5.2.5 Future R&D Plans

Following the significant successes of TSMC’s advanced technologies in 2009, the Company plans to continue to grow the R&D organization. TSMC will further expand its 300mm R&D pilot line to speed up 28nm qualification with its early engagement customers and the 20nm path-finding programs with world-leading research institutions. The Company plans to reinforce its exploratory development work on new transistors and technologies such as 3D structures, strained-layer CMOS, high mobility materials, and novel 3D-IC devices with TSV. These studies of the fundamental physics of nanometer CMOS transistors are core aspects of our efforts to improve the understanding and guide the design of transistors at advanced nodes. The findings of these studies are being applied to ensure our continued industry leadership at the 28nm and 20nm nodes. One of TSMC’s goals is to extend Moore’s Law through innovative in-house work, as well as by collaborating with industry leaders and academia to push the envelope in finding cost-effective technologies and manufacturing solutions.

TSMC will continue working closely with international consortia and photolithography equipment suppliers to ensure the timely development of 193nm high-NA scanner technology, liquid immersion lithography, EUV lithography, and massively parallel E-Beam direct-write technologies. These technologies are now fundamental to TSMC’s process development efforts at the 20nm and 15nm nodes and beyond.

TSMC continues to work with mask inspection equipment suppliers to develop viable inspection techniques, a collaborative partnership to help ensure the Company maintains its leadership position in mask quality and cycle time and continue to meet aggressive R&D, prototyping and production requirements.

With a highly competent and dedicated R&D team, and unwavering commitment to innovation, TSMC is confident of its ability to deliver the best and most cost-effective SoC technologies for customers, and to support the Company’s business growth and profitability.

TSMC R&D future major project summary:

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Description</th>
<th>Risk Production (Estimated Target Schedule)</th>
</tr>
</thead>
<tbody>
<tr>
<td>28nm logic platform technology</td>
<td>28nm technology for both digital and analog products</td>
<td>2010</td>
</tr>
<tr>
<td>and applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20nm logic platform technology</td>
<td>Next-generation technology for both digital and analog</td>
<td>2012</td>
</tr>
<tr>
<td>and applications</td>
<td>products</td>
<td></td>
</tr>
<tr>
<td>15nm logic platform technology</td>
<td>Exploratory technology for both digital and analog products</td>
<td>2014</td>
</tr>
<tr>
<td>and applications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3D-IC</td>
<td>Cost-effective solution with better form factor and</td>
<td>2011</td>
</tr>
<tr>
<td></td>
<td>performance for 5P</td>
<td></td>
</tr>
<tr>
<td>Next-generation lithography</td>
<td>EUV and multiple E-Beam to extend Moore’s Law</td>
<td>2011 - 2012</td>
</tr>
<tr>
<td>Long-term research</td>
<td>Special SoC technology (including new NVM, MEMS, RF, analog) and 15nm transistors</td>
<td>2012 - 2014</td>
</tr>
</tbody>
</table>

The above plans account for roughly 70% of the total corporate R&D budget in 2010, which will be around 7–8% of 2010 revenue.

5.3 Manufacturing Excellence

5.3.1 Efficiency

Fast Yield Ramp

Fast yield ramp for new products is an important factor to help TSMC’s customers shorten their time-to-market. TSMC has developed a comprehensive technology transfer methodology extending from R&D to production in order to shorten the yield learning curve of leading edge technologies.

Accurate Delivery

TSMC has a proven record of providing customers with consistent on-time delivery. The Company has equipped a state-of-the-art supply chain management system in an effort try to improve both our customers’ forecast processes and TSMC’s delivery schedule accuracy. In 2009, the Company was able to make over 98 percent of deliveries within one day of the scheduled delivery date.

Best-in-Class Cycle Time Management

Fast manufacturing cycle time is another important factor behind TSMC’s continued competitive success and that of our customers. Accordingly, TSMC has developed a sophisticated manufacturing scheduling and dispatching system, implemented industry-leading automated materials handling systems, and employed effective lean manufacturing approaches. In 2009, the Company unceasingly strived to optimize manufacturing processes and cycle time management techniques, and continued to break cycle time records.

Flexible Manufacturing Management

Flexible Manufacturing is a crucial element that addresses the fluctuations in demand forecast. In many cases, TSMC has the ability to meet unanticipated customer demand surges, thanks in large part to our cluster fab capability as well as to our extensive know-how in performance matching for both tools and fabs.

Knowledge Management

TSMC has built the industry’s leading, state-of-the-art knowledge management, and Best Known Method (BKM) systems. TSMC maintains a vast database of key TSMC knowledge, which features a sophisticated expert system that embeds captured knowledge into TSMC’s engineering system.

Inventory Management

As semiconductor devices become more diverse, inventory management becomes more critical. TSMC has built integrated supply and demand information into its inventory management system to improve the Company’s responsiveness to the variability of wafer demand forecasts. The speed and accuracy of TSMC’s response has been improved through real-time demand information sharing.
5.3.2 GIGAFAB™ Fabrications

TSMC’s 12-inch fabs are a key part of its manufacturing strategy. TSMC currently operates two 12-inch GIGAFAB™ fabrication facilities – Fab 12 and Fab 14. The combined capacity of the two GIGAFAB™s reached 486,000 12-inch wafers in the fourth quarter of 2009. Production within these two facilities supports 0.13μm, 90nm, 65nm and 40nm process technologies, and their sub-nodes. Part of the capacity is reserved for research and development work and currently supports 28nm, 20nm and beyond technology development.

The GIGAFAB™s are the cornerstones of TSMC’s unceasing efforts to improve manufacturing excellence and to deliver manufacturing breakthroughs. GIGAFAB™s have the inherent scale advantages over smaller fabs and also enable greater flexibility to adapt to demand fluctuations, improve product quality and yields, accelerate yield learning and time-to-volume, shorten cycle times, and minimize costly product re-qualification.

5.3.3 450mm Wafer Manufacturing Transition

TSMC and other leading semiconductor companies have reached a pro-competitive agreement on the need for industry-wide collaboration to target a transition to larger, 450mm-sized wafers. The transition to larger wafers will help lower production costs and energy consumption per chip and enable continued growth of the semiconductor industry.

TSMC will continue to work with International Sematech (ISMI), and material and equipment suppliers to collaborate on new materials, next wafer size transition, lithography strategy, efficient tool platform, and eco-friendly process.

5.3.4 Raw Materials and Supply Chain Risk Management

In 2009, TSMC continued running monthly Supply Chain Risk Management meetings to integrate Company resources from materials management, fab operations, risk management and quality management in lowering supply chain risk. TSMC worked with its suppliers to enhance the performance of quality, delivery, risk management, and to support Green procurement, environmental protection and safety.

Raw Materials Supply

<table>
<thead>
<tr>
<th>Major Materials</th>
<th>Major Suppliers</th>
<th>Market Status</th>
<th>Procurement Strategy</th>
</tr>
</thead>
</table>
| Raw Wafers      | F.S.T. MEMC S.E.H. Siltronic SUMCO | These five suppliers together provide over 85% of the world’s wafer supply. Each supplier has multiple manufacturing sites in order to meet customer demand, including plants in North America, Asia, and Europe. | • TSMC’s suppliers of silicon wafers are required to pass stringent quality certification procedures.  
• TSMC procures wafers from multiple sources to ensure adequate supplies for volume manufacturing and to appropriately manage supply risk.  
• TSMC maintains competitive price and service agreements with its wafer suppliers, and, when necessary, enters into strategic and collaborative agreements with key suppliers.  
• TSMC regularly reviews the quality, delivery, cost and service performance of its wafer suppliers. The results of these reviews are incorporated into TSMC’s subsequent purchasing decisions.  
• A periodic audit of each wafer supplier’s quality assurance systems ensures that TSMC can maintain the highest quality in its own products. |
| Chemicals       | Air Products ATMI BASF Dow MGC TYS | These six companies are the major suppliers for bulk and specialty chemicals. | • Most suppliers have relocated many of their operations closer to TSMC’s major manufacturing facilities, thereby significantly improving procurement logistics.  
• The suppliers’ products are regularly reviewed to ensure that TSMC’s specifications are met and product quality is satisfactory. |
| Photoresist     | AZ Nissan Shin-Etsu Chemical Sumitomo T.O.K. | These five companies are the major suppliers for photoresist. | • TSMC works closely with its suppliers to ensure that they have adequate production lead time to supply the required products to TSMC.  
• TSMC conducts periodic audits of the suppliers’ quality assurance systems to ensure that they meet TSMC’s standards. |
| Gases           | Air Liquide Air Products Linde Taiyo Nippon Sanso | These four companies are the major suppliers of specialty gases. The products of these four suppliers are interchangeable. | • The majority of the four suppliers are located in different geographic locations, minimizing supply risk to TSMC.  
• TSMC has long-term contracts with these suppliers to ensure supply stability and service quality. In addition, the availability of other domestic suppliers enables TSMC to secure better purchase terms for these gases.  
• TSMC conducts periodic audits of the suppliers’ quality assurance systems to ensure that they meet TSMC’s standards. |
| Slurry, Pad, Disk | 3M Cabot DA Nano Krik Planar Solutions Dow | These six companies are the major suppliers for CMP materials. | • Most suppliers have relocated many of their operations closer to TSMC’s major manufacturing facilities, thereby improving procurement logistics and mitigating supply chain risk.  
• TSMC conducts periodic audits of the suppliers’ quality assurance systems to ensure that they meet TSMC’s standards. |
5.3.5 Quality and Reliability

TSMC is committed to providing customers with the best quality wafers for their products. Our Quality and Reliability (Q&R) services lead the partnership between customers and the entire TSMC organization to achieve “quality on demand”. The goal of quality on demand is to fulfill customers’ needs regarding time-to-market, reliable quality, and market competition over a broad range of products.

In the technology development and customer product design stage, Q&R technical services assist customers to design-in their product reliability requirements. Q&R has worked with R&D to successfully establish and implement new qualification methodology for high-k/metal gate since 2008. Q&R also works with design services on embedded memory, high voltage, e-Fuse and MEMS IP developments to expand TSMC’s design portfolio. In package reliability, Q&R extends characterization to the system level by establishing Power Cycling capability and methodology.

Q&R has deployed systems to ensure robust quality, in managing production dynamics and in design services as the Company meets the business requirements of our customers. To sustain production quality and minimize risks to customers when deviations occur, manufacturing quality monitoring and event management span all critical stages – from raw material supply, mask making, and real-time in-process monitoring, to bumping, wafer sort and reliability performance. Advanced failure and materials analysis techniques are also developed and effectively deployed in process development, customer new product development, and product manufacturing. In 2009, new techniques were developed to correlate physical parameters to electrical performance to support ramping of 40nm products and development of 28nm technology nodes. To meet time-to-market needs of customer products in the 45/40nm technology node, in 2009 Q&R established a collaboration platform with customers and major outsource assembly & testing subcontractors (OSAT) to validate assembly and testing processes. This has enabled our customers to introduce and ramp 45 and 40nm products with effective assembly quality improvement. Q&R will continue to enhance this collaboration platform for 28nm and future technologies to support customers from wafer processing to assembly and testing quality management.

TSMC Q&R is also responsible for leading the Company towards the ultimate goal of zero-defect production, through the use of continuous improvement programs. Periodic customer feedback indicates that products shipped from TSMC have consistently met or exceeded their field quality and reliability requirements. In 2009, the effectiveness of TSMC quality management system was upgraded by third-party audit to ISO/TS 16949:2009, and IECQ QC080000 certification was renewed.

5.4 Customer Partnership

5.4.1 Customers

TSMC’s global customers have diverse product specialties and excellent performance records in various segments of the semiconductor industry. Fabless customers include: Altera Corporation, Advanced Micro Devices, Inc., Broadcom Corporation, Marvell Semiconductor Inc., NVIDIA Corporation, Qualcomm Inc. and MediaTek Inc. IDM customers include: Analog Devices Inc., Freescale Semiconductor Inc., NXP Semiconductors, and Texas Instruments Inc.

Customer Service

TSMC believes that providing superior customer service is critical to enhancing customer satisfaction and loyalty, which is the path to retaining existing customers, attracting new customers, and strengthening customer partnerships. TSMC’s goal is to maintain our position as the provider of the most advanced and largest semiconductor foundry services.