*J.E.M.H. van Bronswijk (Convener). Robotics and the changing work force: Examples from the housing domain. Gerontechnology 2010;9(2):72;* doi:10.4017/gt.2010.09.02.125.00 **Participants:** J.E.M.H. van Bronswijk (Netherlands), C. Haas (Canada), F.J.M. van Gassel (Netherlands), A. Badii (UK), and G. Angelis (Netherlands); with J.L. Fozard (USA), discussion leader, and P-C. Tuan (Taiwan), discussant. **ISSUE** Leading governing bodies strive at smart growth, sustainable growth, and inclusive growth[1]. The aging society requests increasingly more services, care and renovation endeavors. Inevitably, much of this future work will not be performed by persons, but by humanoid and non-humanoid robots. The need for higher productivity per worker with the help of newer technologies touches a number of gerontechnology aspects and theories. This includes worker support by automation and robotics, as well as a changing view on man-machine interfaces and housing that will have to be adapted to the technology generation of worker and end-user alike. In addition there are economic issues involved, as well as quality-of-life expectations of the worker. The key issue is how the future society will function with this mix of human and robot employees (including self-service terminals), taking into account the variety in technology generation of end users, and engineers who are responsible for implementation and maintenance. **CONTENT** Findings and expected developments are the focal points in this symposium. Drivers and barriers are discussed from both a technological and a gerontological point of view. **STRUCTURE** Annelies van Bronswijk will draw a picture of the actual changes in work force and general population in Europe, and the mismatch of technology generations. Carl Haas will focus on construction robotics to combat worker shortages and improve the wellbeing of the construction worker. Frans van Gassel will view the complete home as a robot that services the inhabitants. It includes the combination of construction and building services technology and calls for an adapted process for design. Companionship with robots that are integrated in the dwelling is the subject of Atta Badii, who reflects on the European CompanionAble project that includes the integration of robots in smart homes for assisted living. Georgo Angelis dwells on household robots that can both learn and teach, and transfer their newly acquired knowledge to other robots through the Internet. This type of learning and teaching is considered the only possibility for mass-production and mass-individualization of robotic employees. Following the individual presentations there will be an open discussion led by Jim Fozard, focusing on the actual expected needs and options for robot-employees in the coming 20 years. Pan-Cho Tuan will compare the presented information with Asian approaches. **CONCLUSION** The human work force will increasingly need support from a robot workforce. Providing the best robots for the best (parts of) jobs is a challenge. Feasibility and acceptability of the robot-employees may prove to be even more challenging.

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*Keywords:* work force, robotics in construction, robot-employees, user interfaces, robot home
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J.E.M.H. van Bronswijk, J. Knies, F.J.M. van Gassel, G.J. Maas. *The work force may request robots as additional employees in the aging society. Gerontechnology 2010;9(2):73;* doi: 10.4017/gt.2010.09.02.126.00 **Purpose** Aging of society does not only imply that the number of aged persons increases, it may also mean that the work force changes. In this contribution we examine the actual and predicted developments in the workforce and total population in Europe, while assessing the consequences for societal sustainability. **Method** Starting from the figures of the United Nations[1] with enrichments from local data collections, a picture of demographic change and developments in the potential work force (persons aged 15-65 years) was drawn of all 27 countries of the European Union (EU27) (*Figure 1*) as well as individual European countries. In most countries the actual workforce is smaller than the potential one since education tends to go beyond 15 years of age, and women may encounter cultural barriers when they want to be fully employed. Age differences between the total population and the workforce were interpreted in relation to the 'technology generation' hypothesis[2]. For ICT technology, the critical border of easy use of modern layered interfaces is the year of birth 1960[2], or persons currently 50 years of age. People who are older generally consider traditional technology to be electro-mechanical; one button for one function, and are concerned not to push the wrong one! The machine may break down! Those born after 1960 consider a layered user interface of ICT powered products and services as the technological standard. Buttons are for multiple use. Strange things may happen when you push the wrong one, but the machine remains intact. **Results & Discussion** In 1960 both general population and workforce belonged to an electro-mechanical generation. Currently 28% of the workers and 36% of the population are from the electro-mechanical generation, while by 2025 (taking 65 years as the retirement age) none of the designers and engineers belong to that generation, but 22% of the general population will. The gap in technological experience between engineers and service providers on one side, and their older customers on the other, seems to grow. Fewer and fewer human employees will be able to supply enjoyable services for the aged, unless extensive new training takes place. Companion robots may be one of the answers to this problem. As to the total potential workforce, it increased between 1960 and 2010 by more than 25% from 260.5 million to 333.5 million, but the predicted decrease for the time period 2010-2060 is 50 million workers (15%). The population gre from 403.5 million in 1960 to almost 500 million in 2010, and is not predicted to decline until after 2060. In the next 20 years, the predicted reduction in workers is 3.5% or 11.5 million. Robot-employees alongside human ones may be needed to realize the productivity and care requested by societal sustainability.

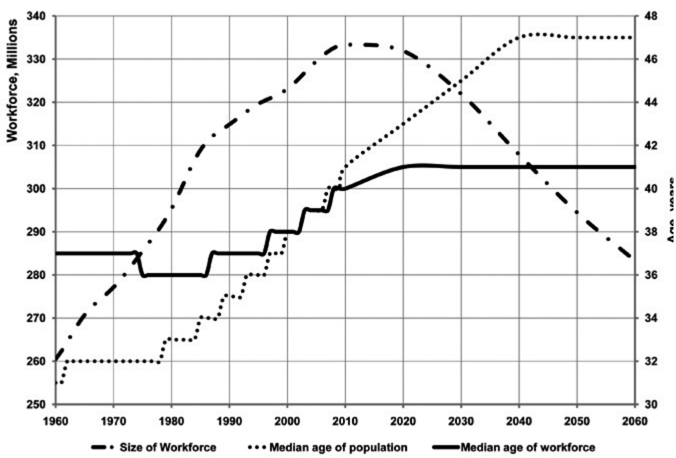


*Figure 1: A century of actual and predicted size of the potential workforce of the 27 EU countries*

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*C. HAAS*. *Robotics and the aging work force in construction. Gerontechnology 2010;9(2):74;*
doi:10.4017/gt.2010.09.02.127.00 **Purpose** Construction robotics experienced their first surge of research in the 1980's. Centers of development included Europe, North America and Japan. Developments in Japan were largely driven by the pressures of culture and an aging workforce. We are beginning to feel these pressures now in North America. **Method** Progress in robotic control of heavy equipment has since revolutionized tasks such as earth moving and paving. Advances that focused more on safety and health include automated tiers for reinforcing bars, remote controlled demolition equipment, and deep underground mining. Future advances for an aging workforce will be driven by the need to further adapt controls of heavy equipment, to reduce physical stress on aging workers, to value the skills and experience of aging workers, and to consider their limitations in terms of peripheral vision, reflexes, night vision, etc[1-3]. **Results** & **Discussion** This presentation will review progress in construction robotics and identify issues to be addressed for an aging workforce. Despite historically high unemployment levels in construction In North America, the demographics are relentless. We are still experiencing a skilled workforce shortage in construction, and we will soon realize that we cannot continue to lose most of our skilled construction workforce before they turn sixty because of the stress of the job. Construction robotics and automation will help us adapt to an aging workforce.


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*F.J.M. VAN GASSEL*. *Robotizing housing and design. Gerontechnology 2010;9(2):74-75;*
doi:10.4017/gt.2010.09.02.128.00 **Purpose** In the next 20 years the Dutch workforce will decrease from 11 to 10 million persons[1]. In the domain of housing construction it calls for two roads of innovation: (i) robotizing of job elements, and (ii) providing the built environment with robot characteristics. Both approaches call for a new view on design and construction. Some best practices already exist: (i) Smoothing concrete floors with a trowel machine, controlled by a construction worker, and (ii) Stairs equipped with small elevators and ceiling cranes in bath rooms, controlled by the end-user. In the future an increase of special equipment or even robotics will take place in dwellings. William Mitchel, former dean of MIT's School of Architecture and Planning, approaches dwellings as 'robots to live in'[2]. An example of such a dwelling-robot is the WABOT home[3] (*Figure 1*). Floors move up and down to increase the mobility of the inhabitants. Although technological support can be made available by current processes of mechanization, robotizing and automation[4], certain physical, cognitive and organizational characteristics are needed in the process of construction and renovation that are little taken into account. Technologi-

*Figure 1. the WABOT home in Japan[4]*

cal knowledge exists in the domains of ergonomics, mechatronics and ICT, and imaging systems, but implementation commonly lacks a deep understanding of design and construction processes and daily living scenarios (ADL, iADL). **Method** The deep understanding needed, is attempted by collaboration of the stakeholders with future users from the earliest stage of the architectural and construction processes[5]. An important part of this collaboration is a well planned and controlled design meeting with well chosen tools to facilitate the meeting activities. Participation of end-users in such design meetings needs special competencies of the design manager to explicate their user values. **Results & Discussion** Successful robotizing of the residential environment is the result of a carefully organized collaborative design process in cooperation with future users, and relevant designers. Contrary to tradition, professional stakeholders need to use new working methods that are based on detailed observations of construction and daily living activities.

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*A. Badii. A framework architecture for care and socialisation to support Aging-in-Place. Gerontechnology 2010;9(2):75-76;* doi:10.4017/gt.2010.09.02.129.00 **Purpose** The evolution of internet-enabled technologies and the new paradigms for communication, services, business, socialisation and virtual worlds have introduced new meanings to experiences such as social networks and second-life. This has opened new degrees of freedom in terms of modalities of engagement, interaction and services provisioning. The re-architecting of our ways and means of providing care and support for the elderly requires the constructive mutual engagement of all participants -designers, care-givers, and, care-recipients. The reality is that 24*7, one-to-one, companionship and support by trained carers for the elderly is unattainable due to the limitations of human and economic resources. This points to leveraging the digital technology to offer the elderly new forms of companionship through robots and avatars, as companions in themselves as well as smart context-aware and secure gateways to socialisation and to receiving care from friends and professionals. **Method** The CompanionAble Integrated Research Programme funded by the European ICT FP7 e-Inclusion Research Unit responds to the above challenges through research and technology innovation for providing an integrated architecture including both a Smart Home and a Companion Robot. The Project has opened a new arena for co-design of ambient systems for assistive living that necessarily includes the re-consideration of new routes to affordability engineering and integration of social care services to interoperate with such a care environment supported by Home Automation and Companion Robotics. The project exploits the new interpretivist framework, UI-REF[1] for the prioritisation and usability evaluation of the users' deeply-valued needs for care and lifestyle support within an environment of evolutionary co-design of such systems and services. It is based on the principles of inclusivity, and reversible and incrementally reconfigurable technology adoption to provide an adaptive spectrum of coherent systems and services that could be orchestrated to remain responsive to the particular usage-contexts. Central to this architecture is the design of the Global Care Control Support Services Manager (GCC-SSM) which can also be controlled by the Remote Controller (RC), the ultimate authority, who would be a care professional in a Care Centre but able, in an emergency, to remotely control the Companion Robot as well as the smart home environment. The GCC-SSM effectively invokes the graceful orchestration of the automated, and if need be human, care support services under routine and emergency conditions as monitored through the Policy Controller and delivered through the Companionable Robot's main interface to the patient which is the Dialogue Management System (DMS). **Results** & **Discussion** The main distinctions between a Companion Robot and a Service Robot is the context-aware responsive interaction of the Companionable Robot through DMS and its ability to offer companionship and close monitoring as needed autonomously as well as mediating routine or emergency social contact. The Companionable project has successfully demonstrated its first prototype Companion Robot, Hector, in Smart Homes Eindhoven, March 2010.

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*G. Angelis, C. van Pelt, M.J.G. van den Molengraft*. *Open innovation to further develop people-friendly robot technology: The RoboEarth Project.* *Gerontechnology 2010;9(2):76-77;* doi:10.4017/gt.2010.09.02.161.00 **Purpose** One of the challenges for the 21st century is the development of robots that can move around in the human world and carry out tasks there that are useful to society, for example in care for the elderly. As it is, robots cannot react independently to new situations. Each task carried out by the robot has been preprogrammed by humans. There is no collective, worldwide memory that robots can plug into to carry out their tasks in a new environment, for instance. The RoboEarth project is going to change that now. The team will be making six demos, which will demonstrate the use of RoboEarth; the six include a robot that can offer patients in hospital a drink, and a system that will show how the knowledge gained by robot A can improve the performance of robot B. **Method** The RoboEarth-project is led by Eindhoven University of Technology (TU/e). Other participants are Universität Stuttgart, the ETH Zürich, Universidad de Zaragoza, Technische Universität München and Philips Applied Technologies. The RoboEarth-project exploits a new approach towards endowing robots with advanced perception and action capabilities, thus enabling robots to carrying out useful tasks autonomously in circumstances that were not planned for explicitly at design time. The core of the innovation proposed by the consortium involves the development of a world-wide web-style database: RoboEarth. RoboEarth will allow robots to share any reusable knowledge independent from their hardware and configuration. When a robot starts performing a task, it is able to download available high-level knowledge on both task and environment; next, it can use and translate this knowledge to its hardware specifications and its configuration and will improve it by learning during the task. Finally, it will upload its knowledge to RoboEarth again. **Results** & **Discussion** Philips Applied Technologies develops human centered

*Figure 1: The people-friendly robot arm of RoboEarth*

technology that allows people to safely benefit from robot assistance in a wide range of human-interaction applications. Within the RoboEarth project we are demonstrating the technology in the form of a people-friendly robotic arm (*Figure 1*). Within our robotic innovation program we will make a limited number of the Philips experimental robotic arm available for universities to maximize innovation, to encourage collaboration and the sharing of knowledge. People who could benefit from robot technology are e.g., elderly or disabled people who need less support as devices using robot technology can help them with simple household tasks as a care assistant. Care providers who can count on a helping hand when performing enduring tasks such as lifting people. Wheelchair bound people who can rely on a wheelchair-mounted robot arm to open doors or perform other tasks, allowing more independent living. Doctors who need to perform complex interventions, where robot technology can take over tasks or improve the doctor's ergonomics, relieving the doctor from physical stress.

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