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FUTURES INC.
Your Bridge to the Future

The New Transformative Technologies

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TFI Communications Technology & Asset Valuation Conference

January 26-27, 2017

Marriott Courtyard Downtown
Austin, Texas

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Fundamental Driving Forces as a Framework for Forecasting

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18th IIF Workshop
Forecasting New Products and Services
Research and Applications

Politecnico di Milano | Milano Bovisa
12 - 13 May 2016 Milan | Italy

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The International Institute of Forecasters
www.forecasters.org

POLITECNICO DI MILANO

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The Forecasters

Communications Forecast Compendium

Fundamental Driving Forces for Forecasting Communications Technologies

Lawrence Vanston, Ph.D.
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36th International Symposium on Forecasting
International Institute of Forecasting

Santander, Spain, Palace of La Magdalena
June 19-22, 2016

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4 Old Major Driving Forces

Physical Movement	⟹	Telecommunications
Analog	⟹	Digital Communications
Low Bandwidth	⟹	High Bandwidth
Wireline	⟹	Wireless

For complete list, please see appendix

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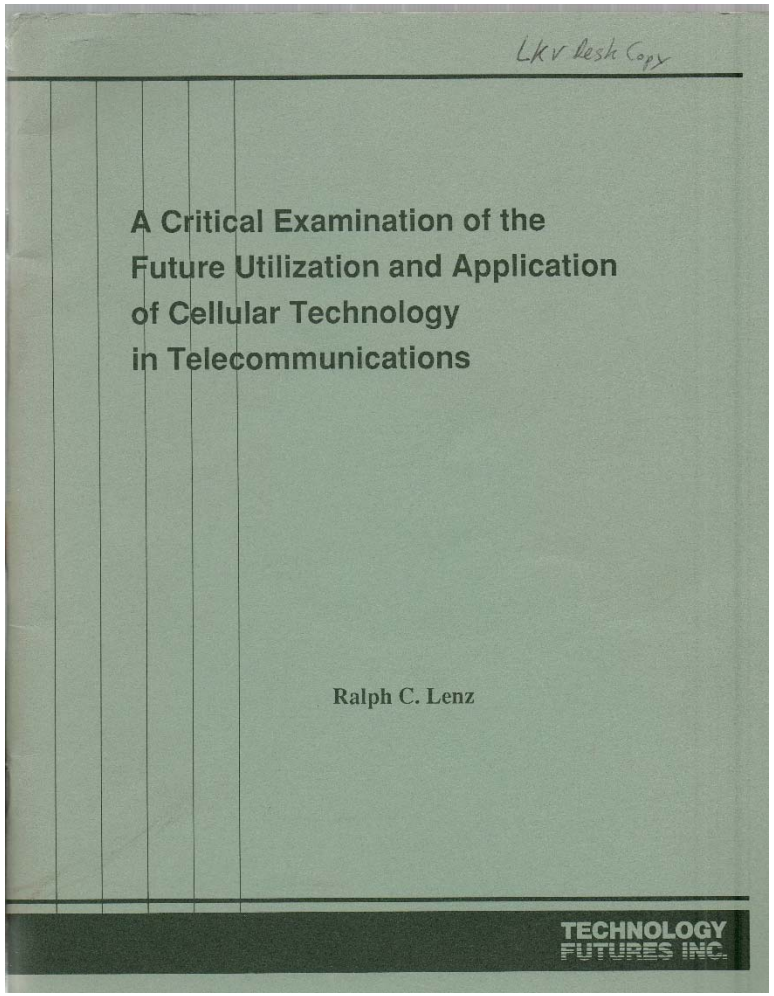

- Conversion to digital systems by 1997
- Total monthly service cost from present $145 to $40-$60 by 1997
- U.S. mobile customers from present 915K to 3.4 – 4.0M by 1997
- Excess cellular capacity to compete with wireline at below landline prices

We believe that the developments of cellular radio service described above demonstrate that, in the future, cellular service will be a strong and economical competitor for many services now offered by wireline companies.

1988 TFI Study on Wireless by Ralph Lenz

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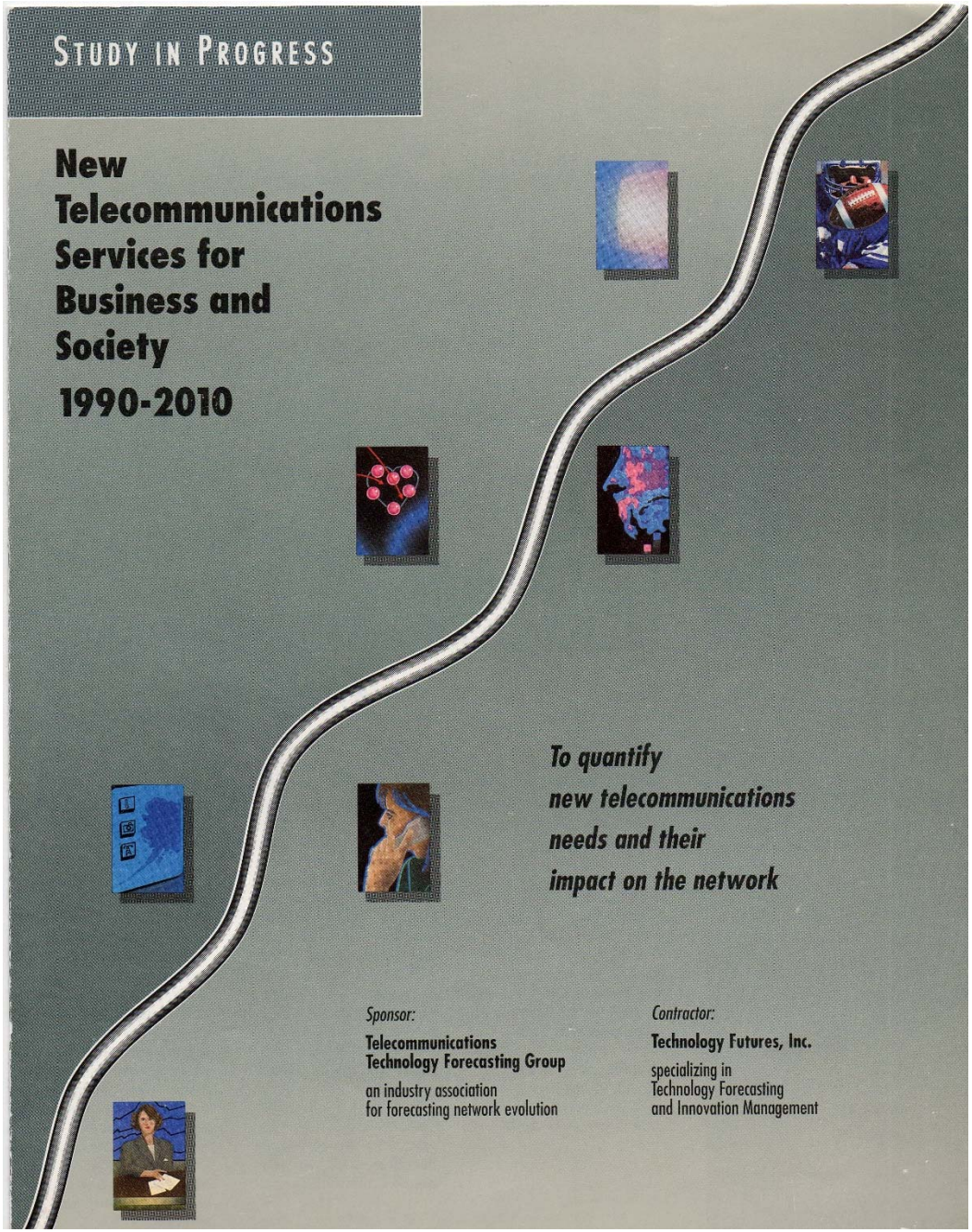

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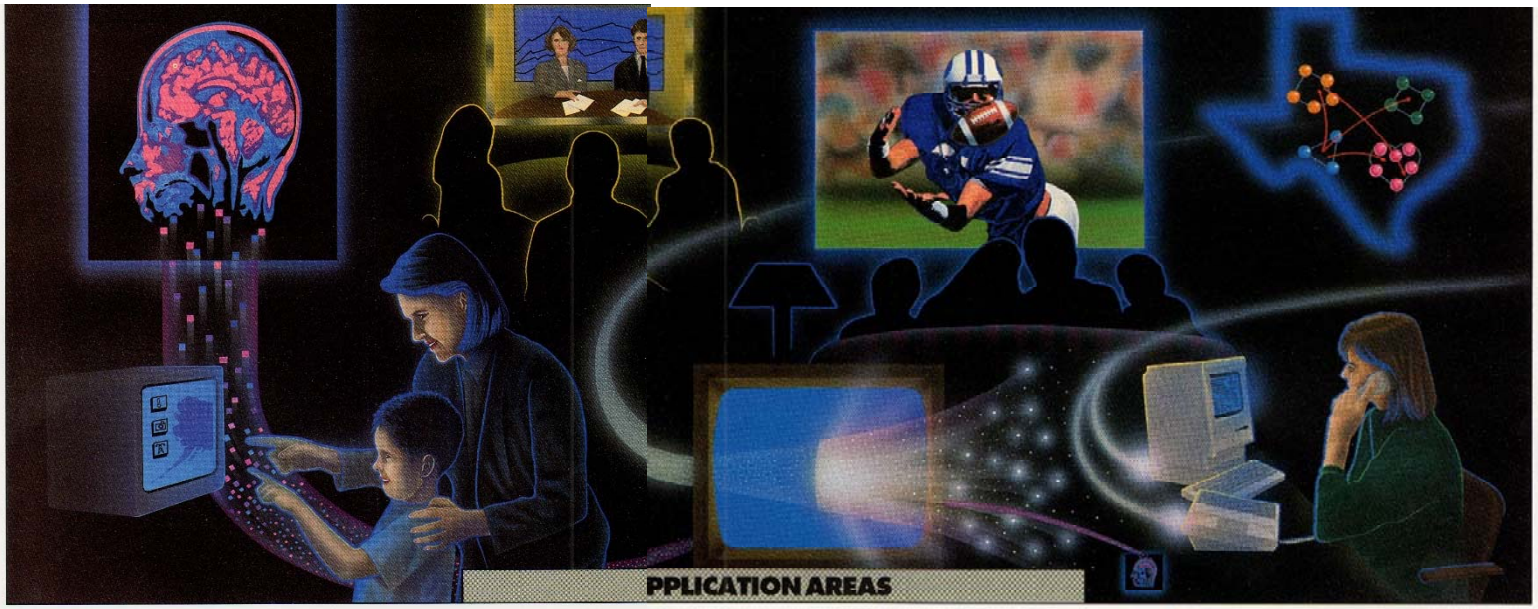
Objectives of the New Services Study...

To quantitatively forecast new telecommunications needs and their impact on technology adoption in the telecommunications network.

To update existing forecasts of technology adoption and obsolescence in switching, outside plant, and circuit equipment.

To communicate with regulators, policy-makers, customers, suppliers, and TTFG member-company employees about the importance of new services and their network impact.



PPLICATION AREAS

Image Transmission:

How will advances in technology and digital communications change the way we create, store, and communicate images? The study will address both high-speed digital facsimile and computer-to-computer graphics. Some key applications are graphic arts, medical imaging, mapping, and records management. Technologies to be examined include facsimile equipment, scanners, graphics printers, image storage and retrieval systems, and personal computers and workstations.

Interactive Multimedia:

Systems that combine data, text, audio, image, and video in a single interactive user interface are beginning to emerge. Early systems include DVI by Intel for business applications and CD-I by Phillips for home applications. Applications will include sales demonstrations, training, education, entertainment, multimedia presentations, and information systems. Although initially provided on stand-alone systems with optical disks, multi-media systems—especially the interactive aspects—can benefit from high-speed digital communications.

LAN Interconnections:

Local Area Networks (LANs) provide the backbone for distributed information processing and data communications at many business locations. Operating at very high data rates, LANs provide the instantaneous computer communications needed for interactive applications. However, connecting LANs at different locations today requires either very expensive digital private lines or very slow communications over the voice network. New services such as the Switched Multi-megabit Data Service (SMDS) may soon provide an economical, high-performance solution.

Voice/Data:

New developments such as ISDN, Signalling System 7, and the enhanced network, will enable improved voice and data services. For voice, digital access promises better quality, advanced signalling capabilities, and, eventually, lower CPE and network costs. For data, it promises higher-speed, more reliable, and more economical communications compared to even the best modems at any price. A key issue: When will access costs and equipment costs fall to the level required for universal ISDN service?

Video Communications:

Video communications is a reality today, albeit an expensive one. Falling costs for digital transmission, video codecs, and video and electronics components will make desktop, as well as conference room, video communications more economical. Video conference calls, complete with graphical interfaces for control, will ameliorate many of the problems with today's audio conference calls. Tried and found lacking in the 1960s, widespread video communications may finally emerge in the 1990s, a product of the continuing revolution in computers, fiber optics, and consumer video electronics.

Television:

A number of important technical, economic, business, legal, and regulatory issues need to be resolved before a clear picture emerges of the telephone companies' future role in the provision of television via fiber to the home. However, both the benefits for consumers and the network impact are potentially tremendous. Although all issues will be considered, the focus will be on technological, economic, and marketing aspects of providing transport for standard CATV broadcasting and pay-per-view narrowcasting.

Advanced Television:

Advanced Television (ATV) refers to new types of television that offer greater resolution and broader formats than conventional TV. The term ATV is used instead of the more familiar HDTV to avoid confusion with any particular system. Potential revenues and network impact of fiber delivery are even greater for ATV than standard TV, although more distant and uncertain. Key issues include standards, display technologies, economics, market acceptance, and alternative delivery mechanisms—including optical disk systems.

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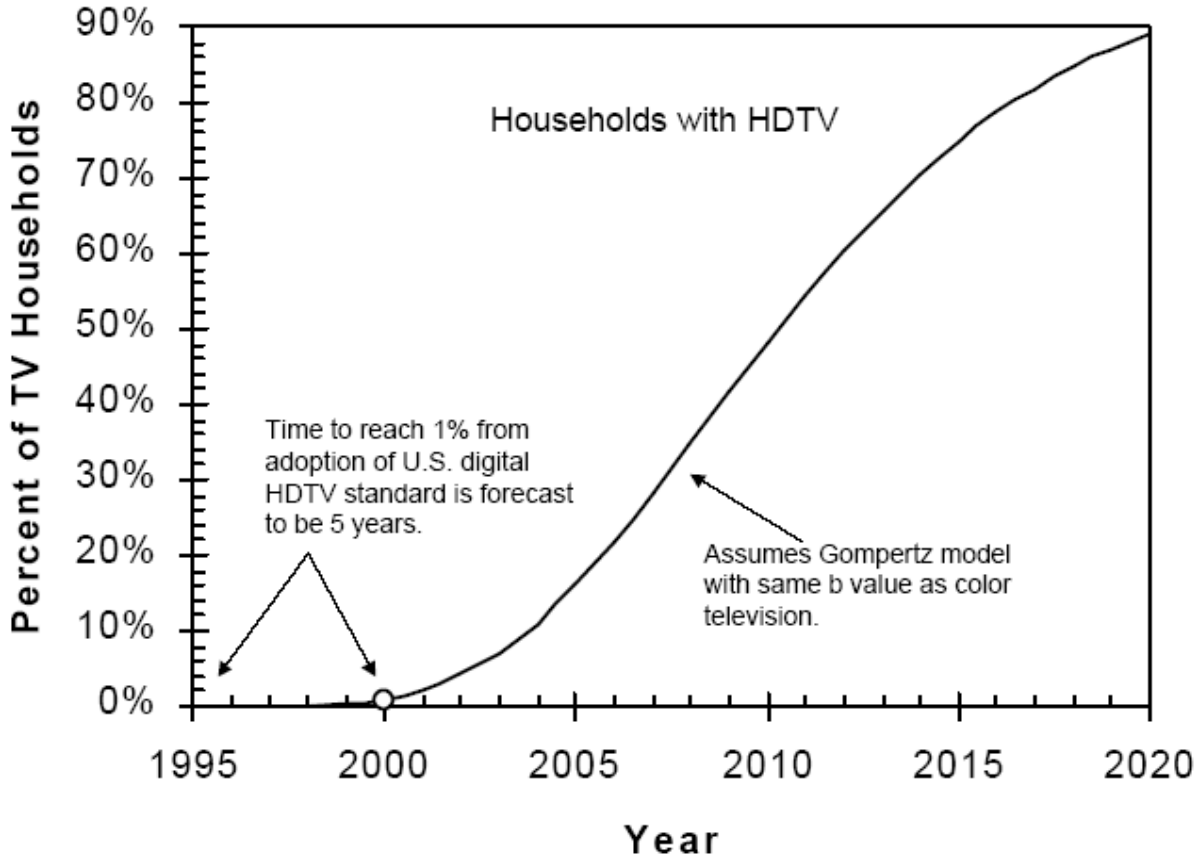
U.S. HDTV Households (1992 TFI Forecast)



Source: Technology Futures, Inc.

Lawrence K. Vanston, Curt Rogers, and Ray L. Hodges, *Advanced Video Services—Analysis and Forecasts For Terrestrial Service Providers*, Technology Futures, Inc., 1995, p. 106. This graphic appears in *Introduction to Technology Market Forecasting*, 1996, p.25.

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Exhibit 9.2
Substitution Patterns for Wideband and Broadband Multimedia Communications Services

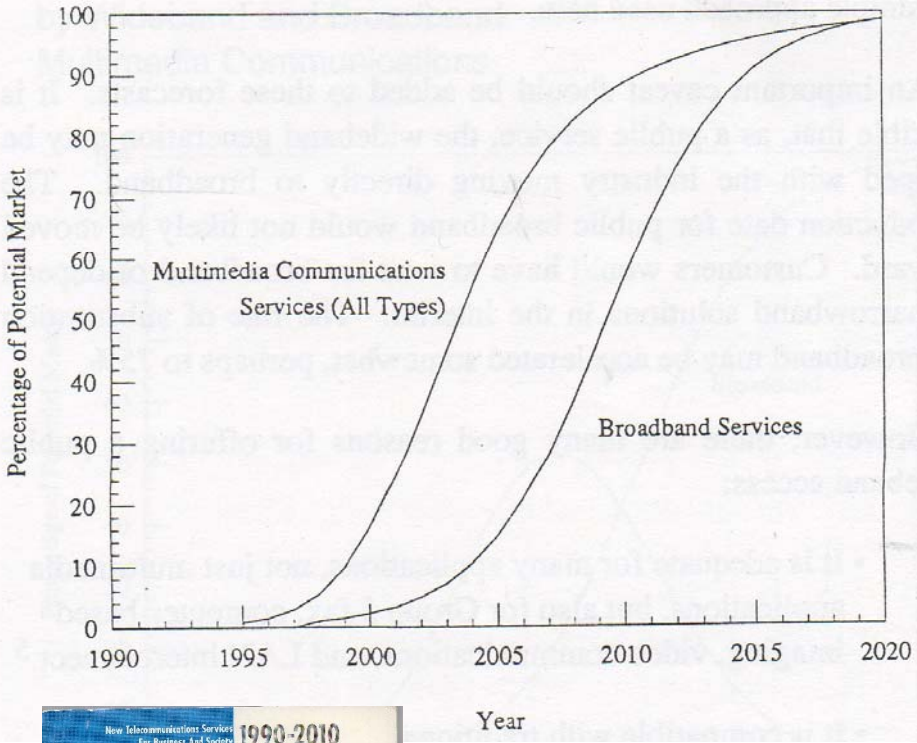
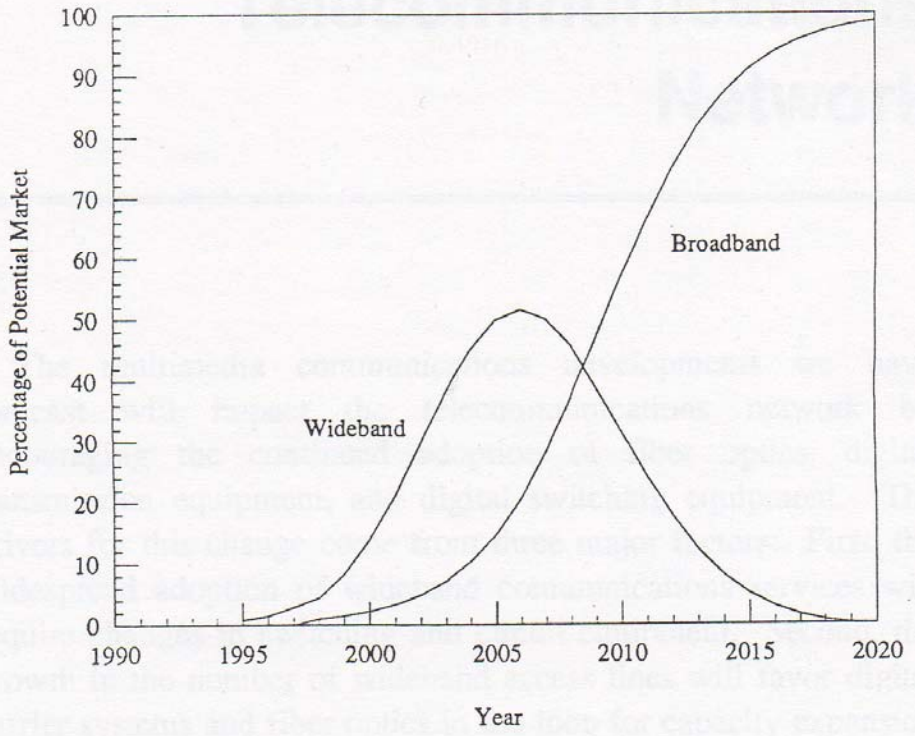
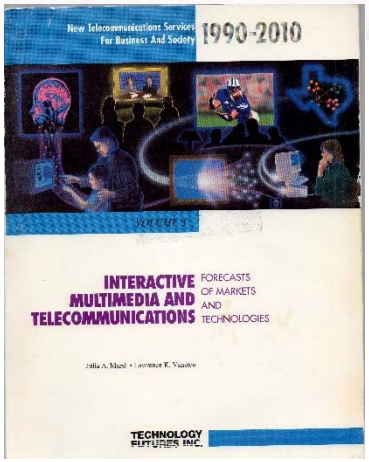


Exhibit 9.3
Percentage of Potential Market Served by Wideband and Broadband Multimedia Communications





1992 TFI Multimedia Study

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4 New Major Driving Forces

Humans	⟹	Machines
Slow Data	⟹	Fast Data
People Communicating	⟹	Things Communicating
Computing	⟹	Cognitive Computing

For complete list, please see appendix

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Humans ⟹ Machines

Robots




Self Driving Vehicles

Drones

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Agricultural Robots

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Rescue Robots

Military Robots












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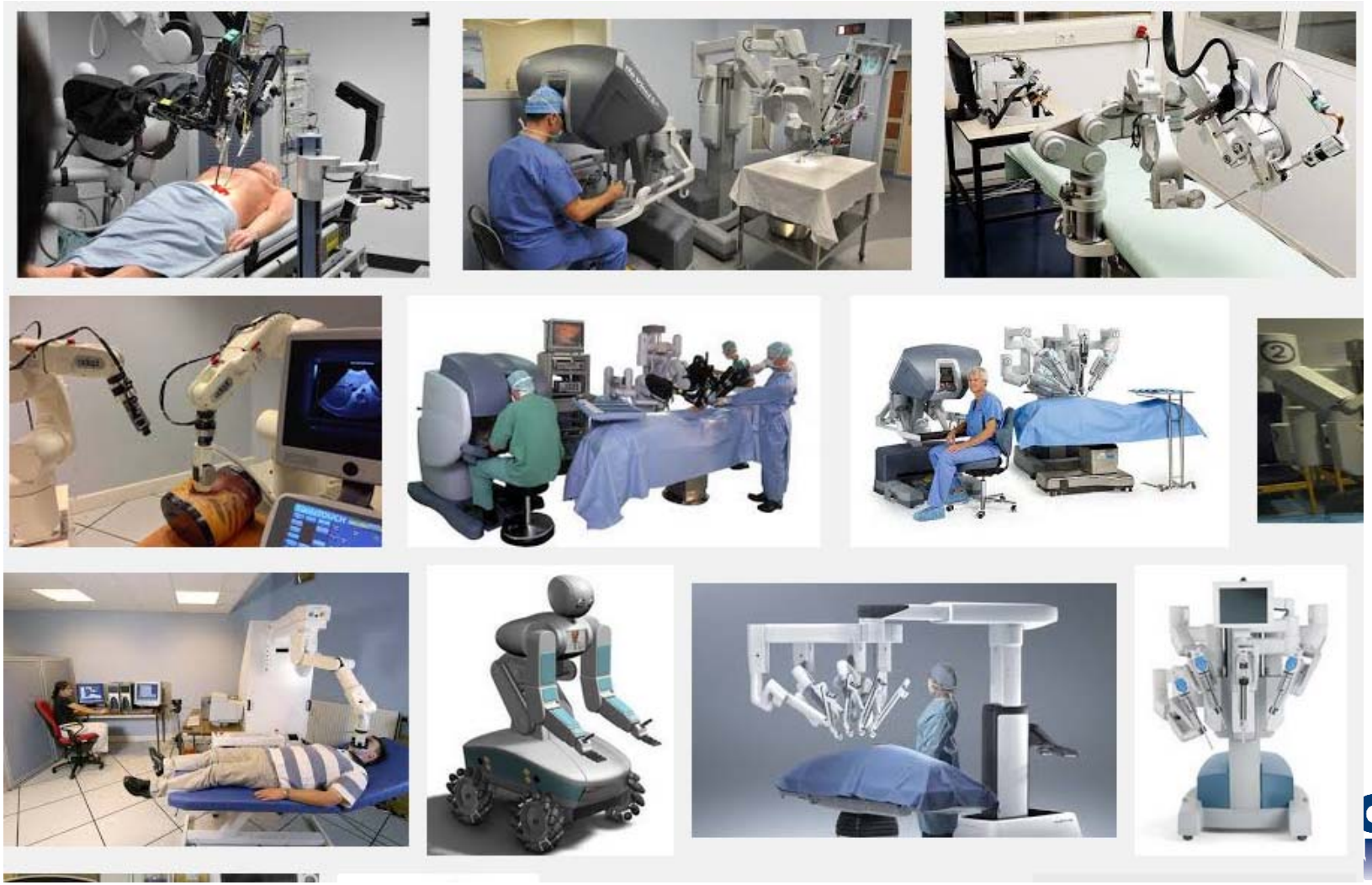
Medical Robots



Telepresence Robots

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Computing ⟹ Cognitive Computing

Cognitive computing refers to systems that learn at scale, reason with purpose and interact with humans naturally. Rather than being explicitly programmed, they learn and reason from their interactions with us and from their experiences with their environment.

Source: John E. Kelly III, "Computing, cognition and the future of knowing", IBM, 2015

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Cognitive Computing Tools

- Machine Learning
- Data Mining
- Pattern Recognition
- Natural Language Processing

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National Science Foundation

INTELLIGENT COGNITIVE ASSISTANTS

Workshop Summary and Recommendations

May 2016

Abstract

A workshop to identify the most critical research needed to create Intelligent Cognitive Assistants: platforms which augment human capabilities.

The group reached a consensus around the concept of Intelligent Cognitive Assistants that complement, rather than replace, human capabilities.

Three scenarios were described –life- long education, group work, and elder care – that incorporate sensitivity to these research parameters in complex social environments, and which require interdisciplinary research to fully address.

https://www.nsf.gov/crssprgm/nano/2016-1001_IntelligentCognitiveAssistants_Workshop_2016_Final_Report.pdf

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In fact, there is a very high likelihood that some of the most historically significant twenty-first century struggles will be over the control of such intelligent assistant systems and the data that is used to teach them – struggles between individuals, corporations, and governments.

Therefore, a public-private partnership within the United States between government, industry, and academia is absolutely essential to drive new fundamental research towards the most appropriate, effective and publicly responsible 'Intelligent Cognitive Assistant' solutions needed to solve our most critical challenges

.

https://www.nsf.gov/crssprgm/nano/2016-1001_IntelligentCognitiveAssistants_Workshop_2016_Final_Report.pdf

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Kognit – Cognitive Assistants for Dementia Patients

http://www.slideshare.net/diannepatricia/kognit-cognitive-assistants-for-dementia-patients

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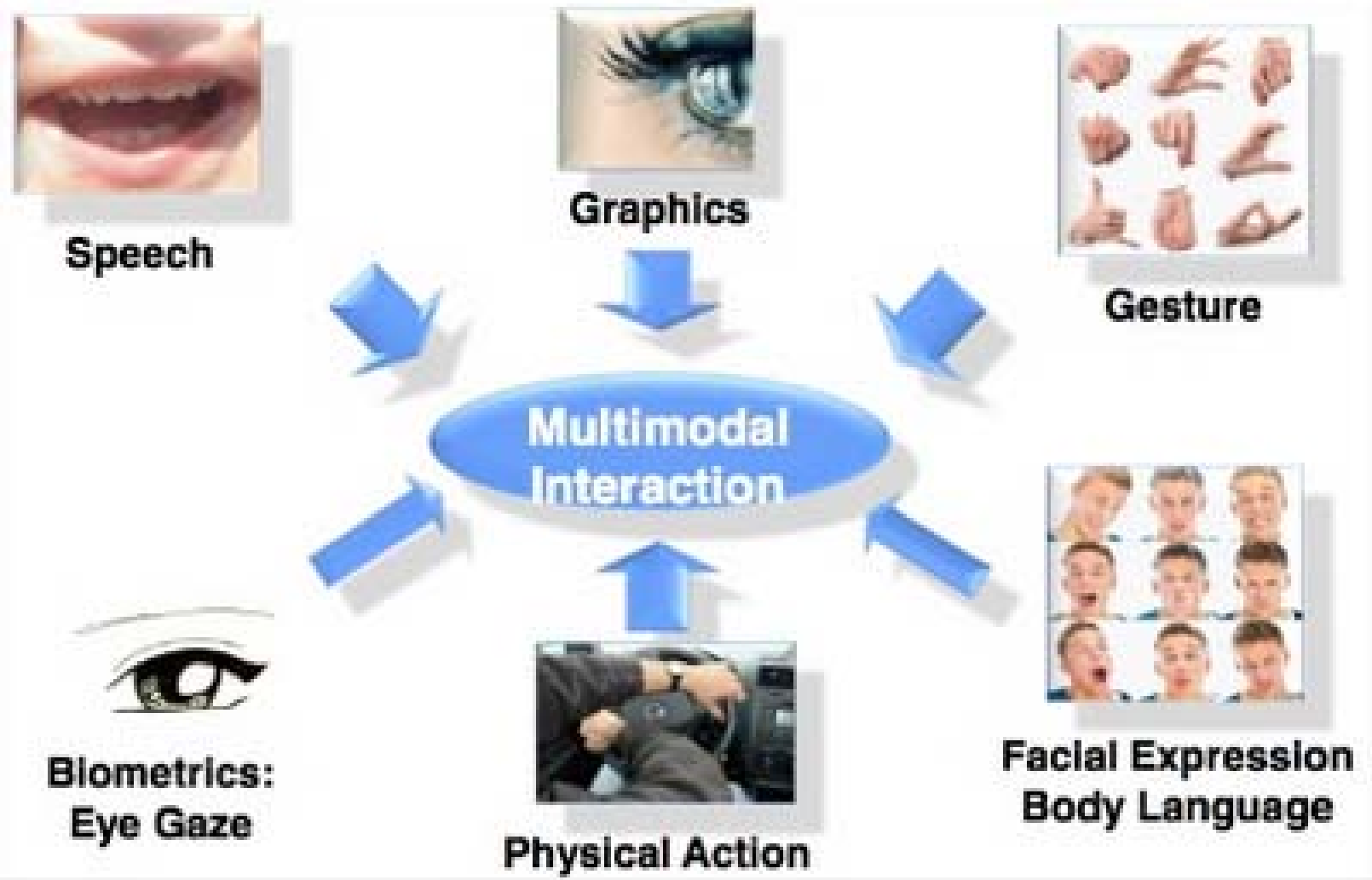
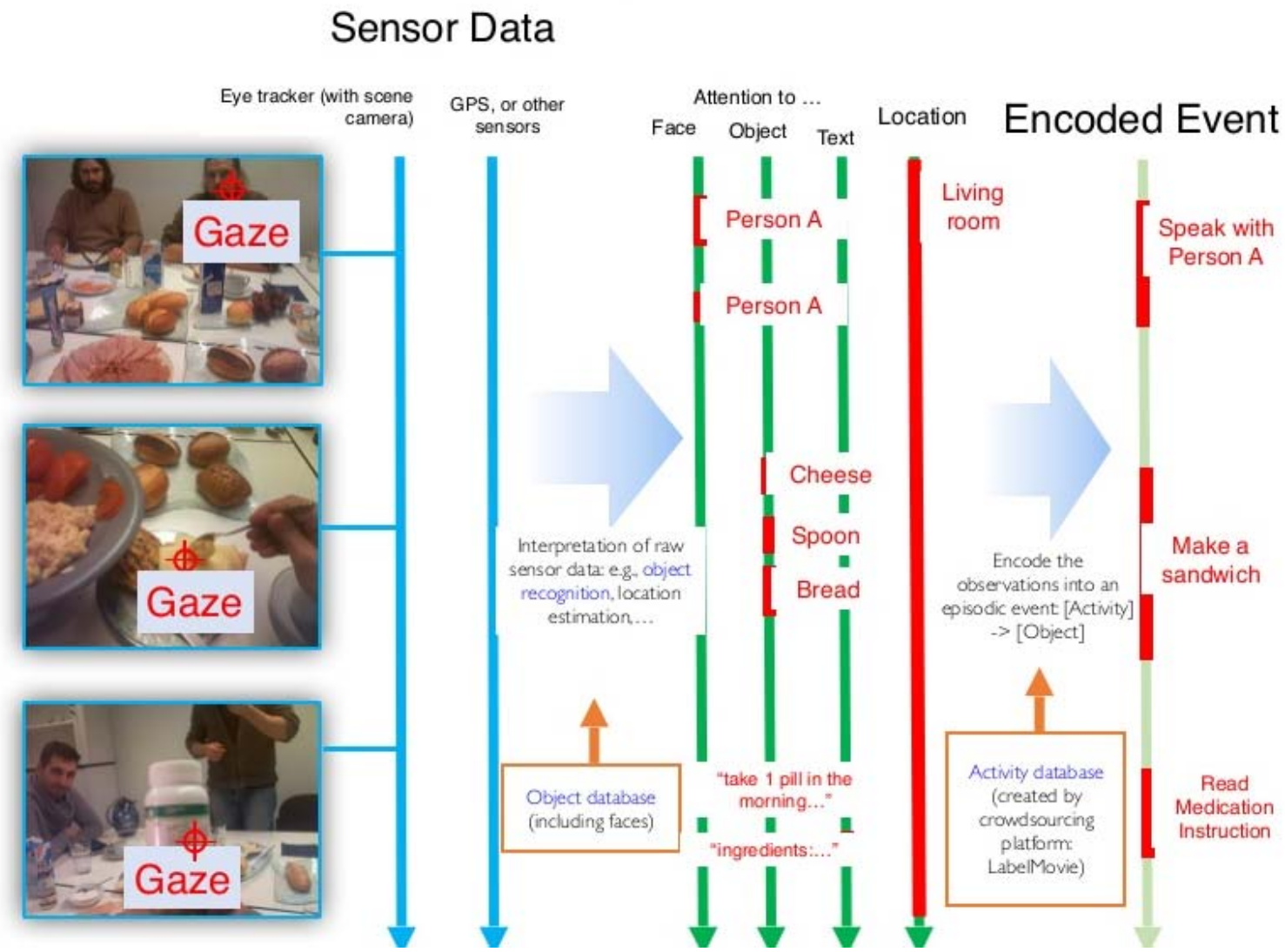


Multimodal Multisensor Interfaces

http://www.slideshare.net/diannepatricia/kognit-cognitive-assistants-for-dementia-patients

Episodic memory event encoding model (Breakfast Scenario)



http://www.slideshare.net/diannepatricia/kognit-cognitive-assistants-for-dementia-patients

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The Kognit Storyboard:

Cognitive Models and Mixed Reality for Dementia Patients

Dr. Daniel Sonntag

http://kognit.dfki.de

https://vimeo.com/132704158

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THE FUTURE OF EMPLOYMENT: HOW SUSCEPTIBLE ARE JOBS TO COMPUTERISATION?*

Carl Benedikt Frey† and Michael A. Osborne‡

September 17, 2013

According to our estimates, about 47 percent of total US employment is at risk. We further provide evidence that wages and educational attainment exhibit a strong negative relationship with an occupation's probability of computerisation.

†Oxford Martin School, University of Oxford,
‡Department of Engineering Science, University of Oxford.

http://www.oxfordmartin.ox.ac.uk/downloads/academic/The_Future_of_Employment.pdf

https://futureoflife.org/data/PDF/michael_osborne.pdf

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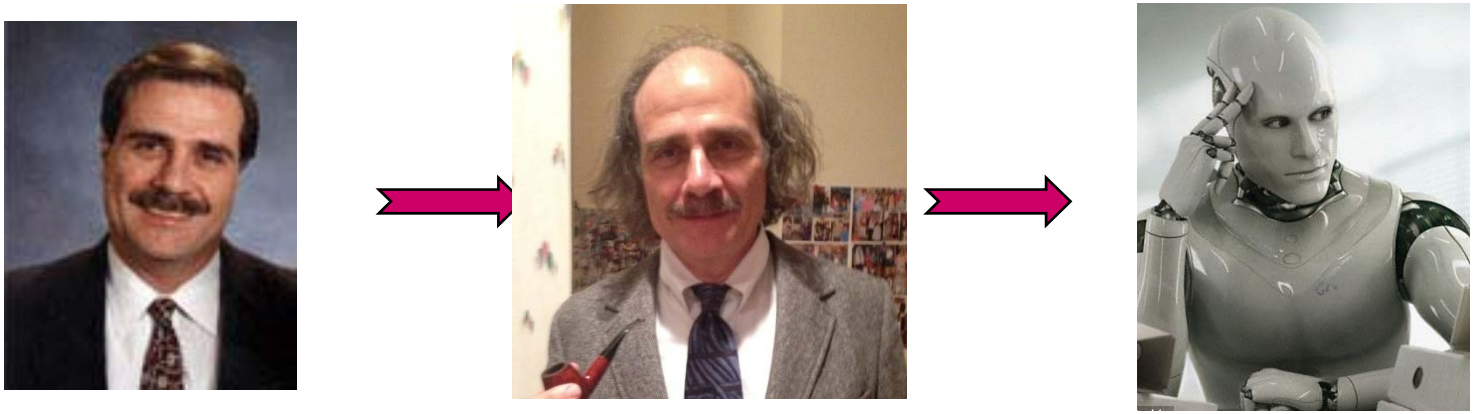
Fundamental Driving Forces Summary



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Epilogue

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Forecasting Technology

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ISIS di Setificio "Paolo Carcano"
Wednesday, 1 June, 2016
via Castelnuovo 5
Como, Italy

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~~4~~5 New Major Driving Forces

Humans	→	Machines
Slow Data	→	Fast Data
People Communicating	→	Things Communicating
Computing	→	Cognitive Computing
Screen-based	→	Augmented/Virtual Reality

For complete list, please see appendix

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Implications

- Mutually reinforcing trends
- Rapidly increasing performance requirements
- Rapidly improving technologies
- Widespread and massive investments
- Frequent upgrades and rapid obsolescence
- Tremendous potential employment disruptions

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APPENDIX

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Fundamental Driving Forces - 1990s View

Physical Movement	→	Telecommunications
Analog	→	Digital Communications
Low Bandwidth	→	High Bandwidth
Niche Markets	→	Mass Markets
Mass Marketing	→	Niche Marketing
Wireline	→	Wireless
Electronic	→	Optical

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(continued)

Dedicated Networks		Integrated Networks
Circuit Switching		Packet Switching
Closed Systems		Open Systems
Single Media		Multimedia

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New Fundamental Driving Forces

Humans	→	Machines
Small Data	→	Big Data
Client/Server	→	Cloud Computing
Slow Data	→	Fast Data
People Communicating	→	Things Communicating
Computing	→	Cognitive Computing
Commonality	→	Personalization
Deterministic	→	Probabilistic
Screen-based	→	Augmented/Virtual Reality

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These overlap & support each other!

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