III. Research and Development

1. Global R&D Strategies

Recently, issues relating to global sustainability such as global warming, resources and energy are being discussed as a common challenge facing all of humankind. For Japan, another pressing issue is how to maintain international competitiveness and sustain a safe and prosperous society in the face of a decreasing workforce and the rising competition from BRICs nations.

To overcome such global issues and create an internationally competitive industry, the Hitachi Group R&D strategy focuses on: (1) generating innovation for the creation of new industries; (2) commitment to maintain and strengthen the MONOZUKURI* industry; (3) speeding-up global deployment; and (4) foster global and innovative human resources. (Fig.3.1)

*MONOZUKURI: Japanese term which represents the total manufacturing solution including software and hardware know-how, and development expertise.

Hitachi group promotes R&D activities in a wide range of fields from information & telecommunication systems to financial services. In FY 2007, the Hitachi Group invested 428.1 billion yen in R&D, which represents approximately 3.8% of revenue (R&D investment of 435 billion yen (3.9%) projected for FY 2008). R&D investment by business sector was largest for the Information and Telecommunication Systems segment, representing approximately 5.6% of segment revenue. Also, in recent years, research in the Power and Industrial Systems segment is being fortified. (Fig. 3.2)

Fig .3.1 Global R&D strategy supporting further new growth in the Hitachi Group

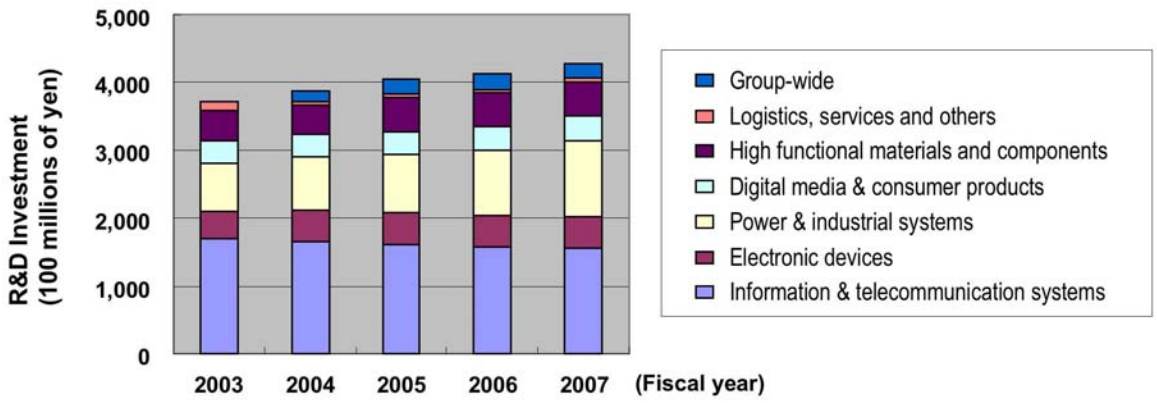

Fig. 3.2 Trends of R&D Investment

The management vision of the Research & Development Group is an organization generating world top-class and "only-one" technology, as well as ensuring return on R&D investments. The vision includes the growth of Hitachi as a company renowned for its technology, identifying R&D as the source of corporate value and prosperity, and placing strong emphasis on research management.

An "Fortifying research matrix" consisting of 5 technology fields and 5 business fields, totalling 25 areas, is established in prioritizing research to visualize and substantiate priority resource allocation.

2. R&D Organization

In the Research & Development Group, there are 6 corporate laboratories and affiliated R&D facilities overseas, with approximately 3,000 R&D staff, with the mission of (1) expanding current business; (2) generating new business; and (3) creating innovative new technology. (See Fig. 3.3)

Further, this organization serves as the R&D hub for the Hitachi Group, with schemes such as the "Technology Platforms across the Hitachi Group" established to gather researchers from Group companies and engage in R&D activities with business divisions and even customers. (See Fig. 3.4). The Platform provides horizontal technological links forming the core of Hitachi's MONOZUKURI

Fig. 3.3 Corporate laboratories

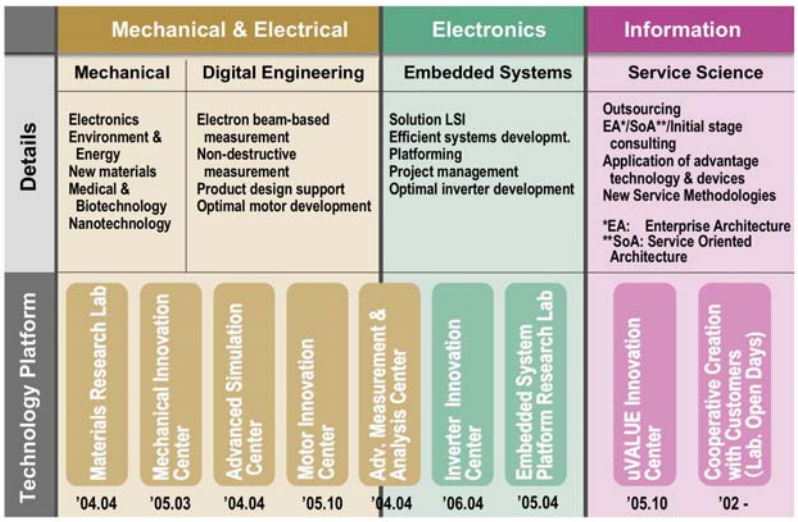

Fig. 3.4 Technology platforms across the Hitachi Group supporting MONOZUKURI innovation

innovation, and the development of human resources contributing to group businesses.

To accelerate R&D (30% reduction in development time), the Research & Development Group in cooperation with the "the Supervisory Office for MONOZUKURI" have been promoting laboursaving design process based on automatically generated analysis model (analysis-led design). Since September 2007, this process is being applied to the express train for the overseas market and next-generation Shinkansen.

The Research & Development Group is also introducing advanced technologies for the innovation of MONOZUKURI, such as high-speed detection of flaws and defects in process and equipment in coordinated with statistical data (data-linked MONOZUKURI) and application of the phase-gate system.

3. Fortifying Growth Strategies

Since 1989, Hitachi has been establishing overseas R&D facilities in the US, Europe, Singapore and China, to accelerate globalization. The mission of these facilities is to (1) contribute to local business operations; (2) promote R&D focused on local needs of the host region; and (3) collaboration with highly-skilled local personnel and centers of excellence such as universities (See Fig. 3.5) Emphasis is placed on the development of global and highly-skilled human resources, which active local recruitment and appointment to leadership positions.

As part of R&D activities to pioneer global businesses, Hitachi has engaged in joint research with universities in Japan, Germany, and the U.S. to develop de facto technologies in the environmental field. As global competition intensifies in the field of coal-thermal power plant, pilot tests are being planned for CO_2 collection in 2009. Also, Hitachi has been conducting joint research with IBM since February 2008 to develop basic sub-32nm semiconductor technology. To promote R&D customized for U.S. automotive manufacturers and take advantage of the strengths of Hitachi's R&D, the Automotive Products Research Laboratory was established to identify latest customer needs, respond promptly to those issues, and deliver of evaluation models.

The Research & Development Group is also promoting R&D activities to implement "Environmental Vision 2025" (See Chapters IV and V) as part of its growth-oriented R&D strategies. Development of core environmental and energy conservation technologies based on the conglomerate strength of Hitachi Group synergy, such as (1) technology to

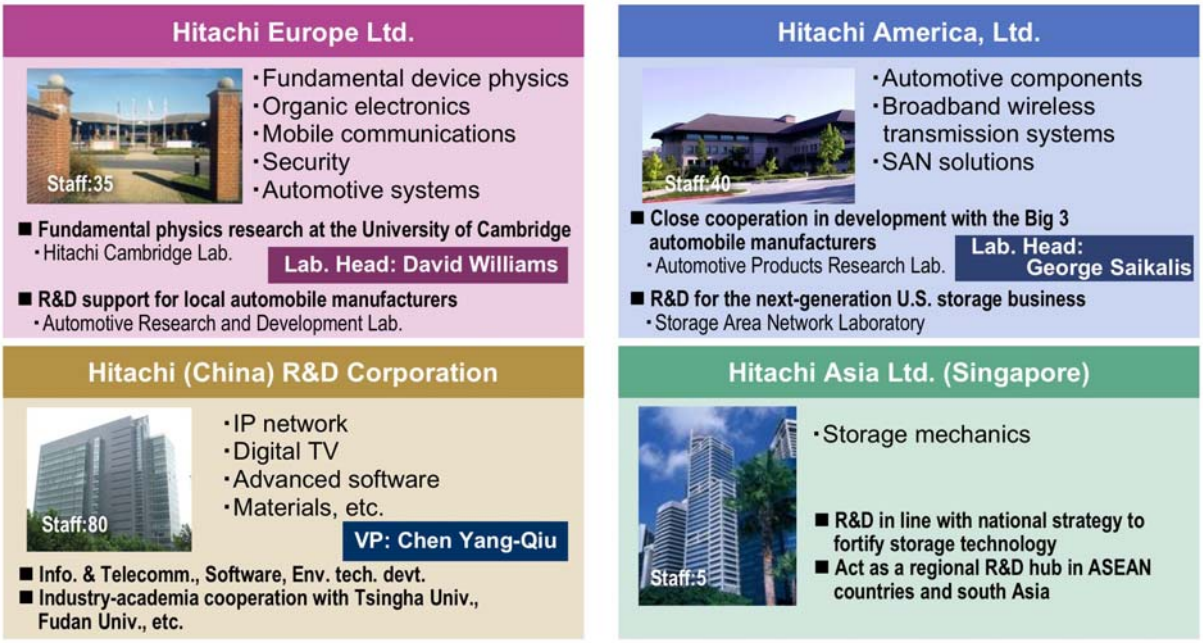

Fig. 3.5 Fortify overseas R&D centers

reduce CO_2 emission through efficiency-enhanced coal-thermal power plants and collection of fossil-fuel CO_2 emissions; (2) energy-conservation technology such as a low-power multi-core LSI and energy-efficient IT equipment; (3) HEV (hybrid electric vehicle) technology such as high-output lithium-ion battery, low-loss inverters and high-output motors; and (4) high-temperature lead-free solder and lead-free glass, are being aggressively pursued as technology to reduce environmental burden. (Fig. 3.6)

4. Creation of Innovative Technologies

The 20th century was the era of industry led by science; where society, people, and science & technologies interacted with each other and innovations were brought about. The Hitachi Group believes that the 21st century will be the "Century of prosperous human " where new business and technologies will emerge to support a clean energy industry, human-centric business, consumer appliances and industry gentle on humans, an ambient information society, and lifelong healthy society. (Source: Innovation 25 Strategy council material, etc.)

R&D activities for the century of human affluence, as illustrated in Fig. 3.7, include research in: (1) brain science (brain activity measurement, and brain machine interface) for the development of digital media and consumer products which operate as desired or have an interface which can detect the users intentions; (2) nanoelectronics

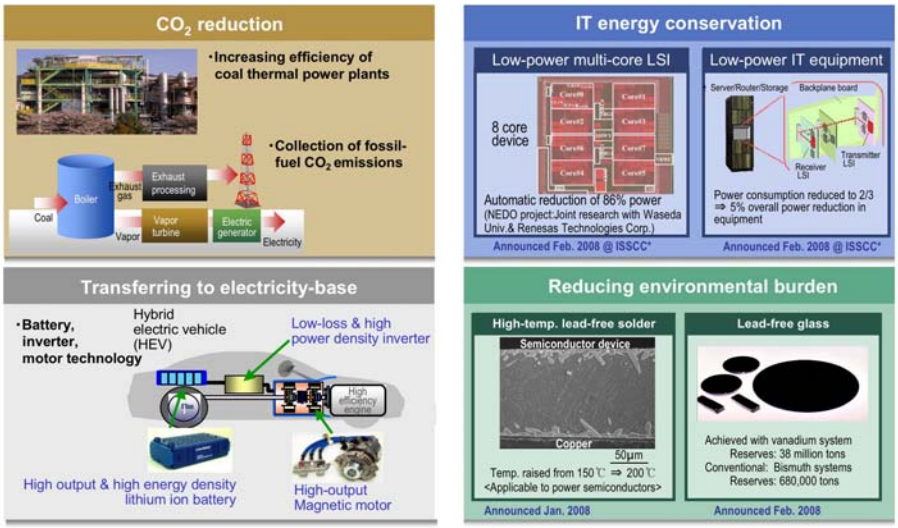

Fig. 3.6 Core technology for environment & energy

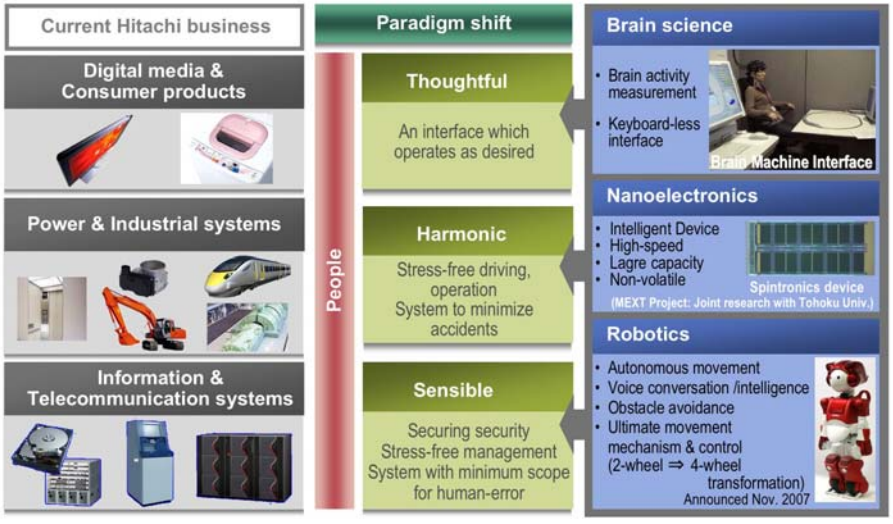

Fig. 3.7 R&D for a century of prosperity: MONOZUKURI

(intelligent devices with decision-making functions) to contribute to the power and industrial systems by the development of stress-free driving or operation, and accident-free system; and (3) interactive robotics as an application of secure, stress-and human-error-free information systems.

Furthermore, technology is being developed to produce new service businesses for the "century of human affluence", such as (1) *Business-Microscope* which visualizes business activity for productivity improvement services; (2) Finger vein authentication technology incorporated steering wheels to achieve key-less motor vehicles, and Wearable Optical Topography to measure brain function during daily activities, for safety and security services; and (3) *Life-Microscope* for long-term visualization of daily rhythms (e.g. temperature, movement, and pulse) and HALSMA* diet technology, an online system for effective diagnosis of metabolic syndrome by medical practitioners, for health-support services. (See Fig. 3.8)

* HALSMA: Hitachi Associates Life Style Modification & Action

Human-centered R&D for new businesses will continue to be a major focus and target of continued priority in R&D activity.

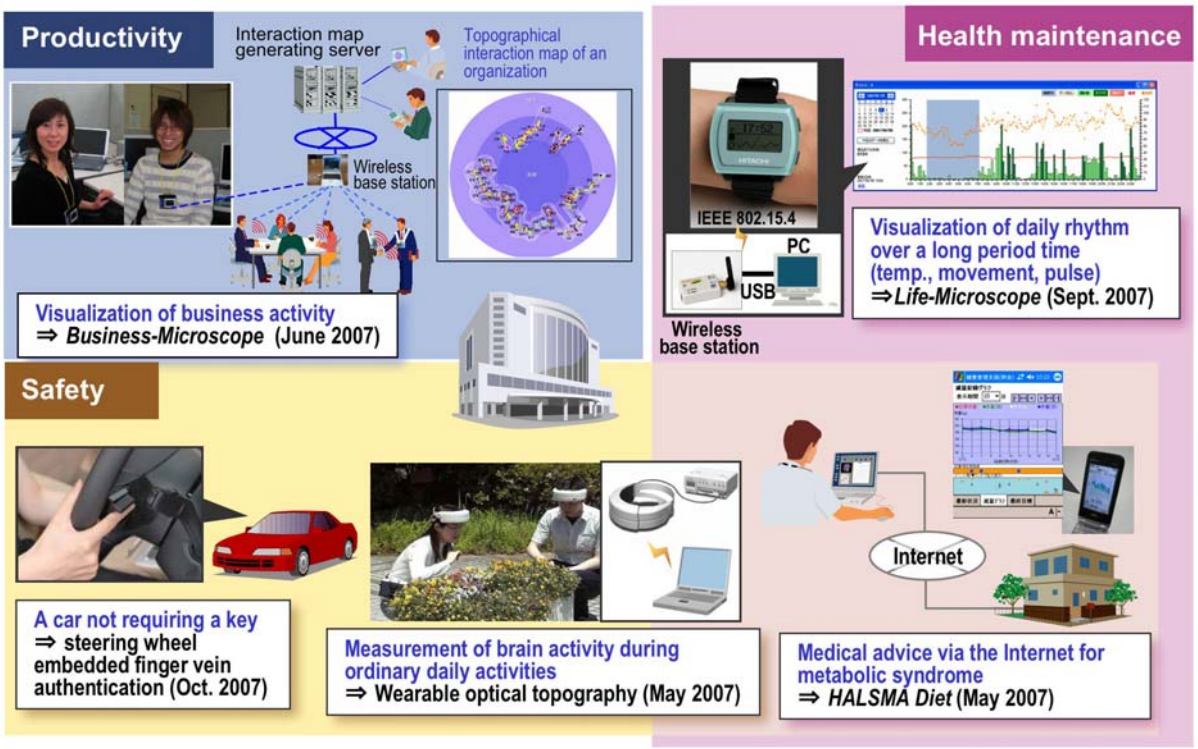

Fig. 3.8 R&D for a century of prosperity: Services (Lifestyle, Business, and Health)