21st Century Workforce Profile Analysis

California Council on Science and Technology
California Space Authority

Developed with the support of:
Bay Area Science and Innovation Consortium
Employment Development Department's Labor Market Division
NOVA Workforce Board
Riverside County Economic Development Agency/Workforce Development
San Bernardino Workforce Development Department
San Diego Workforce Partnership
South Bay Economic Partnership
South Bay Workforce Investment Board

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CCST is a non-profit organization established in 1988 at the request of the California state government and sponsored by the major public and private postsecondary institutions of California and affiliate federal laboratories, in conjunction with leading private-sector firms. CCST's mission is to improve science and technology policy and application in California by proposing programs, conducting analyses, and recommending public policies and initiatives that will maintain California's technological leadership and a vigorous economy.

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Project Overview

As part of the US Department of Labor WIRED initiative within the California Innovation Corridor, a coalition of partners including several Workforce Investment Boards (WIBs) and Economic Development Corporations, the Bay Area Science and Innovation Consortium, and the California Council on Science and Technology (CCST) were contracted to investigate workforce profiles necessary for global competitiveness for the 21st century. Under this scope of work, the WIBs, EDCs and BASIC conducted surveys and interviews in order to investigate the concerns and potential recommendations of employers and the universities involved in workforce preparation. This study is a component of the Innovation Support division of the Innovation Corridor mission, which includes seven projects designed to serve as resources for companies in the Corridor. The goals of this study were to:

- Identify key workforce skills sought by selected high-tech industries in the Corridor
- Assess workforce shortages in the selected industries
- Assess companies' perceptions of the workforce production system(s) in California, and the degree to which they are or are not providing adequate numbers of workers possessing desired skills
- Provide data and recommendations to enable educators and workforce skill training providers to better meet the needs of both existing technical careers and those that could emerge from continuing advances in the specified fields

The selected industries and their North American Industry Classifications are:

- Pharmaceutical and Medicine Manufacturing (3254)
- Semiconductor and Other Electronic Component Manufacturing (3344)
- Navigational, Measuring, Electromedical, and Control Instruments Manufacturing (3345)
- Scientific Research and Development Services (5417)

Eight surveys were conducted as part of the work plan.

- Labor Market Information Division (LMID) survey (results consolidated by the San Diego Workforce Partnership): focused on advanced manufacturing and aerospace employers
- 21st Century Workforce Preparedness in the Life Sciences (BASIC): focused on employers and doctoral scientists

Qualitative surveys: 21st Century Workforce Profiles

- NOVA Workforce Board (Santa Clara, Alameda & San Mateo Counties)
- Riverside County Economic Development Agency/Workforce Development
- South Bay Economic Development Partnership
- San Diego Workforce Partnership: biotech companies

- San Bernardino Workforce Development Department
- South Bay Workforce Investment Board

Each of the studies was limited in scope, and so the results discussed here are directional in nature. A total of 160 responses were obtained by BASIC and the WIBs; in addition the LMID email survey received 230 responses. WIB survey responses included focus group conversations, phone interviews, emailed responses, and online responses to website-based surveys.

A similar range of concerns emerged from the studies that comprised this project. All of the groups surveyed – including recent PhD graduates, human resource professionals, and top executives, as well as the national laboratories and universities, stressed the need to ensure adequate communication skills for workers ranging from technicians to executives. There was widespread concern that the educational system is not providing sufficient numbers of adequately prepared people to meet the needs of a high-tech workforce. Finally, every group cited the need to improve the connection between the educational process and the experience and skills demanded by industry.

National Perspective

While undertaking executive interviews and developing the interview process for doctoral students, BASIC staff reviewed national-level information on the subject to establish baseline issues and concerns, particularly with respect to scientists in the life sciences (the focus of the BASIC study). The following findings are drawn from a literature and documentation search including relevant news media coverage, opinion pieces, and Congressional testimony published in 2006 and 2007, with respect to workforce needs at the scientist level (positions requiring postgraduate degrees).

- **There is disagreement about the extent and nature of shortages of trained scientists.** Government continues to contend there is a current and projected shortage of trained scientists, but independent research shows that this may not be true across the board. Evidence suggests that there is actually an oversupply of PhDs seeking academic positions. Trends with baccalaureate-level graduates were not part of the study, so the situation nationally for baccalaureate graduates within industry is less clear-cut. Attrition is also a problem: many doctoral graduates and mid-career engineers have left science and engineering fields.

- **There are challenging trends in traditional university training for advanced scientists as follows:**

    1. The comparatively greater length of time and cost of university training in the US for doctoral level study may unfavorably influence the number and quality of students.

2. The growing length of time to complete doctoral degrees may be driven by disincentives within universities to graduate people swiftly, as well as insufficient grant funding to support full-time graduate education in science fields.

- **Graduates need more career support.** PhD candidates need exposure and experience in a broader set of activities to prepare for industry or government-industry careers, including entrepreneurship, business/finance, and marketing. They also need mentoring and professional development, as well as career placement assistance for initial and subsequent jobs.

- **It may be useful to promote a professional "Masters of Science" degree.** While there are challenges with making a professional degree responsive and appropriately scoped to meet industry needs, a 2005 study by CCST suggests that there is interest among California companies in expanding availability of such a program[1], and the National Research Council echoed this conclusion in 2008.[2]

- **The educational and workforce development community needs to respond to hiring cycle challenges, particularly in the life sciences.** As an immature industry with a very long lab-to-market cycle, cyclical effects in hiring particularly impact careers in the biosciences. Students need to be graduated and placed more swiftly to reduce the problem of specialized(?) doctoral supply being out-of-phase with hiring demands.

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[1] California Council on Science and Technology, "An Industry Perspective of the Professional Science Master's Degree in California" (Sacramento: California Council on Science and Technology) 2005.
[2] National Research Council Committee on Enhancing the Master's Degree in the Natural Sciences, "Science Professionals: Master's Education for a Competitive World" (Washington, D.C.: National Academies Press) 2008.

Labor Market Information Division survey

Methodology

The project team elected to consign initial data gathering to the Labor Market Information Division (LMID) of the California Employment Development Division (EDD), an organization viewed to possess the resources and analytical capabilities necessary to obtain and analyze data from a statistically significant cross-section of the selected industries. As part of the LMID study, a total of 18,829 questionnaires were mailed out to 4,810 total companies. Data was sought on the following seven occupations:

- Biological Technician
- Chemical Technician
- Electrical Engineering Technician
- Robotic Technician
- Electronics Engineering Technician
- Industrial Engineering Technician
- Mechanical Engineering Technician

Companies were asked to rate the importance of specific tasks and abilities, knowledge requirements, and tools used, and to provide information on hiring difficulty, minimum educational requirements, and hiring trends in the next 12 months. Respondents were generally middle management or human resources directors.

LMID Results

Since the purpose of WIRED Project 1.2 was to develop a profile of anticipated workforce needs in the selected range of occupations, the principal usage of these datasets by the partners was to identify trends and workforce questions that could be followed up in greater detail in the qualitative survey conducted by the WIBs. The response rate from the LMID survey was not sufficient to be statistically significant (230 questionnaires returned, 1.2% of the total). However, certain trends emerged which provided insight into the occupational needs of the advanced manufacturing and aerospace industries for the specified occupations.

- **One of the most important tasks/abilities across the board, besides the core function of the position, was communication and/or knowledge of English.** This was ranked as the most important ability for electrical engineering and robotic technicians, and as the second most important ability for all other positions surveyed except for chemical technicians, which rated it third. The average importance on a scale of one to five, with five being the most important, was 4.05. In addition, respondents for all of the positions scored computer use as an important skill and/or indicated that computer software was one of the most important tools used in the position.

- **At least half of all respondents ranked hiring difficulty as "difficult" or "very difficult".** As seen in Figure 1, the positions with the highest reported hiring difficulty were electrical engineering, electronics engineering, and robotics; biological and chemical technician positions had the lowest reported difficulty levels, but even they had at least fifty percent of respondents describe hiring as difficult or very difficult. It is highly possible that variations in hiring difficulty are related to company size and location; in particular, several of the smaller companies surveyed by the WIBs indicated that competition with larger firms made it difficult to attract sufficient quantities of qualified personnel.

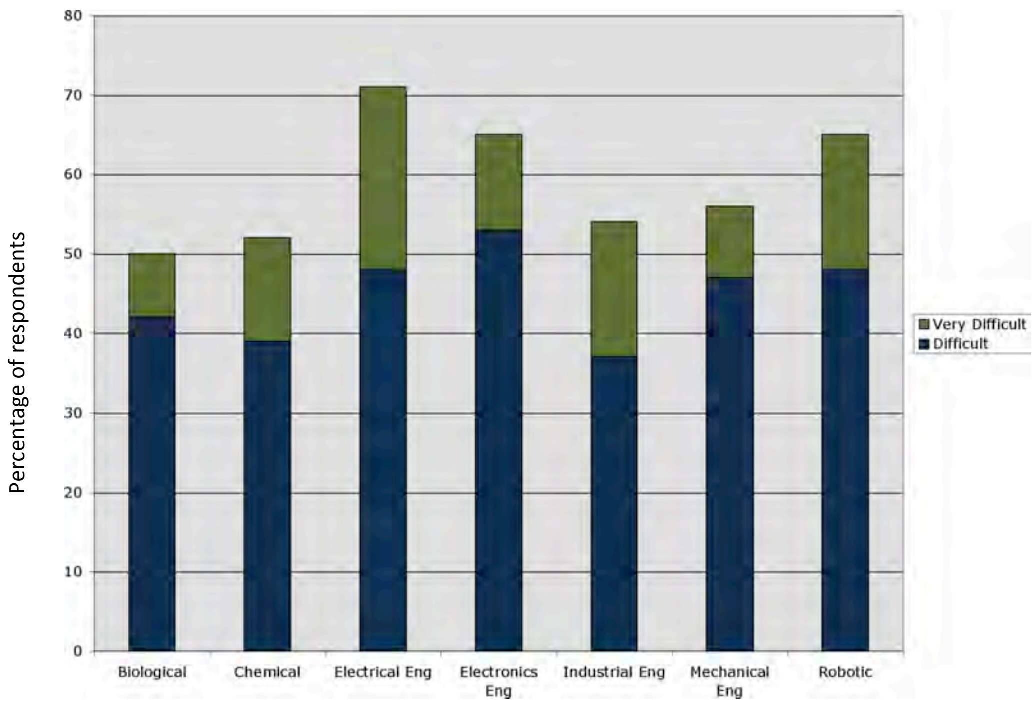

Figure 1: Hiring difficulty reported by LMID survey respondents.

- **Over the next 12 months, respondents predicted that they would be hiring quantities of new workers equivalent to approximately 45% of existing workforces of electrical engineering, mechanical engineering, and robotic technicians** (Figure 2).[3] However, in terms of actual positions, the largest numbers of projected hires were reported for biological and chemical technicians (Figure 4). Notably, these are the two positions which had the highest reported

[3] NB this survey was conducted before the economic downturn which took place in late 2008, and it is uncertain whether hiring projections would remain the same today. However, the relative need for greater numbers of biological and chemical technicians is likely to remain valid even in the face of overall lower hiring numbers.

educational requirements by respondents – nearly three out of four in both cases indicated that a baccalaureate degree was the minimum requirement. In comparison, electrical engineering, electronics engineering, and robotic technician positions all reported the associate's degree as the most common educational credential required (approximately fifty percent of respondents in each case). It is likely that the greater hiring difficulty for the positions requiring associate's degrees is at least partly related to the relatively confined mobility of these graduates, who are more likely to pursue training and employment within the geographic area served by their community colleges or technical institutions.

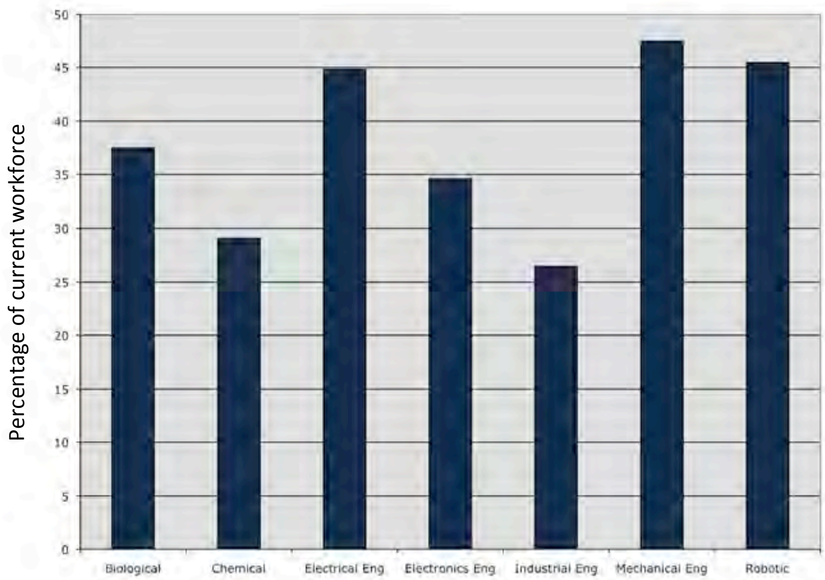

Figure 2: Projected hires as a percentage of current workforce, reported by LMID survey respondents.

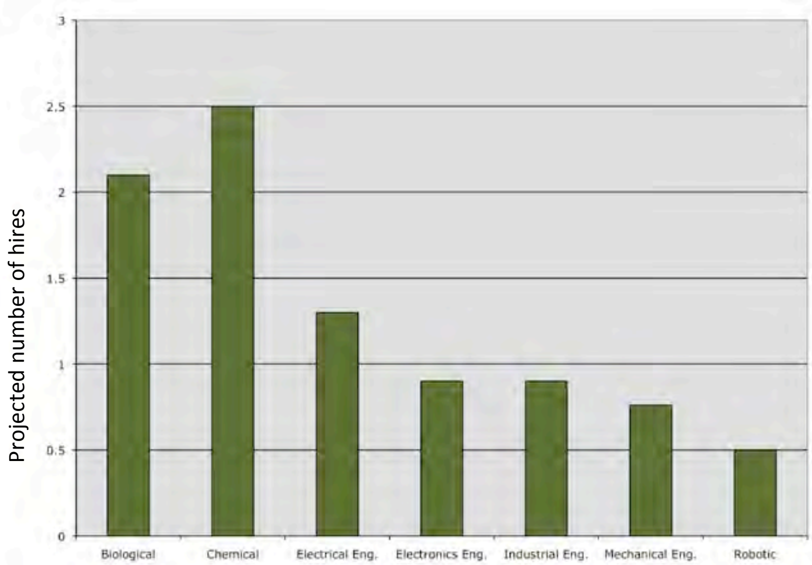

Figure 3: Raw numbers of projected hires in next 12 months, reported by LMID survey respondents.

Notably, while chemical technicians had one of the lowest projected hiring ratios to current staffing levels, they had the highest number of reported projected hires.

The profile that emerges from these data suggests that the most significant skills gap that can be addressed is at the two-year college level; although the raw number of projected hires was larger for the baccalaureate-requiring biological and chemical technicians, there was much greater difficulty reported in hiring qualified personnel with associate's degrees. This may be related to overall challenges at the community college level in arming students with adequate skill sets to enter the high-tech workforce. In the past few years, the community colleges have increased their focus on the problem of underprepared students - those lacking basic reading, writing, and math skills. The California Legislative Analyst's Office has previously noted that incoming community college students are generally not ready for college–level work, and that in addition, relatively few of these students reach proficiency during their time at community colleges.[4] Nonetheless, these are precisely the skills needed to succeed in the high-tech sector being prioritized by employers, particularly at the associate's level. These findings are supported by survey results carried out under WIRED 2.2, where as many as 70% of large aerospace companies surveyed reported that applicants for entry-level positions with a certificate from a community college were poorly prepared. (See figure 4.)[5]

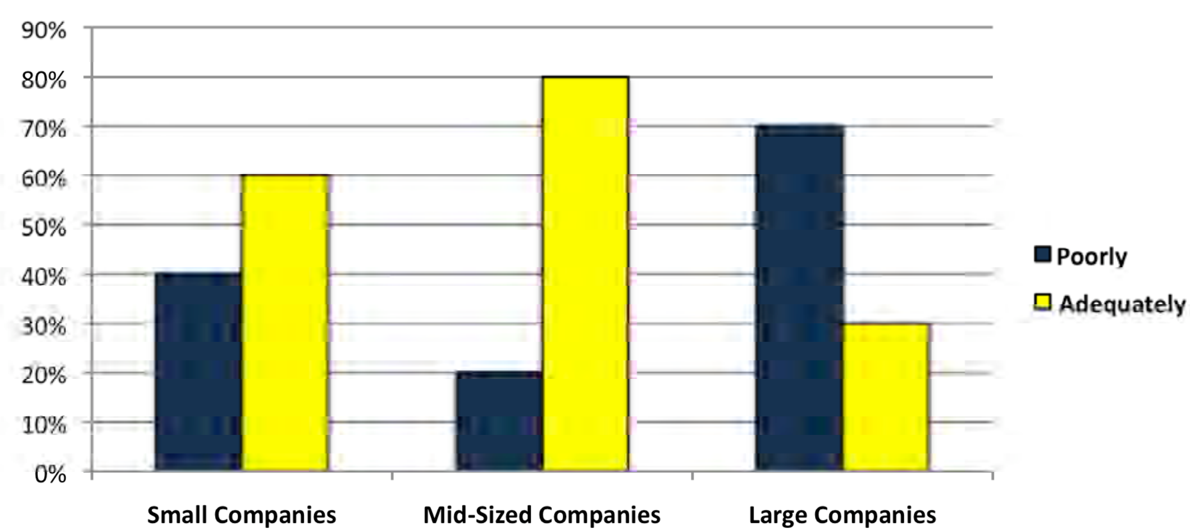

Figure 4: WIRED 2.2 survey respondents' perceptions of how prepared new graduates with community college certificates are for entry-level positions, by size of company.

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[4] Legislative Analyst's Office, "Back to Basics: Improving College Readiness of Community College Students" (June 2008)
[5] Christine Page Chen, " California Aerospace Supplier Transformation Requirements for 21st Century Global Competitiveness" (California Space Authority: 2008) Figure 35, p. 18.

BASIC study: 21st century workforce preparedness in the life sciences

Methodology

The project team undertook a range of activities, including background study of available literature, interviews with 27 employers and doctoral scientists, input from other stakeholders, and a roundtable discussion including representatives from Northern California federal research laboratories, research universities (UC Berkeley, UC Davis, UC San Francisco, UC Santa Cruz, and Stanford University), and industry.

Of the interviews, 17 were conducted with senior executives, with the assistance of the BayBio institute. Another 10 interviews were conducted with recent PhD candidates, in order to address the significant questions raised locally and nationally concerning potential issues in supply and attrition among doctoral level scientists. Consequently, the BASIC report has multiple sets of qualitative findings.[6]

Executive perspectives

Overall, executives see a dramatically evolving industry, with life sciences maturing in a manner similar to the semiconductor industry of 20-30 years ago. At present, medical applications still drive core hiring, but industry growth drivers extend far beyond therapeutics. This is, in part, because the biotherapeutics industry is being driven towards smaller profit margins, with increased specialization and niche market drugs that are driving the growth of smaller, more specialized companies. Small companies are being 'virtually integrated', with major functions being contracted to specialized partners by larger firms. In short, the industry is in a position of transition, with an ongoing convergence of technology and business trends that are shifting workforce needs in a variety of ways.

While there is no system for projecting bioscience industry needs as other industries do, general science acumen remains an essential skill set across the board, particularly for CEOs and business leaders, who are now required to understand the science and what drives it at a fairly deep level. The acquisition of science skills, however, should not come at the expense of business skills; the business of science and managing science toward commercial product development is a unique and essential skill set for life sciences executives. As companies in this industry become more and more virtually integrated, connected with other companies in a network of specialized functions, the person or team developing a compound is more likely to be responsible for a wide variety of business aspects of the lifecycle of that compound – how it will be researched, product

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[6] Paul V. Oliva, "21st Century Workforce Preparedness in the Life Sciences" (Bay Area Science and Innovation Consortium: 2008)

trials, and movement through the approval process, manufacturing, licensing, patenting, networking, partnering and marketing.

This combined skill set is challenging to instill in a workforce, particularly as employee turnover remains steady and company sizes diminish. Industry structure and trends are emphasizing mobility, which make employee development programs more difficult to justify and implement. The executives who provided input felt that research universities have done a good job of stepping into the breach and providing the training required, though challenges remain, especially at lower academic levels.

The challenge of bringing in competent and well-trained people has led to a variety of strategies, in particular expanding outside California or offshoring. However, executives felt these were insufficient solutions and strongly recommended shoring up California's own education system to offset the workforce need gap. In addition, they recommended that the US avoid exacerbating the situation by sending foreign-born scientists home.

Recent PhD perspectives

The goal of the recent PhD interviews was to gain an understanding of the academic experience and perceived workforce issues for recent graduates entering the workforce. Although the sample size was relatively small, the respondents expressed similar concerns and common experiences in their programs. In particular, they found their academic programs to have lacked adequate focus on preparation and planning for careers. Most felt that time to completion for their degrees was excessive (an average of 8 years) and half expressed economic concerns related to the length of these programs. Although 8 out of 10 reported some experience with business training, all felt that the research universities emphasized the academic career as the principal expectation, which contributed to the lack of effective connection with the needs of the business community.

All students reported seeing significant attrition out of their programs, largely due to a lack of opportunities in academia and a perceived glut of PhDs in research universities. Half responded that their training did not give them the best chance to achieve their immediate career goals, and six out of ten reported varying degrees of uncertainty about their future employment.

WIB/EDC surveys: 21st Century Workforce Profiles

Methodology

Participating WIBs and EDCs approached companies in their respective regions to develop more specific and detailed job profiles and workforce needs assessments to complement the data collected through the LMID survey. Staff approached by email and telephone mostly hiring managers and human resource professionals at companies focusing on research and development, environmental and ecological services, pharmaceutical research, and drug production. Staff asked a series of eleven questions focusing on the qualities of workers and the industry. A common set of surveys was completed in the Bay Area (NOVA), in the Los Angeles/Inland Empire region (Riverside, San Bernardino, South Bay Economic Development, South Bay Workforce Investment Board) and in Southern California (San Diego). Responses were obtained through focus groups, phone interviews, email, and website surveys. The surveys obtained responses from an average of 22 respondents apiece, ranging from 10 to 55 per survey.

Results

Future of the industry

Respondents generally stated that they anticipated continued growth in their respective industries, although funding, and the potential for jobs to be offshored were common concerns. Many indicated that the ever-changing nature of their industries made predictions about breakthroughs and future needs difficult, requiring that they continue to add to the workforce to adapt to needs as they change. The development of new equipment, and the need to train people quickly to produce and use it, was a common theme as well. Notably, the need for talent was cited as a principal driving issue in five of the studies (San Bernardino, Riverside, San Diego, NOVA, South Bay), with fears about being able to meet workforce needs at both the technician and the scientist level.

Ideal skills, education and experience

When asked how the future of the industry will impact the skills needed in the workforce, responses generally fell into one of three categories: understanding new technologies, improved skills and education, and increased communication skills.[7] Respondents in all of the surveys indicated that a combination of education and experience was most

[7] This was also consistent with findings in WIRED 2.2, where aerospace suppliers identified "basic skills and ongoing technology training" as two of the three training and workforce development priorities. (Christine Page Chen, p.15.)

valuable at the professional and managerial levels; at the technical level, education was generally ranked as most important, over experience. The most effective preparation cited was a broad range of skills in a variety of areas, particularly for smaller companies where people may need to perform multiple functions. Respondents in every group mentioned effective communication skills as important. This was consistent with findings in WIRED 3.1 and 2.2.

Critical skills gap analysis

Although most respondents stated that they were able to locate individuals with the skills they needed, a majority indicated that there was a shortage of qualified people. Effective communications skills were cited as often missing at both the managerial and technician level (with the latter being an issue of language for the most part). Smaller companies also indicated that larger companies often acquired the people with the best combination of skills, making it difficult for smaller companies to compete. For those studies that indicated a difference, the skills gap was considered most critical at the technician level, where education was ranked as most valuable.

Education report card

Every group expressed concerns about the quality of the education system and its ability to provide people with a suitable base of scientific knowledge and practical experience. Most companies have developed relationships with local universities and/or community colleges to provide training meeting specific workforce needs; however many indicated that more hands-on training was needed at these institutions. Several companies also expressed concerns that educational institutions were not keeping current with technology and were not maintaining close enough ties with industry.

The top concern for industry was lack of basic science and math skills. This concern was closely followed by the observation that educators lack broad understanding of the key elements that are the driving forces of the industries. Again, this mirrors concerns expressed by the aerospace supply industries surveyed in WIRED 2.2.[8]

[8] Christine Page Chen, op.cit.

Workforce profile perspectives: overview

Despite the disparate nature of the surveys, some striking common themes emerged from all of them. All of the groups surveyed – including recent PhD graduates, human resource professionals, and top executives, as well as the national laboratories and universities, stressed the need to ensure adequate communication skills for workers ranging from technicians to executives. There was widespread concern that the educational system is not providing sufficient numbers of adequately prepared people to meet the needs of a high-tech workforce. Finally, every group cited the need to improve the connection between the educational process and the experience and skills demanded by industry.

Although the surveys are limited in scope, some regional variations reflect findings in other WIRED projects focusing on workforce issues. WIRED 3.1, which focused on a regional workforce skills analysis, found the most striking critical skills shortages reported in Riverside and San Bernardino, particularly at the technical level (90 and 100 percent of respondents, respectively).[9] These findings are reflected in the San Bernardino and Riverside WIB studies, with three out of four respondents indicating the same. And overall workforce training priorities expressed in these surveys correlate with those identified by the WIRED 2.2 survey of aerospace industry companies.[10]

Professional/scientist level

At the scientist level, both executives and recent graduates alike suggested expanded use of programs such as the professional science masters' (PSM) degree, a new 'hybrid' degree that combines science and technological expertise with business experience. Although such programs are not widespread at present, and were not specifically mentioned by the human resource level respondents, the California State University system has undertaken a systematic expansion of its PSM degree offerings. The National Research Council has also encouraged the acceleration of developing PSM programs or their equivalents.[11]

Technician level

While postgraduate degrees are not necessarily applicable to the technical positions that employers are seeking to fill, similar concerns about incorporating more practical experience into technician-level training indicate that the hybrid model may serve as a

[9] Paul V. Oliva, "Technology Workforce Issues and Opportunities in the California Innovation Corridor" (California Space Authority: 2008) p.40.
[10] Christine Page Chen, op.cit.
[11] National Research Council Committee on Enhancing the Master's Degree in the Natural Sciences, "Science Professionals: Master's Education for a Competitive World" (Washington, D.C.: National Academies Press, 2008)

suitable template for instilling a broader range of skills and experiences in technical degree programs. Other potential approaches raised in examinations of related high-tech industries, such as aerospace suppliers, include the adoption of a statewide standard applied technology skills assessment and certification process to help address the technical skills workforce development problem.[12]

There are specific recommendations for individual institutions noted in the BASIC report. However, the broader strategic recommendations of the roundtable discussion held by BASIC address the concerns raised in the LMID survey and the WIB qualitative surveys. They address the need for better data and developing a more responsive workforce development system.

1. Actions to better understand pain points

- *For scientists and technicians:* Undertake a focused investigation to understand whether the area has a fundamental worker supply problem (lack of people entering relevant courses of study) or an educational capacity issue (inability to graduate enough people with the right skills)

2. Actions to address acute areas of need

- *For scientists and technicians:* Develop an ongoing, institutionalized process using employers and educational institutions to identify and focus on areas of acute and longer-term needs.

- *For scientists:* Establish a specialized technical training academy to supplement university and community college resources[13] with the following components:
    - Focused, rapidly developed and flexible coursework in very specific areas that address acute needs of industry and potentially incorporate retraining of displaced workers
    - Internship placements to address identified needs
    - Industry-sponsored trainers and employers to speak at universities to educate students on career opportunities and to serve as adjunct lecturers
    - Expanded Trade Adjustment Assistance and Department of Labor funding for financial support
    - Web-based information resources for students, counselors, teachers, and professors on job opportunities, qualifications, and pathways, such as those at biospace.com and biotechwork.org
    - Work with community colleges & universities to cover other areas of acute need
    - Coordinate with local policy organizations on lobbying at the federal level for a green card fast track program

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[12] Christine Page Chen, p.8.

[13] "21st Century Workforce Preparedness" (Oliva, 2008) includes a list of selected current programs intended to expand the Bay Area's talent base in the life sciences; see pp. 20-24.

3. Actions to address longer-term needs

- *For scientists and technicians:* Bring together the complete set of educational institution stakeholders spanning representatives from secondary schools, technical training institutions, community colleges, undergraduate institutions, postgraduate universities, and research institutions to be involved in whatever organization is addressing industry-education-government coordination
- Share these findings more widely to gain support for changes within the academic domain (such as eliminating bias against industry careers, increasing multi-disciplinary elements within university programs, adding a short-track / MS program, adding dual-degree programs, improving career placement services or realigning university mentorship activities with employer needs)
- On an ongoing basis analyze government spending, macro trends and other indicators to assess medium-term needs and develop a strategic plan to meet industry workforce needs

- *For technicians:* Develop at the state level a common assessment and certification program for basic fundamental technology skill (Career Readiness Program) – basic mechanical, thermal, fluid and electrical knowledge, coupled with problem solving and workplace scenarios, aligned with college entrance assessments.

  One possible model to consider is the 10-year strategic plan proposed in Ohio by the Board of Regents, which calls for each of Ohio's 13 universities to capitalize on its strengths in a way that supports economic development; establishes a "skills bank" to better link course offerings with labor demands; and ties state aid for colleges to progress on 20 "measures of success," such as graduation rates.[14]

4. Actions to increase interest in and support for science and science teaching

- Engage in a coordinated PR campaign such as the Year of Science
- Rally support for a Junior Achievement-style program for science
- Promote enrollment in STEM teacher training programs such as CalTeach

Conclusions

Responses were remarkably consistent across the regions included in the current group of surveys and with data from WIRED 3.1, namely that there are significant difficulties in recruiting candidates with the level of skills and experience necessary. While there are not enough data to determine whether there is an overall shortage of scientists at the PhD level, the hiring difficulties experienced by Bay Area firms are manifest, and the shortage

[14] Karin Fischer, "Ohio's Public Colleges Lure Businesses with the Promise of a Skilled Workforce," *The Chronicle of Higher Education* (11/14/08).

of technical level people in Southern California is apparent as well. Although Riverside and San Bernardino cited a number of factors affecting their overall industries, respondents from both regions were clear, in both the present surveys and in 3.1, that they have difficulty finding suitably qualified people. Education reform is called for at every level, with an eye towards better career advice, experiential learning and preparation at the associate's, baccalaureate, and postgraduate levels alike. Perhaps rather than just ad hoc approach, an institutionalized model that integrates mentorship (perhaps a combination of industry and academic mentors), experiential learning (with real world objectives and metrics) and formal learning (traditional education), mirroring some best practices in industry for human capital development should be encouraged as an effective model for all levels of education.

Appendix A: LMID survey instruments

Robotics technicians (Electro-Mechanical Technicians) 17-3024.00

Definition - Operate, test, and maintain unmanned, automated, servo-mechanical, or electromechanical equipment. May operate unmanned submarines, aircraft, or other equipment at worksites, such as oil rigs, deep ocean exploration, or hazardous waste removal. May assist engineers in testing and designing robotics equipment.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Test performance of electromechanical assemblies, using test instruments such as oscilloscopes, electronic voltmeters, and bridges. 1 2 3 4
2. Read blueprints, schematics, diagrams, and technical orders to determine methods and sequences of assembly. 1 2 3 4
3. Install electrical and electronic parts and hardware in housings or assemblies, using soldering equipment and hand tools. 1 2 3 4
4. Align, fit, and assemble component parts, using hand tools, power tools, fixtures, templates, and microscopes. 1 2 3 4
5. Inspect parts for surface defects. 1 2 3 4
6. Analyze and record test results, and prepare written testing documentation. 1 2 3 4
7. Verify dimensions and clearances of parts to ensure conformance to specifications, using precision measuring instruments. 1 2 3 4
8. Operate metalworking machines to fabricate housings, jigs, fittings, and fixtures. 1 2 3 4
9. Repair, rework, and calibrate hydraulic and pneumatic assemblies and systems to meet operational specifications and tolerances. 1 2 3 4
10. Train others to install, use, and maintain robots. 1 2 3 4
11. Should have good knowledge of electronic equipment, and computer hardware and software, including applications and programming; solid math and mechanical skills; practical application of engineering science and technology and production processes. 1 2 3 4
12. Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar. 1 2 3 4

Are there tools, equipment, or software that are particular to your firm? Please list.

Additional:

1. Do you have a difficult time recruiting for this occupation? Yes/No Why?____
2. Do you have a minimum educational requirement for this occupation? Yes/No If so, what? _________________________________

3. Do you test for skills? Yes/No If so, how? ____
4. How many of these technicians does your firm employ? ____
5. Do you expect to hire more of these occupations in the next 12 months? If so, how many? ________________________________
- Are there other points to this occupation that this survey should reveal?

____
____
____
____

- In your firm are there any occupations with critical skills shortages you would like to notify us about?

____
____
____
____

- Are there trends in this industry that you foresee affecting this occupation? If so,
  how?____
  ____

May we contact your firm for further questions about this occupation?
If so, name and contact information.___________________________________

Biological Technicians 19 – 4021.00

Definition: Assist biological and medical scientists in laboratories. Set up, operate, and maintain laboratory instruments and equipment, monitor experiments, make observations, calculate and record results. May analyze organic substances, such as blood, food, and drugs.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Monitor laboratory work to ensure compliance with set standards. 1 2 3 4
2. Isolate, identify and prepare specimens for examination. 1 2 3 4
3. Use computers, computer-interfaced equipment, robotics or high-technology industrial applications to perform work duties. 1 2 3 4
4. Conduct research/assist in the conduct of research, including the collection of information and samples, such as blood, water, soil, plants and animals. 1 2 3 4
5. Set up, adjust, calibrate, clean, maintain, and troubleshoot laboratory and field equipment. 1 2 3 4
6. Provide technical support and services for scientists and engineers working in fields such as agriculture, environmental science, resource management, biology, and health sciences. 1 2 3 4

7. Clean, maintain and prepare supplies and work areas. 1 2 3 4
8. Participate in the research, development, or manufacturing of medicinal and pharmaceutical preparations. 1 2 3 4
9. Conduct standardized biological, microbiological or biochemical tests and laboratory analyses to evaluate the quantity or quality of physical or chemical substances in food or other products. 1 2 3 4
10. Keep detailed logs of all work-related activities. 1 2 3 4
11. Should have good knowledge of electronic equipment, and computer hardware and software, including applications and programming; solid math and mechanical skills; use of scientific rules and methods to solve problems; practical application of engineering science and technology and production processes. 1 2 3 4
12. Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar. 1 2 3 4

Tools in use:

1. Inverted microscopes YES/ NO
2. Manual or electronic hematology differential cell counters YES/ NO
3. Microplate readers YES/ NO
4. Robotic or automated liquid handling systems YES/ NO
5. Temperature cycling chambers or thermal cyclers YES/ NO
6. Analytical or scientific software YES/ NO - if so, what kind?
   ____
7. Data base user interface and query software YES/ NO - if so, what kind?
   ____
8. Graphics or photo imaging software YES/ NO – if so, what kind?
   ____
9. Are there other special tools, equipment, or software that are critical to your firm? Please
   list.____
   ____
   ____
   ____

Additional:

6. Do you have a difficult time recruiting for this occupation? Yes/No
   Why?_____________________________________
7. Do you have a minimum educational requirement for this occupation?
   Yes/No If so, what? ___________________________
8. Do you test for skills? Yes/No If so, how?
   ____
9. How many of these technicians does your firm employ?
   ____
10. Do you expect to hire more of these occupations in the next 12 months? If so, how many? ________________________________

- Are there other points to this occupation that this survey should reveal?

____
____
____
____

- In your firm are there any occupations with critical skills shortages you would like to notify us about?

____
____
____
____

- Are there trends in this industry that you foresee affecting this occupation? If so,
how?____
____

May we contact your firm for further questions about this occupation?
If so, name and contact information.____________________________________

Chemical Technicians - 19-4031.00

Definition: Conduct chemical and physical laboratory tests to assist scientists in making qualitative and quantitative analyses of solids, liquids, and gaseous materials for purposes, such as research and development of new products or processes, quality control, maintenance of environmental standards, and other work involving experimental, theoretical, or practical application of chemistry and related sciences.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Monitor product quality to ensure compliance to standards and specifications.
2. Set up and conduct chemical experiments, tests, and analyses using techniques such as chromatography, spectroscopy, physical and chemical separation techniques, and microscopy.
3. Conduct chemical and physical laboratory tests to assist scientists in making qualitative and quantitative analyses of solids, liquids, and gaseous materials.
4. Compile and interpret results of tests and analyses.
5. Provide technical support and assistance to chemists and engineers.
6. Prepare chemical solutions for products and processes following standardized formulas, or create experimental formulas.
7. Maintain, clean, and sterilize laboratory instruments and equipment.
8. Write technical reports or prepare graphs and charts to document experimental results.

9. Order and inventory materials to maintain supplies.
10. Develop and conduct programs of sampling and analysis to maintain quality standards of raw materials, chemical intermediates, and products.
11. Knowledge of the chemical composition, structure, and properties of substances and of the chemical processes and transformations that they undergo. This includes uses of chemicals and their interactions, danger signs, production techniques, and disposal methods.
12. Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.

Tools and Technology:

Analytical or scientific software

Data base user interface and query software

Electrical Engineering Technicians - 17-3023.03

Definition: Apply electrical theory and related knowledge to test and modify developmental or operational electrical machinery and electrical control equipment and circuitry in industrial or commercial plants and laboratories. Usually work under direction of engineering staff.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Provide technical assistance and resolution when electrical or engineering problems are encountered before, during, and after construction.
2. Assemble electrical and electronic systems and prototypes according to engineering data and knowledge of electrical principles, using hand tools and measuring instruments.
3. Install and maintain electrical control systems and solid state equipment.
4. Modify electrical prototypes, parts, assemblies, and systems to correct functional deviations.
5. Set up and operate test equipment to evaluate performance of developmental parts, assemblies, or systems under simulated operating conditions, and record results.
6. Collaborate with electrical engineers and other personnel to identify, define, and solve developmental problems.
7. Build, calibrate, maintain, troubleshoot and repair electrical instruments or testing equipment.
8. Analyze and interpret test information to resolve design-related problems.

9. Write commissioning procedures for electrical installations.
10. Prepare project cost and work-time estimates.

Tools & Technology

Analytical or scientific software — Mathworks MATLAB; Mentor Graphics ModelSim; Proportional integral derivative control PID software; Root cause analysis software

Computer aided design CAD software — Autodesk AutoCAD; Cadence software; Prentice Hall Electronic Workbench MultiSim

Data base user interface and query software — Database software; Oracle software

Development environment software — Assembler; C; Verilog

Spreadsheet software —

Electronics Engineering Technicians - 17-3023.01

Definition: Lay out, build, test, troubleshoot, repair, and modify developmental and production electronic components, parts, equipment, and systems, such as computer equipment, missile control instrumentation, electron tubes, test equipment, and machine tool numerical controls, applying principles and theories of electronics, electrical circuitry, engineering mathematics, electronic and electrical testing, and physics. Usually work under direction of engineering staff.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Test electronics units, using standard test equipment, and analyze results to evaluate performance and determine need for adjustment.
2. Perform preventative maintenance and calibration of equipment and systems.
3. Read blueprints, wiring diagrams, schematic drawings, and engineering instructions for assembling electronics units, applying knowledge of electronic theory and components.
4. Identify and resolve equipment malfunctions, working with manufacturers and field representatives as necessary to procure replacement parts.
5. Maintain system logs and manuals to document testing and operation of equipment.
6. Assemble, test, and maintain circuitry or electronic components according to engineering instructions, technical manuals, and knowledge of electronics, using hand and power tools.

7. Adjust and replace defective or improperly functioning circuitry and electronics components, using hand tools and soldering iron.
8. Procure parts and maintain inventory and related documentation.
9. Maintain working knowledge of state-of-the-art tools or software by reading or attending conferences, workshops or other training.
10. Provide user applications and engineering support and recommendations for new and existing equipment with regard to installation, upgrades and enhancement.
11. Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.
12. Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
13. Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
14. Knowledge of machines and tools, including their designs, uses, repair, and maintenance.
15. Knowledge of arithmetic, algebra, geometry, calculus, statistics, and their applications Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.

Tools & Technology

Analytical or scientific software — Mathworks MATLAB; Mentor Graphics ModelSim; Root cause analysis software. YES/NO
Other

Computer aided design CAD software — Cadence software; MicroSim Pspice; Prentice Hall Electronic Workbench MultiSim. YES/NO
Other

Development environment software — C; Microsoft Visual Basic; Verilog. YES/NO
Other

Graphics or photo imaging software — Graphic software; National Instruments LabVIEW. YES/NO
Other

Spreadsheet software — Microsoft Excel YES/NO
Other

Industrial Engineering Technicians - 17-3026.00

Definition: Apply engineering theory and principles to problems of industrial layout or manufacturing production, usually under the direction of engineering staff. May study and record time, motion, method, and speed involved in performance of production, maintenance, clerical, and other worker operations for such purposes as establishing standard production rates or improving efficiency.

Tasks/Abilities: Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

- Recommend revision to methods of operation, material handling, equipment layout, or other changes to increase production or improve standards.
- Study time, motion, methods, and speed involved in maintenance, production, and other operations to establish standard production rate and improve efficiency.
- Interpret engineering drawings, schematic diagrams, or formulas and confer with management or engineering staff to determine quality and reliability standards.
- Recommend modifications to existing quality or production standards to achieve optimum quality within limits of equipment capability.
- Aid in planning work assignments in accordance with worker performance, machine capacity, production schedules, and anticipated delays.
- Observe worker using equipment to verify that equipment is being operated and maintained according to quality assurance standards.
- Observe workers operating equipment or performing tasks to determine time involved and fatigue rate using timing devices.
- Prepare charts, graphs, and diagrams to illustrate workflow, routing, floor layouts, material handling, and machine utilization.
- Evaluate data and write reports to validate or indicate deviations from existing standards.
- Read worker logs, product processing sheets, and specification sheets, to verify that records adhere to quality assurance specifications.
- Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods.
- Knowledge of the practical application of engineering science and technology. This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services.
- Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar.
- Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models.

- Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming

Tools & Technology:

Coordinate measuring machines CMM — Direct computer-controlled coordinate measuring machines DCC-CMM

Gauges or inspection fixtures — Dial indicators

Lathes — Computerized numerical control CNC lathes

Milling machines — Computerized numerical control CNC milling machines

Analytical or scientific software — ProMODEL software; Statistical software; Wilcox Associates PC-DMIS

Computer aided design CAD software — Autodesk AutoCAD; SolidWorks CAD productivity enhancement tools software

Data base user interface and query software — Data entry software; Microsoft Access Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming.

Spreadsheet software — Microsoft Excel

Word processing software — Microsoft Word

Mechanical Engineering Technicians - 17-3027.00

Definition: Apply theory and principles of mechanical engineering to modify, develop, and test machinery and equipment under direction of engineering staff or physical scientists.

Tasks/Abilities – Please indicate level of use/activity. 1=minimal, 2=desirable, 3=high use/important, 4=critical

1. Prepare parts sketches and write work orders and purchase requests to be furnished by outside contractors. 1 2 3 4
2. Draft detail drawing or sketch for drafting room completion or to request parts fabrication by machine, sheet or wood shops. 1 2 3 4
3. Review project instructions and blueprints to ascertain test specifications, procedures, and objectives, and test nature of technical problems such as redesign. 1 2 3 4
4. Review project instructions and specifications to identify, modify and plan requirements fabrication, assembly and testing. 1 2 3 4

5. Devise, fabricate, and assemble new or modified mechanical components for products such as industrial machinery or equipment, and measuring instruments. 1 2 3 4
6. Discuss changes in design, method of manufacture and assembly, and drafting techniques and procedures with staff and coordinate corrections. 1 2 3 4
7. Set up and conduct tests of complete units and components under operational conditions to investigate proposals for improving equipment performance. 1 2 3 4
8. Inspect lines and figures for clarity and return erroneous drawings to designer for correction. 1 2 3 4
9. Analyze test results in relation to design or rated specifications and test objectives, and modify or adjust equipment to meet specifications. 1 2 3 4
10. Evaluate tool drawing designs by measuring drawing dimensions and comparing with original specifications for form and function using engineering skills. 1 2 3 4
11. Knowledge of the practical application of engineering science and technology. 1 2 3 4 This includes applying principles, techniques, procedures, and equipment to the design and production of various goods and services
12. Knowledge of machines and tools, including their designs, uses, repair, and maintenance
13. Knowledge of design techniques, tools, and principles involved in production of precision technical plans, blueprints, drawings, and models. 1 2 3 4
14. Knowledge of raw materials, production processes, quality control, costs, and other techniques for maximizing the effective manufacture and distribution of goods. 1 2 3 4
15. Knowledge of the structure and content of the English language including the meaning and spelling of words, rules of composition, and grammar. 1 2 3 4
16. Knowledge of circuit boards, processors, chips, electronic equipment, and computer hardware and software, including applications and programming. 1 2 3 4

Tools & Technology in use:

Gas welding or brazing or cutting apparatus — Brazing equipment; Gas welding equipment; Oxyacetylene welding equipment; Stick welding machines Yes/No

Gauges or inspection fixtures — Bore gauges; Dial indicators; Screw pitch gauge sets; Taper plug gauges Yes/No

Milling cutters — Combination milling machines; Computerized numerical control CNC vertical milling machines; Sheet metal slitters; Track burning machines Yes/No

Analytical or scientific software — Mathworks MATLAB; Spectral Dynamics STARAcoustics; Spectral Dynamics STARModal; Wolfram Research Mathematica Yes/No

Computer aided design CAD software — Autodesk AutoCAD Mechanical; IBM CATIA V5; SolidWorks CAD Yes/No

Computer aided manufacturing CAM software — CNC Mastercam; Computer assisted manufacturing CAM software; Three-dimensional 3D solid modeling software   Yes/No

Industrial control software — Computerized numerical control CNC programming software; Robotic control software; Soft Servo Systems LadderWorks PLC   Yes/No

Are there other special tools, equipment, or software that are critical to your firm? Please list.

Appendix B: BASIC Executive Survey Instrument

PROJECT 1.2 – 21ST CENTURY WORKFORCE
Questions for One-on-One Interviews with Life Sciences Executives

0. What are the realities and future implications of the marketplace on this industry and how will those forces shape the workforce?
   - Where is the industry going
   - What are the issues/ideas driving your industry
   - How will the future of the industry impact the skills needed in the future workforce

1. What combination of education, skills and experience will be the most valuable in this industry?
   - Where would you rank the need for management to have both business and science expertise – Masters of Science? Science Services?
   - Where would you rank the need for professional staff in life sciences to have interdisciplinary skills – i.e., skills that may not now fall within the generally accepted description of a biologist/researcher
   - Where will you be looking for the future leaders

3. Do the current leaders generally have that broad span of knowledge that crosses beyond the scientific focus?

4. Is there a critical skills shortage – the type of skills needed for 21st century innovative businesses – and if so, is it more critical at the

   - Technician level
   - Professional level

5. What are some of the key concerns regarding the future of ensuring a skilled workforce?
   - Lack of interest in becoming a "bench" scientist
   - Lack of system for quickly incorporating needed changes into the education system
   - Lack of easily accessible training for professional and management to obtain the added knowledge necessary as a corporation moves into different areas
   - Lack of broad understanding by educators of the key elements that are the driving force of the life sciences industry
   - Lack of basic math and science skills

6. We would be interested in hearing
   - How would you profile today's effective life sciences manager
   - How would you profile an effective life sciences manager in 2017
   - How would you profile today's effective technician

- An effective technician in 2017

7. What is the key message concerning workforce development that you, as a life sciences executive, would like to give to California leadership at the state and local levels

Appendix C: BASIC New PhD Survey Instrument

Survey Tool for Student Interviews

[Call initiation cushion—2:00 min. | 02:00 elapsed]

[Introduction—2:00 min. | 04:00 elapsed]

Thank you for taking the time to speak with me about your experience pursuing doctoral-level education and the career you have envisioned in the life sciences.

I expect we will take a little more than 45 minutes for this conversation. Is that okay?

[If not, work out when / how to follow-up to complete the interview.]

First, a little about myself [quickly, where you're from, academic course of study].

Our conversation is part of research I am conducting on behalf of the Bay Area Science and Innovation Consortium, known as BASIC, which is part of the Bay Area Council Economic Institute. BASIC is a partnership of national laboratories, research universities, private and independent laboratories and community organizations. BASIC works to support the Bay Area's scientific and research infrastructure, and advance science as a cornerstone of the region's technology-led economy. This project is funded by a grant from the US Department of Labor and the California Space Authority under a project called WIRED, a portion of which is focused on developing profiles for the 21st Century Workforce.

Our conversation is one of 20 such interviews we are conducting with people like yourself. We will be using this information in conjunction with other background research we have conducted, including interviews of employers and industry experts. Any resulting findings that we produce will be available to you.

Your comments will only be used in the aggregate. You will not be personally identified. Your name will not be used publicly in our findings, so I hope you will be as candid with me as possible.

I will be recording our conversation, but that is only to be sure I capture all your thoughts. We will not be using the recording publicly.

Do you have any questions for me?

[Basic information—2:00 min. | 06:00 elapsed]
Tell me a little about yourself:

1. [30 sec.]
   When did you (or when do you expect to) get your doctorate, what university, and what is your area of expertise?
2. [Number. 10 sec.]
   How old are you?

3. [Short answer. 30 sec.]
   Where were you born or grew up / what is your nationality? [For US-born, what city/state]

[Initial career decision factors—5:00 min. | 11:00 elapsed]
Thank you. I'd like to explore how you got into this field.

4. [Short list. 45 sec.]
   Describe for me the main factors that persuaded you to pursue an advanced degree in this field.
5. [Yes/No. 10 sec.]
   Was this the same general area as your undergraduate degree?
6. [Short answer. 45 sec.]
   Thinking back to elementary and high school, did your early schooling help you at all in deciding and preparing to pursue a science career?
7. [Short answer, 90 sec. Prompt with the examples, but skip if already covered in #4.]
   Were you familiar with the <u>technical area</u> of your PhD before entering the PhD program? For instance:
   - Did you work in the field before, during or after your undergraduate degree?
   - Did you complete work-study or an internship in the field?
   - Have a relative or a close friend or associate who works in the field?
8. [Y/N plus short answer. 60 sec.]
   Did you experience any people strongly pushed you into or out of this field? [If yes, probe briefly for who and what did they say or do.]

[Academic satisfaction / abandonment factors—19:00 min. | 30:00 elapsed]
Let's turn to how your academic program went.

9. [Probe for thoughtful answer. 2 min.]
   Thinking back over the time from when you decided to enroll to today, describe for me any of the major moments when you considered abandoning the field [probe for who/what/why and how strong].
10. [Number 1-10. 30 sec.]
    On a scale of 1 to 10, with 10 being highest, how satisfied were you with your university experience?
11. [Number and short answer. 45 sec.]
    How many years after receiving your undergraduate degree, including time off from school for work or travel, will it have taken to get your PhD, and is that a problem?

12. [Probe. 60 sec.]
    While it is common for many to struggle with money during school, to what extent did economic issues make it difficult for you to pursue this degree or pursue opportunities after the degree [probe for how much and why]?
13. [Probe for thoughtful answer. 2 min.]
    In your university experience, was (is) there a reasonable balance between your research interests and a need to pursue grant funding projects?
14. [Probe for thoughtful answer. 2 min.]
    Thinking back to when you started your PhD program, were your career path options made clear to you?
15. [Short answer. 60 sec.]
    What, if any, adjustments did you make in your academic program to accommodate the university system?
16. [Probe for thoughtful answer. 2 min.]
    Was the university supportive of your needs/ambitions? [If not, how did you overcome this lack of support?]
17. [Probe for thoughtful answer. 2 min.]
    What ways, if any, has the university exceeded your expectations?
18. [Probe for thoughtful answer. 2 min.]
    How would you rate the level of structure in your university training (i.e. overly structured and confining, too broad and unsupervised, etc)?
19. [Short answer. 60 sec.]
    Did your university help you gain experience using automated lab equipment and computing packages for research or project design and management?
20. [Probe for thoughtful answer. 2 min.]
    Have you had any structured opportunity to gain business knowledge—such as business development, people management, or finance—either through classes or some form of work placement?

[Post-graduate success / abandonment factors—10:00 min. | 40:00 elapsed]
Thanks for all that. I'd like to look at how things are going for you now as you start to pursue work after your PhD.

21. [Short answer. 30 sec.]
    (If not already working) how soon do you plan to enter the workforce in your field?
22. [Short answer. 60 sec.]
    Do you plan to engage in a post-doc (or are you already), where, and for how long?
23. [Probe for thoughtful answer. 2 min.]
    Do you have a focused goal in your future employment, do you have a good

understanding of the opportunities and career path of that choice [if not, why not]?

24. [Short answer. 60 sec.]
    Looking over the next two to five years, what do you want from your workplace (eg, type and size of organization, amount of research, work on a large team or independently)?
25. [Probe for thoughtful answer. 2 min.]
    Do you feel that the training you have received has given you the best chance to achieve your immediate goals? Please describe why or why not.
26. [Short answer. 60 sec.]
    Looking long term, how would you measure success in your career? (money, advancing science, improving the human condition, meeting expectations of friends and family, career stability, diversity of experiences)?
27. [Probe for thoughtful answer. 2 min.]
    Did your PhD program support you and other students in entering a variety of career paths? In other words, to what extent is the program highly focused on and directly supportive of producing university researchers, industrial lab researchers, entrepreneurs, or industry technical executives/managers?

- **[Suggestions—6:00 min. | 46:00 elapsed]**

Terrific. We're almost done.

28. [Probe for thoughtful answer. 2 min.]
    Overall, what things do you believe should be implemented at the university level that would maximize the students' academic experience and better prepare them to achieve their expectations? (e.g., industry internship program, more grant money, more structured training/oversight, guaranteed tenure, etc?)
29. [Probe for thoughtful answer. 2 min.]
    Nationally, there is a concern that an increasing number of new technical PhD graduates are seeking employment in other, non-technical jobs or even abandoning PhD programs and just taking a Masters. Thinking about the people you know or have observed, do you think this is true, and if so, why do you think it's happening?
30. [Probe for thoughtful answer. 2 min.]
    Do you think that not enough people are entering science careers? If so, do you have any ideas on how to increase the number of people?

Thank you very much. We've covered all my questions.

Appendix D: WIB Survey Instrument

WIRED 1.2

Qualitative Report Instructions and Outline

Reporting on qualitative data is, by nature, subjective. Two people looking at the same interview may end up with very different conclusions. However, our task as WIRED participants is to try to reach broad conclusions about the Innovation Corridor.

Therefore, it is recommended that you look at your data first by breaking the responses down by question and entering them into the Excel Template for Qualitative Data Entry. Once you have lined up your data by question, trends will emerge that will be more objective and less skewed by personal opinion. The goal is to answer the questions from the survey instrument by reporting the trends from your data as follows:

I. Future of the Industry

1. Where is the industry going and how will changes in the industry shape the workforce?
    - What are the issues/ideas driving your industry? What do you see as the next frontier? The next great breakthrough?
    - How do you think the future of the industry will impact the skills needed in the workforce?

II. Ideal skills, education and experience needed to effectively staff up both now and in 10 years.

2. What combination of education, skills, and experience will be the most valuable in this industry at each level? Where would you rank the need for management expertise, science expertise, interdisciplinary expertise, etc
    - Managerial level:
    - Professional level:
    - Technician level:

3. Is there a critical skills shortage in the type of skills needed for 21st century innovative businesses – and if so, what skills are missing at each level? At which level is any gap most critical?
    - Managerial level:
    - Professional level:
    - Technician level:

4. We would be interested in hearing:
    - How would you profile today's effective life sciences manager?

- How would you profile an effective life sciences manager in 2017?
- How would you profile today's effective life sciences professional?
- How would you profile an effective life sciences professional in 2017?
- How would you profile today's effective technician?
- An effective technician in 2017?

III. Leadership and Skills Gap Analysis

5. Do the current leaders in your company have a broad span of knowledge that crosses beyond the scientific focus?
    - What skills will future leaders need to have?
    - Where will you be looking for the future leaders?

6. Are you able to find individuals with the skills you currently need? If not, what are your skill shortages?

IV. Education Report Card

7. Are there specific educational institutions or types of institutions (e.g. community colleges, four-year universities, manufacturing technology centers) that have been particularly good in meeting your skill needs? Are there ones that have been bad?

8. Are there educational institutions you think would be good at meeting the new skill requirements that you foresee?

9. What do you think needs to be done to ensure that our educational institutions prepare individuals for the skilled jobs you see in the future?

V. Primary Concerns & Key Message From Industry

10. What are some of your key concerns about ensuring a skilled workforce in the future?
    - Lack of interest in becoming a "bench" scientist?
    - Lack of system for quickly incorporating needed changes into the education system?
    - Lack of easily accessible training for professionals and management to obtain the added knowledge necessary as a corporation moves into different areas?
    - Lack of a broad understanding by educators of the key elements that are the driving force of the life sciences industry?
    - Lack of basic math and science skills?

11. What is the key message concerning workforce development that you, as a life sciences executive, would like to give to California leadership at the state and local levels?

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NOVA Workforce Board
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San Bernardino Workforce Development Department
San Diego Workforce Partnership
South Bay Economic Partnership
South Bay Workforce Investment Board

Labor Market Data

Employment Development Department, Labor Market Information Division
California Labor and Workforce Development Agency