

World *Robotics*

S e r v i c e R o b o t s

2 0 2 3



Statistics, Market Analysis and Case Studies

The cover features a light blue world map background. On the left, a vertical grey bar contains the text 'one market' in white, with 'one' and 'market' stacked vertically. The main title 'World Robotics' is centered, with 'World' in a large, light grey sans-serif font and 'Robotics' in a large, black, cursive script font. Below this, 'Service Robots' is written in a smaller, light grey sans-serif font, underlined. At the bottom of the title section, the year '2023' is displayed in a light grey sans-serif font.

World Robotics

Service Robots

2023

World Robotics 2023 – Service Robots

Produced by VDMA Services GmbH, Lyoner Str. 18, 60528 Frankfurt, Germany.

The service robot statistics is carried out by the IFR Statistical Department.

Chapter 3 is co-edited by Dr. Werner Kraus, Head of Department Robot and Assistive systems with his team Dr. Birgit Graf, Head of the Group “Personal and Domestic Robotics”, and Kevin Bregler, Head of the Group “Industrial and Commercial Service Robots”, both at Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart (Germany) in close collaboration with scientists from their research groups.

The cover and the editorial are sponsored by Kuka Deutschland GmbH.

Assisting in statistics data collection, text and charts processing: Nina Kutzbach, IFR Statistical Department

We express our most sincere gratitude to all partners!

Dr. Christopher Müller
Director
IFR Statistical Department

Tel: +49 69 66 03-11 91
E-Mail: statistics@ifr.org
Internet: <http://www.worldrobotics.org>

Copyright ©2023 by International Federation of Robotics (IFR) Statistical Department

All rights reserved.

Suggested citation: Müller, Christopher; Kraus, Werner, Graf, Birgit; Bregler, Kevin (Eds.): World Robotics 2023 – Service Robots, IFR Statistical Department, VDMA Services GmbH, Frankfurt am Main, Germany, 2023.

Short citation: World Robotics 2023 – Service Robots

No part of this publication may, for sales purposes, be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, electrostatic, magnetic tape, mechanical, photocopying or otherwise, without prior permission in writing from VDMA Services GmbH (contact via IFR Statistical Department).

ISBN 978-3-8163-0761-7

Contents

Foreword	3
Editorial	6
Contents	8
Executive Summary World Robotics 2023 - Service Robots	11
1 Introduction into service robotics	14
1.1 Structure of the World Robotics 2023 - Service Robots.....	14
1.2 Definitions: robotics, Service Robotics, Industrial Robotics	16
1.2.1 Statement on revised ISO vocabulary definitions (ISO 8373:2021)	16
1.2.2 ISO 8373:2012 Vocabulary definitions	16
1.2.3 Deviations of IFR definitions from ISO definitions and IFR refinements of ISO definitions – Service Robots.....	17
1.2.4 Scope of IFR Service robot statistics.....	18
1.2.5 Summary: IFR service robot definition	19
1.3 Compliance and privacy (service robot statistics).....	19
1.4 Classification of service robots.....	20
2 Distribution of Service Robots	26
2.1 Service robots for professional use, sales 2021 and 2022, market potential 2023-2026	28
2.2 Service robots for consumer use, sales 2021 and 2022, Market potential 2023-2026.....	35
2.3 Service robots by region of origin	37
3 Major application areas	42
3.1 Introduction	42
3.2 AP: Professional Service Robots	46
3.2.1 AP1: Agricultural robots	47
3.2.1.1 AP11: Cultivation	47
3.2.1.2 AP12: Milking.....	73
3.2.1.3 AP13: Other livestock Farming.....	77
3.2.2 AP2: Professional cleaning	81
3.2.2.1 AP21: Floor cleaning.....	81
3.2.2.2 AP22: Window and Wall cleaning	101
3.2.2.3 AP23: Tank, tube, and pipe cleaning.....	102
3.2.2.4 AP24: Hull cleaning.....	106
3.2.2.5 AP25: Disinfection robots	109
3.2.2.6 AP29: Other professional cleaning	118
3.2.3 AP3: Inspection and maintenance robots.....	122
3.2.3.1 AP31 Buildings and other construction.....	122
3.2.3.2 AP32: Tank, tubes, pipes, and sewers	132

3.2.3.3	AP39: Other inspection and maintenance robots	140
3.2.4	AP4: Construction and demolition	144
3.2.4.1	AP41: Construction	145
3.2.4.2	AP42: Demolition	154
3.2.5	AP5: Transportation and logistics.....	163
3.2.5.1	AP51: Indoor environments without public traffic.....	165
3.2.5.2	AP52: Indoor environments with public traffic.....	174
3.2.5.3	AP53: Outdoor environments without public traffic.....	199
3.2.5.4	AP54: Outdoor environments with public traffic.....	203
3.2.5.5	AP55: Inventory	206
3.2.6	AP6: Medical robots.....	211
3.2.6.1	AP61: Diagnostics.....	212
3.2.6.2	AP62: Surgery	216
3.2.6.3	AP63: Rehabilitation and non-invasive therapy	225
3.2.6.4	AP69: Other medical robots	238
3.2.7	AP7: Search, Rescue and security applications	247
3.2.7.1	AP71: Firefighting	247
3.2.7.2	AP72: Disaster relief	254
3.2.7.3	AP73: Security services	259
3.2.8	AP8: Hospitality.....	267
3.2.8.1	AP81: Food and drink preparation	267
3.2.8.2	AP82: Mobile guidance, information, telepresence robots.....	274
3.2.9	AP99: Other professional service robots	279
3.3	Consumer Robots	284
3.3.1	AC1: Robots for domestic tasks	285
3.3.1.1	AC11: Domestic floor cleaning (indoor).....	285
3.3.1.2	AC12: Domestic Window cleaning	289
3.3.1.3	AC13: Gardening	292
3.3.1.4	AC14: Domestic cleaning (outdoor).....	295
3.3.1.5	AC19: Other domestic tasks	297
3.3.2	AC2: Social interaction, education	299
3.3.2.1	AC21: Social interaction, companions.....	299
3.3.2.2	AC22: Education.....	304
3.3.3	AC3: Care at home	312
3.3.3.1	AC31: Mobility assistants	315
3.3.3.2	AC32: Manipulation aids	321
3.3.3.3	AC39: Other care robots	323
4	Service robotics industry structure.....	328
4.1	Service robot suppliers by region of origin and company age.....	329
4.2	Service robot suppliers – top 10 countries.....	332
4.3	Service robot suppliers by business size.....	335
4.4	Service robot suppliers by application – consumer use.....	336
4.5	Service robot suppliers by application – professional use	338

4.6	List of Service robot suppliers worldwide.....	343
5	Case studies.....	394
5.1	Introduction	394
5.2	Case Study 1 - Robots in the bakery - "Bakisto" relieves employees and reduces food waste.....	397
5.3	Case Study 2 – picking up grapes with WooTzano´s robotics hands....	400
5.4	Case Study 3 – KR AGILUS climbs to new heights.....	403
5.5	Case Study 4 – Improving operations and product availability at stores globally	407
5.6	Case Study 5 – Rohlik Group - One of Europe’s largest online grocers automates order picking in Prague fulfillment center	411
	References	414