

**EDN**

# GLOBAL REPORT

IN THE LAST THREE *GLOBAL REPORTS*, WE'VE FOCUSED ON GLOBALLY IMPORTANT APPLICATIONS, GLOBAL STANDARDS AND REGULATIONS, AND HOT ENABLING TECHNOLOGIES. WHEN WE STARTED PLANNING THIS YEAR'S REPORT, HOWEVER, WE WERE ALSO IN THE MIDST OF CONDUCTING OUR FIRST GLOBAL SALARY-AND-CAREER SURVEY. WHAT BETTER WAY TO KICK OFF OUR FOURTH *GLOBAL REPORT* THAN TO FOCUS ON THE PROFESSION. WE ALSO OFFER A TECHNICAL ARTICLE FOCUSING ON HOW ENGINEERS USE REFERENCE DESIGNS AROUND THE GLOBE.

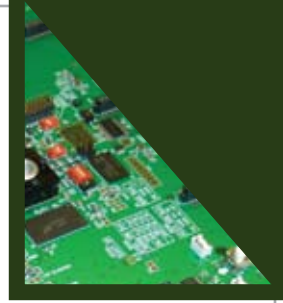


**Globally, engineers share similar gratification and concern** pg 61

**Reference designs worldwide: understanding the IP imbalance** pg 75



OUR FIRST GLOBAL SALARY SURVEY SHOWS THAT NORTH AMERICAN ENGINEERS RECEIVE HIGHER COMPENSATION THAN COUNTERPARTS IN ESTABLISHED REGIONS, SUCH AS JAPAN AND WESTERN EUROPE.



# Globally, engineers share similar gratification and concern

BY MAURY WRIGHT • EDITORIAL DIRECTOR, *EDN* WORLDWIDE

“It was the best of times. It was the worst of times.” The classic Charles Dickens quotation could easily have applied to the situation in the engineering profession last year. Engineers are worrying about outsourcing of their jobs, feeling decidedly underappreciated, and working what they believe are excessive hours. But engineers receive higher compensation than workers in many other professions, and job satisfaction is high. This conundrum led *EDN* to conduct its first salary-and-career survey, and we believe it is the only such survey ever fielded worldwide. A summary presentation of the results here kicks off our fourth annual *Global Report*, and, as in the past, the print offering is a small part of the complete online *Global Report*, which you can find at [www.edn.com/global](http://www.edn.com/global).

Over the summer, *EDN* and our regional global editions conducted the salary-and-career-satisfaction survey. *EDN* in the United States focused on North America, *EDN Europe* focused on Western Europe, *EDN Japan* focused on Japan, and *EDN China* focused on mainland China. *EDN Asia* fielded surveys separately in India, Korea, Southeast

Asia, and Taiwan. We conducted the surveys via e-mail. We are hosting the complete set of data that we gathered in a new career section of our Web site. On the Web, you will find the intricate details on how we fielded the surveys as well as all of the data. Here, we’ll take a look at details that stand out along with some of the most interesting verbatim responses that we gathered.

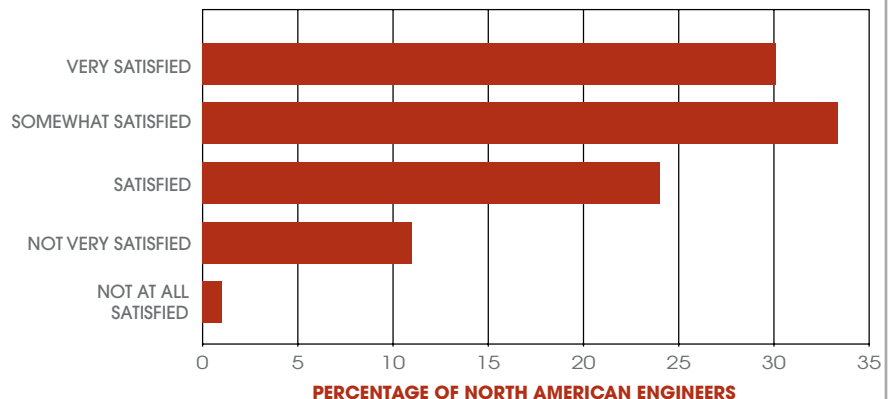
## JOB SATISFACTION

The combination of outsourcing and staff reductions has left North American engineers worrying about their future. Meanwhile, new engineering opportu-

nities abound in parts of Asia. The situation seems ripe for a vastly different set of results when you ask engineers globally how satisfied they are with their career. And you might expect poor job satisfaction in North America.

**Figure 1** shows the results from North America. Surprisingly, most respondents in North America feel somewhat satisfied to very satisfied. The 30% that chose very satisfied dwarfs the response in that category from all of the regions that *EDN Asia* covers. We admit one slight discrepancy. Arguably, we incorrectly ordered the “satisfied” and “somewhat satisfied” choices on the questionnaire, but that

FIGURE 1

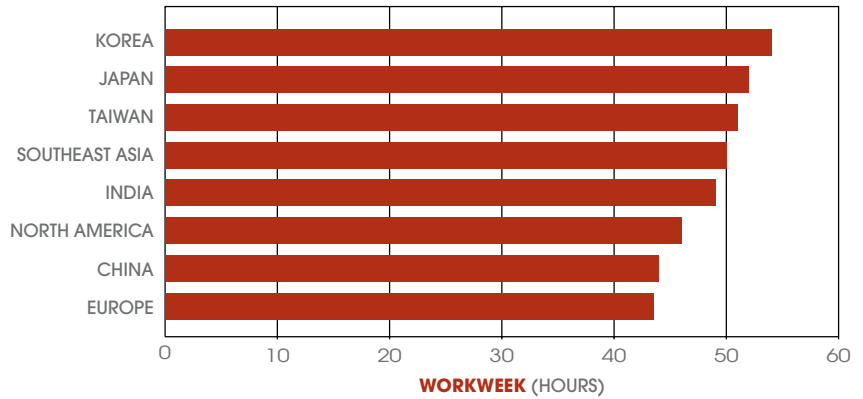


discrepancy certainly doesn't affect the "very satisfied" category. Check the online details, and you will see that only India came close to North America at 27.2%. Europe also delivered positive numbers, and the sidebar "UK engineers relish working with technology and quality of life" chronicles several such engineers. Conversely, in Japan, only 2.8% feel very satisfied. Excluding North America, the job-satisfaction curve has the traditional bell shape.

Looking at verbatim responses from engineers in North America, it's hard to match those responses to the figure. There are plenty of positive responses, but there are also plenty of negative ones.

Outsourcing is near the top of the list of complaints. One North American re-

FIGURE 2



spondent noted as a concern, "Job security—my company generally takes attrition in the US and does massive hiring in China and India. I'm even hearing of start-up companies that want to out-

source all product development to India or China to conserve capital." Outsourcing isn't just prevalent in North America. Japanese respondents indicated that 18.7% of their design work is outsourced.

## CHINESE EEs SEEK TRANSFORMATION BEFORE THE AGE OF 35

Jeff Lu, Executive Editor, EDN China

**China's electronics industry has grown rapidly in the past two decades. The growth is a key reason that many young Chinese select electronic engineering as their occupation. In the past decade, China has transformed beyond its role as the manufacturing center of the global electronics industry. As local OEMs have matured and more and more multinational companies have established R&D centers in China, the amount of design work has skyrocketed. Today, young Chinese electronic-design engineers get more job opportunities, better salaries, and loftier social status than engineers in other industries. Nonetheless, many young engineers are acutely concerned about continuing in a design job after the age of 35 and look toward management and entrepreneurial opportunities.**

"I have been considering transformation," says Nathan Lei, project manager of a German communications company's Shenzhen office. Despite many years' work experience at UT Starcom and a master's degree in electronic engineering from Hong Kong Polytechnic University, he says he does not want to be an engineer for a lifetime.

Two reasons drive the midcareer designers away from engineering. First, R&D is an arduous job. Young engineers need to spend a lot of time and energy to meet challenges in their daily work and still stay abreast of the latest technology. Overtime is commonplace for Chinese electronics engineers. As they age, the engineers are less willing to endure such intensive work requirements. If an engineer has not landed in a team-leading position on the strength of his experience and capabilities by the age of 35 and is immersed in development work, he will inevitably feel competitive pressure from more energetic young people.

Opportunity is the second force that drives engineers to other jobs. Today, opportunities abound in China's fast-growing electronics industry. Many young engineers yearn to one day start a company of their own. Generally, engineers believe that pure R&D work—even at a multinational company—will restrict their horizons. Experience built from R&D work does not qualify an engineer to operate a company. Therefore, many young engineers take on sales and marketing as their choices for the postdesign step of career develop-

**Generally, engineers believe that pure R&D work—even at a multinational company—will restrict their horizons.**

ment. The engineers hope to gain more experience in business and corporate operations before turning 35.

Chongjun Zhu currently serves as general manager of the new-business-development department in an independent design house for handset products in Shanghai, and he is one of the company's shareholders. "Just a year ago, I was staying up writing code," he says. He is satisfied with the fact that he turned from an engineer into a business executive before the age of 35. Zhu believes that, in China's electronics industry, a technology-type executive who knows how to do business has greater potential for growth and success than an engineer. He believes that his experiences as an engineer were just steppingstones in his career development.



Still, in North America and Japan, the prevailing mood is positive. And the primary reasons seem to be the satisfaction of tackling difficult problems, learning challenging technologies, and creating useful products (see sidebar “Technology creations drive Japanese engineers”). The North American survey identified “technical challenge” and “feeling of accomplishment” as the top two factors influencing job satisfaction.

The feelings extend to the global engineering community. An Indian re-

spondent said, “I have been able to put most of my knowledge and skills in engineering to productive use. As I have worked in very small companies, mostly start-ups, I have been extremely hands-on and see the companies grow very visibly, and that has given me the most satisfaction.”

A respondent from Europe noted, “A multidisciplinary engineering career has got to be the most satisfying career; how else can you help mould the World whilst you learn how it works—

magical!” An engineer in Taiwan added, “There is an opportunity to develop new products and to realize my professional expertise,” and a respondent in Southeast Asia stated, “Work is challenging in a way that there’s always new problems to solve.” Only China had a decidedly different take on satisfaction, choosing “advancement opportunities” and “benefits” as the two most important factors.

As for the most difficult challenge in their current jobs, Japanese engineers

## UK ENGINEERS RELISH WORKING WITH TECHNOLOGY AND QUALITY OF LIFE

*Graham Prophet, Editor In Chief, EDN Europe*

**E**ngineers in the United Kingdom have long had a complex relationship with their chosen profession. In almost any era of recent history, the industry has complained that it could not find enough engineers with the right skills. At the same time, engineers have frequently regarded themselves as under-rewarded in financial terms and undervalued in society relative to their contemporaries in other professions. As long ago as the late 1970s, this concern became so acute that the British government set up an official inquiry into the engineering profession. Industrialist Sir Montague “Monty” Finniston conducted this inquiry, which in 1979 proposed a number of remedies to enhance the status of engineers and increase the flow of aspiring young engineers into the profession.

To judge by many indicators in the UK engineering scene, not much has changed in nearly 30 years. You still hear many of the same gripes. So, are the UK’s electronics designers an embittered and unhappy group? On the contrary, as a group, they seem to be happy with their chosen path.

A relatively recent entrant into the UK’s engineering community is hardware engineer Charlotte Doyle, who designs embedded-system-computer boards for Varisys, a UK-based supplier of COTS (commercial-off-the-shelf) and custom hardware for the

embedded-computer market. Having worked in the industry for five years since graduating from university in 2002, Doyle says, engineering has been the right choice for her. She is happy with the position she holds and says that electronic design, with its problem-solving challenges, continues to hold her interest, as someone who came into the profession through enjoyment of the technology. Her job, she says, also offers the right combination of conditions and benefits, and the company she works for is “family-friendly”—a theme that recurs in talking to today’s UK engineering community. Within her field, she does not find that keeping up with technology is a particular issue. “There is time to keep up to date technically, as part of the problem-solving,” she says. Doyle would see an ideal career path as one that allowed her to stay in engineering, “perhaps more involved with project management,” but she has no wish to move into, for example, a sales or FAE (field-application-engineering) role.

When Doyle completed her university studies, financial institutions were trying to tempt engineering and science graduates away from technology and toward finance. The financial businesses told the recent graduates that the rigor of their scientific education would lend itself to this alternative career. “A number of people from my year group did that,” Doyle says,

“and they currently have significantly better rewards than those of us who continued with engineering.” But she has no doubt that technology—and the engineering profession—has been the right choice for her.

Martin O’Hara is technical director at Danfoss Randall Ltd, leading a team of 15 designers of systems for heating controls. With a career that has included posts with Ferranti, Newport Components (now C&D Technologies), and Motorola, O’Hara is an example of an engineer who has kept technology as the focus of his professional life. The rewards of the job, he says, have shifted throughout his career from the fascination with technology itself to managing the process: getting a product through to production and interacting with teams in other geographically distributed branches of his company. Danfoss is a Danish company; other locations that O’Hara works with are in Slovenia and China.

O’Hara sees keeping up to date with technology as a significant challenge for himself and his team “in an environment of information overload.” In material terms and perhaps due to a career structure in which he has always chosen a new area of technology with each move, O’Hara believes that he has fared at least comparably with and perhaps better than most of his peer group. He

*continued on pg 66*



yielded some surprising answers. They mentioned the expected time crunch, excessive workload, and technical challenges, but several responses mirrored one respondent's "shortage of mid-career engineers." On the other hand, the survey revealed an average age of 41.2 years, with an average of 15 years as an engineer and more than seven in the current job—presumably a midcareer description.

Several Japanese respondents also noted managerial issues. One respondent

claimed a "divergence in consciousness with management" and another noted "arguing with the management team." Rightfully or wrongfully, many view Japan as a region in which engineers once wouldn't question authority, but that's not the case today. Old generalizations would also suggest that motivation would never be an issue in discipline-centric Japan, yet respondents identified issues with lack of motivation.

Without question, engineers globally feel time-to-market pressure and

note the inevitably compressed schedules that are exacerbated by increasingly more complex technology. With regard to such challenges, an engineer from Southeast Asia pointed to "customer product deadline and debugging the complex boards." Responses concerning keeping up with technology were among the most popular among North American respondents. One noted "keeping on top of the current technologies" as the biggest

*continued from pg 64*

is also in a minority among UK engineers and engineering managers, in having added to his technological qualifications by earning a degree in management.

From a manager's perspective, O'Hara sees one of the UK industry's problems as a failure to attract sufficient young entrants to the profession. "In response to one of our recent advertisements, which was not specific on experience expected, no young graduates applied at all. All of the applicants were in the 35-to-45 age range," he says.

O'Hara values the freedom his current position offers him to "do what needs to be done" without excessive pressure on spending. There is also no great pressure on him to outsource design work, although he does contract out some work—mainly software.

O'Hara says it is becoming more difficult to find engineers with cross-discipline knowledge—for example, analog and digital or hardware and software—or designers with application knowledge. Although he does not outsource design, O'Hara notes a negative trend emerging with the general move to offshore manufacturing. "Without the link to manufacturing," he says, "the design community is losing design-for-manufacturing skills."

The ultimate expression of a wish to move your career progression ahead is, of course, to look for a new job. One person who sees that process in action is Kay Alexander, divisional manager of John Prodger Recruitment, a UK-based agency

that operates across the breadth of the UK electronics industry.

When British engineers seek a move, Alexander says, it's rarely just for financial reasons; more often, it's about moving their careers forward. She confirms that most UK engineers were initially attracted to the profession by their enthusiasm for the technology, and most would prefer a career path that keeps them in direct contact with engineering and that continues to present technical challenges.

Because of the lure of technology, most engineers prefer an upward move into engineering management rather than, for example, a move to sales or marketing. Ultimately, as Alexander points out, "A company needs only one chief technology officer." In cases in which engineers do leave a mainstream career path—what Alexander describes as "leakage" to the profession—it's most often to free-lance design work or into teaching; science teachers are in short supply in Britain's schools.

Alexander sees a trend in the increasing determination of engineers to consider family-friendly and quality-of-life factors, such as working hours, flexible working time, and paternity leave—as well as maternity leave, which is a legal right in the United Kingdom as in most other European countries—alongside direct career issues, such as pay and technological challenges. "A few years ago, these 'soft' topics would have been mentioned only late in a job negotiation," says Alexander. "Now, they

**It is becoming more difficult to find engineers with cross-discipline knowledge—for example, analog and digital or hardware and software—or designers with application knowledge.**

are discussed right away. I think many companies have underestimated the contribution these factors can make to recruiting good people. It has become acceptable for engineers to put a high priority on these matters, whereas before it was not."

O'Hara agrees with Alexander's assessment and adds that, as his current employer is a branch of a Danish company, its engineers do enjoy favorable conditions in that respect; Scandinavian countries and companies are noted for progressive policies.

It is more difficult as a UK engineer to build a career in engineering and make a lot of money. An engineer with a few years' experience might earn less than £30,000. Alexander observes a problem with experienced engineers: "Eight to 10 years ago [at the height of the dot-com 'bubble'], a lot of engineers moved from, for example, defense into communications, which was relatively much better paid at the time. Now, there is interesting work opening up in defense and other areas. Companies need those experienced engineers but cannot pay enough to tempt that cadre of engineers out of their current positions."



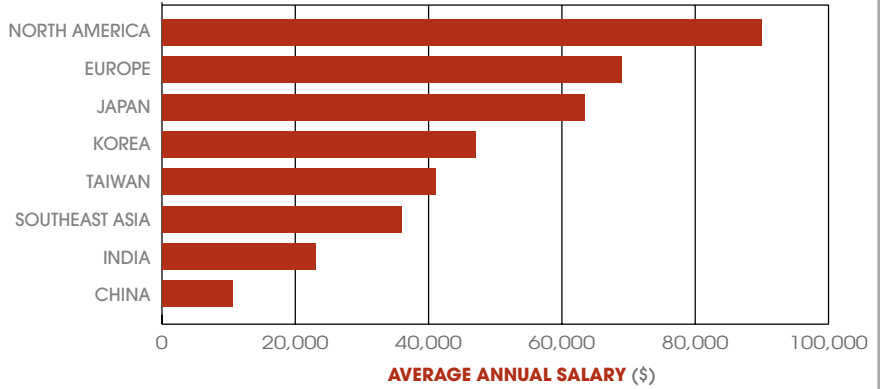
challenge. “[I] finished college over 15 years ago, technological advances are happening all the time, and keeping abreast of the latest and greatest is time-consuming in itself.”

### LONG DAYS, LONG WEEKS

Complexities of enabling technologies and end applications combine with tight schedules to make workload a global problem that straddles the issues of job challenges and job dissatisfaction. We asked engineers about the number of hours that they work per week. **Figure 2** summarizes the results; the hours they work range from 43.5 to 54 per week. The gap of more than 10 hours seems small, but it represents approximately 25% of the workweek. If you peruse the online data, you will find wide ranges of responses in each region. In Japan, for instance, more than 10% of the respondents work more than 60 hours per week.

Verbatim responses and other data indicate a more trying workload situation than **Figure 2** depicts. The **sidebar** “Korean engineers face mandated career choices” paints the profession as a 365-day-a-year job in that region. A North American respondent chose “work-life balance” as a key challenge, adding, “My employer

FIGURE 3



is always wanting more of my time than I can give and then downgrades my performance because I cannot give as many hours as others.” A number of Taiwanese respondents note overtime work as an issue, especially relative to their pay.

### JOB DISSATISFACTION

Other factors in job dissatisfaction range from complaints about management to lack of recognition and decision-making power. Japanese engineers’ sources of job dissatisfaction match those in other regions, but responses that stood out relate to career track, skills, and decision-making. One respondent noted,

“My technical capabilities are too narrow.” Several mentioned the gap between the job at hand and the job that they would prefer to perform. Perhaps the most notable response, however, is “not authorized to make a decision.” Engineers globally believe in their ability to do their job and make good decisions, and Japan has among the deepest of experienced-talent pools.

Career track appears to be a big issue in China. According to the **sidebar** “Chinese EEs seek transformation before the age of 35,” Chinese engineers seek to move into marketing or sales roles by midcareer. Some Korean engineers, on the other hand, would prefer to stay on a technical career path but are forced into management.

The engineering profession in other parts of Asia is far younger both figuratively and literally than in Japan. That fact translates to lower pay, less job choice, and, potentially, greater dissatisfaction.

Responding to the dissatisfaction question, an Indian engineer from our *EDN Asia* survey noted, “I’m dissatisfied because of the pay structure of my company. I am still not into a proper development project. I’m forced to take on the assignments mandated by management. My achievements are not recognized.”

But the positive responses in India outnumber the negative. Remembering that India is a newcomer in prevalent relatively-well-paying engineering jobs, it’s still humbling to read a reason behind job satisfaction such as “sense of accomplishment and, of course, money for bread.”

Not surprisingly, making a living and salary top the list of concerns for engineers globally. Our survey has a lot of

## TECHNOLOGY CREATIONS DRIVE JAPANESE ENGINEERS

Takatsuna Mamoto, Editor in Chief, EDN Japan

**A couple of trends are evident in the career choices of Japanese engineers: They yearn to create and build things, and the skills that their fathers and mentors possessed influence them. “Watching my father make things during my childhood led me to an engineering career,” says one. Another notes that, when he was young, his father’s skill in repairing broken radios, TVs, and VCRs impressed him.**

**The creative instinct provides the biggest motivation. “It is always nice to see that the product I design is a bestseller,” says another Japanese engineer.**

**“I am satisfied to be involved with development of the state-of-the-art**

**robots that walk on two legs,” says still another. “It was my childhood dream.”**

**The engineers also greatly appreciate and are proud of the recognition that they receive, especially when trade publications cover the technologies and products on which they work.**

**Japanese engineers are generally happy with their career choices. Some note the difficulty of long hours and lengthy product-development schedules. Others note the occasional mismatch of skills on a design team to an application. But the sense of accomplishment the engineers feel after developing a successful product makes the work worthwhile.**

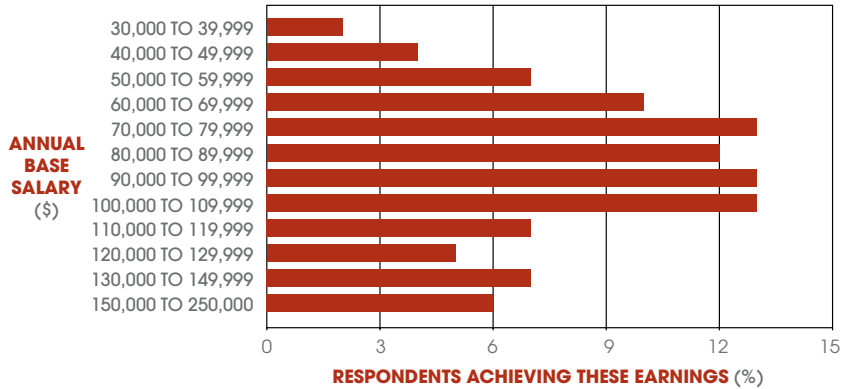


data on salaries, and you should explore the Web data for details. The highlights follow.

First, we offer a disclaimer. We conducted all of the surveys with salary questions pegged to local currency. We then converted the amounts to US dollars. The conversions were accurate in August 2007 when we compiled the data but will vary—possibly greatly—over the long and even short term.

North American engineers won't like a quick generalization of the results in Fig-

FIGURE 4



## KOREAN ENGINEERS FACE MANDATED CAREER CHOICES

Jade Jin, Executive Editor, EDN Korea

Since 1990, the electronics industry has driven economic growth in Korea and has become one of the chief national industries. Accompanying the industry growth, an increasing number of engineering opportunities have emerged. The engineers largely like the profession, although some feel they have too little choice about how their career progresses.

For example, Senior Engineer Kyung-Fan Shin at the Overseas HSDPA (high-speed-downlink-packet-access) Development Group of Pantech and Chief Engineer David Yoon at the Mobile Communication Lab of LG Electronics both majored in electronics engineering in the early 1990s. Both have also worked since 1996 as engineers in the telecommunication field in Korea, which has experienced the rapid growth of the electronics industry. Moreover, the two have worked as engineers in mobile communications and directly on mobile handsets. More than any other segment, mobile communications has been the heart of the Korean electronics industry for more than 10 years.

Generally, engineers sacrifice their personal life in Korea to survive in the competitive field. Work that continues for 365 days a year and frequent overtime hours are the symbols of the profession. Given those facts, you might expect this

duo to complain about such conditions, but generally they like their jobs.

“Engineering is a realistic and creative occupation,” says Yoon, who develops GSM (global-system-for-mobile)-communication and WCDMA (wide-code-division-multiple-access) mobile phones at LG Electronics after working for the Wireless Telecommunication Division of Samsung Electronics. “When the products I develop are used in everyday life and the end users are satisfied with them, I feel joy as an engineer.” However, he notes, “As the lifetime of products is getting shorter, I have been under stress due to the pressure for shorter development cycles and excessive work hours. But I have the greatest sense of accomplishment when I acquire command of new technologies and resolve problems.”

“Engineers design the world by exploring new areas and leading technologies,” says Shin. “So, Korea has to accommodate the trends of the global market as well as the Korean market and should make efforts to continue to do self-development. These requirements represent the pride and pressure of engineers.”

The demand that engineers move beyond design jobs proves to be the biggest complaint of Korean engineers. “I envy engineers who have worked in foreign coun-

“When the products I develop are used in everyday life and the end users are satisfied with them, I feel joy as an engineer.”

tries for 30 to 40 years,” says Yoon. “It is difficult to be an engineer for more than 10 years in Korea. In most cases, engineers are promoted to engineering management in accordance with a promotion system. Because personal choice is not allowed, the prospect of working in an engineering role throughout a career is not guaranteed.”

The engineers identified mobile phones and mobile communication as technologies on which Korea should continue to focus. Global standards are now incorporated in 4G technologies that Korean companies developed. Accordingly, Korea should lead in 4G technology and have a competitive edge when the market accelerates.

Other strengths include robotics. “We should focus on robot technologies in the long haul,” says Shin. “The trends of technologies will change from mobile phones to robots at home and overseas. The robot technologies are applicable to a variety of fields, such as games, electric home appliances, and industries. Many Korean companies, including Pantech, are paying attention to the technologies or are now developing them.”

Figure 3. That data—touting a \$90,000 annual average salary—screams “North American engineers are overpaid.” The inequity between average salaries in North America and those in new engineering markets, such as China and India, will surprise few engineers. Moreover, engineers in those regions generally benefit from a very low cost of living. But engineers in mature markets, such as Japan and Europe, trail North American engineers by a broad margin, as well. And the cost of living in parts of Japan and Europe is higher than the cost of living in much of North America.

A more detailed look at the full compensation charts that we present on the Web paints a bit of a different picture. For instance, 13% of North American engineers make \$90,000 to \$100,000. In Japan, 9.8% make roughly \$84,000 to \$101,000. Moreover, the bulk of the Japanese engineers are clustered in groups making slightly less than \$84,000. A look at the salaries above and below the average North American salary does not suggest an almost \$27,000 gap.

The big difference in North American and Japanese salary distribution really comes at the high end of the range. Figure 4 shows that 6% of the engineers in North America make more than \$150,000. Check the Web, and you will see that the percentage of such earners in Japan is approximately 0.5%.

In North America, engineers have surely benefited from stock options and other forms of bonuses that boost salary. That compensation could partially explain the difference. Again, however, close perusal of the online data provides more hints. In the North American survey, a greater number of respondents are in the R&D and engineering-management categories than those from Japan, whereas the Japanese survey has a greater percentage of design-engineering respondents. The European responses fall between the North American and Japanese responses, with 3% earning more than \$150,000 and a relatively high management response.

There is no way to rationalize the gap in other regions, other than to accept that engineering salaries across Asia, except Japan, significantly trail North American salaries. The facts are that

FIGURE 5

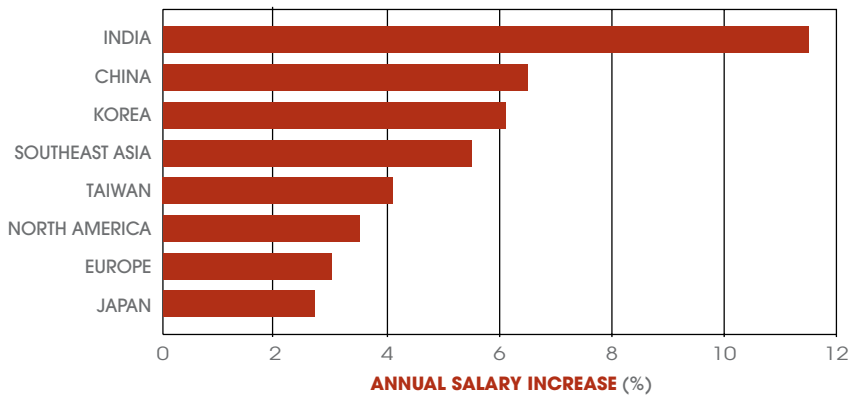
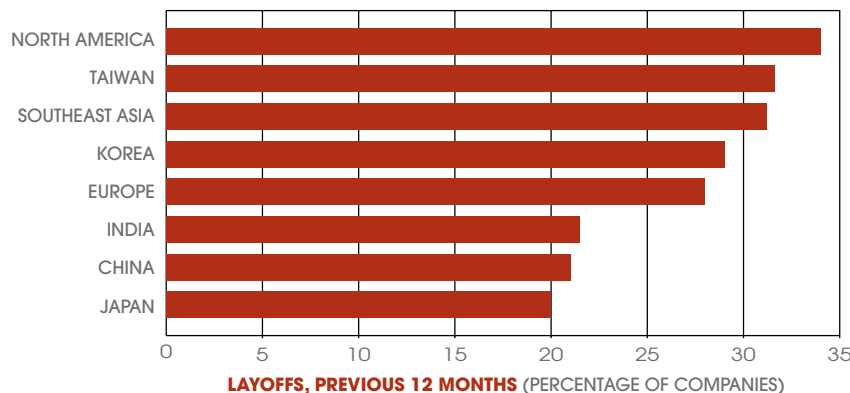


FIGURE 6



\$90,000 salaries are simply unheard of in the regions that EDN Asia surveyed.

**RAISES**

The good news for engineers across Asia is that the gap will close as engineers from India to Korea are getting greater annual increases percentage-wise than Japanese and North American engineers. A number of verbatim responses lament low pay and nonexistent or small raises. One respondent from Taiwan stated, “There have been no increments in salary for a long time. In the long run, my salary might even be reduced.”

Overall, however, our survey paints a brighter picture. Figure 5 shows the annual average increase by percentage. India tops the list at 11.5%, but even the typical average increases across Asia come in at approximately double the average increases in Europe, Japan, and North America. In India, more than 30% of workers received a 10 to 20% raise.

**STAFF REDUCTIONS**

We asked the respondents in every region whether their companies had laid

off engineers in the previous 12 months. Figure 6 depicts the results. Frankly, the results are pretty good. Most companies lay off some number of workers, either to eliminate employees that aren’t superstars yet aren’t performing poorly enough to fire or to scrap one project at the expense of a competing project.

We also asked respondents whether their companies had hired engineers in the previous 12 months. The answers were uniformly positive, with India at 93.6% and North America at 73%. Of course, we asked the respondents only whether their companies had hired engineers in the previous 12 months—not where the jobs were located. To relieve those of you in North America worrying that the new jobs were overseas, 89% of the North American respondents revealed that the jobs were indeed located in North America. EDN

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