Entertainment Robotics

WTEC Robotics Workshop

Dan Kara
President, Robotics Trends

82 East Main Street, Suite 2
Northboro, MA 015
(508) 351-6606
dk@roboticstrends.com

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Entertainment Robotics

Defining the Market

Industrial Robots

Service Robots

Personal Robots

- **Marketing Robots**
- **Entertainment Animatronics**

- **Education/Hobbyist Robots**
- **Entertainment Robots**
  - **Smart Toys**
  - **Robotics Pets**
  - **Automated Home**
- **'Partner' Robots**

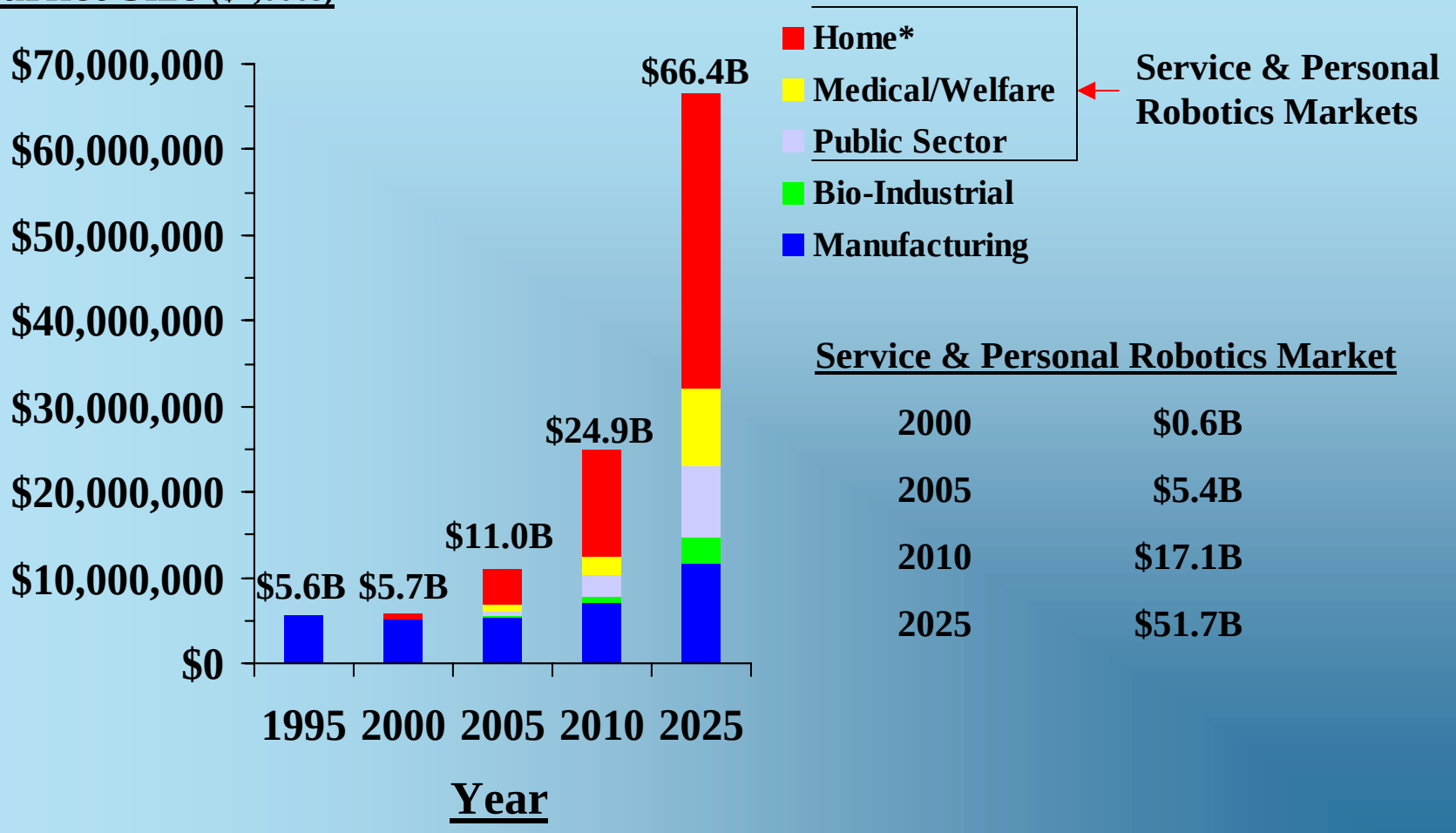
"We strongly believe that after the Gold Rush of the Internet and cyberspace, people will eagerly seek real objects to play with and touch. Robot Entertainment provides tangible physical agents and an unquestionable sense of reality."

- Internal Sony Document

Worldwide Robotics Market Growth

Personal and Service Robotics Markets Drive Growth

Market Size ($1,000s)



Service & Personal Robotics Market

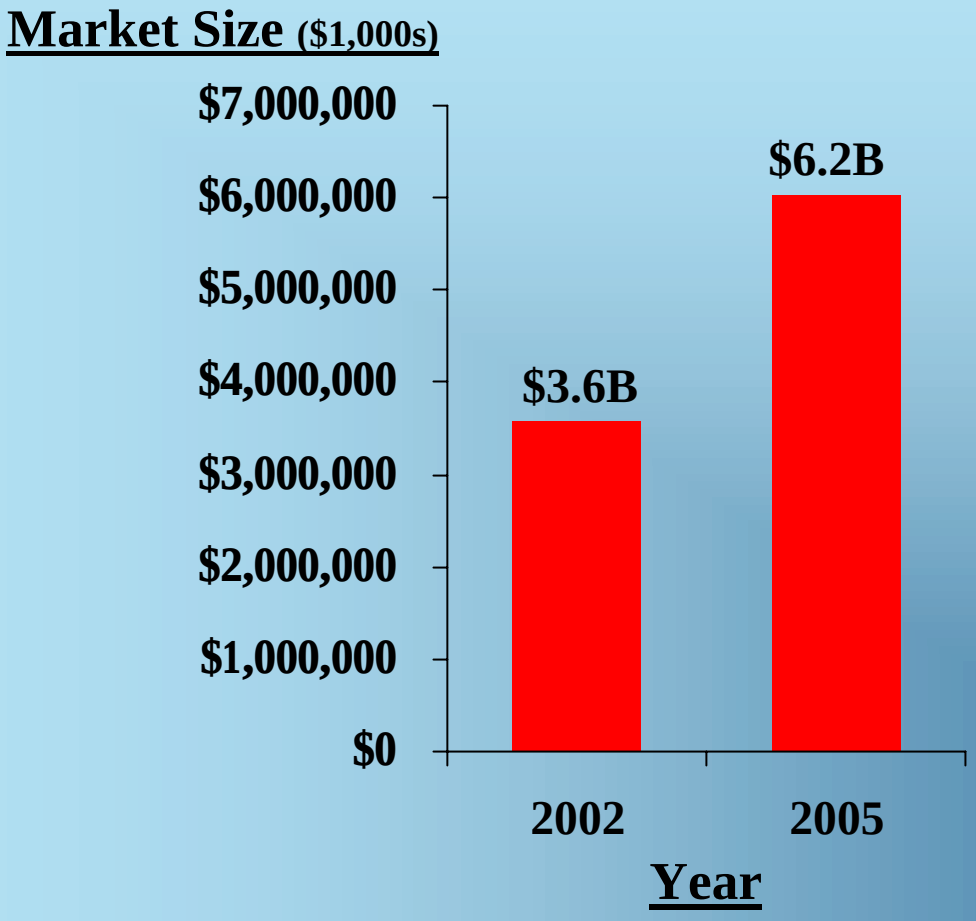
2000	$0.6B
2005	$5.4B
2010	$17.1B
2025	$51.7B

Source: Japan Robotics Association

* Excludes Low Level Electronic Toys

Service and Personal Robotics Market Growth

UNEC and IFR Predict Strong Growth



Source: United Nations Economic Commission and International Federation of Robotics

Service and Personal Robotics Market Growth

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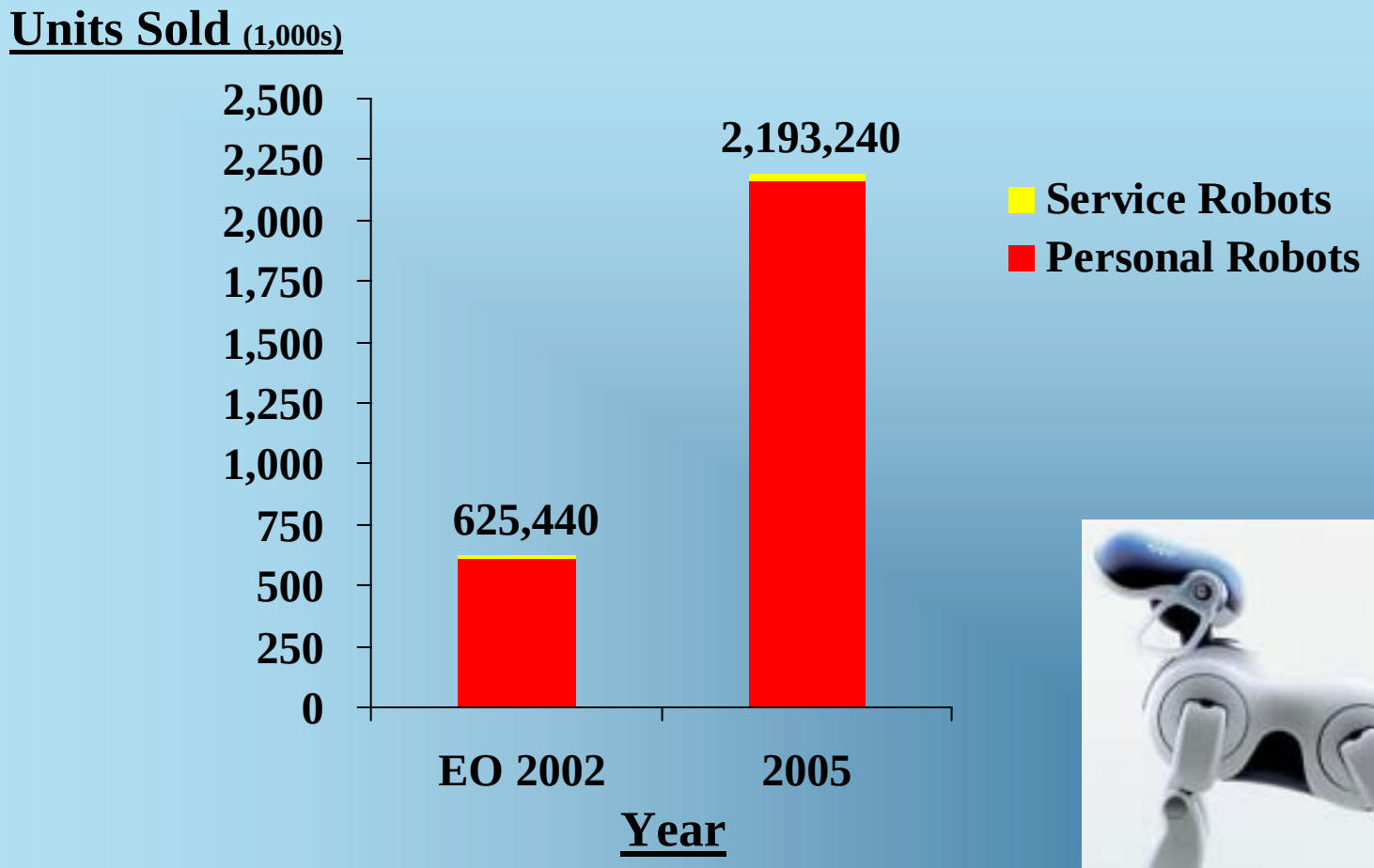

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Research Goals

Modes of Interaction Maps to Key Research Areas

- **Watch the Robot**
  - Requires high level of mechanical complexity
    - Mobility, fluidity, robustness (servos, sensors, actuators, power etc.)
  - Situational awareness
  - Design
    - Human factors, emotional appeal
- **Interact With the Robot**
  - Vision (object recognition)
  - Teleoperation
  - Speech (not the King's English), speech recognition (not NLP)
- **Raise the Robot**
  - Experiential learning (speech, social interaction, recognition)
  - Cognition
- **Control the Robot**
  - Speech learning , vision, gestural control, attention management
  - Teleoperation
  - Pervasive computing (including M2M)
- **Develop the Robot**
  - Simulation
  - Standards
  - API's
  - Abstraction layers

Research Goals

‘Core’ Research is Not Enough

- Low cost Manufacturing
- Emphasis on Design
  - Relative Advantage
    - Degree to which innovation is perceived better than the idea it supercedes
    - Economic and socio-prestige advantages
  - Compatibility
    - Degree to which innovation is perceived as being consistent w/ existing values, past experiences and needs of adopters
    - Innovations that are consistent are adopted more readily
  - Complexity
    - Degree to which innovation is perceived as difficult to understand and use
    - The simpler the quicker the adoption rate
  - Trialability
    - Degree to which innovation may be experimented with on a limited basis
    - Trialibility equals less uncertainty
  - Operability
    - Degree to which innovation may be experimented with on a limited basis
    - The easier to see results, the more likely to be adopted

Major Accomplishments - Commercial

Relatively Recent

- Honda P3 (Honda 1997)
- LEGO Mindstorms Launch (1998)
- Furby Released (Tiger Electronics - 1998)
  - 'Toy of the Year'
- AIBO (Sony - 1999)
- My Real Baby (Hasbro – 2000)
- B.I.O. Bugs (Wow Wee – 2001)
- Asimo (Honda – 2002)
- My Real Kitty (2003)
- QRIO (Sony - 2003)
- Garage development of humanoids (2002)
  - Commercialized
  - Turning, balancing and recovery
- Robosapien Launched (Wow Wee 2004)

Upcoming Products

Coming

- **White Box Robotics**
  - **912**
  - **‘PC Bot’ (PC-based mobile robotic platform)**
  - **Designed for customization**

- **RoboDynamics**
  - **Robotic Personal Assistant**
  - **De facto standards (Win CE, x86, 802.11, USB, Web Cams etc.)**
  - **Remote presence (security and surveillance)**
  - **Communications facilitator**
  - **Open platform**

Major Accomplishments in Other Countries

Investment in Core Research - Korea

- 316.5 billion won (US $264 million) over the next five years in 16 projects to boost the domestic intelligent robotics industry (December 2003)
- Task force of businesses and research groups will seek ways to link the robotics industry with potential growth industries such as display equipment, next-generation chips and networked homes
- Establish a robotics cluster for the development of the industry
- Goal
  - Korea one of the world's top three nations in the robotics industry
  - World market share of 15 percent by 2013

Major Accomplishments in Other Countries

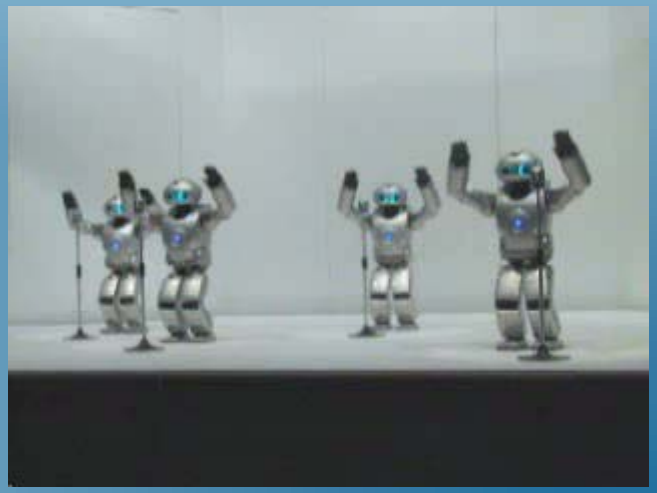
Commercial - Sony

- **AIBO**
  - **OPEN-R entertainment platform architecture**
  - **Software Releases**
    - **September 2003 – *AIBO MIND* allow owners to interact with the robot in numerous ways, including voice and tactile touch sensors, along with the ability to remotely access the robot and retrieve digital images on their PC via e-mail commands or an Internet browser.**
    - **May, 2003 - AIBO *EYES* allow AIBO to send digital images from remote location to PC or mobile communication device. Retail $199.**
    - **November 2002 - *AIBO Dancer* software package uses tempo analysis technology to detect the speed of a particular song and features more than 30 new dance-steps.**
    - **Oct. 2002 - Owner recognition technology that enables robot to recognize owner name, voice and face.**
    - **October 2002 – Free downloadable software.**
  - **Originally robotic pet, now educational and research vehicle**

Major Accomplishments in Other Countries

Commercial - Sony

- **QRIO**
  - **State-of-the-art machine**
  - **Three 64-bit processors, 192Mb DRAM, 38 motors, nearly 80 sensors**
  - **Two 110,000 pixel CCD color cameras, seven microphones, a speaker and 5 LED displays**
  - **Recently demonstrated running, jumping**
  - **Efforts to link QRIO with Grid computing architectures**
    - **250 personal computers linked to QRIO via high-speed wireless communication**
    - **Total computing power is estimated to reach 1 teraflops**
    - **QRIO to "think" on its own instead of just following orders**



Major Accomplishments in Other Countries

Commercial - Fujitsu Laboratories

- **Maron-1**
  - **Sentry robot**
  - **Remotely controlled with an internet-enabled phone**
  - **Can send pictures of its surroundings to mobile phone**
  - **Auditory, visual and proximity sensors**
  - **Can operate various household appliances**
  - **US $2,750**

- **HOAP-2**
  - **Originally developed and manufactured for research purposes**
  - **Sold internationally (March 2004)**
  - **Incorporates innovative system for teaching robots movement/motor coordination, based on a dynamically re-configurable neural network - a mathematical model of the nervous system found in humans and animals**

Major Accomplishments in Other Countries

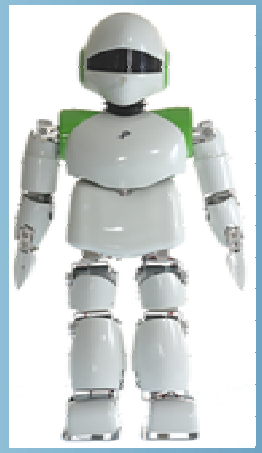
Commercial - Toshiba

- **Maron-1**
  - **Face recognition**
  - **Speech recognition and a voice synthesizer.**
  - **Communicates via wireless LAN (802.11b), IR and Bluetooth**
  - **Built-in Video Camera can also be used to take photos and send them via i-mode to a mobile Phone.**
  - **Autonomous and teleoperated**
    - **Obstacle avoidance**

Major Accomplishments in Other Countries

Commercial

- **Robovie-M (Vstone – Japan)**
  - **Programmable & autonomous humanoid robot**
  - **$4,500 US**
- **Pino and Novo (ZMP – Japan)**
  - **Speech recognition, programmable, activate through cell phone**
  - **$4,600**
- **Morph3 (Kitano Symbiotic Systems Project along with Leading Edge Design - Japan)**



Major Accomplishments in Other Countries

Commercial - NEC

- **PaPeRo (Partner-type Personal Robot)**
  - **Face and speech recognition (@3000 phrases)**
  - **Speech (@ 650 phrases)**
  - **Sensors (patting, stroking, ultra-sonic sensors – 5, floor and lift)**
  - **Functionality**
    - **Small talk, dancing, quiz, fortune telling, game playing**
    - **Send and receive aural and video messages, act as TV remote control, access messaging via the Internet, let you know the time, measurer time, act as an alarm clock etc.**
  - **RoboStudio**
  - **Partnership with academia**
    - Kobe University, Osaka University, Musashi Institue of Technology etc.

Major Accomplishments in Other Countries

Commercial Products - Russia

- **ARNE and ARNEA**
  - **New Era**
  - **Walking, obstacle avoidance**
  - **Some object/color recognition**
  - **Limited voice control and speech**
  - **Collaboration between New Era and St. Petersburg State Polytechnical University**

Major Accomplishments in Other Countries

Commercial Products - China

- **Robosapien**
  - **WowWee Toys**
  - **US$ 1 million to develop**
  - **Hopes to sell 3M units - has a manufacturing capacity of 5M**
  - **One new robot a year for the next five years**
  - **Programmable, hackable**
  - **Real multi-speed fast dynamic walking, running, and turning**
  - **Fast, full function arms with two types of grippers**
  - **67 pre-programmed functions**
  - **Programmable "reflexes" to touch, pickup, kicks, or sound**
  - **Up to 84 program steps, with 4 program modes for advanced operations**
  - **Designed by Mark Tilden**
    - **Father of BEAM robotics**
    - **Joined Wow Wee because the firm was prepared to invest in an expensive project few others were willing to explore**
  - **<$100 US**

International Co-operation

Examples

- Evolution Robotics ER Vision software to be licensed by Entertainment Robot Company (a Division of Sony Corporation)
- B.I.O. Bugs and RoboSapien developed by Tilden for Wow Wee Toys
- Evolution Robotics distributes ER1 Hobbyist Robot Kit to partners Bandai (Japan) and Neuro Systems (Korea)
- Asimo X2 advanced recognition of faces, coupled with voice and hand gestures likely the result of collaborative research with CMU Robotics Institute

Recommendations

Research and Otherwise

- Recognize personal, service and mobile robotics as a new industry and new opportunity (intelligent robotics)
  - Treat as such at national level
- Baseline Quantitative Data
  - Massive market potential
  - Most commercial efforts outside US
  - Interacts with many aspects of robotics research
- Research
  - Vision
  - Social interaction, human factors
  - Telerobotics, teleoperation
  - Toolboxes
    - Vision, motion, social interactions
- Closer integration with industry (formalized, nationalized)
  - Higher order entertainment robots
  - Funding, testbed, practicality
  - Leverage
    - Education
    - Elder Assistance/ Personal Companions
    - Commercial Potential
    - The “next, next big thing”

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Thank You!

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