sensoren te detecteren.
- › Een wearable robot mag enig discomfort geven.
- › Extra gewicht (>5kg) van een wearable robot moet naar de grond worden afgestemd.
- › Extra activiteit van andere sterke spiergroepen (bv in de benen) bij het gebruik van een wearable robot is een optimalisatie van de mens.