



# EUROPÄISCHE AKADEMIE

zur Erforschung von Folgen wissenschaftlich-technischer Entwicklungen  
Bad Neuenahr-Ahrweiler GmbH

Direktor: Professor Dr. Dr.h.c. Carl Friedrich Gethmann

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### FOCUS

#### A helping artificial hand?

#### Interdisciplinary problem setting of service robotics in caretaking

Michael Decker, Karlsruhe

Almost the same market potential as for industrial robots has been predicted for service robots for some time now. From the technology assessment perspective, this introduces new aspects regarding the human-machine communication and co-operation. Now not only robotic experts are working with robot systems but also robotic laypersons who must be considered as both robot users and a target group for the use of robots. Taking the example of service robots in caregiving, this includes the caregivers on the one hand and the patients on the other. This article discusses the interdisciplinary questions regarding the replaceability of human beings in the service sector.

#### Introduction

Industrial robots are established in almost all areas of the manufacturing industry. The automotive industry, just like metalworking, plastics, rubber, timber, and furniture industry, is barely conceivable without industrial robots. According to the German Engineering Federation (Verband Deutscher Maschinen- und Anlagenbau e.V.) in 2006 already 50% of all industrial robots had been installed in sectors other than the automotive industry.

Over the last few years the world market for industrial robots has grown continuously, however, not in all regions of the world to the same extent (World Robotics 2008). Features of industrial robotics include high speed and precision, enormous power and an almost unlimited repeatability of movements in combination with little downtime. From the economic point of view human output has been replaced by technological output or, to put it more simply: Labour costs have been replaced by costs of acquisition and operation. The fact that the complete production process had to be rebuilt for the use of robots is not a technical problem at all. A production hall is a confined space and

its interior is optimized for the production process and designed according to the regulations for safe production and occupational safety.

Almost the same innovation potential as for industrial robots has been predicted for “service robots” for some time now. To begin with, the term service robots seems to cover all “non-production robots”. A closer look at the areas of application of service robot systems sold worldwide until the end of 2008 reveals that out of 63,000 service robots for commercial applications the greater number were used in the fields of defence, rescue and safety (30%), followed by agriculture (23%), here especially milk robots (IFR 2009). These are areas where the service robots are operated and supervised by a human expert and/or in a protected surrounding. This can therefore be interpreted as a transition zone between industrial robotics and general service robotics. The robot itself is no longer active within its “safety cage” which is normally set up for a safe production process. However, outside its cage it is only used in areas where it generally does not come into contact with a third party or does not carry out services around human beings. The person who co-operates with the robot can be trained for

this co-operation which turns him – to a certain degree – into a robotics expert himself.

Most services, however, are characterized by the fact that they have to be performed in an environment full of people (one example might be the cleaning of train stations) or directly involve a human being (museum guide, nursing or elderly care). The people in contact with these robots cannot be expected to be robotics experts themselves. Thus, these services implicate that a robotic layperson can and has to interact with robots and that third parties will encounter a robot's direct environment. In addition, services performed in everyday life can only be adapted to a limited extent to the deployment of robots. As an example, care robots will be discussed below.<sup>i</sup>

#### Case study: Autonomous robots in caregiving

The combination of increasing life expectancy and declining birth rate is leading to dramatic changes in the age structure of the populations of Western industrial nations. The German Federal Statistical Office prepared the following prognosis for Germany in 2050: The population will plummet from 82.4 million today to 68.5 million, almost 40% of whom will be over 60. Only every seventh German will be younger than 20; today it is every fifth. For every 100 Germans between 20 and 60, there will be 85 seniors. The average age will be over 50.

In the context of these demographic changes the newspaper "Die Welt" published the article "Final Stop Robotic Nursing Home?": "The shift in the age structure will also wreak havoc with Germany's nursing care insurance system. While in 1999 one caregiver was responsible for nine care recipients, by 2050, based on the most recent calculations, the relationship of caregivers to those receiving care will have increased to 1:17." Currently, Japan is the country with the largest number of aged inhabitants (viewed as a proportion of the country's population). Since robotic research has a long tradition in Japan, it should not come as a surprise that the humanoid robot Ri-Man was developed in Japan. It is 158 cm tall, weighs 100 kg, and by 2011 is supposed to be capable of lifting and carrying patients weighing up to 70 kg. Ri-Man is also able to perceive some odours such as the smell of urine.

Germany also has a tradition of developing robots for nursing care. The most prominent example undoubtedly is Care-O-bot, a prototype of a multi-functional robot assistant for house-keeping and home care to be used by the elderly or the handicapped in order to help them to live longer independently in their homes. Accordingly, this homecare system is easy to operate, intuitive, and dependable. Care-O-bot observes its environment by means of cameras and a laser scanner on its freely rotational head. The robot is controlled by means of a detachable radio panel with a touch screen, which also offers a

microphone for oral commands. Care-O-bot is able to cope with many different situations and fulfils complex tasks even in dynamic environments. Furthermore, the robotic assistant can execute not only one single task at a time but also several tasks concurrently. Care-O-bot II, an updated version, is equipped with a manipulator arm to perform household tasks such as fetch-and-carry duties, setting the table, or basic cleaning. By means of an additional camera system on its hand, the robot can carry out very precise grasping, such as passing a glass or a bottle. It is, in addition, both a mobility aid which enables the patient to move behind the robot, and a communication tool including a camera system and a videophone. Care-O-bot is capable of monitoring vital functions, such as pulse and blood supply, and can independently contact a physician or a hotline in case of emergency. Care-O-bot 3 is able to detect the environment in which it operates through multiple sensors. Moreover, it is capable of learning new objects independently. A special focus of the development was on safe interaction as well as on functional design "intentionally moving away from existing humanoid service robots". Care-O-bot 3 is one of two service robots in the WiMi-Care project (Supporting the Knowledge Transfer for a Participative Design of the Care Work Sector through Microelectronics), funded by the German Ministry of Education and Research (BMBF).

#### The interdisciplinary perspective

Considering these technical aspects, economic factors must be taken into account in order to reflect upon promising innovations. Due to the high cost of rehabilitation caregiving, even an expensive robot borrowed or leased on health insurance has the potential to save the health-care system money. Given the wish of many elderly people to stay in their accustomed social setting as long as possible, one could expect a win-win situation. There is even a chance that the quality of care provided might be improved because robots would probably assist, not replace human nurses. In the current situation of an insufficient number of care providers this might be a real advantage.<sup>ii</sup> One improvement in the current situation might be reached with regard to the regular repositioning of patients in connection with bed sores.

The discussion of the legal situation has mainly focused on liability. Who is liable if a robot malfunctions? Since a learning algorithm is involved, there might be a conflict between robot manufacturer and robot owner. Nevertheless, a system for teaching a robot individual tasks, regardless of how this is actually realized, is a necessary precondition for a widespread use of these systems. Phrased differently, a robot must be capable of adapting to its environment. The case of robots in caregiving is dealt with in the

EC directive on the activities of nurses responsible for general care.<sup>iii</sup> This directive and its national implementations cover the care-providing portion of the preventive, diagnostic, therapeutic and rehabilitational measures to maintain or restore a person's health and to prevent illnesses. Machines such as robots can provide support to caregivers in these tasks. Replacing the caregiver would, however, amount to a violation of this directive. The same is true of the autonomous execution of higher technical medical tasks.

Ethical reflection should focus on the nursing scenario in general. Until now it has been unusual to transfer any nursing tasks to robots. Nursing is a task typically fulfilled by human beings. The question is whether a modern society wants to or should delegate some nursing tasks to robots. From a humanistic perspective, the care recipient in the caregiving relationship may not be degraded to an object. Bearing in mind that a certain degree of assertiveness may indeed be necessary in caregiving, such as in the caregiver insisting that the care recipient take medication on schedule, it is obvious that a detailed analysis of the actions and assistance provided by the robot is advisable. It must also be taken into consideration that a robot can certainly represent increased autonomy for the care recipient. Whether the use of a robot in connection with caregiving is perceived as degrading or as providing increased independence can ultimately only be decided by the individual patient. This individual viewpoint should be either confirmed by the patient's explicit acceptance of the use of a robot in caregiving, or, if it is viewed as standard, by giving the patient the power of veto (as proposed by Christaller et al. 2001, p. 221).

#### Conclusion

Caregiving is certainly a field of service robotics with a societal need and statistics on demographic change speak for themselves. From the perspective of problem-oriented technology assessment not only do societal aspects have to be taken into consideration but also the acceptability on the individual level. A technical development preferred by society might cause considerable conflicts on the individual level. Non-technical solutions have to be assessed as an alternative, one possibility is supporting the immigration of nursing staff. Such problems will be discussed, among other case studies, in the upcoming project "Technology assessment of service robotics" of the Europäische Akademie.

*i) The case study mentioned in this Focus is part of the full paper "Caregiving robots and ethical reflection: the perspective of interdisciplinary technology assessment" by M. Decker (in: AI & Society 22(2008)3, pp. 315–330.) including references.*

*ii) The German Worker Welfare Organization (Arbeiterwohlfahrt) calculates the lack of caregivers*

in Germany to be 40,000 (AWO 2004). The World Health Organisation estimates a worldwide shortage of more than four million doctors, nurses, midwives and others (WHO 2006, p.11).

iii) Council Directive of 27 June 1977 concerning the co-ordination of provisions laid down by law, regulation or administrative action in respect of the activities of nurses responsible for general care (77/453/EEC), ABl L 176/1977, 8, modified directive 89/595/EWG, ABl L 341/1989, p. 30.

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## PROJECT GROUPS

### Fifth meeting of the project group “Clinical research in vulnerable populations”

■ The fifth meeting of the project group took place at the Berlin-Brandenburg Academy of Sciences and Humanities (BBAW), Berlin, on 5 October 2010. Guest speakers Professor Dr. Arved Weimann, Head of the Department of General and Visceral Surgery, St. Georg Hospital Leipzig, and Professor Dr. Armin Sablotzki, Head of the Clinics of Anaesthesiology, Critical Care and Pain Therapy, St. Georg Hospital Leipzig, gave a talk on problems of clinical research in intensive care against the background of their work in a German clinical study network (“KKS-Netzwerk”). They identified obstacles for including critically ill patients in clinical studies, especially due to time restrictions, and discussed incentives to increase participation in clinical studies.

### Second scientific meeting of EU consortium on nanotechnology in medicine (NanoDiaRA)

■ The second scientific meeting of NanoDiaRA took place at the Europäische Akademie GmbH in Bad Neuenahr-Ahrweiler from 11 to 13 October 2010. The project partners presented their work of the first six months and constituted actions and milestones for the following six months. The members of the project boards had the opportunity to discuss administrative and financial issues and questions about project reporting with the EC project officer Dr. George Kirmizidis and attended an exploitation strategy seminar under the auspices of the European Commission Research Direction. Furthermore, the academy’s project group “Technical medical and ethical aspects of nanoparticles for medical

purposes”, one of the NanoDiaRA work packages, held its kick-off meeting and discussed the preparation of their final work programme.

## CONFERENCES

### Autumn Conference 2010 on interdisciplinary research

■ Interdisciplinarity has become a matter of course and seems to have become a promising working approach in modern research. For instance, interdisciplinary research in global change is of high public interest. Nevertheless, its outcome is often strongly disputed and therefore has to be justified. Expectations and justification of interdisciplinary research is mainly based on: (1) complex problems of modern societies, (2) vast public funding schemes for certain interdisciplinary research programmes, and (3) controversial debates about the validity of recommendations made to decision-makers. Against this background, the Europäische Akademie Bad Neuenahr-Ahrweiler GmbH organized its autumn conference “Interdisciplinary research between societal expectation and scientific validity” held on 7 and 8 October 2010 at the Academy of Sciences and Literature in Mainz. Preliminarily it was agreed that interdisciplinarity has a specific potential and competence in the solution of complex, uncertain and ambivalent questions with societal relevance. However, that does not mean that interdisciplinarity would be prudent or necessary in every case. Therefore, one should also refrain from using interdisciplinarity as a “buzz word”, in order to prevent a dilution of its meaning. Instead, the term always has to be specified with regard to the objectives of interdisciplinarity.

## NEWS

### Netzwerk Technikfolgenabschätzung (NTA)

■ Das Netzwerk TA veranstaltete vom 24.–26. November seine vierte Konferenz zum Thema „Der Systemblick auf Innovation – Technikfolgenabschätzung in der Technikgestaltung“, zu der auch Wissenschaftler der Europäischen

Akademie mit einschlägigen Vorträgen beitrugen. Die Konferenz wurde mit einem Rückblick auf das zwanzigjährige Bestehen des Büros für Technikfolgenabschätzung beim deutschen Bundestag (TAB) eröffnet. Das Tagungsthema wurde in drei Sektionen erörtert, die sich mit „Transition Management“, ausgewählten Schlüsseltechnologien und methodischen Fragen auseinandersetzten. Abgeschlossen wurde die Veranstaltung mit einer hochrangig besetzten Plenarsitzung zum Systemblick von Innovation. Die Europäische Akademie ist Mitglied im NTA.

### Medical Ethics Working Group

■ On 14 October Priv.-Doz. Dr. jur. Dr. rer. pol. Tade Matthias Spranger (Institute of Science and Ethics, University of Bonn) gave a presentation on the legal viewpoint of the new German law regulation of advance directives. He emphasized that this reform does not only bring about issues regarding civil and penal law but also far-reaching questions on constitutional law.

### Managing Committee/Partners’ Assembly

■ On 28 October the budget of the Europäische Akademie GmbH was reviewed and confirmed during the 28<sup>th</sup> general meeting of the Managing Committee and the Partners’ Assembly in Bad Neuenahr-Ahrweiler.

## LECTURES

### Dorothee Dörr 2/12/2010

■ “Ethische Aspekte der Lebensqualitätsbewertung in der Intensivmedizin”  
 Poster presentation, 10<sup>th</sup> Congress of the “Deutsche Interdisziplinäre Vereinigung für Intensivmedizin und Notfallmedizin”, Congress-center Hamburg

### Bert Droste-Franke 30/10/2010

■ “Energiespeicher für die Integration erneuerbarer Energien in die Stromversorgung”  
 Forum at the Ahrtschau 2010, Bad Neuenahr-Ahrweiler

## CURRENT PROJECTS OF THE EUROPÄISCHE AKADEMIE

- Deep brain stimulation in psychiatry. Guidance for responsible research and application (duration 10/08–9/11)
- Radioactive waste. Technical and normative aspects of its disposal (duration 10/08–spring 2011)
- Clinical research on vulnerable populations (duration 12/08–6/11)
- Energy storages and virtual power plants for the integration of renewable energies into the power supply. Potentials, innovation barriers and implementation strategies (duration 1/09–6/11)
- Development of novel nanotechnology based diagnostic systems for Rheumatoid Arthritis and Osteoarthritis (NanoDiaRA) (duration 2/10–1/14)
- Nanoparticles for medical purposes. Technical, medical, and ethical aspects (duration 5/10–9/12)
- Long-term planning. The relevance of social and cognitive resources for sustainable economic activities (duration 9/10–2/13)

**22/11/2010**

■ “Zusammenfassung und Schlussfolgerungen zu den vorgestellten Studien zum Speicherbedarf”  
5<sup>th</sup> International Renewable Energy Storage Conference (IRES 2010), Berlin

**25/11/2010**

■ “Systemanalytische Elemente in der Projektgruppe der Europäischen Akademie zur Untersuchung von Ausgleichsstrategien für die Integration erneuerbarer Energien in die Stromversorgung”

Systemic Reflection of Innovation – Technology Assessment in Shaping Technology, 4<sup>th</sup> Conference of the “Network Technology Assessment” (NTA4), Berlin

**Thorsten Galert**

**9/11/2010**

■ “Neuro-Enhancement als Herausforderung der Selbstbestimmung”

DHS-Fachtagung (Deutsche Hauptstelle für Suchtfragen), Essen

**22/11/2010**

“Potentiale und Risiken des pharmazeutischen Enhancements psychischer Eigenschaften”, Statusseminar of the German Ministry of Education and Research on “Bioethik”, Berlin

**26/11/2010**

“Neuroenhancement – Ethische Implikationen”  
DGPPN-Kongress 2010 (German Association of Psychiatry and Psychotherapy), Berlin

**Carl Friedrich Gethmann**

**19/10/2010**

“Gepürfte Sicherheit. Von den Möglichkeiten und Grenzen der Reproduktionstechnologien”  
Interview, Radio Bremen

**25/10/2010**

“Gastfreundschaft als Topos eines universellen Ethos”

Festvortrag 100 Jahre Privat-Hotel Aurora, Bad Neuenahr-Ahrweiler

**25/11/2010**

“Die Erkundung des Weltraums als Kultur- aufgabe”

Symposium “Planetenforschung und bemannte Raumfahrt unter philosophischen und kulturellen Aspekten”, Spree-Athen e.V., Berlin

**Georg Kamp**

**8/10/2010**

“Vom Ende her gedacht. Beratung als Produkt interdisziplinärer Forschung”

Autumn conference of the Europäische Akademie GmbH (7–8 October), Mainz

**3/11/2010**

“Langfristige Planung. Die Bedeutung kognitiver und sozialer Ressourcen für nachhaltiges Wirtschaften”

Project presentation at the kick-off meeting  
“Wirtschaftswissenschaften für Nachhaltigkeit”, Berlin

**Stephan Lingner**

**10/12/2010**

“Elektromobil in die Zukunft? Chancen und Probleme”

Workshop, “Tag der Energie und Menschenrechte”, Gutenberg-Gymnasium Bergheim

PERSONALITIES



■ Kalle Hoppu, M.D., Ph.D., is a paediatrician and clinical pharmacologist currently working as Director of the Finnish Poison Information Centre at the Helsinki University Central Hospital, Helsinki, Finland, and Associate Professor of Paediatric Clinical Pharmacology at the University of Helsinki. A graduate in medicine from the University of Bern, Switzerland, he trained in paediatrics and in clinical pharmacology at the University of Helsinki. His main research interests are in paediatric clinical pharmacology, with emphasis on pharmacokinetics and clinical trials. Dr Hoppu has worked as an external expert for the World Health Organization (WHO) for over 20 years and is currently a member of the WHO Expert Advisory Panel on Drug Evaluation. He has regulatory experience from having worked at the European Medicines Agency (EMA) as a member of the Committee for Orphan Medicinal Products (COMP), and the Paediatric Expert Group/Working Party. Dr. Hoppu is currently Chairman of the International Union of Basic and Clinical Pharmacology (IUPHAR)/Section of Pediatric Clinical Pharmacology, technical advisor for IPA (International Pediatric Association) in the area of better medicine for children, and Director of FINPEDMED, the Finnish Investigators Network for Pediatric Medicines.

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