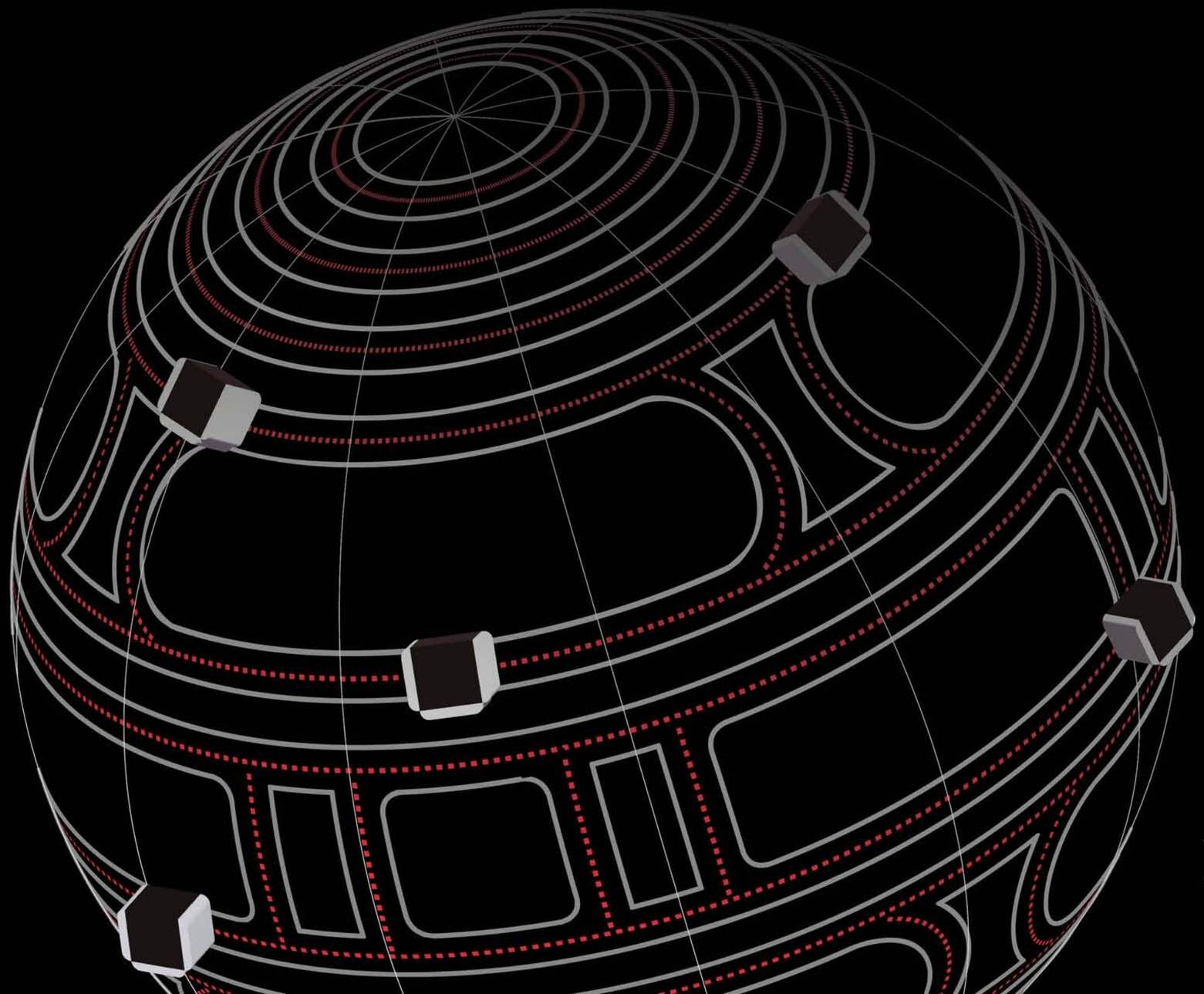
# 5 OPERATIONAL *Highlights*



The total daily travel distance of TSMC's AMHS vehicles is equivalent to circling the Earth 40 times.

## 5.1 Business Activities

### 5.1.1 Business Scope

As the founder and a leader of the dedicated semiconductor foundry segment, TSMC provides a full range of integrated semiconductor foundry services, including leading advanced process, specialty technologies, advanced mask technologies, TSMC 3DFabric™ advanced packaging and silicon stacking technologies, excellent manufacturing productivity and quality, as well as comprehensive design ecosystem support, to meet a growing variety of customer needs. The Company strives to provide unparalleled overall value to its customers and views customer success as TSMC's own success. As a result, TSMC has gained customer trust from around the world and has experienced strong growth and success of its own.

In 2022, TSMC developed or introduced the following technologies:

**Logic Technology**

- 2nm (N2) technology development is on track and making good progress. N2 technology features TSMC's first generation of nanosheet transistor technology with full-node strides in performance and power consumption. Volume production is expected in 2025.
- 3nm fin field-effect transistor (FinFET) (N3) technology started volume production in the second half of 2022 as planned.
- N3E technology, an enhanced version of N3 technology, will continue to provide industry-leading advantages for both mobile communication and high-performance computing (HPC) applications. Volume production is expected in the second half of 2023.
- 4nm FinFET (N4) technology, an enhanced version of 5nm FinFET (N5) technology, started volume production in 2022.
- 4nm FinFET Plus (N4P) technology development is on track and making good progress. Customer product tape-outs were received in 2022 and volume production is expected in 2023.
- N4X technology, introduced in 2021, is TSMC's first high performance computing (HPC)-focused technology, representing the ultimate performance and maximum clock frequencies in TSMC's 5-nanometer family. It is expected to receive customer tape-outs in 2023.
- 5nm FinFET Plus (N5P) technology, a performance-enhanced version of 5nm technology (N5), entered its second year of volume production in 2022 for customers' smartphone and HPC products.
- 6nm FinFET (N6) technology entered its third year of volume production in 2022 and was widely adopted for customers' smartphone, HPC, and consumer electronics products.
- 7nm FinFET (N7) and 7nm FinFET plus (N7+), which have been in volume production for customers' 5G and high-performance computing products for several years, entered their second year of volume production for customers' consumer electronics and automotive products in 2022.
- N12e™ technology, which leverages TSMC's 12nm FinFET compact plus (12FFC+) baseline, started volume production in 2021. Following this, N12e™ technology introduced innovative low-leakage input/output (IO) devices in 2022 and is planned to start risk production in 2023.
- 22nm ultra-low leakage (22ULL) technology introduced new enhanced low leakage in 2021 and has been applied to IoT products since 2022.

**Specialty Technology**

- 5nm FinFET Automotive (N5A) technology, an automotive qualified version of 5nm technology (N5) with automotive design enablement platform, completed technology and IP AEC-Q100 qualification and certified by ISO 26262: Functional Safety – Road Vehicles Standard in 2022. Customer product tape-outs are expected to start in 2023.
- N6 radio frequency (N6 RF) technology received multiple customer product tape-outs in 2022. In addition, the second generation N6 radio frequency (N6 RF+) technology is under development, and its process design kit (PDK) is expected to be completed in 2023.
- 12FFC+ RF technology version 1.0 simulation program with integrated circuit emphasis (SPICE) model and PDK were released in 2022. This technology was developed on the same logic process platform as N12e™ technology and targets IoT wireless connectivity applications and the second wave mobile RF customers.
- 16FFC FinFET compact (16FFC) RF technology received multiple customer tape-outs in 2021. The development of its enhanced version (Enhancement I/II) was completed in 2022 to support applications such as 28/39/47GHz mmWave RF front-end module and 77GHz/79GHz automotive radar.
- 16FFC embedded magnetoresistive random access memory (MRAM) technology completed reliability qualification in 2022, with one million cycles endurance and reflow capability. This technology is ready for production and is expected to pass AEC-Q100 Grade-1 reliability qualification in 2023.
- 22ULL and 28ULL embedded resistive random access memory (RRAM) technologies, TSMC's second generation of RRAM solutions, featured balanced cost and reliability. Several customers qualified products with these technologies and started volume production in 2022.
- 40nm Silicon on Insulator (N40SOI) technology on 12-inch wafers, which provides industry-leading competitive advantages, received multiple customer tape-outs in 2021 and started volume production in 2022.
- 6-inch gallium nitride (GaN) on silicon technology successfully passed customer product quality and reliability qualification. In 2022, this technology was widely adopted in power supplies for various consumer electronic devices featuring high power efficiency and small footprint. 8-inch GaN on Silicon technology development is on track and is expected to be ready in 2025 to further support automotive applications.
- CMOS image sensor (CIS) technology was enhanced and moved to the next generation to further strengthen the capabilities of advanced smartphone cameras. In 2022, TSMC continually helped customers roll out products with the world's smallest pixel size. In addition, TSMC successfully completed technology development of the world's first three-wafer-stacked global shutter image sensor and it is ready for production.
- For silicon photonics technology, TSMC is developing an innovative 3D photonics stack technology – compact universal photonics engine (COUPE), which can integrate silicon photonics chip and electrical control chip into a single-chip photonic engine. This photonics engine can be co-packaged with a high performance computing chip to provide low power and high speed data transmission. In 2022, several test chips were taped out for early evaluation to lay a solid foundation for future volume production.

**TSMC 3DFabric™ - TSMC Advanced Packaging and 3D Silicon Stacking Technologies**

- TSMC-SoIC® (System on Integrated Chip) Chip-on-Wafer (CoW) technology successfully entered volume production in 2022. Stacking SRAM chips on logic wafers through CoW technology demonstrates significant performance improvement.
- TSMC-SoIC® Wafer-on-Wafer (WoW) technology demonstrated superb system performance enhancement for high performance computing (HPC) products in 2022 by stacking 7nm logic wafer on deep trench capacitor (DTC) wafer.
- Chip on wafer on substrate with silicon interposer (CoWoS®-S) technology that integrates multiple system-on-chip (SoC) chips, second generation high bandwidth memory (HBM2E) stacks, and a 3-reticle size silicon interposer that features embedded deep trench capacitor (eDTC) successfully started volume production for customer HPC products in 2022.
- Chip on wafer on substrate with redistribution layer interposer (CoWoS®-R) technology featuring redistribution layer (RDL) interposer for better signal integrity for HPC applications successfully started risk production in 2022 and is expected to start volume production in 2023.
- Integrated Fan-Out on Substrate (InFO_oS) technology that integrates multiple SoC chips in a 2-reticle size fan-out package on a >90mmx90mm substrate successfully entered volume production in 2022.
- Integrated Fan-Out with local silicon interconnect (InFO_LSI) technology, which integrates 5nm SoCs with ultra-high density die-to-die interconnects for high performance computing products, successfully started volume production in 2022.
- Fine pitch copper (Cu) bump technology for flip chip packaging on 4nm silicon successfully started volume production in 2022.

### 5.1.2 Customer Applications

TSMC manufactured 12,698 different products for 532 customers in 2022. These chips were used across a broad spectrum of electronic applications, including computers and peripherals, information appliances, wired and wireless communication systems, high-performance computing servers and data centers, automotive and industrial equipment, as well as consumer electronics such as digital TVs, game consoles, digital cameras, AI-enabled IoT and wearables, and many other devices and applications.

The rapid ongoing evolution of end products prompts customers to pursue product differentiation using TSMC's innovative technologies and services and, at the same time, spurs TSMC's own development of technology. As always, TSMC believes success depends on leading rather than following industry trends.

### 5.1.3 Consolidated Shipments and Net Revenue in 2022 and 2021

Unit: Shipments (thousand of 12-inch equivalent wafers) / Net Revenue (NT$ thousands)

| Shipments | | 2022 | | 2021 | |
|---|---|---|---|---|---|
| | | Shipments | Net Revenue | Shipments | Net Revenue |
| Wafer | Domestic (Note 1) | 2,324 | 202,075,489 | 2,562 | 172,814,551 |
| | Export | 12,929 | 1,789,780,458 | 11,617 | 1,232,485,722 |
| Others (Note 2) | Domestic (Note 1) | N/A | 16,668,631 | N/A | 13,055,166 |
| | Export | N/A | 255,366,714 | N/A | 169,059,598 |
| Total | Domestic (Note 1) | 2,324 | 218,744,120 | 2,562 | 185,869,717 |
| | Export | 12,929 | 2,045,147,172 | 11,617 | 1,401,545,320 |

Note 1: Domestic means sales to Taiwan.
Note 2: Others mainly include revenue associated with packaging and testing services, mask making, design services, and royalties.

### 5.1.4 Production in 2022 and 2021

Unit: Capacity / Output (million 12-inch equivalent wafers) / Amount (NT$ millions)

| Wafers | | | |
|---|---|---|---|
| Year | Capacity | Output | Amount |
| 2022 | 15-16 | 15-16 | 854,900 |
| 2021 | 13-14 | 14-15 | 791,459 |

## 5.2 Technology Leadership

### 5.2.1 R&D Organization and Investment

In 2022, TSMC continued to invest in research and development, with total R&D expenditures amounting to 7.2% of revenue, a level that equals or exceeds the R&D investment of many other leading high-tech companies.

Faced with the continuous challenge to significantly scale up semiconductor computing power every two years, thereby extending Moore's Law, the Company has focused its R&D efforts on contributing to customers' product success by offering leading-edge technologies and design solutions. In 2022, the Company successfully started risk production of N3E, an enhanced version of N3 technology; while the development of 2nm, the leading-edge technology in the semiconductor industry at this time, moved into baseline setup and the yield learning stage. Furthermore, the Company's research efforts continued pushing forward with exploratory studies for nodes beyond 2nm.

In addition to complementary metal oxide semiconductor (CMOS) logic, TSMC conducts R&D on a wide range of other semiconductor technologies that provide the functionality required by customers for mobile SoC and other applications. Highlights in 2022 included:

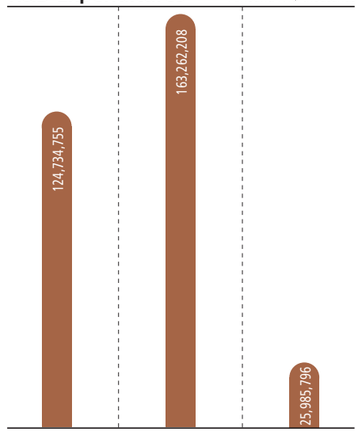
- The Company's integrated interconnect and packaging solution, the 3DFabric™, showed significant progress by completing certification of HBM3 (third generation HBM) on CoWoS-S; qualifying InFO_PoP Gen-8 for mobile applications and enhanced thermal performance; and developing on schedule the next-generation InFO_PoP with backside redistribution layers (RDL).
- In specialty technologies, examples of progress included: improving figure-of-merit of 5V devices of 55nm bipolar-CMOS-DMOS (BCD) technology and extended 0.13$\mu$m BCD technology to support 55V in automotive applications; qualifying next generation monolithic CMOS-MEMS technology with highly reliable 6-axis inertial measurement unit (IMU); starting risk-production of the world's smallest chips of voltage domain global shutter CMOS image sensors with 3-wafer stack technology; and demonstrating next generation MRAM with smaller cell size, faster writing speed and more power saving for use in MCU, AR/VR/edge-AI applications.



In 2022, TSMC maintained strong partnerships with many world-class research institutions, including SRC in the U.S. and IMEC in Belgium. The Company also continued to expand research collaboration with leading universities throughout the world for two major purposes: the advancement of semiconductor technologies and the nurturing of human talent for the future.

**R&D Expenditures**

Amount: NT$ thousands




### 5.2.2 R&D Accomplishments in 2022

**Highlights**

- 3nm Technology

In 2022, TSMC established platform support of N3E technology for both HPC and SOC applications, started risk production, and planned to launch volume production in the second half of 2023.

- 2nm Technology

Also in 2022, TSMC's 2nm technological development focused on baseline setup, yield learning, transistor and interconnect R/C performance improvement, and reliability evaluation. During the year, major customers completed IP design and started silicon validation. TSMC also developed low resistance RDL and super high performance metal-insulator-metal (MiM) capacitors to further boost performance.

- Lithography Technology

The Company's R&D in lithography in 2022 focused on 3nm volume production, 2nm technology development, and preparation for the next generation. In 2nm, enhanced variation control, material quality, and defect reduction demonstrated good performance with expected wafer yield. In 2023, TSMC R&D will continue to pursue extreme ultraviolet (EUV) technology development, mask pellicle research, and cost reduction for 2nm technology. In the future, TSMC R&D will continue to develop leading-edge technology with next generation EUV scanners to extend Moore's Law.

- Mask Technology

In 2022, R&D focused on improving critical dimension, pattern fidelity, overlay performance and defect reduction of EUV masks yields, exposure durability and wafer productivity by EUV photoresist and absorber material improvement, multibeam writer fine-tunning, process recipe modification, and introducing dry clean and inspection deep learning to meet the lithography requirements of the 3nm node. Continuous advancement was made for EUV mask technology by development of new mask materials and new mask processes for nodes at 2nm and beyond.

**Integrated Interconnect and Packaging**

TSMC has named its fine pitch chip-to-chip connection leveraging existing wafer processes 3DFabric™, which consists of both wafer-level frontend and backend technologies. The Company's frontend technologies, or TSMC-SoIC® (System on Integrated Chips), enables leading-edge silicon for 3D silicon stacking. TSMC's advanced backend technologies includes CoWoS® with chips placed onto pre-made RDLs and InFO with chips embedded before interconnection. The Company's 3DFabric offers the ultimate flexibility in product design with integrated frontend and backend technologies to meet future computing systems integration scaling needs.

- 3DIC and TSMC-SoIC®

TSMC-SoIC® is an innovative wafer-level frontend 3DIC chip stacking platform with outstanding bonding density, interconnect bandwidth, power efficiency, and thin profile. It extends Moore's Law through system-level scaling with sustainable performance gains and corresponding cost benefits. SoIC integrated chips can be subsequently assembled by using conventional packages or TSMC's new 3DFabric™ technologies, such as CoWoS® or InFO, for next generation HPC, AI and mobile applications. Currently, several SoIC product tape-outs are under verification. The Company is also planning the next generation of SoIC platform with more bandwidth improvement at a competitive cost. TSMC will continue pursue SoIC technological improvements and to co-optimize with the Company's advanced silicon technologies for further gains in transistor density, and system power/performance/area and cost.

• CoWoS®

CoWoS® with Si interposer is the leading 2.5D technology for high-end HPC and AI product applications. The technology features a Si interposer with sub-micron routing layers and integrated capacitors (iCaps) so that various chiplets such as SoC and high bandwidth memory (HBM) can be placed on it. The new third generation HBM3 was certified on CoWoS-S in 2022. In parallel, CoWoS-L with multiple local Si interconnects (LSIs) embedded in an organic interposer are being developed. Compared with CoWoS-S, CoWoS-L dramatically improved the size limitation of a Si interposer and enabled more features in an interposer to boost overall system performance.

• InFO

In 2022, TSMC continued its industry leadership in high-volume manufacturing of InFO_PoP Gen-7 packaging for mobile applications. InFO_PoP Gen-8 was also successfully qualified for mobile applications and displayed enhanced thermal performance. InFO-oS Gen-4 qualified in 2022 and offers more chip-partition integration, larger package size and higher bandwidth. Based on standard InFO_PoP structure, InFO_M_PoP Gen-1, which integrates different functional chips suitable for wearable applications, was developed and qualified in 2022. The next-generation InFO_PoP is being developed on scheduled to provide backside RDL for integrated commodity of low power DDR DRAM technology (LPDDR).

• Advanced Interconnect

TSMC provides unique interconnect technologies for its customers to design competitive products. In 2022, innovations on metallization enabled both line and via resistance reduction. In addition, development of novel materials also provided capacitance reduction. Those creative solutions deliver better chip performance with lower cost.

**Corporate Research**

Innovation in low-dimensional devices and materials continues to drive higher performance and reduced power consumption in advanced logic technologies. In 2022, TSMC stayed at the forefront of 2D transistor research. At the 2022 Symposia on VLSI Technology and Circuits, TSMC demonstrated a novel wafer-scale semi-automated dry transfer process for monolayer (1L) chemical vapor deposition (CVD) 2D $WS_2$ utilizing the weakly coupled interface between semimetal (Bi) and 2D $WS_2$. Using this semimetal-assisted transfer process, TSMC showcased a record high on current and a record low contact resistance for wafer-scale 1L CVD $WS_2$ transistors. At the 2022 International Electron Device Meeting (IEDM), TSMC successfully integrated Hf-based atomic layer deposition (ALD) higher-k dielectrics with CVD-grown monolayer (1L) $MoS_2$ to build top-gate 2D nFET with equivalent oxide thickness (EOT) of ~1nm with a nearly ideal subthreshold swing of 68 mV/dec. Also at the 2022 IEDM, TSMC demonstrated the first successful integration of monolayer $MoS_2$ nanosheet (NS) FET in a gate-all-around configuration. The successful demonstration of $MoS_2$ NS with high performance and of the stacked NS modules further clarifies the value proposition in 2D materials for transistor scaling.

TSMC continues to research emerging high-density, non-volatile memory devices and hardware accelerators for AI and HPC applications. At the 2022 International Solid-State Circuits Conference (ISSCC), TSMC demonstrated a 40nm phase change memory (PCM) compute-in-memory macro with a hybrid SLC and MLC configuration. Combining an input-reordering scheme to enhance sparsity, the 2Mb-cell design achieved state of the art energy efficiency. At the 2022 IEDM, TSMC had previously introduced a new approach towards forming-free chalcogenide selectors, where extra defects were introduced to assist the forming process and reduce the forming voltage. Forming-free low voltage selectors based on SiNGeCTe (SNGCT) chalcogenide were demonstrated along with excellent endurance characteristics over $10^{10}$ cycles.

**Specialty Technologies**

TSMC offers a broad array of technologies to address a wide range of applications:

• Mixed Signal/Radio Frequency (MS/RF)

The confinement caused by the COVID-19 pandemic over the past two years triggered a growing demand for MS/RF chips in wireless connectivity, such as applications in 5G communications, WiFi7, IoT, and so on. In 2022, TSMC continued to enhance RF design-technology co-optimization (DTCO) to a systematic methodology by bridging the validation between key process knob/device option/layout optimization and benchmarking circuit performance, and applied these results to RF technology to provide best performance/power/cost-tradeoffs solutions, such as 6nm/12nm FFC+ for transceiver designs, 16nm/28nm HPC+ for 5G mmWave frontend module (FEM) designs, and enhanced 40nm special process for 5G RF FEM designs.

• Power IC/Bipolar-CMOS-DMOS (BCD)

TSMC continued to increase its 12-inch BCD technology competitiveness in 2022. The figure of merit of 5V devices of 55nm BCD technology was enhanced, targeting power switches for portable devices. The Company plans to further develop 28V and 5-16V for the 40nm BCD 20/24V technology platform. The 22nm BCD technology offers 5V to 20V devices that are in reliability certification stage and has also extended 0.13$\mu$m BCD technology to support 55V in automotive applications.

• Micro-Electromechanical Systems (MEMS)

In 2022, TSMC implemented qualified piezoelectric micro electromechanical systems (MEMS) technology for mass production of MEMS speakers with high audio quality and fast response. In parallel, TSMC's capacitive micro-machined ultrasonic transducer (CMUT) MEMS technology was qualified for medical ultrasound imaging transducer chips with high image quality and low cost and entered the mass production stage. In addition, TSMC's next generation monolithic CMOS-MEMS technology was qualified in 2022 to produce highly reliable 6-axis inertial measurement unit (IMU) for automotive safety and autonomous driving. Future plans include the development of next-generation high-sensitivity piezoelectric microphones, total solutions for high SNR automotive 6-axis IMU, and medical single chip ultrasound probe applications.

• Gallium Nitride (GaN)

TSMC's first generation of 650V enhanced GaN high electron mobility transistors (E-HEMT) went into mass production in 2022. In order to fill customer demand, TSMC tripled its production capacity from 2021 levels. Further, to support the Company's leading position in the GaN power transistor field, the second generation of 650V and 100V power E-HEMT entered the final reliability assessment stage and will start production in 2023. For GaN transistors application in the automotive electronics market, the third generation 650V power E-HEMT development was developed to be delivered in 2025.

• Complementary Metal-Oxide-Semiconductor (CMOS) Image Sensors

In 2022, TSMC made several major technical advances in CMOS image sensor technology including: (1) starting risk production of a new sub-micron pixel technology with 16% pixel area reduction for mobile imaging market; (2) risk-producing the world's smallest voltage domain global shutter CMOS image sensor chips with 3-wafer stack technology for NIR/security camera market; (3) completing the technology transfer of silicon direct time-of-flight single photon avalanche diode (SPAD) process to a manufacturing fab for 3D distance sensing applications; and (4) proceeding with risk production of stacked CMOS image sensors with N22 logic wafers as image signal processing units for high-dynamic range automotive imaging applications.

• Embedded Flash/Emerging Memory

TSMC reached several major milestones in embedded non-volatile memory (NVM) technologies in 2022. At the 28nm node, the Company's embedded flash development for high-performance (HP) mobile computing and HP low-leakage platforms maintained a stable high yield consumer electronics grade for mass production, achieved the highest automotive grade-0 qualification, and are scheduled for product qualification in 2023. TSMC also offered RRAM as a low-cost embedded NVM solution for the price sensitive IoT market. The Company's 40nm & 28nm nodes entered mass production, while the 22nm node was ready for production.

The Company also enjoyed several major accomplishments in embedded MRAM technology, including TSMC's 16nm node for automotive applications, which is expected to achieve technical qualification in 2023. TSMC also had demonstrated an advancement in next generation memory cells with smaller cell size, faster writing speed and more power saving to meet the requirements for MCU, AR/VR/edge-AI applications.

### 5.2.3 Technology Platform

TSMC provides customers with advanced technology platforms that include the comprehensive infrastructure needed to optimize design productivity and cycle times. These include: electronic design automation (EDA) design flows; silicon-proven libraries and IP; and simulation and verification design kits, also known as process design kits (PDKs), and technology files.

For the latest advanced technologies such as 3nm, 4nm, 5nm and TSMC 3DFabric™, the Company provides EDA tools, features and IP solutions for adoption at various design stages by customers for system innovation to meet their product requirements. To help customers plan new product tape-outs incorporating library/IP from the Company's Open Innovation

Platform® (OIP) ecosystem, the OIP ecosystem features a portal to connect customers to solution providers from 16 EDA partners, six Cloud partners, 37 IP partners, 23 design center alliance (DCA) and eight value chain aggregator (VCA) partners, as well as 19 inaugural partners with 3DIC expertise for the new 3DFabric Alliance, which was officially announced in October 2022 during TSMC's North American OIP Ecosystem Forum in Santa Clara, California.

### 5.2.4 Design Enablement

TSMC's technology platforms provide a solid foundation to facilitate the design process. Customers can design using the Company's internally developed IP and tools or use tools available from TSMC's OIP partners.

**Tech Files and PDKs**

EDA tool certification, an essential element for IP and customer designs to ensure that features meet TSMC process technology requirements, can be found on TSMC-Online™. Corresponding tech files and PDKs are available for customers to download and use with certified EDA tools. TSMC provides a broad range of PDKs for digital logic, mixed-signal, radio frequency (RF), high-voltage driver, CMOS image sensor (CIS) and embedded flash technologies across a range of nodes from 0.5$\mu$m to 3nm. In addition, the Company provides tech files for design rule checking (DRC), layout verification of schematic (LVS), resistance-capacitance (RC) extraction, automatic place and route, and a layout editor to ensure that process technology information is accurately represented in EDA tools. By 2022, TSMC had provided customers more than 43,000 tech files and 2,900 PDKs.

**Library and IP**

Silicon intellectual property (IP) is the basic building block of IC designs. Various IP types are available to support different customer design applications including: foundation, analog/mixed-signal, embedded memory, interface and soft IP. TSMC and its alliance partners offer customers a rich portfolio of reusable IPs, which are building blocks for many circuit designs. To support 3DIC customer needs, TSMC introduced 3DIC IP in 2019. By 2022, the Company had expanded its library and silicon IP portfolio to contain more than 55,000 items, a 37.5% increase over 2021.

**Design Methodology and Flow**

Design reference flows are built on top of certified EDA tools to provide additional design flow methodology innovations that can help boost productivity. In 2022, TSMC released N3E HPC, mobile and custom design reference flows through OIP collaboration and announced the availability for customer adoption of design applications in mobile and HPC platforms. In addition to process technology advancements, the Company released the design reference flows for analog design migration, N16 mmWave and N6 RF sub-6G technologies, and continued to develop and offer TSMC 3DFabric™ design solutions for both 3D chip stacking and 2.5D advanced packaging technologies, including solutions to support the 3Dblox™ standard to unify EDA tool solutions to reduce 3DIC design complexity, thus helping customers to effectively improve productivity in their system-level designs. These design reference flows feature FinFET-specific and 3DFabric™ design solutions to optimize PPA (performance, power and area).

### 5.2.5 Intellectual Property

For a long time, TSMC has been protecting R&D innovation and operation development by way of utilizing patents and trade secrets as dual tracks under the established comprehensive IP management system, encouraging Company's innovation culture, and strengthening Company's competitive strengths so as to fulfill the Company's ESG vision. TSMC's General Counsel updates the Board of Directors on the status of the intellectual property management scheme.

TSMC's comprehensive patent management system includes: Patent management strategies, such as Global patent deployment, Exploratory invention mining, Patent portfolio expansion, and Patent exploitation and exercise; and Patent management rules, such as Tier-based IP evaluation, Patent competition rewards, Educational patent promotion, and Patent professional training. We have established technological patent road maps by way of innovative patent strategy, strict management and risk-control measures; analyzed and monitored competitors by using intelligent patent maps; conducted core technology mining through invention workshops; expanded patent families on key technologies; filed and maintained patents by tier-based management, further enhanced patent protection through quality control on patent applications and continued to construct massive global patent portfolio with high quality; and, diversified exploitation of patent assets. In terms of patent filings, TSMC has accumulated more than 85,000 patent applications worldwide as of end of 2022, including 8,500+ applications filed in 2022. TSMC ranked No.2 among global US patent applicants, and No.1 among patent applicants in Taiwan. In terms of patent grants, TSMC has accumulated 56,000+ patents worldwide as of end of 2022, including more than 5,500 global patents received. TSMC ranked No.3 among U.S. Patentees, and No.1 among patent patentees in Taiwan. In terms of patent quality, the allowance rate of TSMC's U.S. applications approached 100%.

Turning to trade secret management and strategy, as the pioneer of institutionalized trade secret registration systems since 2013, TSMC continues to develop and innovate trade secret management. The Trade Secret Registration System (TSR) keeps daily records of TSMC employees' wealth of inventions and innovations at work and encourages further innovations in targeted technical fields with tailored initiatives. For example, 2021's promotion of trade secret registration coverage for mass production fabs of advanced processes in N3, N5, and N7 met with great success, and 100% of all eligible engineers involved in such processes completed trade secret registration. Then in, 2022, TSMC further encouraged "Manufacturing Excellence" in trade secret registrations by ensuring that accumulation of the Company's competitive advantages stemming from "technology leadership" and "manufacturing excellence" had appropriate documentation in TSR. The wealth of innovations contained in TSR also act as valuable sources for patent mining. TSR also includes business-related trade secrets such as capacity planning and pricing strategies. By integrating TSR with the company's contract management system and human resource system, TSMC further bolsters its competitiveness. TSMC also identifies and rewards impactful and high-quality innovations at its annual Golden Trade Secret Award ceremony. With implementations of intelligent automation and artificial intelligence, TSMC has created a culture that fosters innovation. Between 2013 and 2022, TSMC has presented 2,279 trade secrets with the Golden Trade Secret Award, and the TSR has exceeded 241,740 registered trade secrets as of 2022.

In 2022, TSMC adopted the following innovative measures of trade secret management to fulfill its vision of sustainable business: (1) Create an "Encourage Green Trade Secret Registration, Sharing, and Incentive Guidance" to support TSMC employees in registering green trade secrets and engage in sharing and dissemination of green innovations with the public while complying with company policies on confidential information protection, and (2) Establish the "Trade Secret Registration System Alumni Association" to selflessly share TSMC's experience in and methodologies of building TSR and intelligent management. In doing so, TSMC expands its cross-industry promotion of TSR, continually promotes public welfare, and increases the awareness and understanding of trade secret management and its effectiveness.

TSMC received a AAA (the highest tier) certificate by Taiwan Intellectual Property Management System (TIPS) in December 2021, and the valid period will expire after December 31, 2024.

TSMC's IP team works closely with technical teams from R&D in early stage to mass production, and actively constructs IP portfolio for each key innovative technology, including the latest 3nm and 2nm technology nodes, so as to ensure Company's technology leadership in semiconductor field; TSMC's revenue reached historical highs for 13 consecutive years, and we utilize patents and trade secrets as dual tracks to successfully protect Company's main business including process technologies, designs, manufacturing and sales, and have been strategically utilized for defense and cross-license negotiation, so as to secure freedom of business operation worldwide.

### 5.2.6 TSMC University Collaboration Programs

In recent years TSMC has collaborated closely with a number of prestigious universities in Taiwan to carry out a variety of joint research projects. These collaborations encourage more university professors to conduct leading-edge semiconductor research in areas such as novel devices, process and materials technologies, semiconductor manufacturing and engineering, and specialty technologies for electronic applications. At the same time, these projects provide hands-on training for interested students to prepare for joining the semiconductor industry after graduation. Back in 2013, TSMC established research centers at four top universities in Taiwan: National Yang Ming Chiao Tung University, National Taiwan University, National Cheng Kung University and National Tsing Hua University. In the past nine years, a total of 245 professors and more than 3,600 students with backgrounds in the disciplines of electronics, physics, materials, chemistry, chemical engineering, and mechanical engineering have joined the research centers. In 2022, TSMC has also proactively supported the establishment of national academies at National Taiwan University, National Cheng Kung University, National Tsing Hua University, National Yang Ming Chiao Tung University, National Sun Yet San University, and National Chung Hsing University. In 2019, the Company jointly launched the TSMC-NTHU Semiconductor Program to enhance the quality and number of domestic semiconductor students and attract more outstanding students to a career in the semiconductor

industry. In 2022, the list of school partners had grown to nine universities, including National Taiwan University, National Cheng Kung University, National Yang Ming Chiao Tung University, National Taipei University of Technology, National Taiwan University of Science and Technology, National Central University, National Sun Yet San University, and National Chung Hsing University, and had attracted more than 4,000 students to enroll in the program. In addition, TSMC has long conducted strategic research projects at top overseas universities such as Stanford, MIT, UC Berkeley and so on, focusing on innovative capabilities in transistors, interconnect, materials, device simulation and circuit design.

**TSMC University Shuttle Program**

The TSMC University Shuttle Program was established to provide professors at leading research universities worldwide with access to the advanced silicon process technologies needed to develop innovative circuit design concepts. In 2022, despite the continued spread of COVID-19 and the ongoing global chip shortage, TSMC continued the University Shuttle Program that links motivated professors and graduate students with enthusiastic managers at TSMC in order to promote excellence in the development of advanced silicon design technologies and to nurture new generations of engineering talents in the semiconductor field. The University Shuttle Program provides access to TSMC silicon process technologies for digital and analog/mixed-signal circuits, RF designs, non-volatile memory design and ultra-low power designs. TSMC and the University Shuttle Program participants enjoy win-win collaboration through the program, which allows graduate students to implement exciting designs and achieve silicon proof points for innovation in various end-applications.

### 5.2.7 Future R&D Plans

To maintain its technology leadership, TSMC plans to continue investing heavily in R&D. While TSMC's 3nm and 2nm advanced CMOS logic nodes are progressing through the development pipeline, the Company's reinforced exploratory R&D work is focused on beyond-2nm nodes and on areas such as 3D transistors, new memories and low-R interconnect, to establish a solid foundation to feed into future technology platforms. TSMC's 3DFabric™ advanced packaging R&D is developing innovations in subsystem integration to further augment advanced CMOS logic applications. The Company maintains its intensified focus on new specialty technologies such as RF and 3D intelligent sensors for 5G and smart IoT applications. TSMC research continues to develop novel materials, processes, devices and memories that may be adopted in the long run, ten years and beyond. The Company also continues to collaborate with external research bodies from academia and industry consortia alike with the goal of gaining early awareness and adoption of future cost-effective technologies and manufacturing solutions for its customers. With a highly competent and dedicated R&D team and unwavering commitment to innovation, TSMC is confident in its ability to drive future business growth and profitability for years to come by delivering competitive semiconductor technologies to its customers.

**Summary of TSMC's Major Future R&D Projects**

| Project Name | Description |
|---|---|
| 3nm logic technology platform and applications | 3D CMOS technology platform for SoC |
| 2nm and beyond logic technology platform and applications | 3D CMOS technology platform for SoC |
| 3DIC | Cost-effective solutions with better form factor and performance for 3DIC integration |
| Next-generation lithography | Next-generation EUV lithography and related patterning technology to extend Moore's Law |
| Long-term research | Specialty SoC technology (including new NVM, MEMS, RF, analog) and transistors with 8 to 10 years horizon |

The projects above account for roughly 80% of the total R&D budget for 2023. Total R&D budget is estimated to be around 8% of 2023 revenue.

## 5.3 Manufacturing Excellence

### 5.3.1 GIGAFAB® Facilities

Maintaining reliable production capacity is a key TSMC manufacturing strategy. The Company currently operates four 12-inch GIGAFAB® facilities: Fabs 12, 14, 15 and 18. The combined capacity of these four facilities exceeded 11 million 12-inch wafers in 2022, while producing 0.13$\mu$m, 90nm, 65nm, 40nm, 28nm, 16nm, 7nm and 5nm process technologies, and their sub-nodes. 3nm technology has successfully entered volume production in Fab 18 with good yield in the second half of 2022. Capacity has been expanded at Fab 12 for R&D work on leading-edge manufacturing technologies including current support for the development of 2nm nodes and beyond.

TSMC GIGAFAB® facilities are coordinated by a centralized management system known as super manufacturing platform (SMP) to provide customers with consistent quality and reliability, improved flexibility to cope with demand fluctuations, and faster yield learning and time-to-volume production, as well as lower-cost product requalification.

### 5.3.2 Engineering Performance Optimization

As advanced technology continues to evolve and IC geometry keeps shrinking, the need for tighter manufacturing process and quality control becomes extremely challenging. TSMC has tailored its manufacturing infrastructure to handle a diversified product portfolio that uses strict process control to meet tightened specs and higher product quality, performance and reliability requirements. TSMC's process control systems are integrated with numerous intelligent functions to achieve excellence in both quality and manufacturing. Through intelligent detection, smart diagnosis, and cognitive action, the Company produces remarkable yield enhancement, quality assurance, workflow improvement, fault detection, cost reductions, all while shortening the R&D cycle.

To meet 5G's stricter quality requirements for mobile, high performance computing (HPC), automotive and the Internet of Things (IoT), TSMC is implementing artificial intelligence (AI) and machine learning technologies, and has developed systems for precise fault detection and classification, intelligent advanced equipment and process control to ensure the consistency of tool matching and process stability. TSMC combines intelligent process variation detection with foundry know-how to identify potential defects and minimize the convergence of process variation through self-diagnosis and cognitive action. As the result, each chip can be precisely controlled at the nanometer level to produce the highest quality wafers for customers.

### 5.3.3 Agile and Intelligent Operations

The Company's use of sophisticated, agile and intelligent operating systems drives manufacturing excellence. TSMC has integrated intelligent process experience, machine tuning, manufacturing know-how, and artificial intelligence technologies to create an intelligent manufacturing environment. Intelligent manufacturing technologies are widely applied to enhance lean manufacturing, boost employee and equipment productivity, and improve process and equipment control, quality control, and robotic control. The end result is real-time information analysis, improved forecast capability, maximum cost effectiveness, and accelerated innovation.

TSMC has also integrated new applications such as intelligent mobile devices, IoT, edge computing, and mobile robot, with intelligent automated material handling systems (AMHS) to consolidate wafer manufacturing data collection and analysis, utilize manufacturing resources efficiently, and maximize manufacturing effectiveness. TSMC continues to intellectualize semiconductor production through AI that processes massive amounts of production data to achieve agile and intelligent operations. In addition, TSMC has implemented augmented reality (AR) technology to improve equipment installation efficiency and assist equipment engineers to diagnose remotely during the COVID-19 pandemic.

### 5.3.4 Digital Transformation

To meet the strong, pent-up demand for wafers during the ongoing pandemic era, TSMC continues to implement technology to transform the "automated fab" into the "intelligent fab," with simultaneous improvement in product quality, equipment capacity, and personnel effectiveness. Intelligent fabs have integrated the domain knowledge of semiconductor manufacturing, kept the system self-learning, and expanded the application of AI and machine learning, which includes dispatching, equipment tuning, process control, equipment diagnosis and maintenance, and quality inspection. As a result, today's engineers have been freed up to focus on problem solving. This digital transformation platform breaks through the limitations of the physical workplace, combines the expertise of those in different locations, and makes centralized management of global manufacturing a reality.

### 5.3.5 Raw Materials and Supply Chain Management

In 2022, TSMC continued to review and resolve, together with suppliers, supply issues and quality issues as well as potential supply chain risks through the collaboration of teams formed by fab operations, quality control and business organizations. TSMC also worked with suppliers to further advance material and process innovation, improve quality and create recycling savings with benefits from win-win solutions.

### Raw Materials Supply

| Major Materials | Major Suppliers | Market Status | Procurement Strategy |
|---|---|---|---|
| Raw Wafers | FST<br>GlobalWafers<br>SEH<br>Siltronic<br>SK siltron<br>SUMCO | These 6 suppliers together provide over 90% of the world's raw wafer supply. | •TSMC's suppliers of silicon wafers are required to pass stringent quality certification procedures.<br>•TSMC procures wafers from multiple sources to ensure adequate supplies for volume manufacturing and to appropriately manage supply risk.<br>•Raw wafer quality enhancement programs are in place to support TSMC's technology advancement.<br>•TSMC regularly reviews the quality, delivery, cost, sustainability and service performance of its wafer suppliers. The results of these reviews are incorporated into subsequent purchasing decisions.<br>•A periodic audit of each wafer supplier's quality assurance system ensures that TSMC can maintain the highest quality in its own products.<br>•TSMC takes various approaches with suppliers to better manage the cost and supply. |
| Chemicals | Air Liquide<br>BASF<br>DuPont<br>Entegris<br>Fujifilm Electronic Materials<br>Kanto PPC<br>Kuang Ming<br>Merck<br>RASA<br>Shiny<br>Tokuyama<br>Wah Lee | These 12 companies are the major worldwide suppliers of chemicals. | •Most suppliers have located their new operations closer to TSMC's major manufacturing facilities, thereby significantly improving procurement logistics and reducing supply risk<br>•All supplied products are regularly reviewed to ensure that TSMC's specifications are met and product quality is satisfactory.<br>•TSMC encourages and engages with chemical suppliers to implement innovative green solutions for waste reduction |
| Lithographic Materials | 3M<br>Fujifilm Electronic Materials<br>JSR<br>Nissan<br>Shin-Etsu Chemical<br>Sumitomo Chemical<br>T.O.K. | These 7 companies are the major worldwide suppliers of lithographic materials. | •TSMC works closely with suppliers to develop materials that meet all application and cost requirements.<br>•TSMC and suppliers periodically conduct programs to improve their quality, delivery, sustainability and green policies, and jointly set improvement programs and monitor progress to ensure continuous improvement in TSMC's supply chain.<br>•Some major suppliers have relocated or plan to establish new manufacturing sites closer to TSMC's major manufacturing facilities, thereby significantly improving procurement logistics and reducing supply risks. |
| Gases | Air Liquide<br>Air Products<br>Central Glass<br>Entegris<br>Linde LienHwa<br>Praxair<br>SK Materials<br>Taiwan Material Technology<br>Nippon Sanso Taiwan | These 9 companies are the major worldwide suppliers of specialty gases. | •The majority of these suppliers have facilities in multiple geographic locations, which minimizes supply risk for TSMC.<br>•TSMC conducts periodic audits to ensure that the suppliers meet TSMC's standards. |
| Slurry, Pad, Disk | 3M<br>AGC<br>Cabot Microelectronics<br>DuPont<br>Fujibo<br>Fujifilm Electronic Materials<br>Fujimi | These 7 companies are the major worldwide suppliers of CMP (Chemical Mechanical Polishing) materials. | •TSMC works closely with suppliers to develop materials that meet all application and cost requirements.<br>•TSMC and suppliers periodically conduct programs to improve their quality, delivery, sustainability and green policy, and jointly set improvement programs and monitor progress to ensure continuous improvement in TSMC's supply chain.<br>•Most suppliers have relocated or plan to establish new manufacturing sites closer to TSMC's major manufacturing facilities, thereby significantly improving procurement logistics and reducing supply risks. |

### Suppliers Accounting for at Least 10% of Annual Consolidated Net Procurement

Unit: NT$ thousands

| Supplier | 2022 | | | 2021 | | |
|---|---|---|---|---|---|---|
| | Procurement Amount | As % of 2022 Total Net Procurement | Relation to TSMC | Procurement Amount | As % of 2021 Total Net Procurement | Relation to TSMC |
| Company A | 18,259,301 | 20% | None | 14,469,081 | 20% | None |
| Company B | 16,120,039 | 18% | None | 13,352,067 | 19% | None |
| Company C | N/A | N/A | None | 7,784,013 | 11% | None |
| Others | 56,546,611 | 62% | - | 35,181,148 | 50% | - |
| Total Net Procurement | 90,925,951 | 100% | - | 70,786,309 | 100% | - |

- **Reason for Increase or Decrease:** The changes of procurement amount and percentage were mainly due to customer product demand change.



## 5.3.6 Quality and Reliability (Q&R)

TSMC strives to provide excellence in semiconductor manufacturing services to all its customers worldwide. The Company is dedicated to providing outstanding quality in every facet of its business and maintains a culture of continuous improvement to assure customer satisfaction. TSMC implements containment and preventive measures to protect customers from potential product defects.

In the technology development stage, the Q&R organization helps customers design in superior product reliability. In 2022, Q&R worked continuously with R&D in advanced logic, specialty and advanced packaging technologies throughout development and qualification stages to ensure meeting commitments to customers with respect to device characteristics, process yield and product reliability.

For advanced logic technology, in 2022 Q&R focused on certifying technology quality and reliability for risk production of 3nm FinFET. For specialty technologies, Q&R successfully completed IP qualification of consumer grade 22nm embedded RRAM (resistive random access memory). In Bipolar-CMOS-DMOS (BCD) technologies, Q&R qualified 40nm BCD with 20/24V applications. In addition, TSMC's advanced packaging solutions enabled system improvement of the wafer level process by integrating the frontend wafer process and the backend chip packaging. In 2022, Q&R achieved qualification of the TSMC 3DFabric™ technology platform and successfully qualified the first SoIC, WoW and CoWoS® technologies for HPC products to provide better system-level integration through heterogeneous chip package interaction.

To continuously reduce product defects, enhance process controls, facilitate early detection of abnormalities and prevent quality problems in general, Q&R collaborates with other operational entities to establish real-time defense systems using advanced statistical methods and quality tools. Q&R and the Company's fabs have also worked together on enhancements for automotive product quality improvement, including design rule implementation and migration to Automotive Quality System 2.0. This covers process capability requirements to tighten in-line and wafer acceptance testing in fabs and the handling of maverick wafers and lots. Q&R also provides dedicated resources for field/line return analysis and timely physical failure analysis (PFA) for process improvement to meet automotive customers' stringent defective parts per million (DPPM) requirements.

To stimulate employee problem-solving and develop related quality systems and methodologies, Q&R held several company-wide symposia and training programs on total quality excellence (TQE) in 2022. Furthermore, several digital transformation projects were completed in the areas of raw materials management, statistical process control (SPC), metrology and laboratory analysis by leveraging machine learning and artificial intelligence to achieve TSMC's goal of digital transformation. In these endeavors, Q&R had the capability of intelligent quality defense and remote management of manufacturing to overcome the impact of the COVID-19 pandemic, making seamless quality control across its worldwide fab network a reality. In 2023, Q&R will continue to enhance employee capabilities by promoting quality methods and professional trainings and applying artificial intelligence to enhance TSMC competitiveness.

Q&R is committed to green manufacturing, responsible supply chain and sustainable management practices. In 2021, Q&R set up a new advanced chemical laboratory to enhance continuous quality monitoring of raw materials. This helped R&D make significant innovations in materials and it provided services to enhance the technologies in the industry supply chain. Q&R collaborates with the corporate ESH organization to ask suppliers to declare that their materials to ensure compliance with international regulation for carcinogenic, mutagenic and reprotoxic (CMR) substances and to classify all risky materials and carry out test sampling. In 2020, Q&R had 100% inspection capability for CMR substances and shared its inspection methods and capabilities with major material suppliers to enhance the monitoring of hazardous substances and control capability in the supply chain. Furthermore, in 2021 Q&R assisted TSMC subsidiaries in setting up inspection capability for hazardous substances to enhance corresponding monitoring and control capability for industry supply chain. In 2022, Q&R continuously provided state-of-the-art material analysis and applied best knowledge management methods to assist capacity expansion and technology enhancement of new raw material production lines or to assist new suppliers with the fundamentals to optimize the balance between quality and capacity. All the efforts above have supported TSMC in navigating through geo-political turmoil to achieve continuous growth in 2022.

Q&R also worked with manufacturing teams on recycling and reuse of chemical acids and enabled several recycled chemicals to achieve the quality level for electronic grade in 2021. In 2022, Q&R continued sharing its technical knowledge to assist

chemical suppliers in developing further recycling and reuse projects and worked with Company operations to implement engineering validation for recycling chemicals to meet TSMC's quality requirements and environmental sustainability. Q&R is also committed to the continual improvement of local supply chains and developing local talent. In 2022, Q&R again collaborated with Semiconductor Equipment and Materials International (SEMI) to hold the fourth Strategic Materials Conference (SMC) in Taiwan to motivate talented domestic personnel and share win-win strategies for technology and sustainable development, environmental, social, and governance (ESG) objectives both within TSMC and industry wide to elevate the competitiveness of the local supply chain.

TSMC fully supports continuous improvement programs to strengthen the work culture, improve product quality and production efficiency, reduce production costs, and enhance customer satisfaction. These programs encourage colleagues to strive for excellence, drive cross-departmental observation and learning, and enhance their innovative, problem-solving abilities – all traits that greatly contribute to achieving a win-win outcome of honing TSMC's competitive edge and building customer satisfaction. In addition to internal cross-organizational learning and exchange, TSMC participates in the Taiwan Continuous Improvement Competition to promote the development of other local industries by sharing its experience, and to enhance the problem-solving and innovation ability of its colleagues by observing improvement methods of other industries. In 2022, TSMC's outstanding performance was recognized with six gold, four silver and three "best improvement and innovation" awards. At the same time, Q&R coached domestic material suppliers to participate in the competition for local suppliers' quality culture and capability enhancement. In 2022, despite COVID-19 restrictions affecting suppliers› resources and willingness, Q&R encouraged 76% of TSMC's material suppliers to participate in the competition to promote a quality culture of continuous improvement. In the end, 16% of these suppliers were finalists with four gold, three silver and four bronze awards. In addition, in order to enable new employees to understand and integrate into TSMC's quality culture more quickly, Q&R added quality culture courses to the newcomer training program at the beginning of 2022. So far, more than 12,000 new employees have completed the training.

Thanks to qualification in technology development, real-time defense systems and innovative applications in semiconductor manufacturing services, as well as its continuous quality improvement culture, TSMC had no major product recalls in 2022. Meanwhile, a third-party audit verified the effectiveness of the Company's quality management systems in compliance with IATF 16949: 2016 and IECQ QC 080000: 2017 requirements. In 2022, TSMC's four backend fabs also continually passed the certification of American National Standards Institute ANSI/ESD (Electrostatic Discharge) S20.20 standard. Regular customer feedback indicates that products shipped from TSMC have consistently met or exceeded all field quality and reliability requirements. In these ways, TSMC helps customers improve time-to-market delivery and competitiveness with excellent, reliable products for the five major growth markets the Company serves: high performance computing (HPC), mobile communications, the Internet of Things (IoT), automotive and digital consumer electronics.

## 5.4 Customer Trust

### 5.4.1 Customers

TSMC's customers make a wide variety of products that deliver excellent performance across the semiconductor industry. Customers include fabless semiconductor companies, system companies, and integrated device manufacturers such as Advanced Micro Devices, Inc., Amazon Web Services, Inc., Broadcom Inc., Intel Corporation, MediaTek Inc., NVIDIA Corporation, NXP Semiconductors N.V., Qualcomm Incorporated, Renesas Electronics Corporation, Sony Semiconductor Solutions Corporation, STMicroelectronics N.V. and many more worldwide.

**Customer Service**

TSMC is committed to providing the best possible service, which is critical to customer satisfaction, retention, relationship enhancement and attracting new customers. TSMC has established a dedicated service team that strives to provide world-class services to support customers in product design, mask making, wafer manufacturing, and backend services, hence TSMC can increase customer satisfaction and win customer trust in order to maintain sales and profitability of the company.

To improve customer interaction on a real-time basis, TSMC-Online™ offers a suite of web-based applications to provide more proactive customer service and support in design, engineering and logistics. Customers thus have 24-7 access to critical information and are able to create customized reports. TSMC-Online™ facilitates design collaboration by maintaining data availability and accessibility and providing customers with accurate up-to-date information at each stage of design process. Engineering collaboration includes engineering lots, wafer yields and wafer acceptance test analysis, as well as quality and reliability data. Logistics collaboration includes information on wafer fabrication, backend processes, and order shipments.

**Customer Satisfaction**

To ensure customer satisfaction, TSMC must fully comprehend its customers' needs. To this end, the Company appoints third-party consulting firms to conduct annual customer satisfaction surveys (ACSS) with majority of existing customers either via online surveys or direct interviews. In addition to the survey, TSMC also conducts quarterly business reviews (QBRs) with customers to collect their feedback on a regular basis. Customer feedback is routinely reviewed, analyzed and then used to develop appropriate improvement plans, all in all becoming an integral part of the customer satisfaction process. Through surveys and feedback reviews, TSMC is able to closely interact with customers, provide better services, and enhance the quality of customer collaboration.

**Customer Information Protection**

TSMC complies with applicable regulations and international standards in terms of customer information protection and has received ISO 27001 international information security certification. Relevant proprietary information protection policies and standard work process are established to ensure only authorized personnel can access the engineering and production data of a specific customer.

**Customers Accounting for at Least 10% of Annual Consolidated Net Revenue**

Unit: NT$ thousands

| Customer | 2022 | | | 2021 | | |
|---|---|---|---|---|---|---|
| | Net Revenue | As % of 2022 Total Net Revenue | Relation to TSMC | Net Revenue | As % of 2021 Total Net Revenue | Relation to TSMC |
| Customer A | 529,649,200 | 23% | None | 405,402,955 | 26% | None |
| Customer B | N/A | N/A | None | 153,740,831 | 10% | None |
| Others | 1,734,242,092 | 77% | - | 1,028,271,251 | 64% | - |
| Total Net Revenue | 2,263,891,292 | 100% | - | 1,587,415,037 | 100% | - |

- **Reason for increase or decrease:** The changes of sales amount and percentage were mainly due to customer product demand change.

### 5.4.2 Open Innovation Platform® Initiative

At TSMC, innovation has always been an exciting challenge. Competition continues to intensify in the face of increasing industry consolidation and the commoditization of technology at more mature, conventional levels, and thus semiconductor companies must find ways to keep innovating in order to survive and prosper. One way to promote innovation is through active collaboration with external partners. At TSMC this is known as Open Innovation®, an "outside in" approach to complement traditional "inside out" methods. TSMC has chosen this path to stimulate innovation via its OIP initiative, which is a key part of the TSMC Grand Alliance.

The OIP initiative is a comprehensive design technology infrastructure that encompasses all critical IC implementation areas to lower design barriers and improve first-time silicon success. OIP promotes the speedy implementation of innovation within the semiconductor design community and its ecosystem partners using TSMC's and partners' IP and process technology in design implementation and backend services.

Crucial to OIP are ecosystem interfaces and collaborative components initiated and supported by TSMC to empower innovation throughout the supply chain and, in turn, drive the creation and sharing of new revenue and profits. TSMC's active accuracy

assurance (AAA) initiative is key to OIP, providing the precision and quality required by the ecosystem interfaces and collaborative components.

TSMC's Open Innovation® model brings together the creative thinking of customers and partners under the common goal of shortening each of the following: design time, time to volume production, time to market and, ultimately, time to revenue. The model features:

- The foundry segment's earliest and most comprehensive electronic design automation (EDA) certification program, delivering timely design tool enhancement required by new process technologies.
- The foundry segment's largest, most comprehensive and most robust silicon-proven IP (intellectual properties) and library portfolio.
- Alliances that enable semiconductor designing in the Cloud for the benefit of scalability, agility and flexibility to meet different customer demand in work models.
- Alliances that provide design services to support customer demand regarding resources and capabilities, depending upon the various scope and requirements in the semiconductor design stages and value chain.
- Alliances to enable customers' system-level designs for integrating multiple chips/chiplets in 3D stacking and advanced packaging.
- Participants consisting of 16 EDA partners, six Cloud partners, 37 IP partners, 23 design center alliance (DCA) partners, eight value chain aggregator (VCA) partners and 19 partners in the new 3DFabric Alliance. TSMC and partners work together proactively and engage much earlier and deeper than ever before in order to address the mounting design challenges of advanced technology nodes. Through this early and intensive collaboration, TSMC's OIP is able to deliver the needed design infrastructure with timely enhancement of EDA tools, early availability of critical IPs and quality design services when customers need them. Taking full advantage of the process technologies once they reach production-ready maturity is critical to customers' success. Hence, this helps achieve design technology co-optimization (DTCO) among TSMC process technologies, OIP design solutions and customer product designs.
- A partner management portal, which facilitates communication with ecosystem partners for efficient business productivity. Designed with a highly intuitive interface, this portal can be accessed via a direct link from TSMC-Online™.
- The in-person OIP Ecosystem Forum held by TSMC in October 2022 after the forum had been held online the past two years due to COVID-19 pandemic. This annual event demonstrates how TSMC and its ecosystem partners jointly develop design solutions on top of TSMC's advanced technologies. At the forum, TSMC made key presentations on its TSMC FinFlex™ innovation that combines both process and design co-optimization for 3nm technology that continues the full-node power performance area (PPA) scaling trend together with the offering of high-density and high-performance libraries and design solutions for the support of smartphone and HPC design applications. The Company also made presentations on the readiness of analog cell that can help boost analog IP yield, with the design solutions in 5nm, 4nm and 3nm to enable EDA and design flow automation to support analog design migration. Other presentation topics included: enhanced automotive design enablement platform (ADEP) with design solutions and ecosystems readily available in 16nm, 7nm, 5nm and 3D chip stacking and 2.5D advanced packaging design solutions together with EDA tools that support 3Dblox™ ready to facilitate integration of multiple chips/chiplets in customer's system-level designs using TSMC 3DFabric™ technologies, which include TSMC-SoIC®, InFO (Integrated FanOut) and CoWoS® (Chip on Wafer on Substrate). The availability of the aforementioned design ecosystem solutions will help customers successfully pursue opportunities in all major markets: high performance computing, mobile, the IoT, automotive and digital consumer electronics.

## 5.5 Information Security Management

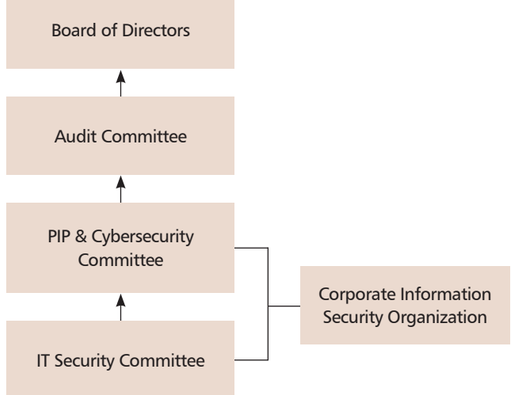
### 5.5.1 Information Security Policy and Organization

TSMC is committed to information security and confidentiality protection for its customers, shareholders, and partners. To this end, the Company has formulated, implemented and regularly updated rigorous cybersecurity policies, procedures and measures to achieve information security and confidential information protection, as reflected in TSMC's "Information Security Declaration."

Top TSMC executives are involved in planning the direction and implementation of this information security strategy with the goal of achieving optimum information security management. The Company has established a dedicated organization, Corporate Information Security (CIS), which is in charge of information security policy formulation, implementation, risk management, and strengthening information security through regular compliance audits. The head of CIS leads and collaborates with the security task force, "PIP and Cybersecurity Committee", and "IT Security Committee" to plan and implement security management activities and reports to the Audit Committee every six months on the performance and effectiveness of information security management. The Audit Committee Chairperson also reports to the Board of Directors on the implementation status of information security management. The PIP and Cybersecurity Committee is chaired by the Senior Vice President of Information Technology and Materials Management & Risk Management; vice presidents of legal, human resources, R&D, and operations are also members of this Committee, which meets quarterly to review and formulate information security policies to ensure TSMC can fulfill its goals and commitment in this aspect.

In 2022, TSMC assigned the Senior Vice President of Information Technology and Materials Management & Risk Management as the Chief Information Security Officer (CISO) in charge of information security risk management to review the effectiveness of security policy, procedures and cybersecurity measures.

**Corporate Information Security Organization Structure**




### 5.5.2 Information Security Management Strategy and Resources

To achieve TSMC's information security management goals and maintain competitiveness, the corporate information security organization actively strengthens security and confidential information protection mechanisms. CIS sets clear policy, procedures and guidelines and continuously enhances the Company's management systems and implements comprehensive risk controls. In addition, CIS regularly performs information security risk assessments and sets priorities based on the impact and probability of a risk, as well as the cost of reducing such risk. CIS uses the plan-do-check-act (PDCA) methodology to continuously enhance multi-layer information security defenses and establish key performance indicators (KPIs) for information security. In 2022, TSMC invested in excess of NT$1 billion to strengthen information security, employing more than 500 employees for information security-related activities, with more than 1,000 external security personnel engaged in the physical aspects of information security services.

### 5.5.3 Information Security Incident Handling and Notification

TSMC has established enterprise risk management mechanisms and procedures to handle information security incidents. The mechanisms and procedures define relevant processes and measures for incident notification, designation of personnel responsible for handling material information security incidents, and assessment of losses suffered as well as additional measures needed, evaluation of information security risks to the Company's financial and operations, and proposed countermeasures to mitigate these risks. For the year 2022 and as of the date of this Annual Report, TSMC has not suffered any financial losses nor operational impact due to material information security incidents.

## 5.6 Human Capital

Human capital is TSMC's most treasured asset. The Company strives to provide employees with meaningful work content, continuous learning, a safe and pleasant work environment that is both diverse and inclusive, and high-quality compensation and benefits. TSMC goes beyond this, by actively encouraging employees to nurture and enjoy a healthy family life, develop personal interests, expand social participation, and, in general, live a happy life.

### 5.6.1 Human Rights Policy and Specific Actions

TSMC believes that respecting human rights and promoting a decent work environment are important throughout the Company and its supply chain. TSMC abides by local laws and regulations in all countries and regions where we operate, and upholds the human rights of all workers, including regular, contract and temporary employees, and interns. We also require our suppliers to act in the same fashion, as addressing human rights issue in complex supply chains is a shared responsibility. We support the *UN Universal Declaration of Human Rights (UDHR)*, and are committed to treating all workers with dignity and respect as understood by international human rights standards, including *The International Bill of Human Rights*, The International Labour Organization's (ILO) *Declaration on Fundamental Principles and Rights at Work*, *The UN Guiding Principles on Business and Human Rights (UNGPs)*, *The OECD Guidelines for Multinational Enterprises and The Ten Principles of The United Nations Global Compact (UNGC)*. We also align our actions with the *Responsible Business Alliance (RBA) Code of Conduct*. The guiding principles for TSMC's human right policy are as follows, and *TSMC's Supplier Code of Conduct* requires all of our suppliers to follow the same standards.

**Guiding Principles**

- Embed respect for economic, social, cultural, civil, and political rights, as well as the right to development, in the way we operate
- Provide a safe and secure work environment that is free of harassment
- Eliminate unlawful discrimination and ensure equality in the workplace
- Zero tolerance for child labor
- Forbid forced labor
- Commit to responsible sourcing of minerals
- Protect labor rights of vulnerable groups or marginalized groups such as indigenous peoples, women, migrant workers, contracted labor and persons with disabilities
- Comply with all applicable wage laws and regulations, and legal limits to working hours
- Provide fair living wage and pay in full and on time with pay slips to state legitimate deductions
- Enable a communication-friendly environment and maintain an open-style management system
- Support the physical and psychological well-being of employees, and the balance between work and life
- Make diverse open dialogue channels available for stakeholders such as suppliers, business partners, and others to report concerns or suspected violations to the Company, including ways to report anonymously
- Monitor and assess relevant risks, practices, and impacts regularly to respond to evolving situations and stakeholders' needs

In 2022, the Company used the Responsible Business Alliance's Self-Assessment Questionnaire (SAQ) to identify the greatest risks regarding "labor, health and safety, environment, and ethics" matters and to formulate substantive actions and managerial response. The SAQ scores of each of TSMC's operating fabs were in the low risk range, defined as 88 points or above.

In 2022, TSMC conducted multiple human rights protection training courses, including plant safety and health, emergency response, first-aid personnel training, friendly workplace, etc. The total training hours are 205,342.1 hours, and a total of 70,008 employees have completed the training, accounting for 95.7% of the total number of employees, and the total number of participants reached 190,312. Among them, in order to implement the human rights policy, TSMC promotes the "Understand TSMC Human Rights Policy, create a Friendly Workplace, and eliminate Sexual Harassment" course. 63,550 employees have completed the training, and the passing rate of the post-training test is 100%.

TSMC abides by the rights granted to workers by laws and regulations, and respects the freedom of collective consultation and assembly and association of all employees. The company will not interfere or intervene. TSMC holds Silicon Garden Meeting, aka Labor-Management meeting on a regular basis, listens to employees' opinions and makes timely and appropriate responses through a diversified and comprehensive internal communication framework, in order to strengthen the good communication between the company's management team and employees and ensure a harmonious employee relationship.

### 5.6.2 Diversity and Inclusion

TSMC believes that a diverse management and talent structure will contribute to the company's competitive advantage and sustainable development. Through the implementation of the "Diversity and Inclusion Statement", TSMC actively establishes an open management model, creates an inclusive working environment, and encourages different talents to join the semiconductor industry, so that the industry can maximize the benefits of diverse talent resources.

TSMC has officially established an employee resource group (ERG) – "Women@tsmc" in the middle of 2022. It provides a platform for female colleagues to support each other, strengthens the company's internal network, and encourages women colleagues to realize their potentials. In 2022, the "Inclusive Leadership Workshop" was also held to support senior executives to understand the connotation of Diversity & Inclusion, understand unconscious bias, and promote an inclusive and friendly workplace. By the end of 2022, the training completion rate of senior executives reached 81%. In the same year, the Research and Development organization took the lead in formally establishing the "Diversity and Inclusion Committee", turning the company's goals into concrete actions and promoting the innovative value of diversity and inclusion.

### 5.6.3 Workforce Structure

At the end of 2022, TSMC had 73,090 employees worldwide, including 7,295 managers, 35,189 professionals, 8,665 assistants and 21,941 technicians. The following two tables summarize the makeup of TSMC's workforce and the female portion of management as of the end of February 2023:

**Workforce Structure**

| | | 12/31/2021 | 12/31/2022 | 02/28/2023 |
|---|---|---|---|---|
| Job | Managers | 6,635 | 7,295 | 7,373 |
| | Professionals | 31,920 | 35,189 | 35,174 |
| | Assistant Engineer/Clerical | 6,620 | 8,665 | 8,767 |
| | Technicians | 19,977 | 21,941 | 22,005 |
| Total | | 65,152 | 73,090 | 73,319 |
| Gender | Male | 64.6% | 65.6% | 65.6% |
| | Female | 35.4% | 34.4% | 34.4% |
| Education | Ph.D. | 4.1% | 3.8% | 3.9% |
| | Master's | 47.3% | 47.2% | 47.0% |
| | Bachelor's | 27.6% | 29.3% | 29.4% |
| | Other Higher Education | 8.9% | 8.4% | 8.4% |
| | High School | 12.0% | 11.3% | 11.3% |
| Average Age | | 36.0 | 35.7 | 35.9 |
| Average Years of Service | | 8.6 | 8.3 | 8.4 |

**Female Ratio in Management**

| | 12/31/2021 | 12/31/2022 | 02/28/2023 |
|---|---|---|---|
| Female Ratio in Junior Management | 13.4% | 13.6% | 13.6% |
| Female Ratio in Senior Management | 12.5% | 13.0% | 13.2% |
| Female Ratio in Top Management | 8.3% | 6.1% | 6.1% |

Note: Junior management positions include first-line managers; top management positions include vice presidents and higher as well as CEO.

### 5.6.4 Recruitment

A common vision and values shared by the Company's employees are key to TSMC's growth and success. As for recruitment of new employees, the Company is committed to finding and hiring top-notch professionals in all positions. TSMC is an equal opportunity employer and practices open and fair recruitment. The Company evaluates all candidates according to their qualifications relative to each position without regard to race, gender, age, religion, nationality or political affiliation but instead with an emphasis on integrity and ability.

TSMC adheres to its core values and continues to move forward with a lofty vision. The Company has long attracted new blood both in Taiwan and overseas. To ensure the talent it needs for the continuous growth, TSMC expanded its recruiting channels and employed over 12,000 employees worldwide in 2022.

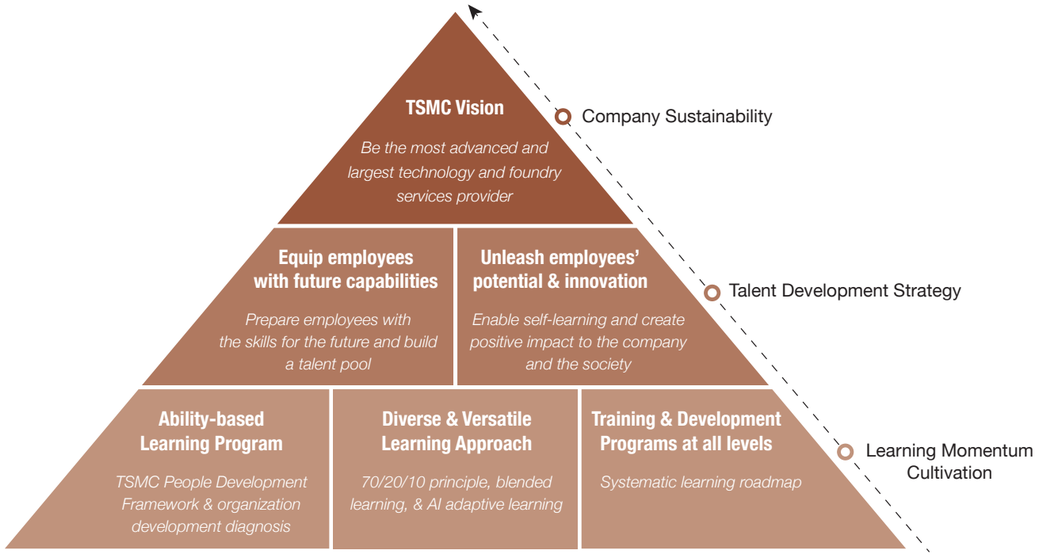
### 5.6.5 Talent Development

Employees are TSMC's most important asset. In addition to creating a diverse and inclusive workplace environment that encourages employees to learn and develop their strengths, TSMC also attaches great importance to the early and continuous development of the capabilities of all employees. In this regard, the Company integrates internal and external resources, provides challenging, meaningful and interesting work in a world-class workplace and creates a continuous, diverse learning environment. In addition, the Company has initiated the TSMC Employee Training and Education Procedures to ensure that the employees and the Company can grow together with "goals, plan and discipline" so as to become a force to uplift the society.

TSMC intends to expand global operations and pursue sustainable growth, and talent development is crucial to the completion of these strategic goals. Therefore, the Company selects and cultivates talented employees based on the "TSMC

Talent Development Model" to support the Company's sustainability, and follows two strategies for talent development: "Equipping Employees with Future Capabilities" – preparing employees with the skills for the future and build a talent pool, and "Unleashing Employees' Potentials and Innovation" encouraging and enabling self-learning and continuous innovation to create positive impact to the company and the society. As for the approach of talent development, the Company initiates ability-based learning programs, focusing on the core traits of character, perseverance, resilience, initiative, innovation, judgment, broadness of mind and breadth/depth of knowledge and develop the leadership, professional and general skills according to different positions, professional and organization diagnosis needs. Meanwhile, through diverse and versatile learning approach, including experiential learning (accounting for 70%), feedback and guidance (accounting for 20%), education and training (accounting for 10%), blended learning and future AI adaptive learning, together with training and development programs at all levels, comprehensively and systematically plan and develop the capabilities required by all employees. In this way, to cultivate the learning momentum, support employees' and the Company's continuous growth and breakthrough.

**TSMC Talent Development Model**




In 2022, TSMC conducted over more than 3,700 classroom training sessions, over more than 8,500 virtual classroom training sessions, and provided over 5.07 million hours of training with a total of more than 2.51 million attendees participating. The average annual training time per employee increased to 69.5 hours, an increase of 42% over the previous year. TSMC training expense reached NT$968 million and the average training cost per employee is about NT$13,000, a 5.6-fold increase from the previous year (Note).

### 5.6.6 Competitive Overall Compensation

In order to develop the most effective compensation strategies, TSMC reviews and selects benchmark companies annually and collects market information on compensation data of the whole industry for competitiveness analysis.

Note: In order to align the definition of training expenses with international market research information (Training Magazine), including total training spending, outside products & services, and training staff payroll, starting from 2022, training staff payroll will be included in annual training expenses.



TSMC's compensation program includes a monthly salary, performance bonuses based on quarterly business results, and profit sharing based on annual results.

The purpose of the business performance bonus and profit sharing programs is to reward employee contributions appropriately, to encourage employees to work consistently toward ensuring TSMC's success, and to align employee interests with those of TSMC's shareholders so as to achieve win-wins for the Company, shareholders and employees alike. The Company determines the bonus and profit sharing amounts based on operating results and domestic industry practice. The amount and distribution of the employee bonuses are recommended by the compensation committee to the Board of Directors for approval. Individual rewards are based on each employee's job responsibility, contributions and performance.

A similar approach is used in TSMC's compensation programs at subsidiaries. In addition to providing employees with a locally competitive base salary, annual bonuses are granted as a part of total compensation, in line with local regulations, market practices and the overall operating performance of each subsidiary.

In addition to the competitive compensation described above, the Company has approved and implemented a global employee stock purchase plan in 2022 which is available to all regular employees of TSMC and its wholly owned subsidiaries. Through this plan, Employees are encouraged to participate in the Company's long-term success.

TSMC believes that long-term ownership of Company shares by corporate officers helps align their interests with those of all shareholders, and therefore, the Company formulated Corporate Officer Shareholding Guidelines in 2020. The required holding value of TSMC shares by the chairman, CEO, and other corporate officers is proportional to their annual base salary: 18 times for the chairman and CEO, nine times for other officers in Taiwan facilities and VisEra, and three times for overseas officers. Officers shall fulfill the required value within three years of appointment and maintain the required value for the entire period of employment. Furthermore, to attract and retain corporate executives and other critical talent and to link their compensation with shareholder interests and environmental, social, governance (ESG) achievements, TSMC established employee restricted stock awards rules in 2021 and 2022.

### 5.6.7 Employee Benefit System Superior to Statute

TSMC offers employee benefits that are superior to the applicable statutes. In addition to twelve national holidays per year, seven memorial days are also designated as holidays. During the COVID-19 pandemic, to reduce the risk of infection in public transportation and crowd gatherings, TSMC launched a split work and work from home policy. The Company provides employees with statuary labor insurance and national health insurance as well as comprehensive paid group insurance plans. Coverage includes life insurance and insurance for accidents, hospital coverage, cancer and critical illness and business travel. There are also various employee self-paid group insurance plans available at lower prices for employee family members. The group insurance coverage is extended to employees on approved unpaid leave. To better support new hires, TSMC offers one day of annual leave for every two months of service in the first year. Employees who need to take long leaves of absence for military service or severe injuries can also apply for unpaid leave, and then apply for reinstatement after the expiration of the period. In addition, TSMC provides pensions, financial assistance for emergencies, subsidies for marriage, childbirth and funerals, as well as discounts in designated shops.

In accordance with local laws and regulations, TSMC provides breastfeeding and breast milk collection rooms. To help employees balance their personal and work lives, TSMC not only offers parental leave but also provides a comprehensive leave management system. The Company established the TSMC childcare benefit program, to extend maternity leave from eight to 12 weeks and paternity leave from five to ten days. It also increased the maternity subsidy from NT$1,000 to NT$10,000 per child. TSMC has set up four on-site kindergartens for employees in Taiwan, so that employees can work in a peaceful mind. In addition, a holiday STEAM campus has been organized to accompany the growth of employee's children.

All TSMC facilities are equipped with 24-hour health centers, where healthcare management professionals and appointed onsite physicians provide quality services beyond those required legally. The health centers work with hospitals and employee assistance program service providers to offer comprehensive support for the emotional and physical well-being of employees. In addition to annual checkups for all employees, in 2022 TSMC began providing employees with five advanced checkup items upon completion of every five years of service.

The Company encourages employees to exercise regularly by subsidizing 59 clubs, improving exercise facilities, and holding regular sports events to help employees find peers with similar sports interests. Also to help employees balance their work and life, TSMC provides:

- Convenient onsite services and amenities such as in-fab cafeterias, convenience stores, and other services
- Comprehensive health management services, including in-fab clinic services, post health-exam follow-up activities, and employee assistance programs
- Diverse employee welfare programs: leisure and art events; encouraging employees to participate in hobby clubs; vibrant sports centers and onsite preschool services to meet employees' needs for childcare; festival bonuses and emergency subsidies if and when needed

Vacation and insurance policies at TSMC's overseas offices are designed in compliance with local regulations. In China, North America and Europe, TSMC provides more vacation days to employees than legally required. In overseas offices, TSMC offers a more comprehensive life and medical insurance than required by local regulations and customs.

### 5.6.8 Diverse Employee Recognition

TSMC sponsors various internal award programs to recognize employees for outstanding achievement, both individual and at a team level. With these award programs, TSMC aims to encourage continued employee development, which also enhances the Company's competitive advantage.

The award programs include:

- TSMC Academy: recognizes outstanding scientists and engineers whose individual technical capabilities have made significant contributions
- TSMC Excellent Labor Award: recognizes technicians whose outstanding performances have made significant contributions
- Total Quality Excellence: recognizes employees' continuous efforts in creating value at each fab
- Service Award: recognizes and shows appreciation of senior employees for their long-term commitment and dedication
- Excellent Instructor Award: praises the outstanding performance and contribution of internal instructors of training courses for employees

Apart from the recognitions above, there are function-wide awards dedicated to innovation, such as the Idea Forum, the Total Quality Excellence Award and the ESG Award, which recognize employee initiative and continuous implementation of innovative practices. In addition, TSMC encourages employees to participate in external talent activities and competitions. In 2022, distinguished TSMC employees continued to be recognized through a host of awards, such as the Model Labor Award, the Excellent Young Engineers Award, the Outstanding Engineer Award, the Taiwan Continuous Improvement Awards, the National Manager Excellence Award and the National Industrial Awards.

### 5.6.9 Employee Engagement

The Company encourages employees to maintain a healthy and well-balanced life while pursuing their career goals effectively. TSMC facilitates employee communication and provides employee caring, benefit, rewards and recognition programs.

**Employee Communication**

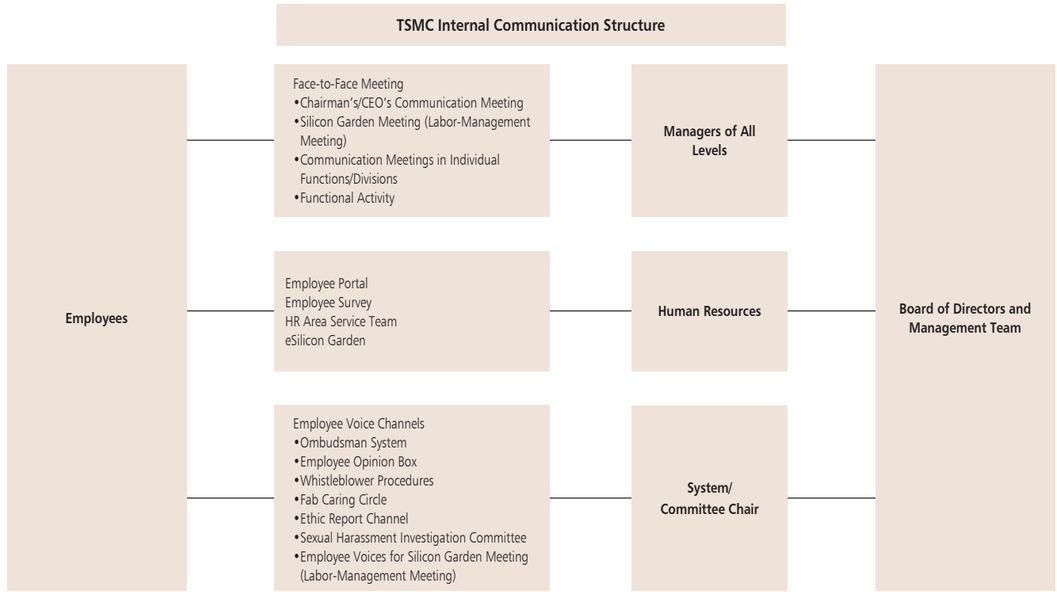
TSMC values employee communication and is committed to keeping communication channels open and transparent between managers and employees, and amongst peers. The Company is committed to ensuring that employees are able to communicate openly and share ideas and concerns with management regarding work conditions and management practices without fear of recrimination, reprisal, intimidation or harassment. TSMC makes continuous efforts to listen to employees and to facilitate mutual and timely employee communication, through multiple channels and platforms, which in turn fosters harmonious labor relations.

TSMC conducted face-to-face CEO dialogue sessions in Hsinchu, Taichung, and Tainan, which allowed the employees to make suggestions, express their thoughts and get direct feedback from the CEO. In addition, the Company also enlarged the scope of the labor-management meeting, transforming it into the "Silicon Garden Meeting," which helped all employees feel free to put forward their ideas so the Company could take appropriate action.

TSMC supports a host of various communication channels including:

- Communication meetings for various levels of managers and employees, e.g. the executives communication meeting, skip levels and communication meetings in individual functions/ divisions
- Quarterly Silicon Garden Meetings, aka Labor-Management meetings to provide business updates and discuss issues of concern for employees
- The biennial employee survey on core values taken to understand the Company's implementation of core values and employees' commitment
- The biennial global employee engagement survey taken to systematically understand the work experience of employees and to enhance employees' engagement and sense of belonging in the Company
- Periodic employee pulse surveys and service satisfaction surveys to selected employees with follow-up actions based on survey findings
- myTSMC employee portal, an internal website featuring the Founder's, Chairman's and CEO's talks, corporate messages, executive interviews, and other topics of interest to employees
- *eSilicon Garden*, TSMC's newsletter providing real-time updates on major activities of the Company as well as inspirational content featuring outstanding teams or individuals
- Three channels for reporting complaints regarding managerial, financial, auditing, ethics and business conduct issues:
  - The whistleblower reporting system administered by the Audit Committee
  - The irregular business conduct reporting system administered by the Ethic Committee
  - The ombudsman system administered by a senior manager appointed by the CEO
- The Employee Opinion Box, which provides an opportunity to submit suggestions or opinions regarding work and the overall work environment
- The Fab Caring Circle in each fab, which addresses issues related to employees' work and personal life; the system is dedicated mainly to the Company's direct laborers
- The sexual harassment investigation committee, a channel dedicated to ensuring a work environment free from the threat of sexual harassment; the committee consists of three directors appointed by the CEO, one from human resources, one from legal affairs, and the third from another organization

**Employee Communication Channels**



During 2022 and as of the date of this Annual Report, TSMC has not incurred any labor-dispute related losses. However, the Company was fined for the following labor inspection results: NT$200,000 issued on 06/08/2022 for overtime applications not being timely processed (Labor Standards Act Article 24 Paragraph 1). NT$250,000 issued on 06/08/2022 for the extension of working hours combined with the regular working hours exceeding permitted limit (Labor Standards Act Article 32 Paragraph 2). NT$100,000 issued on 06/08/2022 for consecutive working days exceeding the permitted limit (Labor Standards Act Article 36 Paragraph 1). NT$300,000, NT$250,000, and NT$40,000 issued on 09/02/2022 for overtime applications not being timely processed, the extension of working hours combined with the regular working hours exceeding permitted limit, and employees not having a break for at least 30 minutes after having worked for four consecutive hours (Labor Standards Act Article 24 Paragraph 1, Article 32 Paragraph 2, and Article 35). NT$350,000 issued on 10/26/2022 for overtime applications not being timely processed (Labor Standards Act Article 24 Paragraph 1). NT$300,000 issued on 10/26/2022 for the extension of working hours combined with the regular working hours exceeding permitted limit (Labor Standards Act Article 32 Paragraph 2). NT$60,000 issued on 10/26/2022 for employees not having a break for at least 30 minutes after having worked for four consecutive hours (Labor Standards Act Article 35). NT$50,000 issued on 12/07/2022 for the extension of working hours combined with the regular working hours exceeding permitted limit (Labor Standards Act Article 32 Paragraph 2). NT$50,000 and NT$50,000 issued on 12/20/2022 for overtime applications not being timely processed, and the extension of working hours combined with the regular working hours exceeding permitted limit (Labor Standards Act Article 24, Article 32 Paragraph 2).

The Company has reviewed its working hour management process and established indices to remind employees to apply for overtime payment on time and for mangers to respond to such applications efficiently and in a timely fashion, and to be more diligent about employee working hours as well as to strengthen communication about these matters and relevant policies.

### 5.6.10 Retention

Overall employee satisfaction with the Company was measured in the biennial TSMC core values survey taken in 2022. The survey scope included operations in Taiwan, China, North America, Europe, Japan, and Korea. (VisEra was not included in the survey due to its different industrial background.) A total of 62,333 respondents represented a high response rate of 91%. In this survey, 93% of participants said they were willing to commit fully in their work to make TSMC even more successful, while 90% concurred with the statement that they were willing to contribute their talent and grow together with the Company for the next five years.

TSMC's employee turnover rate was 6.7% in 2022 compared to 6.8% in 2021, both within a healthy range of 5% to 10%.

### 5.6.11 Retirement Policy

TSMC established its statutory defined benefit plan and supervisory committee of labor retirement reserve according to the Labor Standards Act, and also set up its statutory defined contribution plan according to Labor Pension Act, which was effective starting July 1, 2005. For each region, TSMC also established pension plans according to local standards and regulations. The previously mentioned supervisory committee not only holds quarterly meetings but also supervises affairs in connection with labor's retirement reserve fund. To meet legal requirements for disclosure of financial reporting and ensure sufficient funding levels, TSMC makes contributions based statutory requirement and also engages an actuarial consulting firm to assess the valuation of the defined benefit plan. Please refer to page 43-46 of the attached financial report for details. Thanks to the Company's sound financial condition, it is able to ensure the future viability employees' retirement benefits and solid pension contributions and payments, which encourages employees to make long-term career plans with and further deepen their commitment to TSMC.

## 5.7 Material Contracts

TSMC is not currently a party to any material contracts, other than those entered into in the ordinary course of its business. The Company's "Significant Contingent Liabilities and Unrecognized Commitments" are disclosed in Annual Report section (II), Financial Statements, page 71-72.