Design Trends and EDA Tools: Asia-Pacific

EDA tool requirements & usage
System, IC and PCB design engineers across the Asia-Pacific reveal the level of design activity and share development experience with EDA tools
2006 Design Trends & EDA Tools

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EXECUTIVE SUMMARY

This is the sixth in a series of annual surveys conducted jointly by EE Times-Asia and Gartner Dataquest. Over the last five years, we have focused on following electronics design activity and engineer perception of EDA tools in China and Taiwan. This year we cover other major design countries as well and overview the Asia-Pacific design competence in 2006.

Apart from China and Taiwan, India, Malaysia, Singapore and South Korea are included in the survey that gathered 334 qualified responses. China provided 28% respondents, followed by 22% from Taiwan, 20% from India, 16% from South Korea, and the rest from Singapore and Malaysia combined. The fairly evenly-distributed respondent composition gives us a balanced view of the electronics design activity in the region.

Another first this year: we have highlighted the “design cities” in the region in terms of the respondent concentration. Out of a list of 28 selected design cities, most of the respondents came from the city state of Singapore with an 8.7% share. Hsinchu city came in second with 7.8% respondents. Seoul and Shanghai each had 6.9% and Bangalore is the fifth with 6% respondents. The total of the five major design centers accounted for 36% of the respondents. This is also an indication that none of the countries or cities in the region dominates or biases the end result.

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THE DESIGN ENVIRONMENT

This is the sixth in a series of annual surveys conducted jointly by EE Times-Asia and Gartner Dataquest. This year too the survey was conducted by inviting a segment of the registered user database at EE Times-Asia to a web-based survey.

Five years after following electronics design activities and designer’s perception to EDA tools in China and Taiwan, EE Times-Asia and Gartner Dataquest have expanded coverage to other major design countries and provide an overview of the entire Asia-Pacific design competence in 2006.

Apart from China and Taiwan, India, Malaysia, Singapore and South Korea are now included in the survey conducted July 18 to August 1, 2006. The survey collected 334 qualified responses with China providing 28 percent respondents, followed by 22 percent from Taiwan, 20 percent from India, 16 percent from South Korea, and the rest from Singapore and Malaysia combined. The fairly evenly-distributed respondent composition gives us a balanced view of the electronics design activity in the region (figure 1).

Almost half of the design companies in Asia are funded by local ventures, especially in Taiwan and South Korea (figure 3). These two countries have engaged in electronics design longer than the other countries surveyed, and they are the two biggest EDA markets in Asia-Pacific. As the electronics design market evolves, dependence on technologies and other resources from foreign companies tends to decrease.

In China, the ratio of local venture and foreign company invested subsidiaries are about the same, sharing around 40 percent each in 2006. Given the smaller design engineering population, Singapore and Malaysia combined is the only exception that has a high percentage of design companies as local subsidiaries of foreign companies.
Company revenue

In the Asia-Pacific, 36 percent of respondents come from companies with annual sales volume less than $10 million (Figure 4). Almost 60 percent of the respondents in South Korea report revenues of their companies fall in that range. Singapore-Malaysia combined, on the other hand, has nearly one-third of designers working for companies with revenue over $1 billion. This is another indicator that in Singapore-Malaysia, the majority of design companies are foreign or multinational enterprises. About 60 percent of engineers in our survey communicate that design companies that have revenue over $1 billion are local subsidiaries of foreign companies.

Industry type

Consumer electronics is the most popular end-market for electronics design in Asia-Pacific, as reported by 25 percent of survey participants. China and Taiwan are highly focused on consumer electronic designs.

Telecom/data communications and industrial controls/electronic instruments/medical electronics designs are also popular in the region. India and South Korea both have the largest cluster of engineers designing telecom/data communications applications. Singapore-Malaysia and Taiwan are the hubs for designing computer/computer peripherals applications.

From a regional perspective, Taiwan leads in consumer electronics and followed by China. South Korea, China and India are ahead in telecom/data communications. South Korea, India and Singapore/Malaysia, in that order, dominate the industrial/medical controls and instrumentation market. Figure 5 shows the distribution of industry by region and countries.

Job function

By job function, digital hardware engineers form the largest group that accounts for 38 percent of the engineering population in Asia-Pacific (Figure 6). System design engineers represent 30 percent of the survey participants, followed by analog hardware engineers at 15 percent. This breakout is similar in all Asian countries but Singapore-Malaysia, where system design engineers are the largest pool. Note also that Taiwan has relatively higher percentage of analog hardware engineers compared with other areas.

![Figure 4: Respondents by company size](image-url)

![Figure 5: Respondents by industry segment](image-url)
**Design types**

The survey asked engineers to choose one of various design types—ASIC, FPGA, IC, PCB and System design—they are currently involved in. System design is the most popular selection in the survey, leading in all regions and garnering 36 percent of the responses from the Asia-Pacific design market (figure 7). ASIC design comes in second with a 22-percent share, and PCB design is third with 17 percent.

Regional distribution is slightly different, especially in Taiwan: ASIC design is as common as system design, and IC design wins the third place. In China, PCB design remains the second largest, with ASIC ranking third.

An interesting point to note is that IC design is the least popular design type in all regions, except in Taiwan.
ASIC DESIGN

An ASIC is an application specific IC sold to a single customer. In the survey, we received responses from 75 ASIC design engineers, sharing 22.5 percent of the total as the second most common type of design in the Asia-Pacific.

ASICs are primarily designed for consumer electronics applications, with almost 40 percent of ASICs targeting this market (figure 1). On average, 27 percent of ASIC design size is between 1 million and 2.5 million gates (figure 2). Almost a third of ASIC design teams has about 10-19 engineers (figure 3), the highest among all types of design. The mainstream process technology for ASIC designs is 0.13µm, followed by 0.18µm (figure 4). The two combined account for 80 percent of ASIC designs.

In terms of design speed, ASIC design is concentrated on the mid- to high-range clock frequency (figure 5). About 50 percent of ASICs fall in the 100MHz-to-250MHz range, but ASIC designs above 250MHz also share a big portion: 21 percent. Clock speed is the highest compared with other types of design. Before tape out, ASIC designs generally run 1 to 4 iterations in order to meet timing specification (figure 6). The small number of design iterations hints at EDA tools being adequate in sustaining local ASIC design. The length of de-
Sign time depends on several factors, including the number of engineers in the design team, the complexity of design and the efficiency of EDA tools adopted. In general, nearly 30 percent of ASIC designs take 4 to 6 months to complete (Figure 7). About 23 percent takes between 1 and 3 months, and 20 percent requires 7 to 12 months.

The distribution of prototype to production time is about the same as design time (Figure 8): 34 percent of ASIC design takes 4 to 6 months to produce, followed by 25 percent taking 7 to 12 months, and 24 percent taking 1 to 3 months. These numbers can be used as reference not only by local design teams to assess design and production time but by companies outsourcing design projects to local design houses.

A high 93 percent was recorded for the use of IP cores in ASIC designs (Figure 9). The remaining 7 percent of engineers need to customize every gate or cell, which takes longer time and is rare nowadays, but the advantage is that the cost is possibly lower and the integration between each device/logic tighter, bringing better performance such as faster speed to the end product.

This year we found soft cores are adopted more than the hard cores (Figure 10). Sixty percent of ASIC designers use soft cores in 2006 across Asia-Pacific, comparing from last year, the adoption rate in Taiwan was lower than 50 percent. We believe the programmability issue is the cause of soft cores to be extensively exploited in ASIC.
In the semiconductor market, there are various types of cores such as microprocessor cores, memory cores, digital/analog signal processing cores, etc. supplied by various vendors. Major core vendors, such as ARM and Rambus, are examples of independent third-party suppliers. EDA vendors, such as Synopsys, Virage Logic and Mentor Graphics, provide design libraries and other type of cores. Foundries are also a popular source of cores because they have in-house developed set of cores as well resell cores from other providers.

In this survey, the largest percentage of ASIC design cores is developed in-house with third-party suppliers coming in as the second source of choice (figure 11). Foundries form the third major source followed by EDA vendors.

An ASIC design is sometimes outsourced by passing the gate-level netlist to design service companies or the layout group within the same company. From a cost standpoint, it is cheaper because the cost of tools or the overhead on layout engineers is saved if outsourced to the other company. From a skill standpoint, the expertise of layout engineering is leveraged. In Asia-Pacific, in-house place-and-route and outsourced layout have been about half and half. In 2006 however the percentage of outsourcing is slightly higher (figure 12).

![Figure 11: Source of IP cores used in ASIC design](image-url1)

![Figure 12: ASIC design place-and-route](image-url2)
IC DESIGN

IC design is defined as one that uses custom design methodology, including manual place-and-route, which is broadly adopted by large volume standard ICs such as microprocessor or memories. In the Asia-Pacific, the percentage of engineers involved in IC design is small—on average about 11.4 percent across the entire region. The reason behind this is the requirement for higher design capability and long design times. However, since IC design comes with large-volume manufacture, the higher return is an attractive factor for participating design firms. Taiwan is the only design center among all Asian countries to have over 20 percent of engineers engaged in IC design (see The Design Environment, figure 7).

Like ASIC design, IC design is highly concentrated on the consumer electronics and telecom/data communications markets (figure 1). The smallest IC—with less than 20,000 transistors—has a third of the design market (figure 2), and ICs featuring less than 1 million transistors sharing almost half of the design market. The number of engineers in a design team greatly varies. From the survey, it can be as low as 3 to 4, or beyond 20 engineers (figure 3). Most IC designs use 0.18µm process technology, followed by 0.13µm (figure 4). The 0.35µm process also accounts a significant portion in IC design.

The IC design clock frequency trend goes in two opposite directions. IC designs less than 50MHz are the most popular type with 45 percent share and those 250MHz and above take 32 percent (figure 5). To get timing closure, 3 to 4 iterations are generally needed (figure 6). In the survey, 60 percent of ICs are completed within 4 iterations. An IC usually takes 4 to 6 months to design—from concept to prototype (figure 7)—and another 1 to 3 months from prototype to volume production (figure 8). Overall, 81 percent of IC design is finished within 12 months and close to 80 percent takes a year to manufacture.
Figure 6: Number of designs iteration for standard ICs

Figure 7: Concept-to-prototype time for IC designs

Figure 8: Prototype-to-production time for IC designs

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ELECTRONICS DESIGN - IC
FPGA DESIGN

FPGAs are the second least common type of devices designed in the Asia-Pacific after standard ICs. In 2006, 12 percent of engineers are dedicated to designing FPGAs (The Design Environment, figure 7). Unlike ASICs and ICs, FPGAs in Asia-Pacific are primarily for industrial controls/electronic instruments/medical electronics market (figure 1), and demand from consumer electronics applications is minimal.

The size of FPGA designs is normally distributed across the range of gates with the medium falling in 80,000-to-150,000 gates (figure 2). A design team usually has 3 to 4 engineers, but it can be more to 20 or above designers per design team (figure 3). The main process technology for FPGA is 0.13µm at more than 40 percent of the market (figure 4). The 0.18µm, 0.25µm and above 0.35µm process designs combined take 40 percent of the remaining market.

FPGA design clock speed is concentrated in the lower range (figure 5). FPGAs running at less than 50MHz corner a third of the market, while the upper range of 250MHz and above has only 13 percent of the designs. Most designs require 3 to 4 iterations, and about 65 percent are finished within 10 iterations (figure 6). The proportion of FPGA designs that take more than 10 iterations is the highest when compared with other types of design. Despite the greater number of iterations, the design time is quite small with the majority of designs being completed within 3 months and 80 percent done by 6 months (figure 7). The shorter design time is expected because FPGAs do not require re-spin of silicon if changes are required. The prototype-to-production time for most—76 percent of—FPGA designs is about 6 months (figure 8).

As in ASIC design, cores find a home in FPGA designs (figure 9). Only 7.5 percent of FPGA designs do not use cores. Soft cores once again prevail over hard cores owing to escalating demand for programmability (figure 10). An ASIC or FPGA/PLD company is the primary source of cores (figure 11), given that many FPGA companies, including Xilinx and Altera, offer FPGA design tools and IP to facilitate FPGA design.

Defining the function of gates or logic cells and wiring are the essentials of FPGA design, so 65 percent of FPGA placement and routing are accomplished in-house (figure 12), instead of being sent to outside vendors or other groups for the work.
SYSTEM DESIGN

System design is the most popular design type in the Asia-Pacific (The Design Environment, figure 7). There are three primary design markets for system design: industrial controls/electronic instruments/medical electronics, telecom/data communications and consumer electronics (figure 1).

A system design team could have only one to two engineers or up to 20 people or more, depending on the complexity of design and the structure of the company. From the survey, five to nine and three to four engineers per design team have the greatest number of responses (figure 2).

We also found that system designers spend most of the time in design and debug (figure 3). On the whole, approximately 28 percent of the system design time is spent on logic design and 22 percent on debugging. Defining product specifications and final verification each take about 20 percent of design time. The remaining goes to IP evaluation, and others such as documentation, test the reliability, validation and performance calibration.

Thirty four percent of system design clock speeds fall in the slowest range, which is below 50MHz (figure 4). In addition, system designs with speeds 250MHz and above share a significant 21 percent.

The number of design iterations for systems by and large are between one to four times, and 75 percent of design can be done within 10 iterations (figure 5). The average system design time from concept to prototype is about one to three months, and 82 percent of system design is completed within a year (figure 6). System design production time lasts about four to six months, as reported by 37 percent of survey respondents (figure 7). It can extend from 7 to 12 months for 20 percent of respondents, but only a few go beyond a year’s time to make.
Figure 6: Concept-to-prototype time for system designs

Figure 7: Prototype-to-production time for system designs
Seventeen percent of design engineers in the Asia-Pacific are engaged in PCB design (The Design Environment, figure 7). China is the only country that has a comparatively high percentage of PCB design activity in the region. Nevertheless, when we asked survey participants what type of engineer they consider themselves, only 10 percent classified themselves as PCB design engineers. The fact is that system design engineers at the board level are often given the job title of “system design engineer” even though the actual hands-on product is a printed circuit board. As system design or system integration is on the rise, PCB design is somewhat limited to the on-the-board placement and routing, analysis and prototyping to distinguish it from system design.

The printed circuit board is a key element to form electronic systems or applications. In the Asia-Pacific, PCB design is focused on four end markets: consumer electronics, industrial controls/electronic instruments/medical electronics, computer/computer peripherals and telecom/data communications (figure 1). Ordinarily, a design team is composed of three to nine engineers (figure 2). A board design can be intricate if it is a high frequency board, or if it has multiple layers with numerous logic or IC packages on each layer. In the survey, about 40 percent of PCB design is within 50MHz, and another 40 percent is above 100MHz (figure 3). Designs beyond 250MHz share 13 percent of the market, with a large demand came from the telecom/data communications sector.

The number of layers per board is typically around five to nine, accounting for almost half of the responses to the survey (figure 4). The mainstream of 35 percent of PCB design carries 10 to 24 IC packages (figure 5), and this year it is unusual to see a board holding more than 100 IC packages. Additionally, there is no incidence of PCB design in the more-than-250-IC-packages category of the survey.
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ELECTRONICS DESIGN - PCB DESIGN

Figure 5: Number of IC packages on PCBs

Given the general specification of PCB design in Asia-Pacific, design iteration is mostly within four cycles, and only a few require five or more iterations (figure 6). The majority of design time from concept to prototype is three months, as specified by 76 percent of respondents (figure 7). The prototype to production process typically lasts three months (figure 8), but a third of design might take four months or even up to a year.

Figure 6: Number of design iterations for PCB designs

Figure 7: Concept-to-prototype time for PCB designs

Figure 8: Prototype-to-production time for PCB designs
EDA TOOLS

The survey asked the design engineers about their familiarity with tools matched up to major EDA vendors. Among the 30 vendors we listed, the top three vendors with the highest usage rate are Cadence Design Systems, Mentor Graphics and Synopsys (figure 1). All of them are graded high for their technology leadership; on the other hand, they were poorly rated by users on competitive pricing.

It’s interesting to note that Synopsys has been the largest EDA vendor in Asia-Pacific for at least the past three years in Gartner Dataquest’s annual market share research. The reason Synopsys is not the leader in this survey is mainly because a large percentage of engineers in China are not familiar with them compared with Cadence and Mentor. Besides the big three, the ranking of ARM/Artisan Component, Ansoft and Magma were also lower than the position they held in Gartner Dataquest’s market share finding. Vendors such as Synplicity, Electronics Workbench, which was bought by National Instruments, Novas Software, which is known by SpringSoft in Asia-Pacific, the Mathworks and Altium are tool providers that are also highly adopted by users in the Asia-Pacific. We also asked the designers how important EDA tools are to them and how satisfied they are with the tools they use. Overall, 5 out of 26 tools we listed had satisfaction level exceeding their importance, and they are TCAD/OPC/PSM, VHDL Simulation, RF design and simulation, ASIC emulation and PCB CAM. The widest gap separating importance and satisfaction is seen in timing analysis, logic synthesis, design rule checking (DRC) and design for test (DFT) (figure 2).

This year we listed 13 attributes for users to choose from when they consider purchasing EDA tools. The most critical factor is after-sales support with clear documentation and ease-of-use following. Pricing is not on the top of the priority list, which listed as the fourth critical factor. Other important points that users would consider when purchasing the tools are training services, integration with other vendors’ tools and support for open standards.

Survey respondents were asked about which department makes the purchase decision for EDA tools at their company. With “both CAD and design engineer” or only “design engineer” categories getting most of the responses, the design engineer—the user—still has by far the greatest power in influencing the purchase decision (figure 3).