

ROBOTICS IN HEALTHCARE

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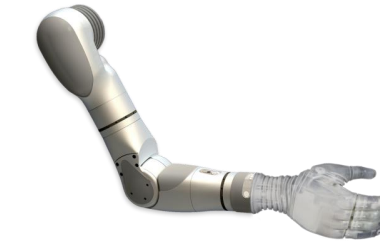
Summary and recommendations for Finnish businesses

Introduction and Objectives

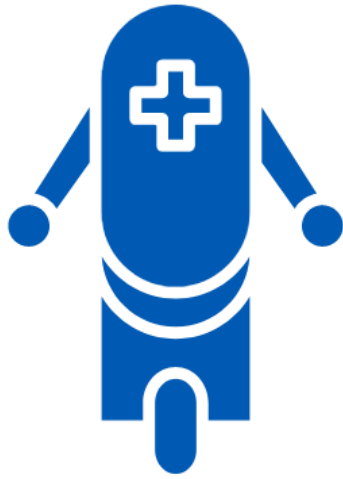
Business Finland aspires to strengthen Finland's economic position through enabling Finnish companies to grow internationally, seize market opportunities and turn them into success stories.

Innovations in automation, cloud computing, touch and motion sensors, and AI are driving new applications for service robots. In addition, rapid technological change and a renewed focus on the healthcare industry is creating new opportunities for robotics in healthcare.

This report summarises the global landscape of robotics solutions in healthcare and wellbeing, as well as in service robotics more broadly. It highlights interesting markets, key players and ecosystems, as well as areas of opportunity where Finnish companies can look for partnerships.



Overview of robotics ecosystem in healthcare and wellbeing



1

Medical Robots

- Surgical robots
- Diagnostic systems

2

Healthcare Service Robots

- Medication delivery and dispensing
- Cleaning and disinfecting
- Telepresence and remote monitoring
- Autonomous vehicles/Auxiliary Robots (including food, specimen and laundry transportation)

3

Care Robots

- Companion Robots/ Personal Assistants
- Assistive Robots (Includes elderly or immobile patient assistance and carriers, Rehabilitation Robots)
- Prosthetics and Exoskeletons

* The ecosystem overview has a specific focus on the hospital and patient end-user group with emphasis on products that enable efficient diagnosis, interventions, therapy, and follow-up care. As a result, robots for lab automation, drug discovery and clinical trial management are not included in the scope of this research study.

Global robotics landscape in healthcare and wellbeing: Leading markets overview

USA

- ✓ Financial position of hospitals to invest in robotic systems
- ✓ Landscape of healthcare start-ups and established companies in the robotics space
- ✓ Increasing patient awareness about computer-assisted surgeries
- ✓ Increasing demand for minimally invasive procedures
- ✓ Healthcare insurance coverage for robotic surgeries

Europe

- ✓ Increasing need for automation to cope with healthcare staff shortages and patient demand
- ✓ Increasing demand for minimally invasive procedures
- ✓ Improving reimbursement landscape for minimally invasive and robotic procedures
- ✓ Aging population with need for assisted living and care givers

Japan

- ✓ Shortage of healthcare staff and care givers, coupled with a rapidly ageing population
- ✓ Aptitude towards technological advancements making adoption of robotics easier, especially social companions and care robots
- ✓ Shifting trend from conventional surgeries to advanced robot assisted procedures

China

- ✓ Favorable government and healthcare authority policies
- ✓ Encouraging investment environment for high-end technologies
- ✓ University-industry-research cooperation, and promising healthcare technology ecosystem
- ✓ Increasing aptitude towards robot assisted procedures and social companions
- ✓ Leader in surgical robotic system innovations with 36.5% of patents between 2015 and 2020.

“A robot is a global product. If you look inside the robot there are sensors, servomotors, algorithms etc, and all could be from different parts of world”.

Albert Yefimov, Head of Skolkovo Robotics Centre

Global robotics landscape in healthcare and wellbeing: Market Potential Assessment Summary

Healthcare Robotics		Technology Readiness	Breadth of Applications	Current Adoption	Growth Potential
Medical Robots	Surgical Robots				
	Diagnostics Robots				
Healthcare Service Robots	Medication Delivery and Dispensing				
	Cleaning and Disinfecting				
	Telepresence and Remote Monitoring				
	Autonomous Vehicles/ Auxiliary Robots				
Care Robots	Companion Robots/ Personal Assistants				
	Assistive Robots				
Prosthetics and Exoskeletons					
LEGEND		Predominantly R&D and prototype phase Several Commercial Products Technology Development	Low, Specific High, Multiple Breadth of Applications	Low, Pilots High, Commercial Current Adoption	Low High Growth Potential

Global robotics landscape in healthcare and wellbeing:

1. Medical Robots

1.1 Global Surgical Robots Market Overview



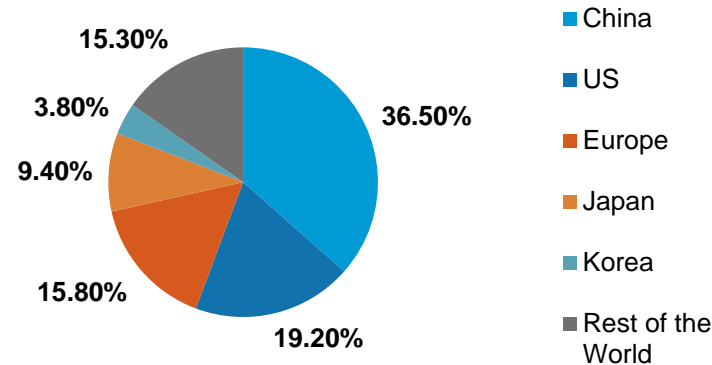
**>1.2 Million Procedures
~1500 Surgical Systems Placements with an
Installed Base of ~6000 hospitals**

- According to the market leader, Intuitive Surgical, more than 1.2 million procedures are performed globally, with a growth of 18% per year.
- There are more than 1500 surgical robots installed across the globe with an installed base of ~6000 hospitals, growing at 12% annually.
- The US is the largest market for robotic-assisted surgeries and has been witnessing strong adoption of these procedures among hospitals in the country. The use of robotic systems for all surgical procedures was 1.8% in 2012 and is expected to be more than 17% in 2020 primarily attributed to more precise surgery, faster recovery rate and better clinical outcomes in patients.

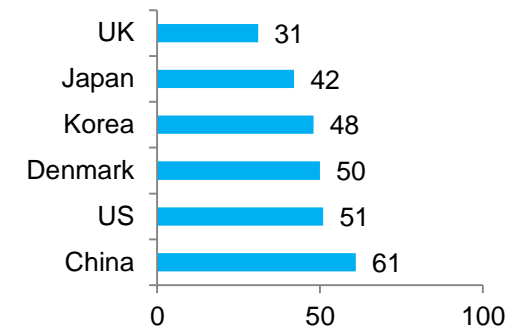
Top Market Participants

- | | |
|------------------------------------|--------------------------------|
| • Auris Health, Inc. | • Renishaw |
| • Accuray Incorporated | • Riverfield Co., Ltd. |
| • Brainlab | • Stryker |
| • CMR Surgical Limited | • Smith & Nephew plc |
| • Corindus Vascular Robotics, Inc. | • Stereotaxis, Inc. |
| • Intuitive Surgical, Inc. | • Synaptive Medical, Inc. |
| • Medtronic | • Think Surgical, Inc. |
| • Medrobotics Corporation | • Titan Medical Inc. |
| • Zimmer Biomet Robotics | • TransEnterix, Inc. |
| • Neocis, Inc. | • Virtual Incision Corporation |

Top Patent Filings by Region, 2015-2020*



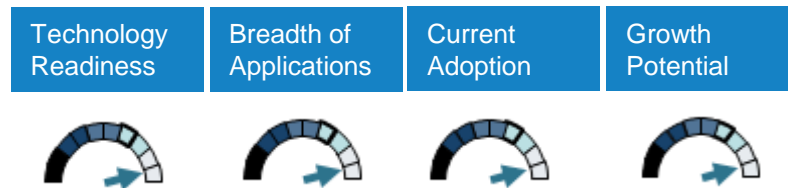
Average Patent Filing Time in Months, 2015-2020



- China has emerged as a leader for next-generation surgical robotic systems' innovations with 237 (36.5%) patents published in this area for the period from 2015 to 2020.
- The US occupied the second spot followed by Europe with 125 and 103 published patents respectively.

Opportunity Assessment

Surgical robots is a high revenue growth market segment. However, the market is highly competitive with established players, well defined market entry routes and a good product innovation pipeline, and hence a mature segment with less opportunities for partnership.



*Note: Data up to date as of H1 2020

Global robotics landscape in healthcare and wellbeing:

1. Medical Robots

1.2 Global Diagnostic Robots Market Overview

- Market growth is driven by increased adoption of automation by most hospitals and clinical diagnostic labs (due to the increasing volume of test samples).
- Demand for minimally invasive procedures (e.g. biopsy, tissue sample collection etc.) and consideration for safety of professionals and prevention of adverse events is also enabling the adoption of the diagnosis robots market.
- However, most of the diagnosis robots are in R&D/prototype or initial stages of commercialisation. As a result, the market is in initial stages of growth.

Market Drivers

- Demand for minimally invasive procedures for diagnosis (e.g. biopsy) and to obtain targeted area samples with precision and less risk of infection due to less invasion.
- COVID-19 has accelerated the adoption with increasing demand for diagnostic tests.
- Scientific and technological advancements in AI/ machine learning etc.

Market Restraints

- High establishment costs
- Fewer trained professionals with capabilities to administer the tests
- Lower/lack of reimbursement

Top Market Participants

- Biobot Surgical
- Brain Navi
- Lifeline Robotics
- Interventional Systems (iSYS Medizintechnik GmbH)
- Rudger's University
- Ubtech

Opportunity Assessment

Due to Covid 19 and the need for safer and more efficient testing, the diagnostic robot space has got a new impetus. The market has several companies in R&D and prototype stage, offering high opportunities for partnership.

Technology Readiness



Breadth of Applications



Current Adoption



Growth Potential



*Note: Data up to date as of H1 2020

Global robotics landscape in healthcare and wellbeing:

2. Healthcare Service Robots

2.1 Medication Delivery and Dispensing Robots Market Overview

- According to the WHO, the global cost associated with medication errors is estimated at \$42 billion USD annually.
- There are several medication delivery and dispensing tools available in the market, and robotics for this is an upcoming market segment, driven by medication adherence policies of hospitals and regional health systems.
- The market is expected to see increasing adoption with pharmaceutical companies partnering with robots for improving adherence to their drugs. e.g. Catalia Health are running a pilot program to explore patient behaviours outside of clinical environments and to test the impact that regular engagement with artificial intelligence (AI) has on patients' treatment journeys. The 12-month pilot uses the Mabu® Wellness Coach, a robot that uses artificial intelligence to gather insights into symptom management and medication adherence trends in select patients.

Market Drivers

- Increasing automation of pharmacies
- Increasing interest in medication adherence management especially as part of follow-up care

Market Restraints

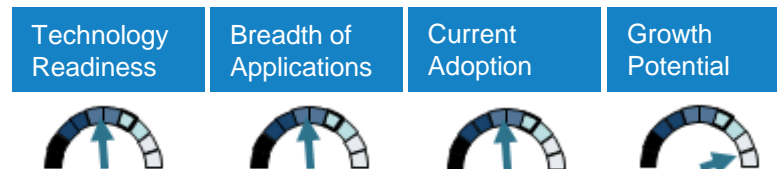
- Adoption is mainly on a pilot program basis and mainstream/ direct to patient uptake is still to take off

Top Market Participants

- Omnicell
- Pillo Health
- Capsa Healthcare
- Catalia Health
- Pria by Black+Decker

Opportunity Assessment

The increasing trend towards medication adherence and delivery, and a broader end user group (consumers, pharmacies, hospitals, rehabs etc.), is driving the growth of medication delivery and dispensing robots. The area is prime with opportunities for partnership as the companies in the space are mostly start-ups or small-medium companies.



*Note: Data up to date as of H1 2020

Global robotics landscape in healthcare and wellbeing:

2. Healthcare Service Robots

2.2 Cleaning and Disinfecting Robots Market Overview

- According to the CDC, 1 in 20 patients will incur an HAI during the course of their hospital stay at an estimated cost of \$1,000-\$25,000 per person.
- 5-10% of hospital patients globally acquire a new infection while in the hospital and the global socio-economic costs of HAIs account for >30 billion dollars.
- With COVID 19 and increasing importance of sanitization and disinfection, cleaning and disinfection robotics market is expected to take off, as it is a simple and easy-to-adopt technology which reduces the manual burden on hospitals that are already facing shortage of staff.

Market Drivers

- Market driven by regional and regulatory policies on reducing HAIs
- Maintaining hygiene protocols and standards especially as it has a direct impact on hospital accreditation
- Reducing manual labour, improving efficiency and cost savings for cleaning and disinfection.

Market Restraints

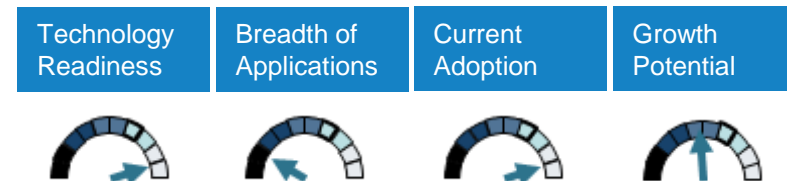
- No significant market restraints as cleaning robots are a proven industry application.
- Initial adoption may be driven by large-medium hospitals as easier to justify the costs

Top Market Participants

- Blue Ocean Robotics
- Xenex Disinfectant Systems
- Finsen Technologies (Thor UV-C)
- Skytron (Infection Prevention Technologies)
- Tru-d Smartuvc
- Steris Healthcare
- Mediland Enterprise Corporation
- Tmirob Technology
- Fuzhou Rockchip Electronics Co. Ltd
- Engmotion
- Bridgeport Magnetics

Opportunity Assessment

Cleaning and disinfecting robots is a mature market, especially as it is a less technology intensive, proven industry application. The users (hospitals) do not consider a cleaning and disinfecting robots as a capital intensive investment. The market has several established companies that have been in the industry for several decades, and consider healthcare as a vertical market expansion. As a result, there are fewer opportunities for partnership.



*Note: Data up to date as of H1 2020

Global robotics landscape in healthcare and wellbeing:

2. Healthcare Service Robots

2.3 Telepresence and Remote Monitoring Robots Market Overview

- Telehealth market has seen increased growth following the disruption of healthcare services by COVID 19. Several countries introduced regulations to reimburse telehealth and remote patient monitoring.
- Telepresence robots have also benefited from this, especially with healthcare staff shortage, and need to improve efficiency in patient flow.
- With growing need to manage healthcare needs of elderly population, telepresence robots are gaining popularity especially for chronic disease management, patient monitoring, remote visiting etc.

Market Drivers

- Demand for bedside assistance, follow up and monitoring
- Gaining acceptance of video conferencing with healthcare professionals
- Support in assisted living and rehabilitation centres

Market Restraints

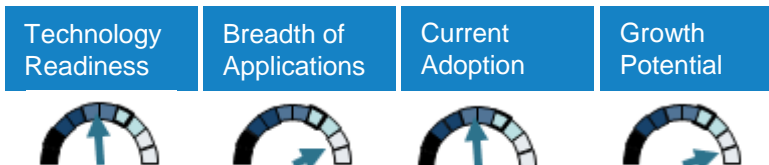
- Technical complexities leading to operational issues

Top Market Participants

- Ava Robotics Inc.
- Double Robotics Inc.
- AMY Robotics
- GoBe Robotics
- Inbot Technology Ltd
- InTouch Technologies Inc.
- VGo Communications Inc.
- Wicron Company
- Endurance Robots

Opportunity Assessment

With increasing interest in telehealth due to Covid 19, telepresence robots have received new momentum. There is increasing acceptance for virtual rounds and there are several healthcare start ups in the space, offering opportunities for partnership.



Global robotics landscape in healthcare and wellbeing:

2. Healthcare Service Robots

2.4 Autonomous Vehicles/ Auxiliary Robots Market Overview

- Studies indicate that 28% of healthcare staff time is spent on non-clinical, repetitive tasks and there is high demand for increased automation of mundane/ repetitive tasks such as collecting samples, delivering supplies etc.
- The opportunity to increase the efficiency of over-utilised healthcare staff (nurses, attenders etc.) especially for sample collection, transporting supplies etc. is driving the demand for autonomous vehicles/auxiliary robots

Market Drivers

- Autonomous vehicles/ auxiliary robots have several proven use cases and industry applications that can be adapted to hospital settings
- Manage surge capacity during peak demand and improves the overall efficiency of logistics.

Market Restraints

- Initial adoption may be driven by large-medium hospitals as easier to justify the costs
- Several projects in this space are pilot programs for automatic collection of lab samples etc. especially with the impact of COVID 19

Top Market Participants

- Diligent Robotics
- Aethon TUG
- ZoraBots
- Panasonic
- Gibotech
- Swisslog Healthcare
- Vecna Technologies
- Savioke
- Nuro

Opportunity Assessment

Autonomous vehicles/auxiliary robots is a growing market offering significant potential. There are promising use cases being developed and the companies in this space will benefit from partnership opportunities for market expansion.

Technology
Readiness



Breadth of
Applications



Current
Adoption



Growth
Potential



Global robotics landscape in healthcare and wellbeing:

3. Care Robots

3.1 Companion Robots/ Personal Assistants Robots Market Overview

- Social companion robotics space is the segment that shows significant growth potential in the personal robotics space (USD 50 billion by 2030).
- There is rising population that are living alone especially in Japan, UK, US etc. For e.g. In the U.S., approximately one-quarter of community-dwelling older adults are considered to be socially isolated, and 43% of them report feeling lonely.
- High cost of elderly care (e.g. in the US, average cost of \$48,000 to live in an assisted living suite, and over four times that for a full-time in-home aid) is also enabling the adoption of companion robots and personal assistants.

Market Drivers

- Large population of chronically ill and disabled population that are also socially isolated
- Need for personalised care and ensuring patient engagement to therapy, medication adherence etc.
- New use cases such as companions for autistic children, rehab for substance abuse etc.

Market Restraints

- Cost of the robots may not make it easier for the elderly population to adopt it (unless through co-living/assisted living facilities)

Top Market Participants

- SoftBank Robotics
- Luvozo
- Ubtech
- Hanson Robotics
- Intuition Robotics
- Honda Robotics
- Blue Frog Robotics
- Paro Robots

Opportunity Assessment

Companion robots/personal assistant robots is a high growth market segment. Patients directly procuring these robots are common in countries such as Japan and China. However, in western economies, purchases are healthcare provider driven. There is a need for viable business models and companies in this space will be looking for partnership opportunities.

Technology Readiness



Breadth of Applications



Current Adoption



Growth Potential



Global robotics landscape in healthcare and wellbeing:

3. Care Robots

3.2 Assistive Robots Market Overview (Includes Elderly or immobile patient assistance and carriers and Rehabilitation Robots)

- According to data from World Population Prospects: by 2050, 16% of global population will be over age 65 up from 9% in 2019. However, the care giver shortage is critical- for e.g. in the US alone, by 2030 the shortfall will be 151,000 paid direct-care workers and 3.8 million unpaid family caregivers.
- US, Germany, the UK, and Sweden are offering financial benefits to physically challenged people for robotic assistants and this is expected to add to the market growth.

Market Drivers

- Increasing prevalence of stroke, multiple sclerosis, Parkinson's disease, cerebral palsy etc.
- Rise of elderly population together with shortage of care givers

Market Restraints

- Inclusion of rehabilitation robots in physical therapy is limited and needs to be increased to improve adoption

Top Market Participants

- PTR Robots
- Kinova Robotics
- Focal Meditech
- SoftBank Robotics

Opportunity Assessment

Assistive robots is an upcoming market segment with a high potential for growth. With increasing inclusion in rehabilitation and improving reimbursement, there will be more commercialisation of products that are currently in R&D and prototype stage, offering partnership opportunities.

Technology Readiness



Breadth of Applications



Current Adoption



Growth Potential



Global robotics landscape in healthcare and wellbeing:

3. Care Robots

3.3 Advanced Prosthetics and Exoskeletons Market Overview

- Technological advancements such as bionic prosthetics, hybrid assistive limbs, gait rehabilitation technologies are expected to transform the advanced prosthetics market.
- Improvements in reimbursement for prosthetics either through government aid or via third party insurance is enabling the market adoption. For e.g. The Medicare, Medicaid, and the US Department of Veterans Affairs provides 40-50% as reimbursements for limb prosthetics services and devices in the US.

Market Drivers

- Provides higher functionality including dexterity, natural mobility, and sense of touch to missing or paralyzed limbs and improves quality of life.
- Traditional prosthetics are heavy, cumbersome, and expensive, and needs to be replaced, while advanced prosthetics can be reconfigured.

Market Restraints

- Varying prices (and impact on reimbursement) of prosthetics due to need for customization (cannot be mass produced)

Top Market Participants

- | | |
|--------------------------|--------------------------|
| • Össur | • Rex Bionics |
| • Ottobock SE & Co. KGaA | • Bionik |
| • Cyberdene | • Bio-xtreme |
| • Ekso Bionics | • Blatchford Group |
| • US Bionics (SuitX) | • Mobius Bionics |
| • ReWalk Robotics | • Willow Wood Global LLC |

Opportunity Assessment

Advanced prosthetics and exoskeletons is a high potential market, with proven clinical use cases, that is expected to grow considerably in next 5 years. Companies in this space are looking for viable business models and will be exploring partnership opportunities for market expansion.

Technology
Readiness



Breadth of
Applications



Current
Adoption



Growth
Potential



In terms of revenue and expertise, industrial robotics is the leading area for robotics in Finland. Finland's strengths are in engineering, manufacturing and machine building. Therefore the largest potential for partnerships would lie in Healthcare Service Robotics, particularly in areas such as autonomous/auxiliary robots and medication delivery and dispensing. Other areas where the market is fragmented with more potential to capture a share of the market include: assistive robots, diagnosis, prosthetics and exoskeletons, and companion robots. For diagnosis in particular, Finnish companies have strong capabilities in machine vision and pattern recognition and analysing data at the algorithmic level.

Examples of Finland-based Health and Wellbeing Robot Companies:

JoyHaptics, Helsinki

iXu is a companion robot to connect long-distance loved ones through new remote touch technology. The iXu Bear is the first product of its kind to use technology based on C-Tactile touch science.



NewIcon, Kuopio

NewIcon is a health tech company specialising in pharmacy automation systems based on advanced software and robotics. The Iso-Fixu automated dispensing system speeds up routine pharmacy work and frees staff to concentrate on pharmaceutical advice and additional sales.



Evondos, Salo

The company's drug dispensing robot ensures a high standard of pharmacotherapy by guiding homecare clients to take the correct medicine in the prescribed dose at the right time. It does this both by issuing spoken instructions and sound signals, and by displaying written instructions on the device screen with indicator lights.



Finnish Robotics Snapshot

Healthcare Robot Initiatives

SARA

The aim of the Social & Autonomous Robotic Health Assistant (SARA) project was to develop a robot that would ease the workload of care facility staff. The robot was developed collaboratively by four project partners: Forum Virium Helsinki from Finland, Bright Cape Holding from the Netherlands and Technische Universität Berlin from Germany. The Finnish company GIM Robotics is responsible for the navigation capabilities of the SARA robot. A startup was established in the Netherlands in autumn 2019 to further develop the care robot, with the aim of bringing it to the market in 2020.



The Well-being and Health AI & Robotics (AiRo) Programme

The objective of the AiRo programme is to speed up the utilisation of artificial intelligence and robotics in the well-being and health services and operating processes in Finland. The key areas of utilisation for robotics and artificial intelligence are: Living at home; Care and logistics in the hospital environment; Pharmacotherapy and pharmaceutical service; Well-being coaching and rehabilitation; and Analytics.



Robots and the Future of Welfare Services (ROSE)

This project examines how advances in service robotics can enable the innovation of social and health services especially with regards to the needs of ageing populations. The research is focused on the coexistence of humans and robots, the societal acceptance of robots and the welfare service systems. Consortium partners are: Aalto University, Laurea University of Applied Sciences, Lappeenranta University of Technology, Tampere University of technology, University of Tampere and VTT Technical research Centre of Finland

ROBOTS & THE FUTURE
OF WELFARE SERVICES

Shortlisted company profiles

From a long list of global companies, the focus of the shortlisted companies is on Healthcare Service Robotics, as well as more fragmented markets such as assistive robots, diagnosis, prosthetics and exoskeletons, and companion robots. In addition, these companies have been filtered by market potential and novel technologies.

Company	Geography (HQ)	Application Area	Technology Readiness Level (R&D, Prototype, Commercial)	Market Potential (Market Size / Growth Potential / Evolving Markets)	Applications beyond primary vertical or current use case	Novel Technologies (Technology Gaps / Underserved Needs)
Ava Robotics Inc.	USA	Telepresence and Remote Monitoring	Commercial	High	Yes	Yes
Bionik Laboratories	Canada	Assistive Robots (Rehabilitation)	Commercial & R&D	High	No	Yes
BioXtreme	Israel	Assistive Robots (Rehabilitation)	Prototype	High	No	Yes
Brain Navi	Taiwan	Diagnostic	Prototype	High	No	Yes
Diligent Robotics	USA	Autonomous Vehicles/Auxiliary robots	Commercial	High	Yes	Yes
Ekso Bionics	USA	Prosthetics and Exoskeletons	Commercial	High	No	Yes
Focal Meditech	Netherlands	Assistive Robots (Social and Therapeutic)	Commercial	High	Yes	Yes
GoBe (Blue Ocean Robotics)	Denmark	Telepresence and Remote Monitoring	Commercial	High	Yes	Yes
Hanson Robotics	Hong Kong	Companion Robots/Personal Assistants	Commercial, Prototype, R&D	High	Yes	Yes
InTouch Health	USA	Telepresence and Remote Monitoring	Commercial	High	Yes	Yes
Intuition Robotics	Israel	Companion Robots/Personal Assistants	Commercial	High	Yes	Yes
Lifeline Robotics	Denmark	Diagnostic	Prototype	High	No	Yes
Mobius Bionics	USA	Prosthetics and Exoskeletons	Commercial	High	No	Yes
Omnicell	USA	Medication Delivery & Dispensing	Commercial	High	No	Yes
PTR (Blue Ocean Robotics)	Denmark	Assistive Robots (Transfer and Rehabilitation)	Commercial	High	No	Yes
ReWalk Robotics	USA	Prosthetics and Exoskeletons	Commercial	High	No	Yes
Rudger's University	USA	Diagnostic	Prototype	High	No	Yes
UVD (Blue Ocean Robotics)	Denmark	Cleaning & Disinfecting	Commercial	High	Yes	Yes
Xenex	USA	Cleaning & Disinfecting	Commercial	High	No	Yes
ZoraBots	Belgium	Autonomous Vehicles/Auxiliary robots	Commercial	High	Yes	Yes

Key players

Telepresence and Remote Monitoring

Ava Robotics Inc.

Overview

Headquarters: Massachusetts, USA

Year Founded: 2016

Funding: \$2.9M raised in seed funding, from Innospark Ventures

No. of employees: 11-50

Value proposition

The company offers end-to-end support in telepresence including pre-deployment consulting, implementation, operations and support, professional services etc.

The telepresence robot (Ava) creates a safe environment and mobile ability to communicate and meet/visit in a space without actually being there, with complete independence and mobility.

With Cisco Webex Teams Video SDKs in Web and iOS apps and Cisco Webex device integration into the robot, Ava fully leverages the Cisco infrastructure for security and manageability.

The company is also working on use cases in UV disinfection robots space.

Target Market

Healthcare (Hospitals and Long term care facilities)

Ava is a mobile intelligent robot that offers HD videoconferencing with up to 1080p30 video resolution along with full-fidelity audio as well as intelligent, autonomous navigation.

Ava comes equipped with full Cisco Webex video conferencing integration and advanced camera views suitable for remote visits and telemedicine support in healthcare facilities.

Existing Partnership Types

Hospitals

Cisco for Webex integration

Ability to integrate with any third party video conferencing solutions such as Zoom

MIT's Computer Science and Artificial Intelligence Lab partnered with Ava Robotics to develop a robotic system to disinfect the Greater Boston Food Bank.

Partnership Alignment

Low

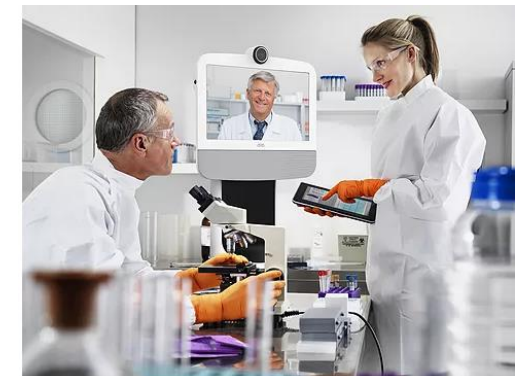
High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Assistive Robots (Rehabilitation)

Bionik Laboratories

Overview

Headquarters: Toronto, Canada

Year Founded: 2010

Funding: \$15.9 M, Ginger Capital Investment Holding Ltd and DMZ are the lead investors

No. of employees: 11-50

Value proposition

The company offers robotic solutions for rehabilitation with data-driven, robotic assisted therapy systems that transform neurorecovery.

The company's product portfolio includes three InMotion Robots for rehabilitation following stroke and other neurological conditions and four products in varying stages of development and have been tested by leading medical centres in more than 150, independent controlled clinical trials.

A home version of the InMotion upper-extremity technology is in development, as well as a wearable, lower-extremity, assistive product based on the company's ARKE exoskeleton technology.

Target Market

Healthcare (Hospitals, Hospice Care, Assisted Living Centers)

InMotion Interactive Therapy improves upper-extremity motor retraining for patients with neurological conditions and injuries. The InMotion ARM, ARM/HAND and WRIST Robots greatly enhance the therapist's ability to drive repetition and neuroplasticity, helping to restore motor function and improve outcomes.

The company is developing products in the field of wearable rehabilitation robots and exoskeletons.

Existing Partnership Types

Partnership with Inteliware Development to provide seamless connectivity between InMotion™ Robotic Devices and hospital information systems.

Partnership with Propel, product success platform built on Salesforce, for product lifecycle management and quality management system solutions provider to accelerate new product development and manufacturing of InMotion™ products and services.

Bionik Laboratories and Wistron corporation has a partnership to develop exoskeleton technologies for consumer medical device market.

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Assistive Robots (Rehabilitation)

BioXtreme

Overview

Headquarters: Rehovot, Central District, Israel

Year Founded: 2010

Funding: R&D grant from the Israel Innovation Authority (coupled with additional investment from our strategic investor) totalling \$1M.

No. of employees: 11-50

Value proposition

BioXtreme has developed a robotic system that helps with upper limb motoric rehabilitation. deXtreme™ performs automatic rebuild of motion range and capability through adaptive/intuitive learning.

With this robot rehabilitation, neurorehabilitation time for stroke patients is expected to be shortened by up to 30%-50%.

deXtreme™ is ready for commercialisation and is US FDA registered.

Target Market

Healthcare (Hospitals, Hospice Care, Assisted Living Centers)

The robot offers patients motoric error enhancement in a combined VR environment to restore and rehabilitate motion and dexterity. The enhanced error forces stimulate an adaptive corrective response from the patient, which leads to the regulation of the system until the desired trajectory is accomplished by the patient. The process shortens upper limb therapy time by up to 50% and patients achieve 100% additional motor improvement compared to traditional physical therapy methods.

Existing Partnership Types

Heliomare rehabilitation hospital in the Netherlands

Partnership Alignment

Low High

Technology Readiness Level

R&D Prototype Commercial



Brain Navi Biotechnology Ltd.

Overview

Headquarters: Zhubei City, Taiwan

Year Founded: 2015

Funding: Undisclosed seed funding

Investors: Sunsino Ventures Group

No. of employees: 11-50

Value proposition

NaoTrac, autonomous surgical navigation robot with machine vision specially designed for cranial neurosurgery was developed and has successfully performed 15 human trial cases at the Hualien Tzu-Chi Medical Center in 2018. In May 2020, prototype of Brain Navi Nasal Swab Robot was developed and submitted to EU/US FDA Emergency Use Authorization (EUA).

The Brain Navi Nasal Swab Robot's has received approval of its clinical trial review from Ministry of Health and Welfare in Taiwan, and Taiwan TFDA for Emergency Use Authorization (EUA).

Target Market

Healthcare (Hospitals, Public Health Systems, Labs)

The Brain Navi Nasal Swab Robot enables hospitals to reduce staff-patient contact with highly infectious diseases at the point of testing by autonomously navigating and collecting patient's samples.

The robot automatically recognizes the patient's facial structure and the precise nostrils location to autonomously take the samples without the need of medical staff.

Existing Partnership Types

Partnership with Silicon Valley prototype development company Triple Ring Technologies to develop prototypes.
Hospitals.

Partnership Alignment

Low High

Technology Readiness Level

R&D Prototype Commercial



Key players

Autonomous Vehicles/Auxiliary robots

Diligent Robotics - Moxi

Overview

Headquarters: USA - Austin, TX

Year Founded: 2014

Funding: \$15.8M

Investors: 13 Investors, including DNX Ventures, True Ventures, Ubiquity Ventures, Next Coast Ventures, E14 Fund, Promus Ventures, Grit Ventures

No. of employees: 32

Value proposition

Diligent Robotics is a female-founded A.I. company creating robot assistants that helps clinical staff with routine, non-patient-facing tasks so they have more time for patient care. Moxi has been successfully deployed in several US hospitals and focuses on fetch and deliver tasks for frontline clinicians. Moxi was named one of TIME Magazine's Best Inventions 2019. CTO and Co-Founder, Vivian Chu, received MIT Technology Review's highly prestigious 35 Under 35 for 2019 award, and CEO Andrea Thomaz was named one of Inc Magazine's 100 Female Founders Building America's Most Innovative & Ambitious Businesses.

Target Market

Healthcare (Hospitals)

Moxi helps hospitals run 24/7 by assisting clinical staff with non-patient-facing tasks such as:

- Gathering patient supplies
- Delivering lab samples
- Fetching items from central supply
- Distributing PPE
- Delivering medications

Existing Partnership Types

Hospitals

Partnership Alignment



Technology Readiness Level



Key players

Prosthetics and Exoskeletons

Ekso Bionics

Overview

Headquarters: USA - California

Year Founded: 2005

Funding: \$70.8M (Public, Listed)

No. of employees: 77

Value proposition

Ekso Bionics was founded in 2005 in collaboration with the Berkeley Robotics and Human Engineering Laboratory of the University of California, Berkeley. It develops exoskeleton solutions to enhance human mobility, strength, and endurance across medical and industrial applications. The latest additions to the Company's medical portfolio include the EksoNR exoskeleton, which is the next generation EksoGT-- the most clinically used robotic exoskeleton, and the upgraded EksoPulse platform, an advanced cloud-based analytics solution that measures and analyzes progress using EksoNR. Ekso Bionics was the 2020 winner of the "Best Healthcare Robotics Company" award in the fourth annual MedTech Breakthrough Awards program..

Target Market

Rehabilitation centres

Developed for neurorehabilitation, EksoNR is an intuitive exoskeleton device that empowers patients recovering from stroke or other conditions to learn to walk again with a more natural gait. Ekso Bionics designed EksoNR with new features to help physical therapists and patients get more out of rehabilitation sessions.

Existing Partnership Types

Rehabilitation centres
Hospitals

Partnership Alignment



Technology Readiness Level



Key players

Assistive Robots (Social and Therapeutic)

Focal Meditech

Overview

Headquarters: Netherlands

Year Founded: 1992

No. of employees: 36

Privately Held

Value proposition

Focal Meditech delivers custom-made robotic medical equipment. It is an independent manufacturer, importer, exporter and supplier of high end assistive devices that contribute to independent home living. The Focal line of products includes:

- High-end body support systems
- Assistive robotics and social robotics
- Feeding aids
- Augmentative and Alternative Communication solutions
- Environmental Control systems

Although the company has its own development and production line, it is also a distributor of several well-known medical aides like the social robotic seal Paro and the personal care robot Jaco.

Target Market

Healthcare (Home and Care Facilities)

Focal Meditech offers a wide range of medical devices for people in independent living homes including personal and social robotics, arm supports and meal supports. The custom made arm support robots are aimed at people with a very limited or no hand function.

Existing Partnership Types

Universities

Rehabilitation Centres

Technology Institutes

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Telepresence and Remote Monitoring

GoBe (Blue Ocean Robotics)

Overview

Headquarters: Denmark, Odense

Year Founded: 2019

Funding: (Blue Ocean Total Funding = \$48.7M)

No. of employees: Unknown (Blue Ocean = 220)

Value proposition

GoBe Robots is a global leader in telepresence, offering companies state-of-the-art telepresence to transform human interaction in an increasingly virtual world. The robots are used worldwide to facilitate corporate meetings, production facility inspections, teaching in schools, hospital consultations, museum visits and much more. GoBe has recently announced a new generation of its climate-friendly telepresence robots with significant demand driven by the COVID-19 pandemic. As Covid-19 spreads, GoBe Robots have emerged as an effective tool in preventing the spread of coronavirus and overcoming closed borders, while reducing travel budgets, working hours and transport time.

Target Market

Businesses, Hospitals, Schools/Universities

Within healthcare, GoBe Robots brings professionals and patients together across distances to provide better outcomes, broader access, quicker responses and a more personal touch. The robots also give experts and family the capability to check in on patients at home.

Existing Partnership Types

Hospitals

RoBi-X - Partnership programmes for co-creation of robots.

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Companion Robots/Personal Assistants

Hanson Robotics

Overview

Headquarters: Hong Kong

Year Founded: 2003

Funding: \$21.7M

No. of employees: 45

Value proposition

Hanson Robotics is an AI and robotics company dedicated to creating human-like socially intelligent machines that improve quality of life. Hanson's AI suite of general purpose, rapid developer tools, API, and SDK, support both product development and research. In 2020, AI developer Singularity Studio and Hanson Robotics have teamed up to launch a robot, named Grace, as part of their new joint venture, Awakening Health. Grace will engage patients naturally and emotionally - providing a variety of benefits including cognitive stimulation, intuitive communication, and secure gathering and management of patient data for use in advanced machine learning and next-gen medicine, while facilitating social distancing for COVID-19 safety.

Target Market

Social Robotics across a variety of applications

Hanson's robots serve as AI platforms for research, education, medical and healthcare, sales and service, and entertainment applications. Within healthcare, Hanson robots have been used in autism treatment, age-related disease research and safety testing at the US Centers for Disease Control, as well as Covid-19 safety.

Existing Partnership Types

Singularity Studio (AI)

iTutorGroup (e-learning solutions)

CereProc (advanced speech synthesis research)

Partnership Alignment



Technology Readiness Level



Key players

Telepresence and Remote Monitoring

InTouch Health (part of Teladoc Health)

Overview

Headquarters: USA – California

Year Founded: 2002

Funding: \$49.2M (recently acquired for \$600M)

No. of employees: 350

Value proposition

InTouch Health is a telehealth services company that offers healthcare providers solutions to deliver virtual care for a broad array of use cases and healthcare environments. It provides a reliable, dedicated cloud-based network and virtual care solutions designed to ensure connectivity for health systems, providers, and patients at all times. InTouch has partnerships with more than 450 hospitals and health systems, and worldwide is supporting over 3,600 care sites. Its enterprise offering provides support for over 40 clinical use cases. It has been awarded the 2020 Best in KLAS distinction for Virtual Care Platforms in the “2020 Best in KLAS: Software & Services” report for the third consecutive year.

Target Market

Healthcare (Hospitals and Care Facilities)

The InTouch Virtual Care Platform enables clinicians to deliver high-quality virtual care in high and low acuity settings across service lines, such as on-demand urgent care, behavioral health, cardiology, neurology (telestroke), infectious disease, endocrinology, wound care and many more.

Existing Partnership Types

Hospitals

Care Facilities

Intuitive Surgical

Mako Surgical

GE Healthcare (for clinical education and training)

KARL STORZ (endoscope and integrated operating room manufacturer)

Partnership Alignment



Technology Readiness Level



Key players

Companion Robots/Personal Assistants

Intuition Robotics

Overview

Headquarters: Israel

Year Founded: 2015

Funding: \$36 million in a series B round of funding co-led by Sparx Group and OurCrowd, with participation from Samsung Next, Toyota AI Ventures, Bloomberg Beta, iRobot, Sompo Holdings, Union Tech Ventures, Happiness Capital, and Capital Point.

No. of employees: 50-100

Value proposition

The company offers ElliQ® social companion robot for elderly population.

The company's value proposition is offering a digital companion (not an assistant) that fully understand context and can make decisions based on preset goals.

The company offers an Insiders program for elderly population to have access to the product and test it out.

Target Market

Healthcare (Long term care facilities and Elderly Patients)

The robot uses voice activation and natural language processing to convey a message or emotion — including shifting its position and using sound and light to express itself.

Unlike other voice assistants, ElliQ does not require a prompt, and can proactively engage in conversations with the user.

Existing Partnership Types

Toyota AI Ventures

Samsung NEXT

iRobot

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Lifeline Robotics

Overview

Headquarters: Odense, Denmark

Year Founded: 2020

Funding: 2 million DKK (\$290,000) in funding from Vaekstfonden, which is the Danish state's investment fund.

Investors: Lifeline Robotics is a spin-out of the Maersk McKinney Moller Institute at the University of Southern Denmark (SDU). The company is owned jointly between the university, Norrsken Foundation, and REInvest Robotics.

No. of employees: 11-50

Value proposition

The first prototype for automated throat swab testing robot-Careebo LLR S1, was built in 4 weeks in May 2020 in partnership with SDU & the University Hospital in Odense. The company is expected to launch the product commercially and is accepting pre-booking from hospitals. The innovation process for developing the robot was made possible due to the unique and well-organized cluster of automation and robotics companies in Odense - a strong national cluster, which includes more than 130 companies. The company aims to use the distribution network of the cluster to hasten the commercialisation process

Target Market

Healthcare (Hospitals, Public Health Systems, Labs)

The process of the automatic swab sample begins with scanning of patient ID-card, following which the robot prepares a sample kit, consisting of a container with a printed ID-label. Using an artificial intelligence based computer vision, a throat swab is performed and the sample is collected and secured for analysis. The process takes around 7 minutes in total, and the swab itself 25 seconds.

Existing Partnership Types

REInvest Robotics
Universal Robotics
Norrsken Foundation

Partnership Alignment

Low High

Technology Readiness Level

R&D Prototype Commercial



Mobius Bionics

Overview

Headquarters: Manchester, United States

Year Founded: 2016

Funding: \$39.5 million by Camp One Ventures

No. of employees: 11-50

Value proposition

Mobius Bionics is a medical device company offering advanced prosthetics for upper limb amputees or disabilities.

The company's flagship product LUKE arm is a commercially-available prosthesis with 10 powered joints that offers multiple configurations enabling better dexterity and functionality.

The LUKE arm is the first arm cleared by the US FDA as a fully integrated prosthetic arm for amputees across a range of levels of amputation, including shoulder-level, above-elbow, and below-elbow.

Target Market

Healthcare (Hospitals, Rehabilitation Centres, Patients with Disabilities)

Luke arm provides 10 powered joints, multiple grip patterns, and a flexible control system that allows the arm to be controlled by a variety of input devices. In addition to the many control input options, the LUKE arm may be controlled with Inertial Measurement Units (IMUs) that are typically worn on the user's shoes. They read the tilt of the user's foot and interpret each movement like a joystick to control the arm.

Existing Partnership Types

Next Step Bionics and Prosthetics

Soldiers Strong

Biodesigns Inc

Handspring

Arm Dynamics

Partnership Alignment

Low

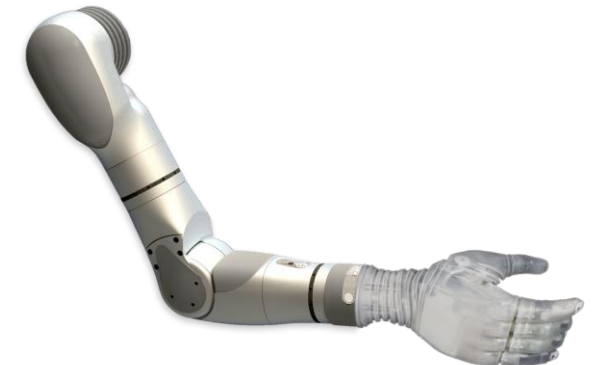
High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Medication Delivery & Dispensing

Omnicell

Overview

Headquarters: USA - California

Year Founded: 1992

Funding: \$20M

No. of employees: 2,700

Value proposition

Omnicell is a global leader in medication and supply dispensing automation, pharmacy automation, IV compounding technology, analytics software, and medication adherence solutions. Omnicell robotic dispensing solutions automate medication dispensing, sorting, packaging, and retrieval. This technology unites with an embedded layer of intelligence to deliver crucial, real-time pharmacy optimisation and insights. Together, these tools and technology can free up clinicians for more patient-focused activities.

Target Market

Healthcare (Hospitals, non-acute care facilities, retail pharmacies, patients)

Omnicell focuses on providing the most comprehensive medication and supply management portfolio in the industry that stretches across the entire continuum of care - from acute care hospital settings to post-acute skilled nursing and long-term care facilities to the patient's home.

Existing Partnership Types

Hospitals and Hospital Trusts

Healthcare providers

Pharmacies

Kit Check (machine learning and advanced tracking technology)

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



PTR Robots – (Patient Transfer & Rehabilitation)

Overview

Headquarters: Denmark, Odense (PTR Robots is a subsidiary of Blue Ocean Robotics)

Year Founded: 2016

Funding: €1M seed funding (Blue Ocean Robotics total investment is \$48.7M)

Investors in PTR: Rikseseg Invest, M. Blæsbjerg Holding, DAHL Holding, Syddansk Innovation.

No. of employees: 7

Value proposition

PTR, jointly developed with healthcare professionals, is a mobile, intelligent robot that helps individuals with impaired functions. Through transfer and rehabilitation tasks, it helps relieve the strain on staff and also reduces the risk of infection, because only one caregiver needs to be present to perform a patient transfer. Lifting injuries account for one-third of all occupational injuries among nurses. The robot is designed to 'shrink' in size to easily fit through a typical doorway. This means that the robot outperforms traditional, stationary ceiling hoists in terms of flexibility. A number of hospitals in Denmark such as University Hospital Køge, Odense University Hospital and Horsens Hospital are customers of PTR Robots.

Target Market

Hospitals and nursing homes:

- According to PTR, one out of four bedridden patients in a typical hospital needs assistance with transfer and rehabilitation. This need is even more pronounced at nursing homes.
- Transfer from bed to wheelchair, stretcher to bed, bathroom etc.
- Rehabilitation: Sit to stand and gait training are supported by the robot meaning less passive transfers and more efficient rehabilitation

Existing Partnership Types

- Public-private innovation project between Blue Ocean Robotics and University Hospital Køge in Region Zealand
- CareNet - Nationalt Netværk for Velfærdsteknologi, (a Danish national network for welfare technology)

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



ReWalk Robotics

Overview

Headquarters: USA

Year Founded: 2001

Funding: 102.7M (Public Company listed 2014)

No. of employees: 50

Value proposition

The company is focused on improving quality of life for individuals with lower limb disabilities through the creation and development of robotic technologies. ReWalk Robotics currently offers its ReStore solution for stroke rehabilitation and ReWalk solution for individuals with spinal cord injuries. ReWalk is a wearable robotic exoskeleton that provides powered hip and knee motion to enable individuals with spinal cord injury (SCI) to stand upright, walk, turn, and climb and descend stairs. ReWalk is the first exoskeleton to receive FDA clearance for personal and rehabilitation use in the United States.

Target Market

The ReWalk is for individuals with lower limb disabilities such as paraplegia. The technology is designed for all-day use at home, at work, and in the community.

Existing Partnership Types

YASKAWA Electric Company (Industrial robotics)

Timwell Corporation Limited (medical devices)

Health Insurance Companies

Partnership Alignment



Technology Readiness Level



Rutgers, State University of New Jersey

Overview

Headquarters: New Jersey, USA

Year Founded: N/A

Funding: University Research Grants.

No. of employees: Department of Biomedical Engineering
(not registered as a company)

Value proposition

The university has performed clinical trials for a tabletop device that combines a robot, artificial intelligence and near-infrared (NIR) and ultrasound (US) imaging to draw blood or insert catheters to deliver fluids and drugs.

In next steps, device can serve as a platform to merge automated blood-drawing and downstream analysis of blood, and can extend to procedures such as IV catheterization, central venous access, dialysis and placing arterial lines.

Target Market

Healthcare (Hospitals, Public Health Systems, Labs)

Over 90% of diagnostic and therapeutic procedures in the emergency room, intensive care unit, catheterization lab and operating room require gaining vascular access. Approximately one billion vascular access procedures are performed annually in the United States (and approximately four billion procedures worldwide). The robot simplifies blood drawing process using: NIR imaging that provides non-contact visualization of superficial vessels over a broad (20 × 15 cm) field of view, while US imaging allows focal visualization of a target vessel and facilitates submillimetre pose adjustments to compensate for vessel motion. The device is further capable of drawing blood into sample collection vials or advancing peripheral catheters up to 25 mm beyond the access point.

Existing Partnership Types

Hospitals
Research Organisations

Partnership Alignment

Low

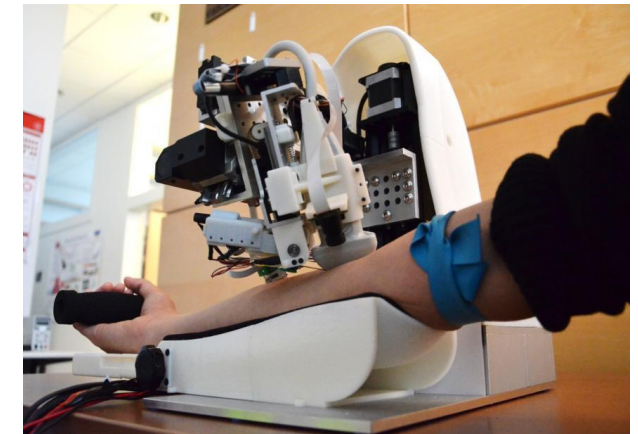
High

Technology Readiness Level

R&D

Prototype

Commercial



UVD (Blue Ocean Robotics)

Overview

Headquarters: Denmark, Odense

Year Founded: 2016

Funding: (Blue Ocean Total Funding = \$48.7M)

No. of employees: Unknown (Blue Ocean = 220)

Value proposition

Blue Ocean's UV-C robot is clinically proven to kill 99.99% of viruses and bacteria on surfaces and in the air in a patient room within approximately 10 minutes of autonomous operation. In 2020, Blue Ocean Robotics was been included in Robotics Business Review's list of the 50 most influential robotics companies in the world for its UVD Robots. The recognition was earned for the health benefits of its technology as well as continued growing demand for its safe disinfecting capabilities. The company's self-driving, disinfecting robots have been rolled out to more than 60 countries worldwide.

Target Market

Hospitals and other places for public gatherings

In December 2020, UVD announced that the European Commission awarded it a contract to supply 200 disinfection robots to hospitals in 10 countries across the European Union. UVD Robots is also seeing growing interest from nursing homes and other healthcare institutions, schools and day care centers, shopping malls, cruise ships and commercial airports.

Existing Partnership Types

Odense University Hospital (and other hospitals)

Robot Distributors

Disinfection and decontamination solution providers

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Xenex - LightStrike Robot

Overview

Headquarters: USA –San Antonio, TX

Year Founded: 2009

Funding: \$91.4M

Investors: 9 including Battery Ventures, Essex Woodlands Healthcare Partners, Piper Jaffray Merchant Services and Tectonic Ventures.

No. of employees: 51-100

Value proposition

Xenex is the world leader in UV disinfection for healthcare facilities and is the global industry standard for effective, safe, and fast UV room disinfection. More than 650 healthcare facilities worldwide use the company's LightStrike robots for room disinfection, including acute care hospitals, long-term care facilities, outpatient surgery centers, nursing homes, and medical office buildings. As a result of the COVID-19 pandemic and the world's focus on preventing disease transmission, organisations outside of healthcare are quickly adopting Xenex's robots for disinfection, including hotels, government buildings, schools, professional sports facilities, police stations, pharmaceutical cleanrooms, and food processing facilities.

Target Market

Healthcare (Hospitals)

Xenex's LightStrike Germ-Zapping Robots can decontaminate up to 65 rooms per day. Xenex is the first and only UV room disinfection technology proven to deactivate SARS-CoV-2, the virus that causes COVID-19. The LightStrike robot achieved a >99.99% level of disinfection against SARS-CoV-2 in 2 minutes. The \$125,000 cost per robot translates to about \$2 to \$8 per room depending on the number of rooms it's used in each day.

Existing Partnership Types

Hospitals

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Key players

Autonomous Vehicles/Auxiliary robots

ZoraBots

Overview

Headquarters: Belgium

Year Founded: 2011

Funding: €5M - Bart Versluys (angel, venture capital)

No. of employees: 40

Value proposition

ZoraBots specialises in robotics software that is able to give life to humanoid robots like Nao and Pepper. It also creates its own humanoid robots. ZoraBots Operating System enables hardware and software to talk to and understand each other – it forms a bridge between the universal robot platform and the platform specific implementation for each robot. The idea behind the solution is that people should not need any specific coding or programming skills to operate robots. With two hours of training, someone with no programming skills can learn to operate a robot. The company offered its James robots to various residential care centers in Belgium for free during the Covid-19 lockdown to keep elderly people in contact with their loved ones. The United Nations Development Program (UNDP) also donated five of the company's Cruzr robots to Rwanda to help counter the spread of the coronavirus

Target Market

Tourism, Retail, Education, Security, Elderly Care, Healthcare

Healthcare applications include:

- Entertainment for patients, children or elders, during their hospital stay
- Personalised treatment or surgery explanations
- Visit and check in on patients
- Reduce loneliness (elderly)
- Reduce cognitive decline (elderly)
- Work on patients memory (elderly)
- Anti-epidemic applications (Mask Identification, temperature Measurement, Policy Promotion, Alerts & Video, Disinfection spraying patrols, Virus prevention patrol)

Existing Partnership Types

- Boston Dynamics
- SoftBank Robotics
- Siasun Robotics
- UBTECH
- Rethink Robotics
- Shark Robotics
- Paragon Semvox (AI language processing)

Partnership Alignment

Low

High

Technology Readiness Level

R&D

Prototype

Commercial



Summary and recommendations for Finnish Businesses

The global healthcare sector is facing increasing demand for services due to ageing populations, growth in chronic diseases, budget constraints, and a shortage of qualified workers. The healthcare robotics market is at an interesting stage of development with many applications moving from R&D and prototype to fully commercial. Finnish companies should consider the following markets and applications when looking for partnership opportunities:

- ✓ **Companion robots:** Ageing populations and care solutions for the home are driving the growth of this market. Finnish companies are already active in this space. The market is still to mature and would benefit from viable business models.
- ✓ **Medication delivery and dispensing:** Aligns with Finland's strengths in engineering and machine building and there are a number of companies in Finland with expertise in this market. There are also a high number of start-ups or small-medium companies in this space globally, which could offer opportunities for Finnish companies.
- ✓ **Telepresence:** This market is largely mature, but there could be opportunities for Finnish companies to find partners to expand to new geographies.
- ✓ **Diagnostic:** Covid-19 has rapidly increased demand in this market. There are also many companies in R&D and prototype stage, offering high opportunities for partnership.
- ✓ **Autonomous vehicles:** This market also aligns with Finland's strengths in engineering and machine learning. It is a high growth market.