PM Masashi Sahashi is taking on the challenge to realize ultimate Green IT Devices with long usage times between charges.

Masashi Sahashi - Program Manager (PM)

1974 Graduate, Nagoya University Master's Course
2002 Doctorate, Engineering (Nagoya University Graduate School)
1974 Researcher, Toshiba Research& Development Center
From 1999 Senior Fellow , Toshiba Research& Development Center
From 2003 Professor, Tohoku University Graduate School of Engineering

As a Corporate Project Manager at Toshiba, Sahashi developed the world's first HDD with a GMR head and guided its commercialization, which garnered him the Nikkei BP Technology, Grand Awards, the Onshi Invention Award, and the Shijuhosho (Medal of Honor with Purple Ribbon). After his university career, he has been promoting high-risk revolutionary basic research and transplanting the seeds of new businesses at companies.

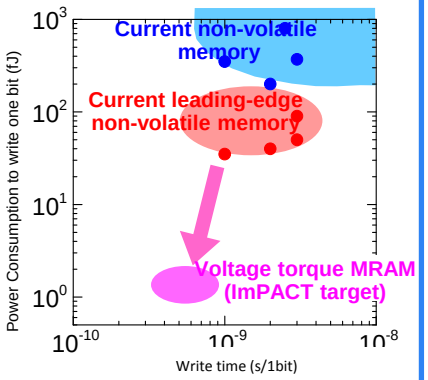
Disruptive Innovation

✓ Keys to the breakthrough

· Today's mainstream large-capacity memory DRAMs and non-volatile memory MRAMs that are in development require large currents for writing information, which limits their energy efficiency.

· Developed the Voltage Torque MRAM, a new type of high-speed and energy-efficient memory that can write information with voltage and store the information for long periods.

· With zero standby power consumption and operating power consumption that is 1/100th of existing memory, the ultimate in green IT has been achieved.



The Challenges for the PM and the Impact of Success

✓ Overview and background

· Today's mobile IT devices require frequent charging.
· The number of charger devices that are left plugged in at the home and office is exploding.
· Risk of loss of access to emergency information during a large-scale disaster or prolonged power outage.

✓ What is the impact to industry and society if achieved?

· Dramatically reduce IT device power consumption by using magnetic memory transistors that use voltage to record information and that can store the information for long periods to enable a comfortable lifestyle free of recharge anxiety.
· Realize a safe and secure IT society where information is accessible during large-scale disasters and prolonged power outages through a distributed spintronics IT system that is powered by harvested energy.

Today's electronics are *"volatile"*
(Information is lost when powered off)
Large standby and operating power consumption

The future envisioned by ImPACT
The ultimate ***"non-volatile"*** green IT device
(Memory stored even without power. 1/100th power operation of today's device.)
Mobile IT devices usable for over 1 month between charges
Eliminate sensor network battery replacements

Mobile devices w/o need of charging / Distributed intelligence

Mobile IT devices that require frequent charges

Increasing number of devices that are left plugged in

The problem of large-scale disasters or prolonged power outages

· **Elimination of charger devices that are left plugged in**
· **Safe and secure IT society where information is accessible during large-scale disasters or prolonged power outages**
· **Discontinuous innovation to revive Japan's electronics industry**

Scenario for Success and Achievement Targets

✓ Method of resolution for success (Approach)

· Achieve voltage control of magnetic storage layers utilizing leading-edge spintronics thin film technology , physics and fabrication technology for elements.
· Comprehensively engage in the implementation of non-volatile functions in all layers of use, including cloud and mobile storage, memory and cache, and math processing, and engage in the development of ultra-low power and current writing technology (merging of magnetism and semiconductors).
· Real progress has been made in the last several years in basic research on voltage spintronics, which has now undercut 1 femtocoulomb of electric charge to write 1 bit of information.

✓ Management strategy

· Clarify the aim of each project and the commercialization target.
For the development of common fundamental technologies, accelerate the pace of development by implementing principles of cooperation and competition, and introduce new methods by calling for participants.

✓ Achievement targets

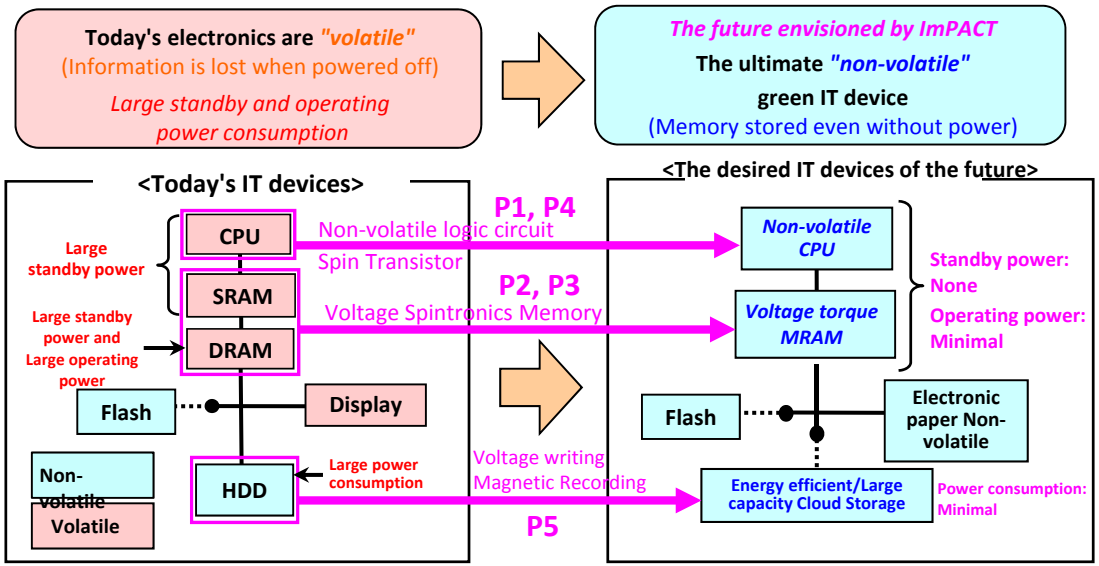
· Create a pioneering and overwhelming differentiating technology in the memory and PC business markets, overtake the market, and gain an outlook on achieving ultimate green IT devices.
· Attain low power consumption that is a magnitude less than compared with DRAMs and STT-MRAMs, and break through the scaling limit (10 nm generation cache/memory (MRAM)).
· Develop an ultra-high energy efficient microcomputer.

✓ Risks

· Achieving magnetic control through voltage will require elucidation of the physics involved, such as of voltage effects on interface.
· Management to run multiple large projects simultaneously.

Achieving ultimate Green IT Devices with long usage times without charging (PM Masashi Sahashi)

Overall research and development program structure created by the PM



P1: Spin FET project

P2: Voltage torque MRAM project

P3: Single crystallization / High integration / 3D project

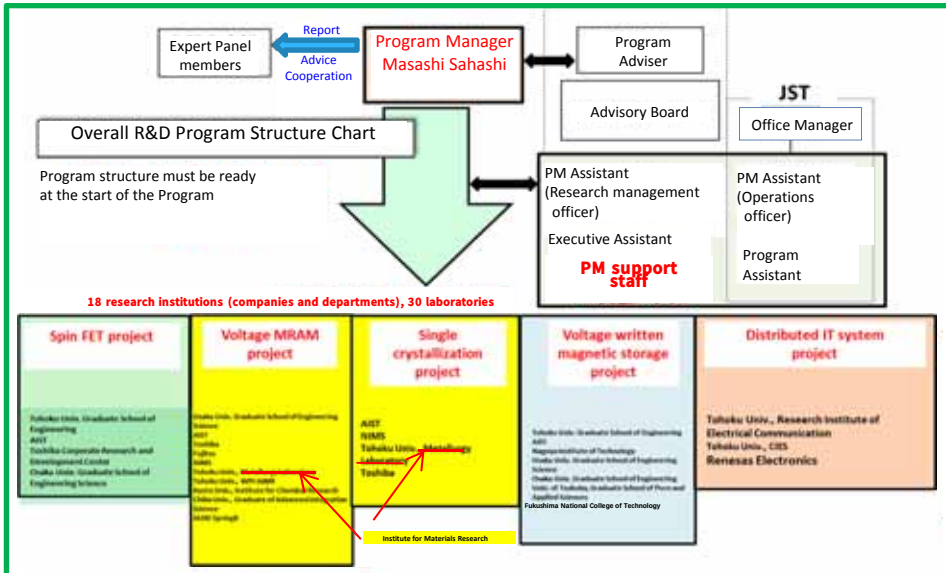
P4: Spintronics integrated circuit / Distributed IT system project

P5: Cross correlation voltage writing magnetic storage project

Total R&D Program Cost
JPY4.0 billion

- May increase/decrease depending on development progress
- Expenses required for PM activities and support will be provided as a separate allowance.

Implementation Structure as Assembled by the PM



✓ Keys of the Implementation Structure

· Placed projects to cover each layer of IT including math processing (spin transistors, integrated logic circuits), cache and main memory, and cloud storage and appointed PLs who have a track record in leading research and were central to the research achievements. Laid out a formation of personnel capable of achieving overwhelming differentiation for the program in a globally and competitively cutthroat field.

· Established an advisory board comprising multiple experts. Provided a stage gate for all projects by establishing an intellectual property capability meeting and making technical competitiveness a criteria.

✓ Approach to selection of institutions

This program, which requires large facilities, has a hub type structure based on the premise of common utilization of existing facilities along with newly installed facilities, with direct invitations to the institutions that have researchers who have made outstanding breakthroughs. The institutions are also capable of competitively and aggressively participating as a satellite for each project. Tohoku University, Osaka university, Toshiba, and AIST are organizations with affiliated researchers who are central to their globally leading research and are indispensable as satellite institutions.