

**Inventory for the Greater Tampa Bay Region's Biotechnology Industry**  
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**Prepared for**



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## Prelude

The Biomolecular Identification and Targeted Therapeutics Center (BITT) at the University of South Florida (USF) is a Florida Department of Education Center of Excellence. Besides its biotechnology development activities, BITT is establishing the foundation guidelines for workforce readiness as related to “Life Sciences innovation Pipeline” issues. The Florida Advanced Technological Education Center (FLATE) is a National Science Foundation (NSF) supported center that works with the Florida Department of Education to enhance Florida’s State College technical degree programs. The BITT/FLATE partnership was defined to capitalize on the application research expertise of BITT and the State College curriculum and industry training program development experience of FLATE.

The partnership addresses key components of BITT’s mission:

- Develop and then facilitate the movement of promising biotechnology-based therapeutics to market and commercialization in Florida.
- Create jobs in the biotechnology industry in the State of Florida and greater Tampa Bay region.
- Promote workforce development through universities, colleges, and industry interaction to foster and support the biotechnology industry in Florida.

The partnership deliverables support BITT’s intent to improve Florida’s national ranking in biotechnology. Activities associated with the BITT/FLATE partnership address workforce objectives that are of mutual interest to both organizations. Both organizations provide resources to:

- Develop an inventory of greater Tampa Bay biomedical, biotechnology, and therapeutics industries.
- Conduct a workforce needs analysis to be able to work for the industries identified in the inventory.
- Produce an academic inventory of educational opportunities and academic programs (high school through university) in the region to identify current or needed local components of bio-related career pathways that can be built upon, including developing a two-year program at Hillsborough Community College (HCC) customizable to industry.
- Use acquired inventory and needs analysis data to work with industry, educators, the Florida High Technology Corridor Council, and the Florida Department of Education to identify the gaps between existing educational programs and industry expected needs.
- Help State College and high school programs align with industry needs using the “Florida Gold Standard Career Pathway Program”, based on FLATE’s model and adopted by the Florida Department of Education.

The following presents a summary of the inventory and workforce needs analysis.

## Introduction

Biotechnology is defined as technology based on biology, biochemistry, food science, and medicine. This broad-based definition includes any technological application that uses biological systems, living organisms, or derivatives, thereof, to make or modify products or processes for specific use. For Florida, especially Tampa Bay, it supports biomedical applications that range from diagnostics, surgical implants and tools, to novel drug and gene targeted therapy applications.

Biotechnology is one of the fastest growing industries in the United States (US) as stated by the 2004 Milken Report.<sup>1</sup> Also, according to an article in the 2007 Milken Report entitled *Florida Life Sciences 2007*, a competitive life sciences economy requires a sophisticated and adaptable innovation pipeline. “Life Sciences Innovation Pipeline” is defined as the support and process infrastructures that buttress the production and creativity in a region’s life sciences industry.<sup>2</sup> The pipeline consists of five components:

- 1) Research and development (knowledge assets)
- 2) Risk capital and entrepreneurial infrastructure
- 3) Industry infrastructure (industry’s full employment base and supports)
- 4) Workforce (human capital)
- 5) Innovation output

The Milken report entitled *Technology and Science Index 2010: Enduring Lessons for the Intangible Economy* contains a nationwide benchmark for states to assess their science and technology capabilities, along with their ecosystems for converting them into companies and high-paying jobs.<sup>3</sup> Seventy-nine indicators were subdivided into five equally-weighted major composites:

- 1) Research and development inputs: The R&D capabilities that can be commercialized for future state and regional technology growth. This category includes measures such as industrial, academic, and federal R&D, Small Business Innovation Research (SBIR) awards, and the Small Business Technology Transfer (STTR) program, among others.<sup>3</sup>
- 2) Risk capital and entrepreneurial infrastructure: The entrepreneurial capacity and risk capital infrastructure of states determine the success rate of converting research into commercially viable technology services and products. Several measures of venture capital that capture the amount placed relative to the size of a state’s economy and recent growth are included, as well as patenting activity, business formations, and initial public offerings.<sup>3</sup>
- 3) Human capital capacity: Human capital is the most important intangible asset of a regional or state economy. This component includes measures of stocks and flows in various areas of educational attainment. Examples include the number of bachelor’s, master’s, and Ph.D.s relative to a state’s population and measures of specific science, engineering, and technology degrees.<sup>3</sup>

- 4) Technology and science workforce: The intensity of the technology and science workforce indicates whether states have sufficient depth of high-end technical talent on the ground. Intensity is derived by finding the percent share of employment for a particular field relative to total state employment; it indicates whether potential human capital is being combined with R&D and financial capital and is actually being transformed into a thriving economy. There are three main categories of computer and information science, life and physical science, and engineers. <sup>3</sup>
  
- 5) Technology concentration and dynamism: This is a measure of technology outcomes. By measuring technology growth, the effectiveness of policymakers and other stakeholders in transforming regional assets into regional prosperity was assessed. This includes measures such as the percent of establishments, employment, and payrolls that are in high-tech categories. It further includes a variety of measures on growth in a number of technology categories. <sup>3</sup>

The table below summarizes Florida’s rankings in each of the five composite areas, followed by Florida’s overall Technology and Science Index.

<b>Composite</b>	<b>Rank 2010</b>	<b>Rank 2008</b>	<b>Rank Change 2008 to 2010</b>	<b>Average</b>
Research & Development Inputs	45	44	-1	25.99
Risk Capital & Entrepreneurial Infrastructure	35	33	-2	45.53
Human Capital Investment	48	46	-2	28.10
Technology & Workforce	38	35	-3	44.78
Technology Concentration & Dynamism	22	19	-3	55.40
<b>Florida Technology &amp; Science Index</b>	<b>40</b>	<b>37</b>	<b>-3</b>	<b>39.96</b>

A recommendation of the 2007 Milken Report is to establish a program to develop R&D centers that maximize the growth of life science clusters. Tampa Bay is developing its potential to serve as such a hub. It has education, research, industry and transportation elements required for commercializing intellectual property and start-ups in medical devices, biomedical and nano-medical devices, and cancer treatments. Tampa’s international airport exceeds all passenger and air-freight needs of the region. The deepwater Port of Tampa is already the outgoing port for Florida’s fertilizer-based biotech products, and is well-positioned as a gateway for the growing markets of Florida and the southeast US. According to Enterprise Florida, the Tampa Bay region houses over 40 biotechnology companies, has a total labor force of over 600,000 with over 20% in the education and healthcare sector. The Tampa Bay region houses three major shipping ports, three major airports, a well-developed and highly utilized commercial transit system, and an extensive interstate access loop with the intersection of two major interstate high ways.<sup>4</sup> Thus, the region is perfectly situated to complement the fact that pharmaceuticals and medical devices are on *Florida’s Top 50 Merchandise Exports* list.

In addition to the region’s existing infrastructure the presence of a strong medical device sector also supports the development of a Milken report suggested center. Florida now has one of the country’s most substantial medical device manufacturing sectors and ranks 2<sup>nd</sup> in the nation for FDA-registered medical device establishments, employing over 20,000 Floridians in the Jacksonville, Central, and South Florida areas. The majority of the medical device manufacturing industries are located along the Florida High Tech Corridor. The recent creation of the Florida High Tech Corridor council, backed by a federal grant program, has assisted more than 300 companies and over 250 university researchers in developing commercially applicable emerging technologies.<sup>5</sup>

## Industry Classification

The survey instrument for this inventory utilized five broad industry classifications:

- 1) Diagnostic & Medical Laboratories
- 2) Drugs & Pharmaceuticals
- 3) Medical Devices & Equipment
- 4) Research & Development
- 5) Other

Diagnostic & Medical Laboratories include medical laboratories primarily engaged in providing analytic or diagnostic services. This includes body fluid analysis, generally to the medical profession or to the patient on referral from a health practitioner. For this inventory, the term Drugs & Pharmaceuticals is used for industries that produce medicinal drugs using various manufacturing techniques including chemical synthesis as well as molecules produced from biological sources.

The US Food and Drug Administration (FDA) defines a medical device as “an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part, or accessory which is intended for use in the diagnosis of disease, or other conditions, or in the cure, mitigation, treatment, or prevention of disease, in man or other animals, or intended to affect the structure of any function of the body of man or other animals, and which does not achieve any of its primary intended purposes through chemical reaction within or on the body of man or other animals which is not dependent upon being metabolized for the achievement of any of its primary intended purposes.”<sup>6</sup>

For this inventory, Research & Development industries include companies, research centers or institutes, and universities that produce creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture, and society, and the use of this stock of knowledge to devise new applications. The Other classification was provided to accommodate any entities that may have a mixed mode of operation and/or a hybrid manufacturing mission. Such organizations may not wish to be strictly identified with any of the other organizational tags provided in this survey. “Other” industries would include companies whose main interest is in the manufacturing or delivery of healthcare, environmental industrial applications, and nutritional or dietary supplements.

## Incubators and Research Parks

One of several incubators in the Tampa Bay region is the **Tampa Bay Technology Incubator**. Its mission is to support technology research as a catalyst for economic development. It advocates the development and construction of facilities for high-technology companies and related support functions. In promoting research with companies and the University of South Florida, the Tampa Bay Technology Incubator seeks to address the needs of local high technology employers in such areas as biotechnologies and life sciences, engineering, and information technologies.<sup>7,8</sup> This 60,000 square foot incubator facility is located in the Business Partnership building in USF’s Research Park at the Tampa Campus. Facilities include quality office and laboratory space designed for biotechnology and life sciences research. Shared laboratory facilities provide technology businesses with access to critical research equipment that would otherwise be cost-prohibitive to most start-up companies.<sup>7,8</sup>

The scientific research conducted by the companies in the Tampa Bay Technology Incubator is carried out for the purpose of aiding the community by attracting new industry and encouraging the development and retention of current industries. This endeavor is providing significant employment both through construction activity and long-term jobs in biotechnology. As of 2010, 40 companies have resided in the the Tampa Bay Technology Incubator. Currently, there are

22 companies in the incubator, 16 of which are in the biotechnology and life sciences categories and the other 6 focus on engineering and software technology. A total of 4 participated in the survey.<sup>7</sup>

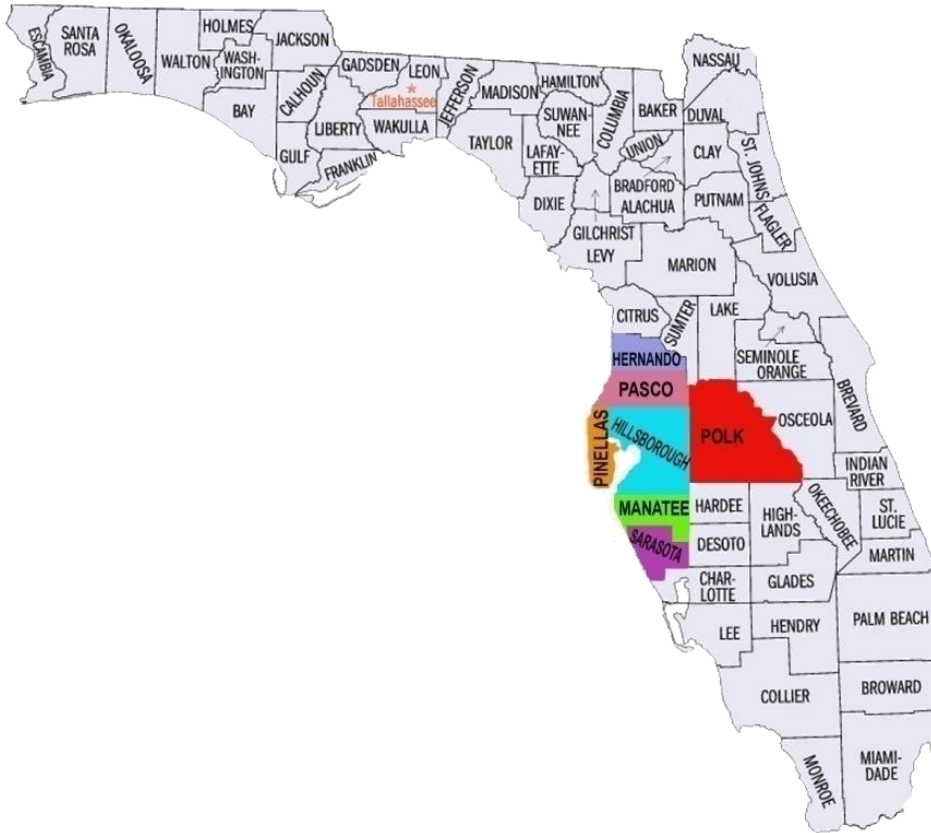
The **Tampa Bay Innovation Center** is located in Pinellas County at the western gateway to Florida's High Tech Corridor and is home to an extensive list of technology companies in the areas of software, electronics, and a variety of defense technologies. The Tampa Bay Innovation Center provides numerous resources to clients and aids them in areas including strategy execution, technology transition, planning and business formation, and business intelligence. The location of the Innovation Center, the presence of such a large medical device manufacturing community in Pinellas County, and the subject matter of the existing tenants should attract more biotechnology industries to the Tampa Bay region.<sup>9</sup>

The **USF Downtown Center** is home to the USF Professional and Workforce Development which assists companies and individuals with their education and training goals by providing noncredit courses and certificate programs. The center is located in Tampa's Channelside District.<sup>10</sup>

The **USF Polytechnic Blue Sky Incubation Program** offers education, expert advice, and business contacts to entrepreneurs that help build successful technology companies. USF's incubation programs are located in Lakeland and Winter Haven, hosting academic and business outreach centers in Wauchula and Sebring. These centers allow both faculty and students to work with entrepreneurs to grow their companies and bring innovative technologies to the market. Blue Sky's substantial benefits have allowed over an 80% success rate for entrepreneurs that utilize their resources.<sup>11</sup>

## Breakdown of Biotech Companies

The survey candidates were identified through direct contact with knowledgeable individuals, the FLATE and BITT data bases, the Florida High Tech Corridor Council, Enterprise Florida, Tampa Chamber of Commerce, and Tampa Bay Partnership. 154 companies were identified in 7 counties in the Tampa Bay area. Categorically the list included 9 Diagnostic & Medical Laboratories, 23 Drugs & Pharmaceuticals, 50 Medical Devices & Equipment, 30 Research & Development, and 42 Other.



## Distribution of Companies

The companies identified were in the University of South Florida service area, Hillsborough, Pinellas, Polk, Sarasota, Manatee, Pasco, and Hernando Counties. The majority of companies were clustered in Hillsborough and Pinellas Counties. [Appendix 1](#) contains the list of respondents, location, and classification.

## Survey

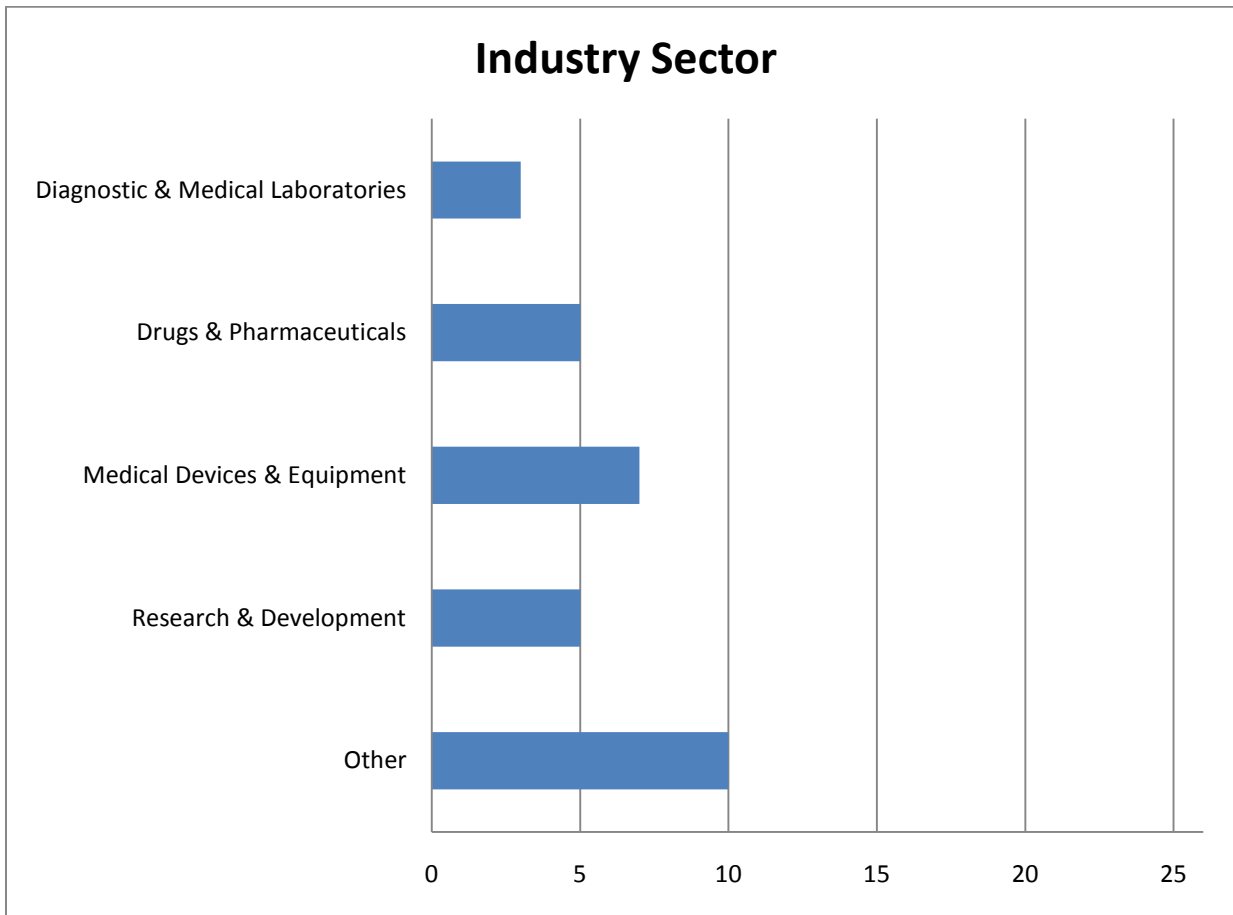
The survey was designed with a balance between comprehensive training needs and workforce skills knowledge acquisition and simplicity to optimize on its return rate. The objective was to determine directly from companies in the region what specific skills were required to do certain jobs as well as educational requirements perceived as necessary for their workplace. However, the first five questions were directed to background information.

## Survey Administration

The survey was distributed to 154 companies. The surveys were distributed via mail, email, phone call, internet, or direct contact with company personnel. A total of 26 surveys (17%) were returned and used as the data base for this inventory. [Appendix 2](#) contains the survey.

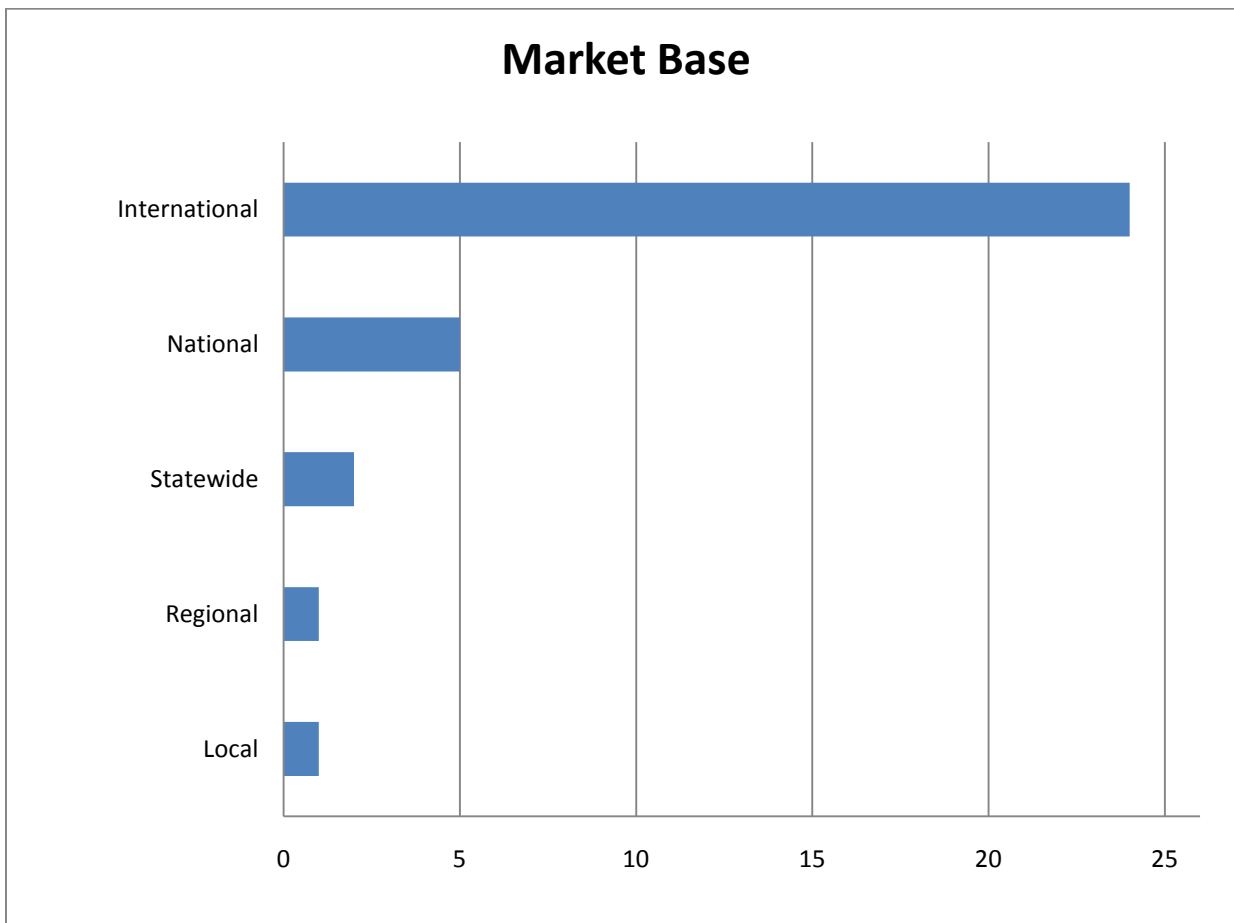
## Survey Results

### Industry Sector



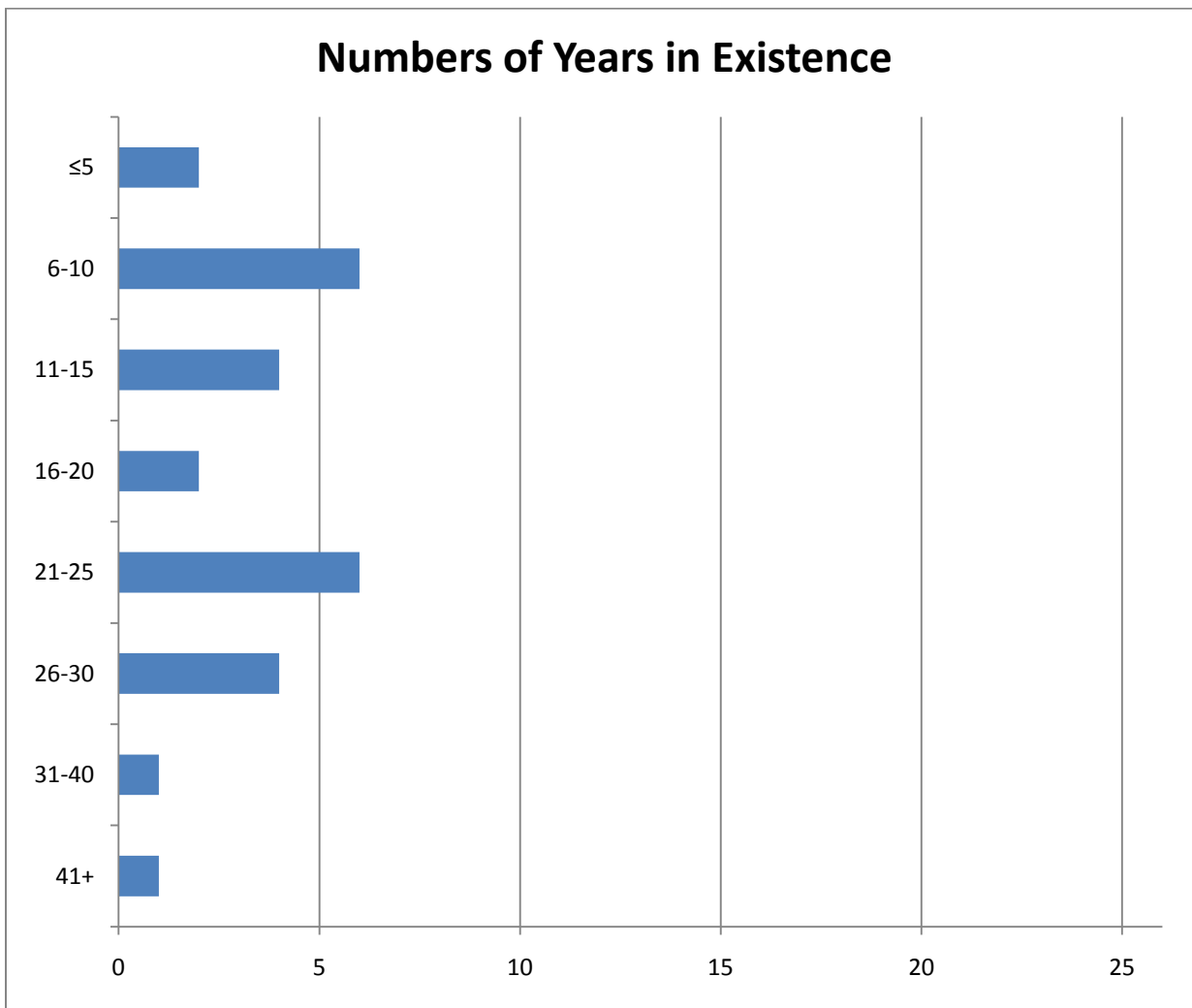
Survey participants were asked to categorize themselves in the 5 categories: Diagnostic & Medical Laboratories, Drugs & Pharmaceuticals, Medical Devices & Equipment, Research & Development, or Other. Of the 26 survey respondents, 3 classified themselves in the Diagnostic & Medical Laboratories category, 5 in the Drugs & Pharmaceuticals category, 7 in the Medical Devices & Equipment category, 5 in Research & Development, and 10 classified themselves in the Other category. Four (4) respondents categorized themselves in more than one sector. Respondents who classified themselves in the Other category listed the following as their industry: Cellular Therapy, Environmental Biotechnology, Enzyme and Reagent Manufacturer, HVAC Homeland Security, Nutraceuticals, Nutritional Products, Manufacturing, and Microbial Biotechnology.

## Market Base



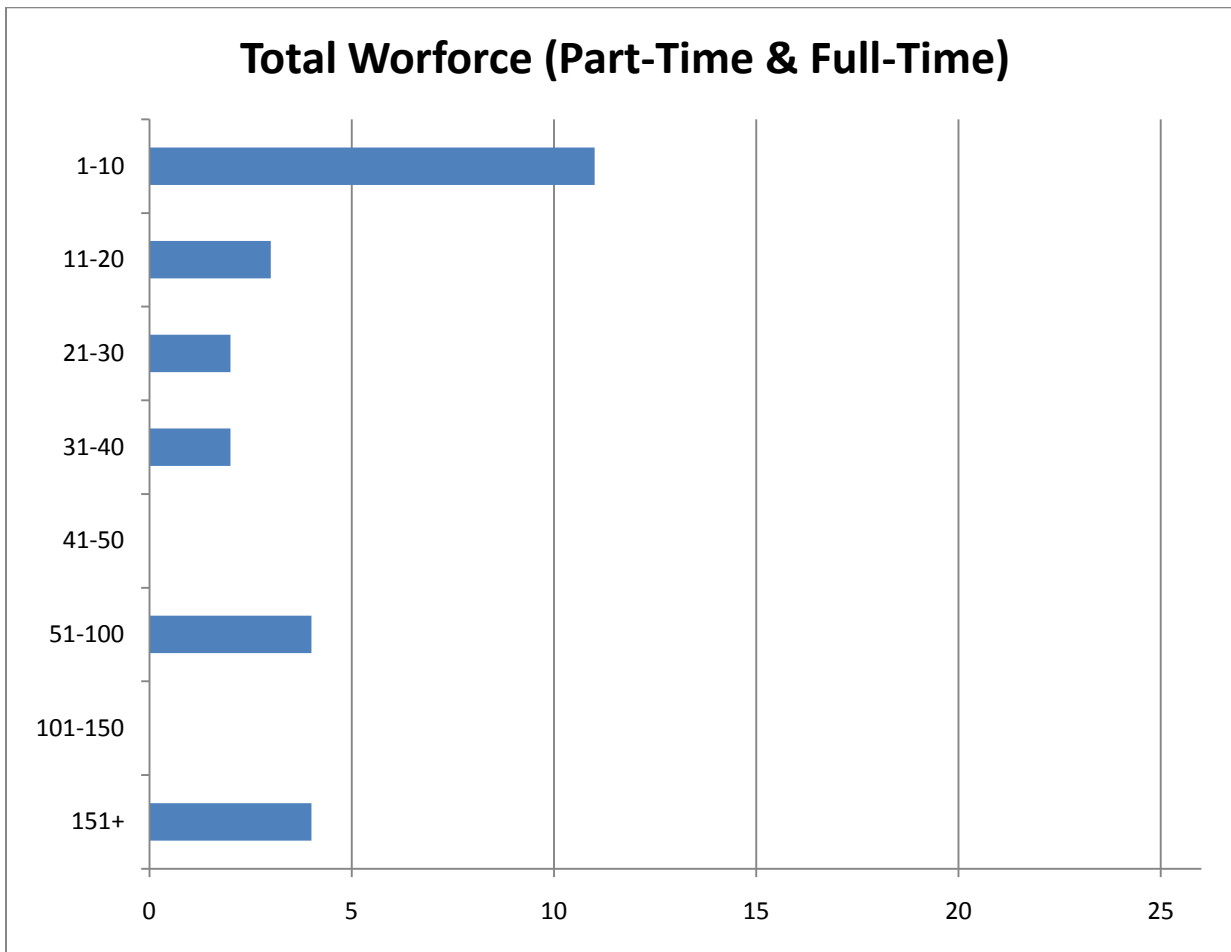
Survey participants were asked to categorize their market base. Ninety two percent (92%) of the companies surveyed market their goods or services internationally. This survey response reflects a high percentage of companies dealing in the international marketplace since pharmaceutical and medical devices are on Florida's Top 50 Merchandise Exports list. Survey respondents were allowed to select multiple categories.

## Number of Years in Existence



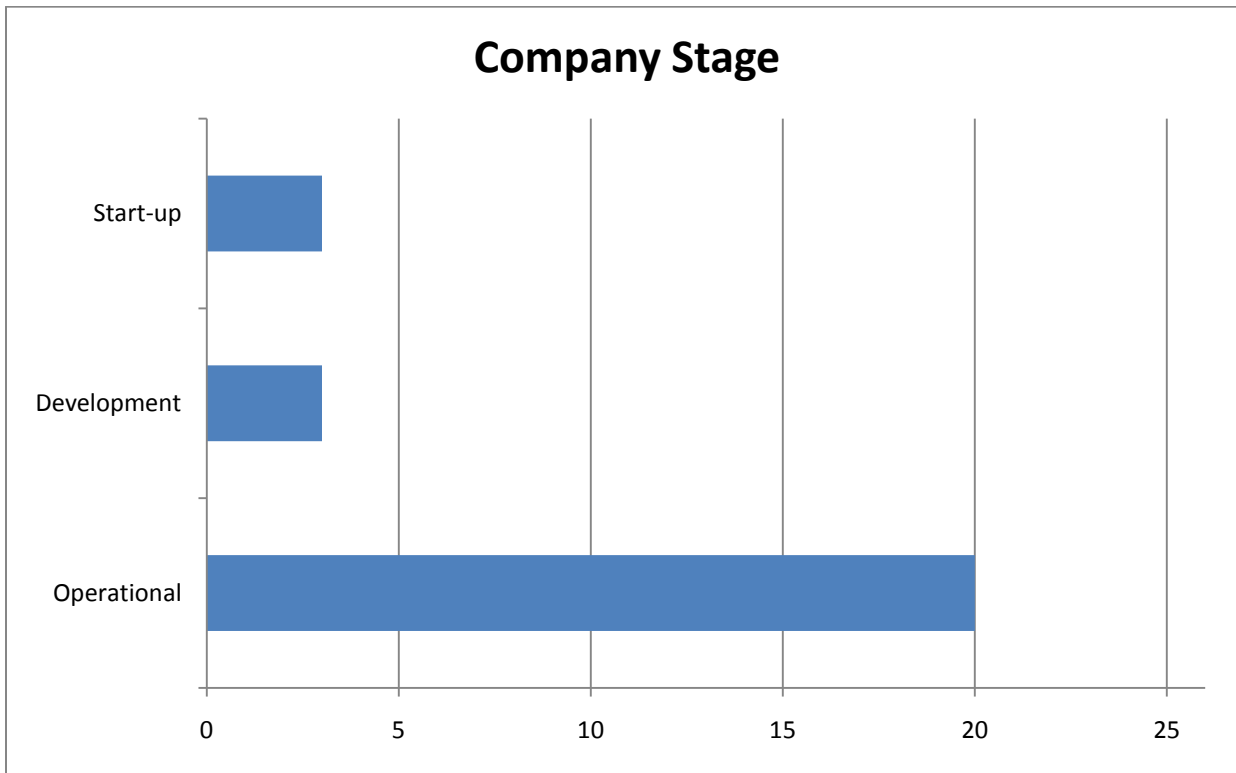
Survey participants were asked to indicate the number of years in existence. Twenty-three percent (23%) of respondents have been in existence for 6-10 or 21-25 years, 15% of respondents have been in existence for 11-15 or 26-30 years, 8% of respondents indicated that they have been in existence for 16-20 or 5 or fewer years, and 4% of respondents have been in existence for 31-40 or 41 or more years.

## Total Workforce (Part-Time & Full-Time)



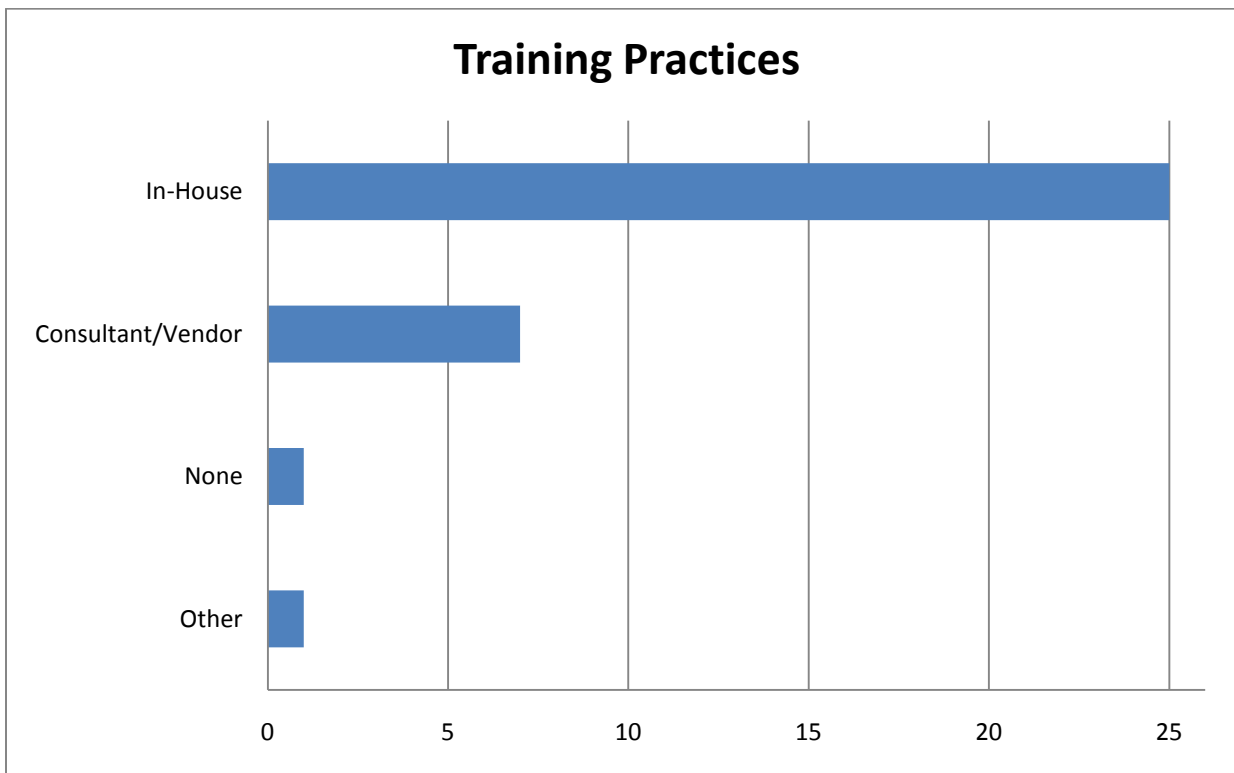
Survey participants were asked to provide approximate number of employees in the range categories in the graph. Fifteen percent (15%) of respondents have 151 or more employees, while another 15% of respondents have 51-100 employees. Twelve percent (12%) of respondents have 11-20 employees. Eight percent (8%) have 21-30 employees or 31-40 employees. The majority of the respondents (11 respondents) have 10 or fewer employees.

## Company Stage



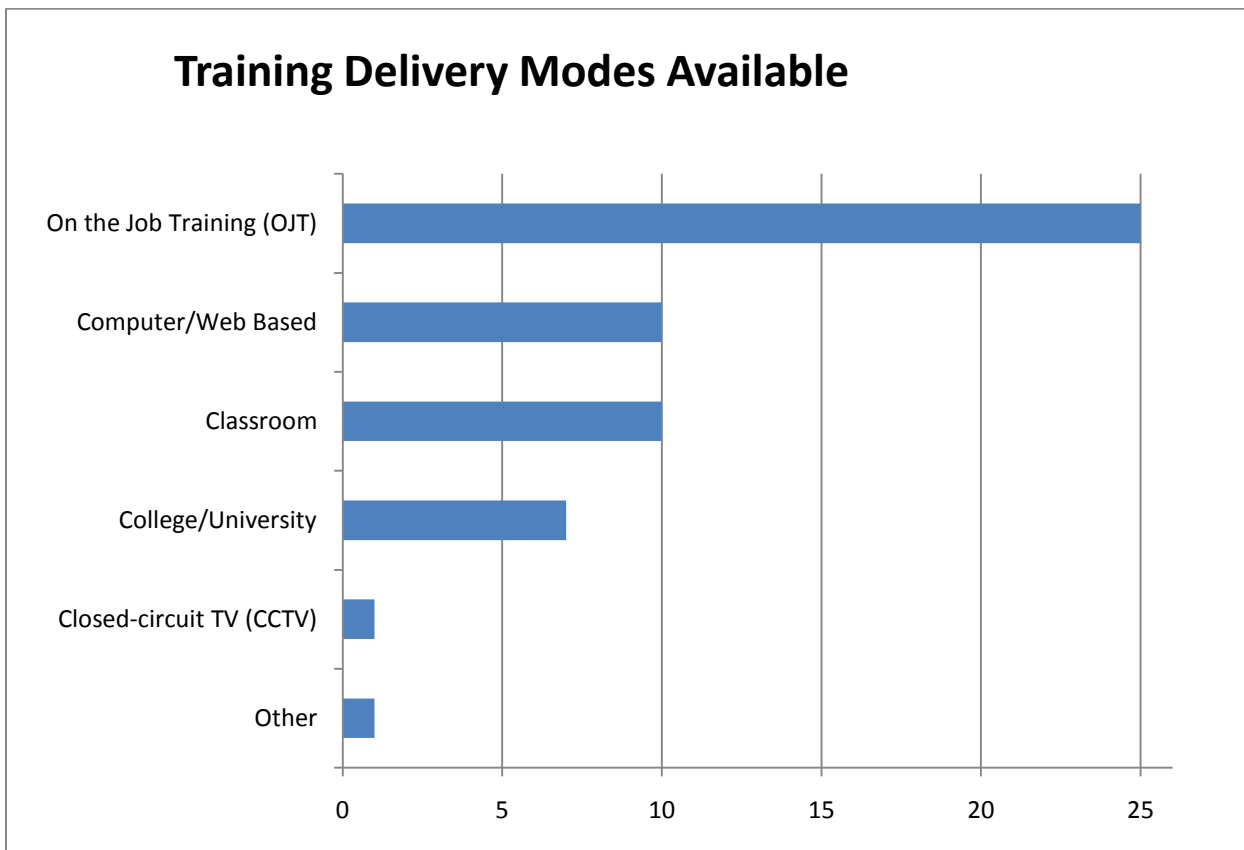
Survey participants were asked to indicate their company stage. The majority (76%) of the companies surveyed are in the operational stage, while 12% are in the development stage and another 12% are in the start-up stage.

## Training Practices



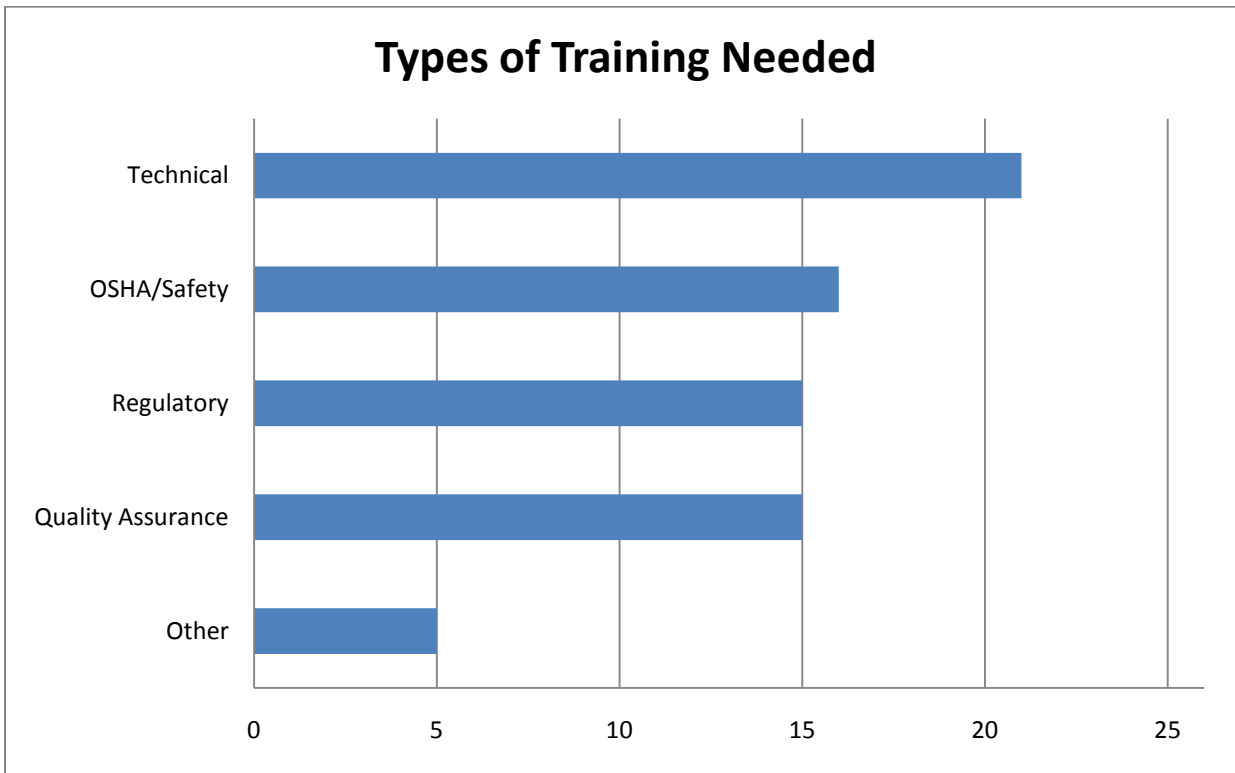
Survey participants were asked to indicate their current training practices. The majority (96%) of the respondents indicated that they use in-house methods, while 27% indicated that they use a consultant/vendor. Four percent (4%) of respondents indicated that they have no training practices, while another 4% indicated that use internships as their training practices which were indicated through the Other category. Survey respondents were allowed to select multiple categories.

## Training Delivery Modes Available



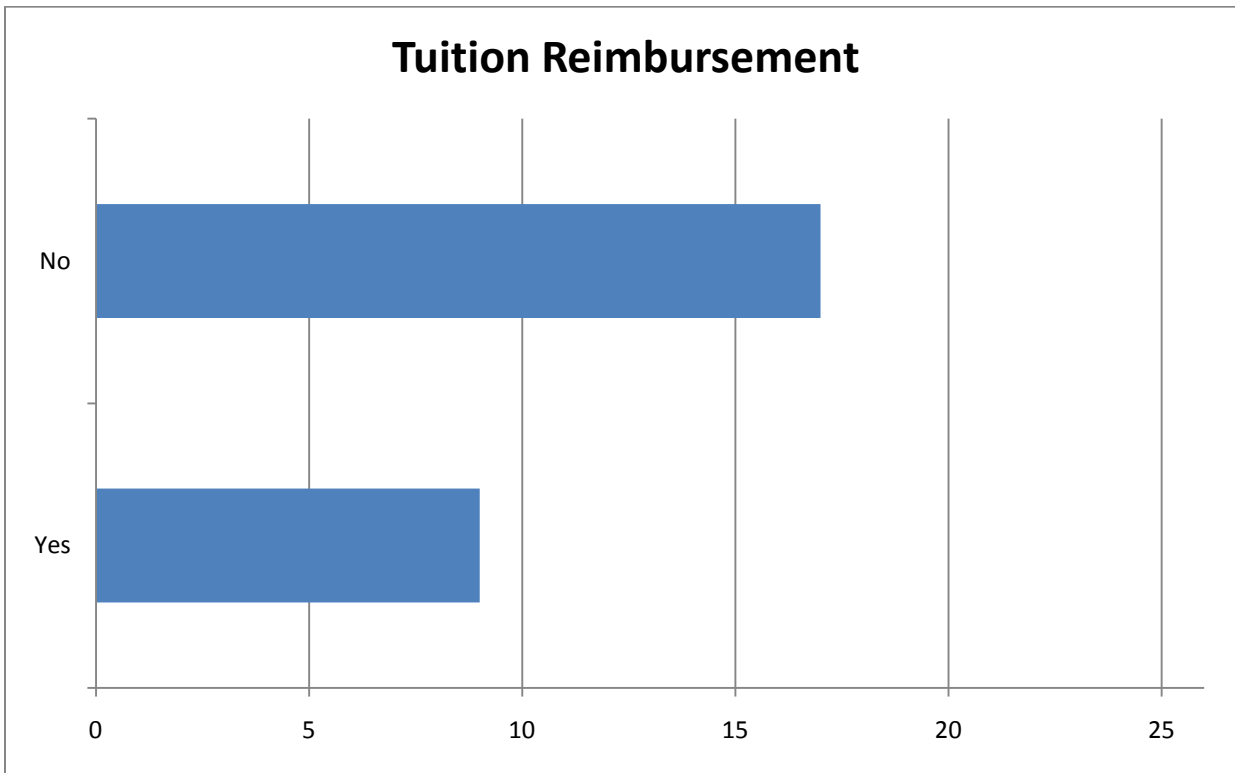
Survey participants were asked to indicate their current training delivery modes from the list contained in the graph above. The majority of the respondents (96%) selected on the job (OJT) training. Thirty-nine percent (39%) selected classroom, while another 39% selected computer/web-based training. College/university training was selected by 27% of respondents. Four percent (4%) of respondents selected closed-circuit TV (CCTV), while another 4% indicated that they have no training delivery modes available which was identified as Other. Survey respondents were allowed to select multiple categories.

## Types of Training Needed



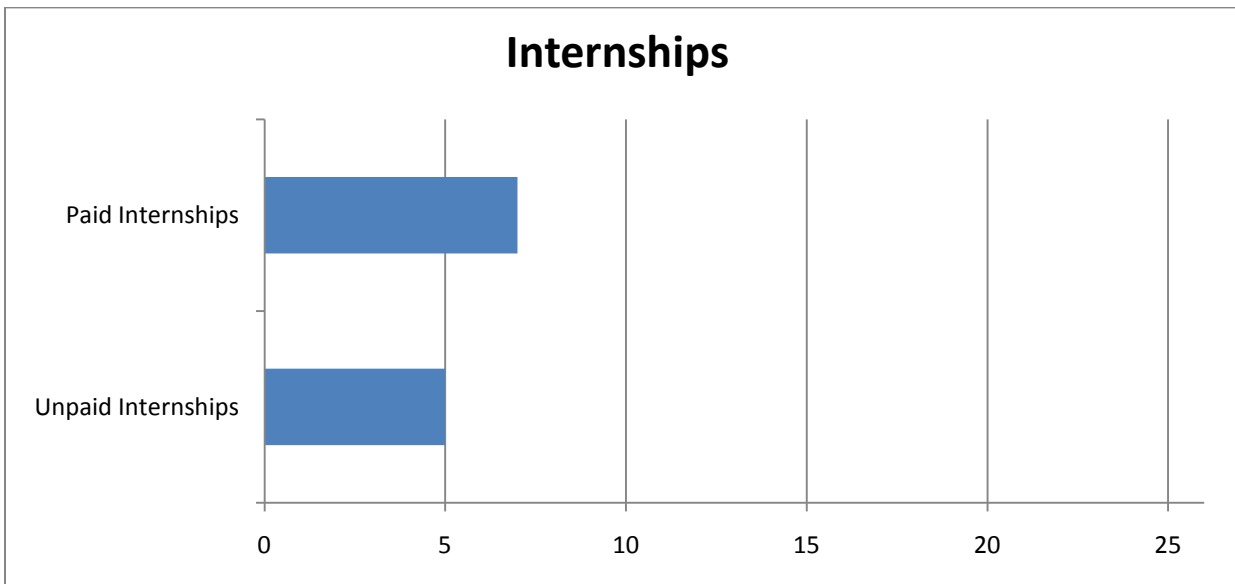
Survey participants were asked to indicate the types of training needed. The majority (81%) of the respondents selected technical training, 62% selected OSHA/safety training, and 58% selected quality assurance training and regulatory training. Five (5) respondents indicated other training needs in areas such as biochemical, professional, telesales, team building, and change management. Survey respondents were allowed to select multiple categories.

## Tuition Reimbursement



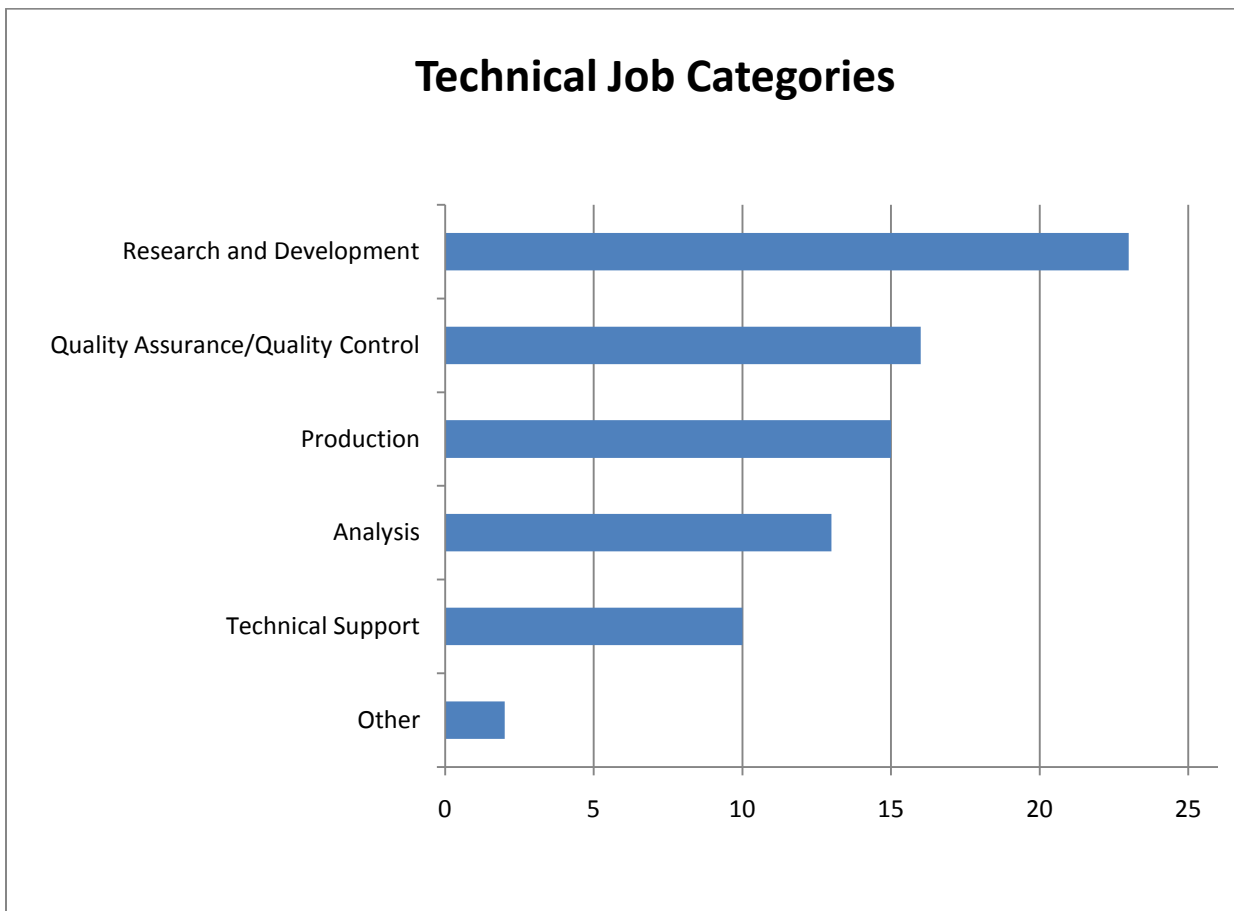
Survey participants were asked whether they have tuition reimbursement. The majority (65%) of the respondents indicated that they do not, while the remaining 35% indicated that they do offer tuition reimbursement.

## Internships



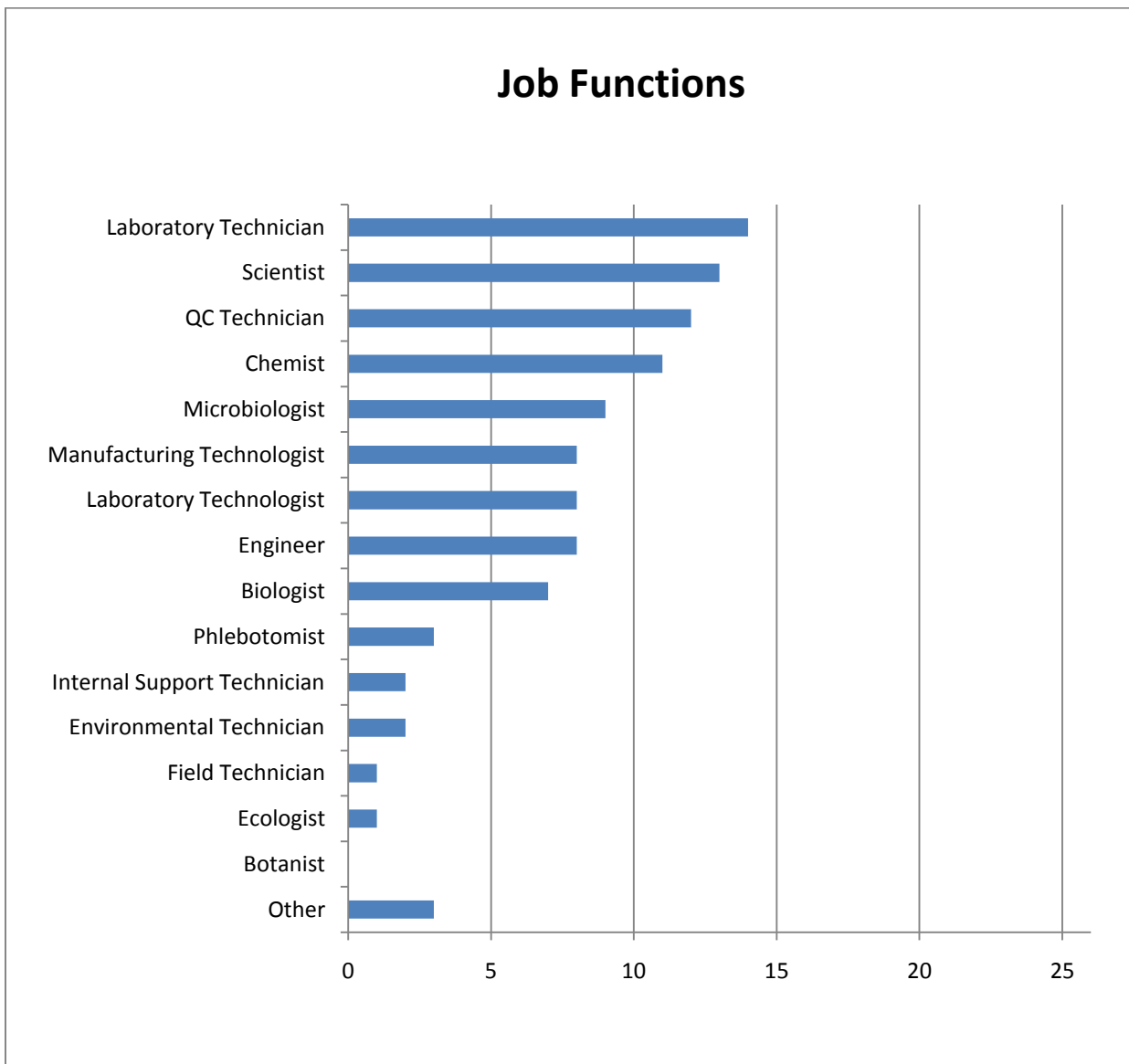
Survey participants were asked whether they have an internship program and whether their internships are paid. Forty-six percent (46%) or 12 respondents indicated that they do have an internship program. Of these 12 respondents, 64% indicated that the internships are paid. One respondent indicated that they are currently revamping their internship program.

## Technical Job Categories



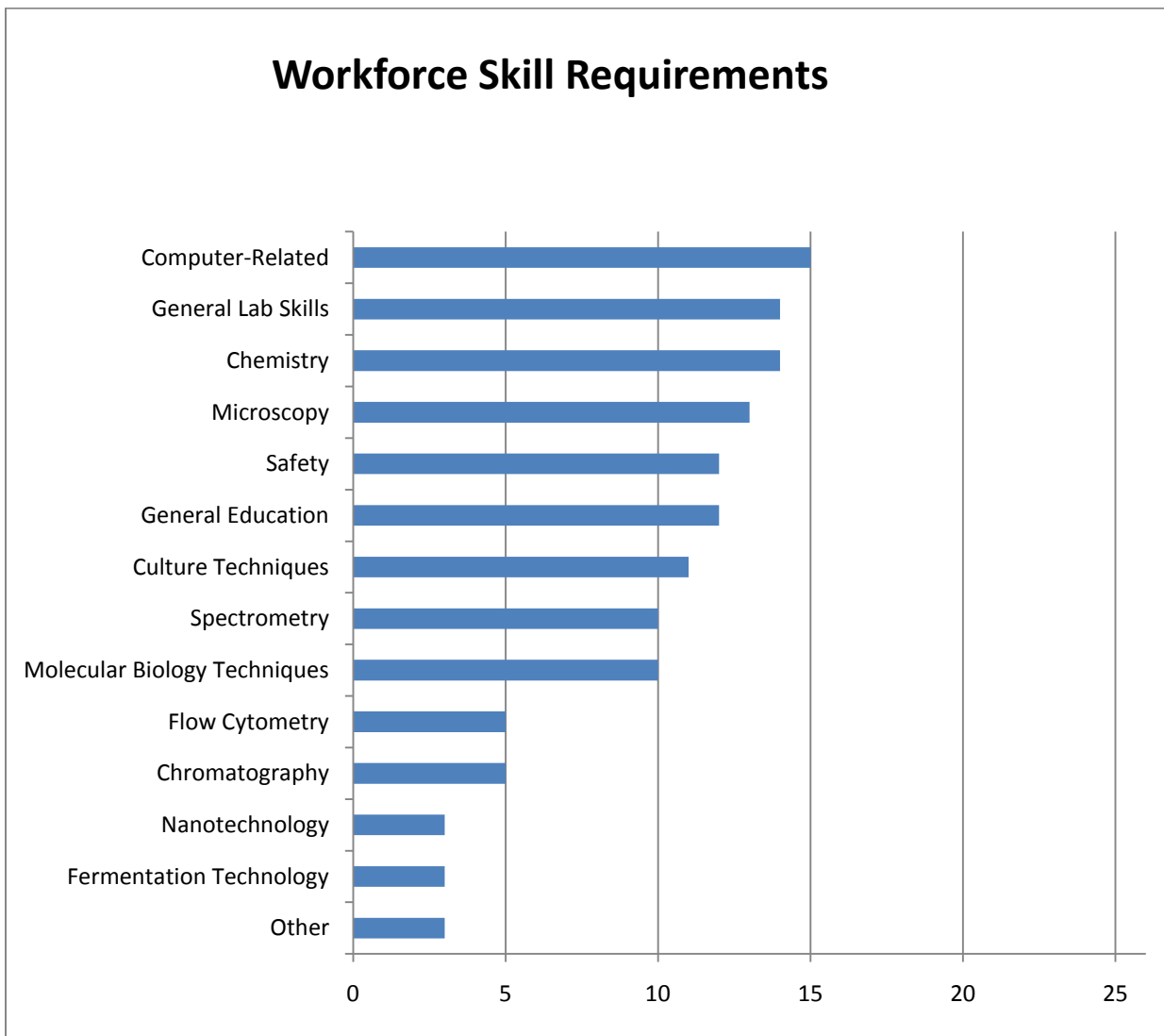
Survey participants were asked to select the technical job categories contained in the graph above. Ninety-two percent (92%) selected research and development, followed by 64% quality assurance / quality control, 60% production, 52% analysis, and 40% technical support. Other responses included business and customer service. Survey respondents were allowed to select multiple categories.

## Job Functions



Survey participants were asked to select their job functions contained in the graph above. Fifty-six percent (56%) selected laboratory technician, 52% selected Scientist, 48% selected quality control (QC) technician, and 44% selected chemist. Botanist was the least selected job function with no respondents making this selection. Other responses include equipment technicians, production technicians, production operators, production mechanics, and administrative functions. Survey respondents were allowed to select multiple categories.

## Workforce Skill Requirements

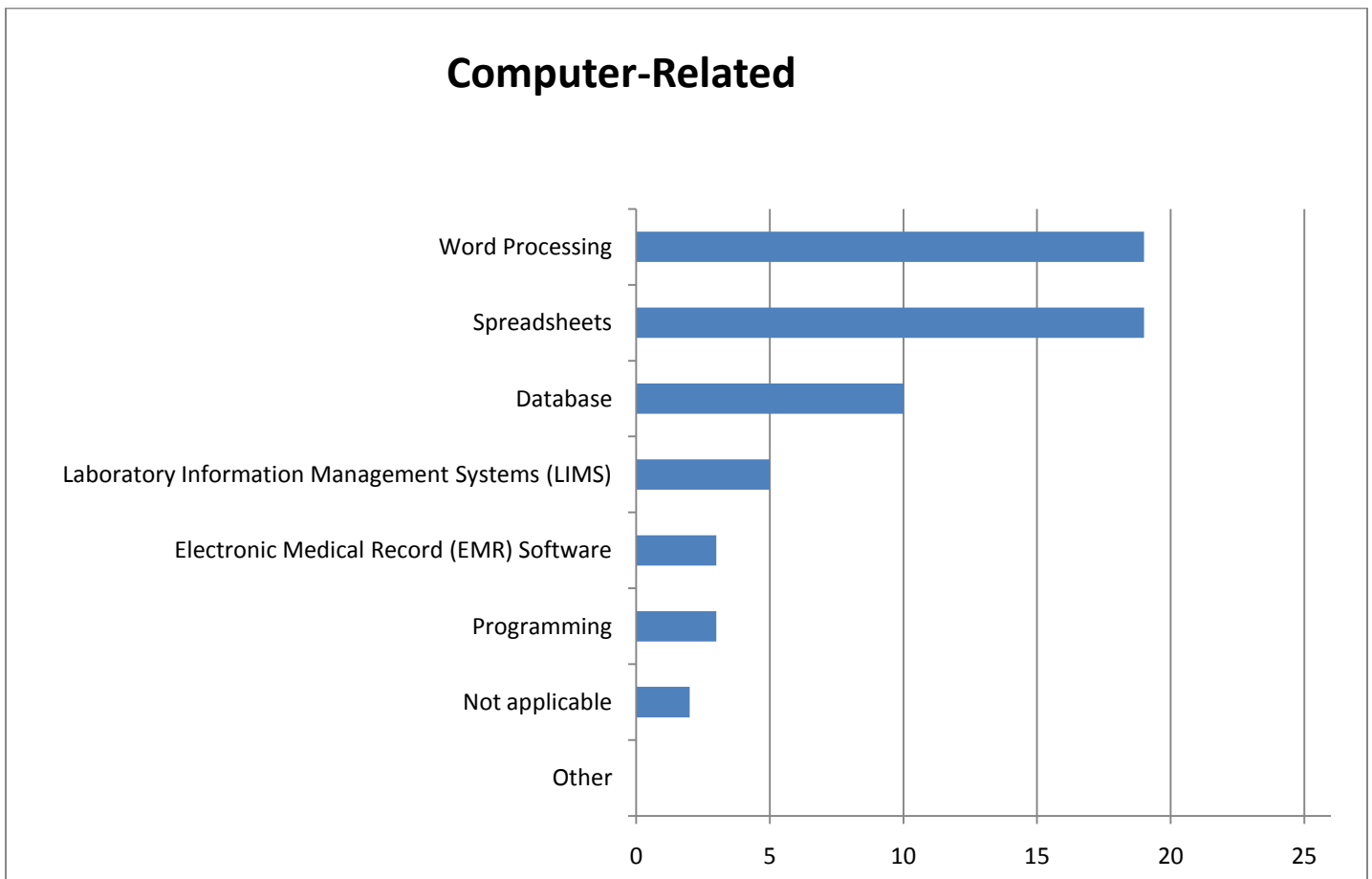


Survey participants were asked to select their workforce requirements from the list contained in the graph above. Computer-related skills were selected as required skills by 60% of the respondents. General lab skills (56%), chemistry (56%), microscopy (52%), safety (48%), general education (48%) were high-ranking skill requirements. Nanotechnology and Fermentation Technology were the least required skills with only 12% of respondents selecting these items. Survey participants were allowed to choose more than one response.

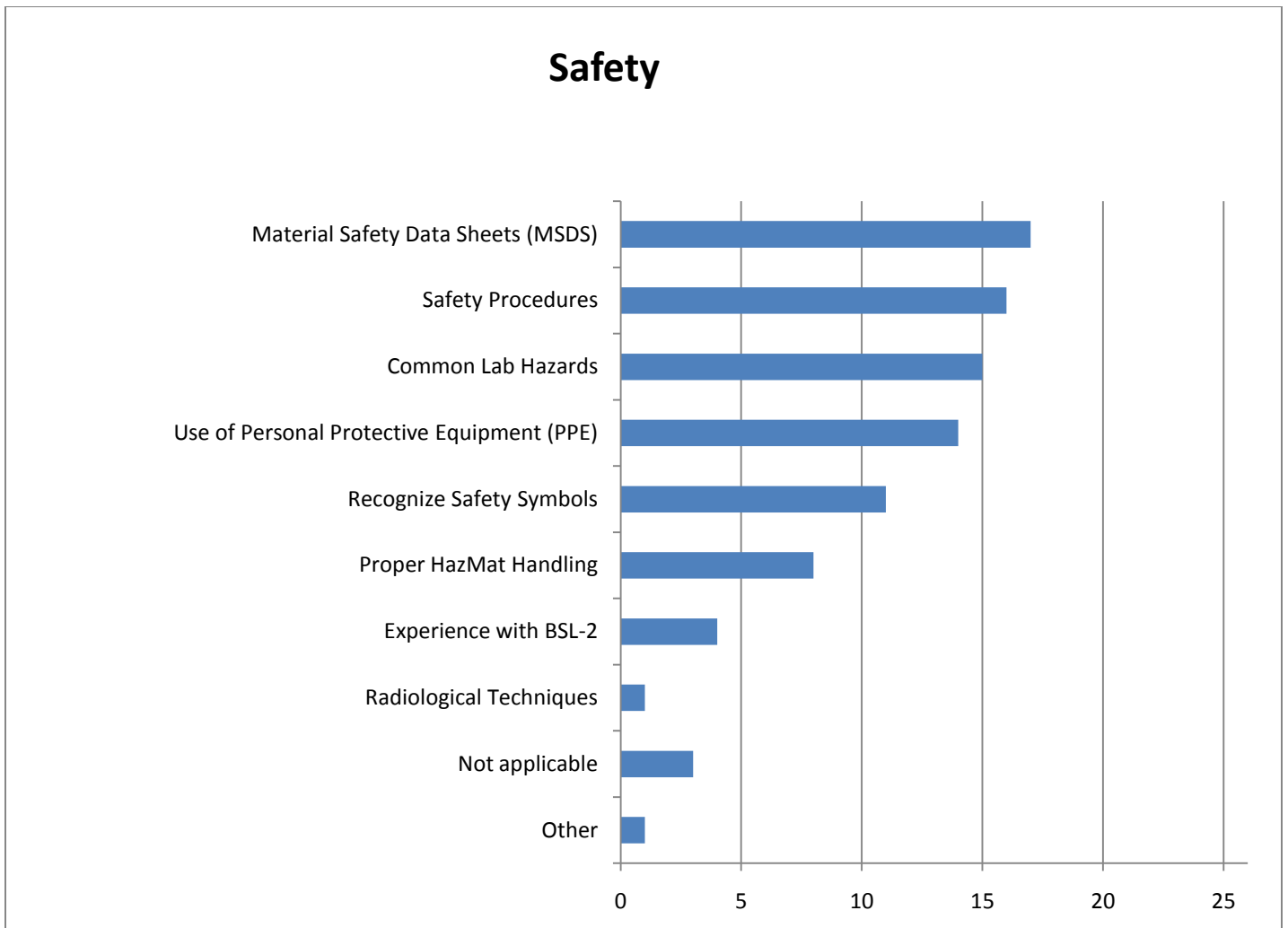
## Knowledge and Skill Sets for Entry-Level Technicians

Survey participants were asked to select the knowledge and skill sets desired for entry-level technicians in categories including computer-related skills, safety, regulatory, general laboratory, cultures techniques, fermentation, microscopy, chromatography, spectrophotometry/spectometry, and other areas including nanotechnology and animal handling. The graphs below illustrate the types of knowledge and skills required by entry-level technicians.

### Computer-Related Skills

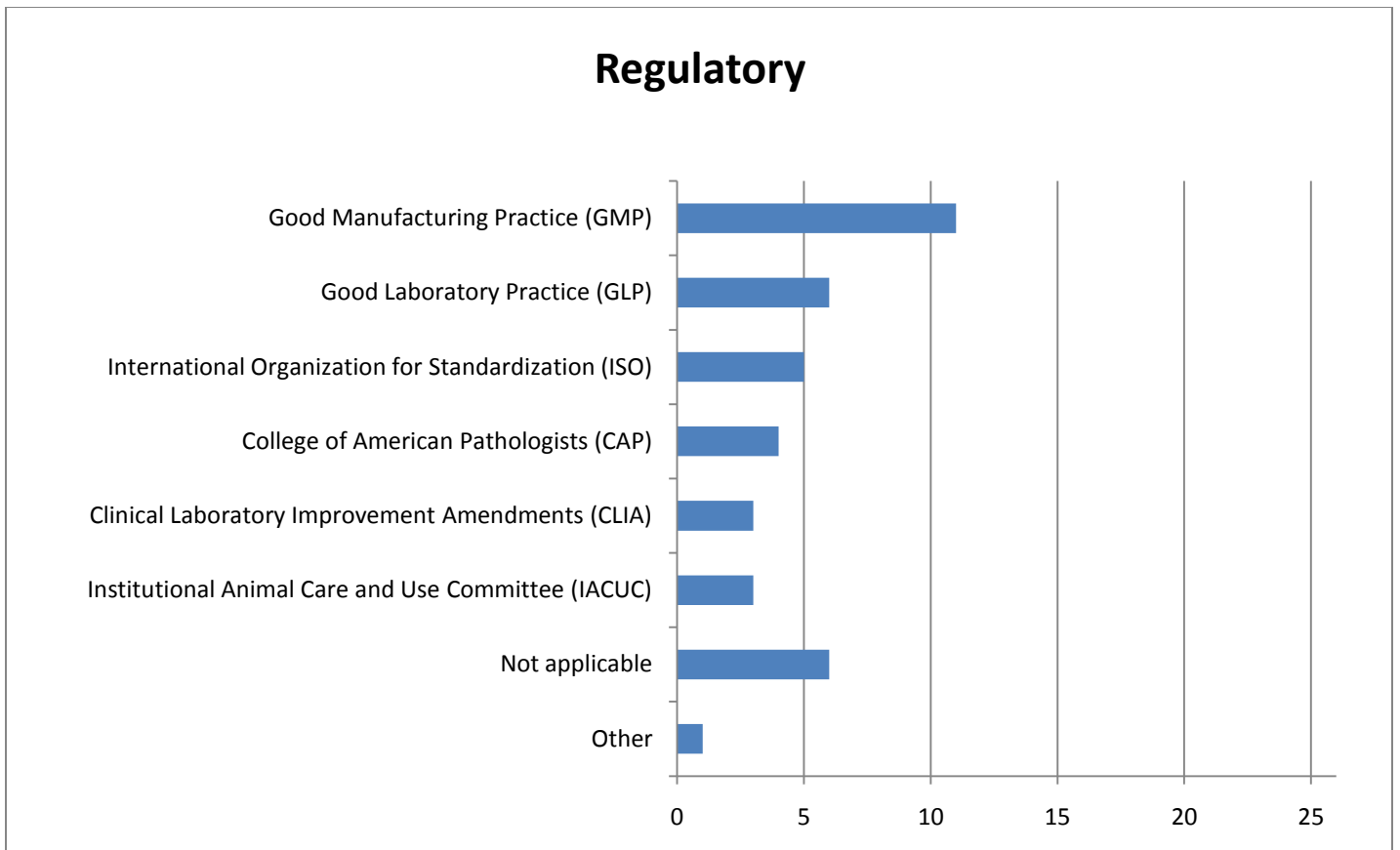


Eighty percent (80%) of the respondents selected word processing and spreadsheet knowledge and skills. Forty-two percent (42%) of respondents selected database knowledge and skills. Twenty-one percent (21%) of respondents selected Laboratory Information Managements Systems (LIMS) knowledge and skills. Thirteen percent (13%) of respondents selected Electronic Medical Record (EMR) Software and programming knowledge and skills. Eight percent (8%) of respondents indicated that computer-related skills do not apply. Survey participants were allowed to choose more than one response.



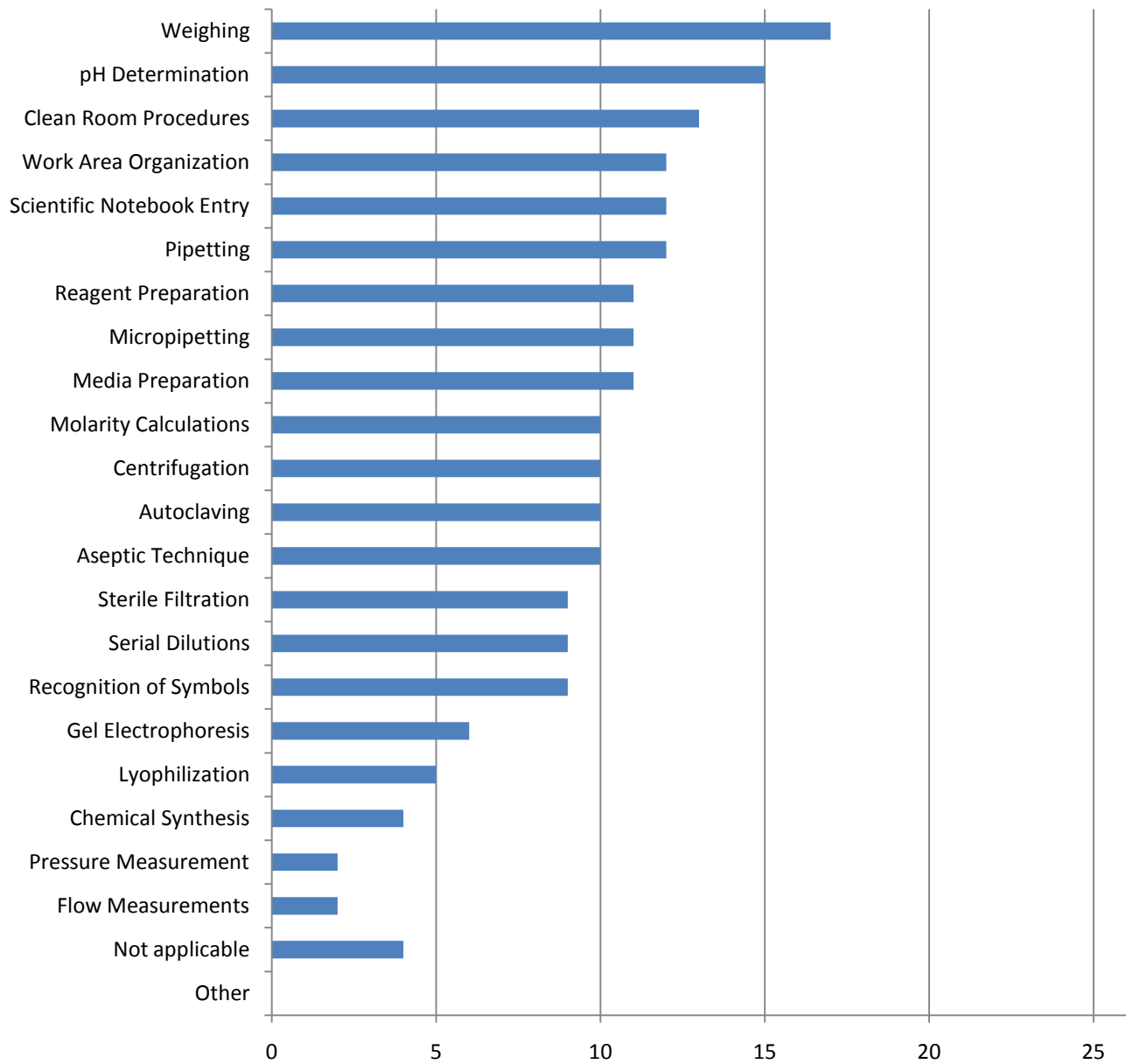
Seventy-one percent (71%) of respondents selected Material Safety Data Sheets (MSDS) knowledge and skills. Sixty-seven percent (67%) of respondents selected safety procedures knowledge and skills, while 63% of respondents selected common lab hazards knowledge and skills. Fifty-eight percent (58%) of respondents selected use of personal protective equipment (PPE) knowledge and skills. Forty-six percent (46%) of respondents selected recognition of safety symbols knowledge and skills, while 33% of respondents selected proper HazMat handling knowledge and skills. Only 17% of respondents selected experience with BSL-2 and 4% of respondents selected radiological techniques knowledge and skills. Thirteen percent (13%) indicated that safety skills do not apply. One (1) respondent indicated clean room operation and manufacturing products for sterilization in the Other category. Survey participants were allowed to choose more than one response.

## Regulatory



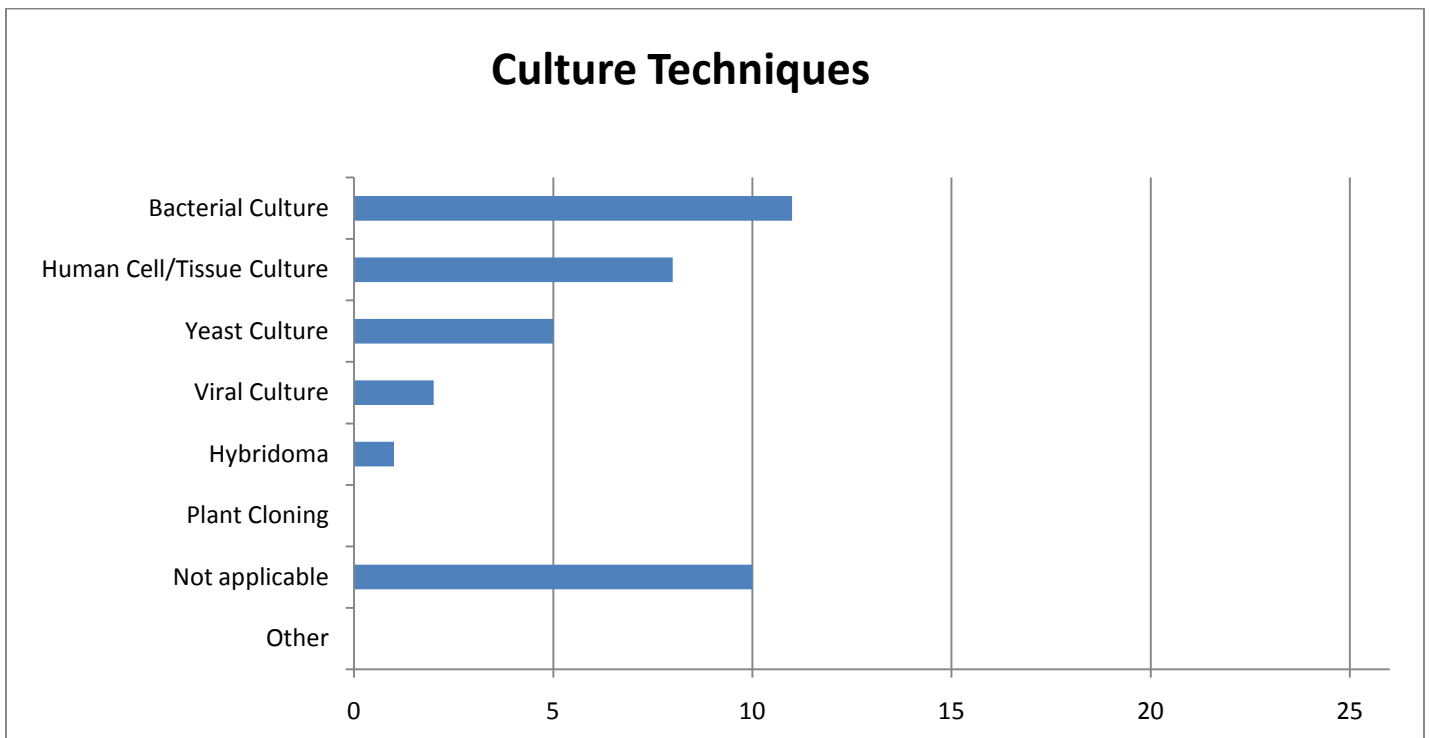
Forty-six percent (46%) of respondents selected Good Manufacturing Practice (GMP) knowledge and skills, while 25% of respondents selected Good Laboratory Practice (GLP) knowledge and skills, and 21% of respondents selected International Organization for Standardization (ISO) knowledge and skills. Seventeen percent (17%) of respondents selected College of American Pathologists (CAP) knowledge and skills, and 13% of respondents selected Clinical Laboratory Improvement Amendments (CLIA) knowledge and skills and Institutional Animal Care and Use Committee (IACUC) knowledge and skills. Twenty-five percent (25%) of respondents indicated that regulatory knowledge and skills do not apply. One (1) respondent specifically indicated ISO 13485 in the Other category. Survey participants were allowed to choose more than one response.

# General Laboratory



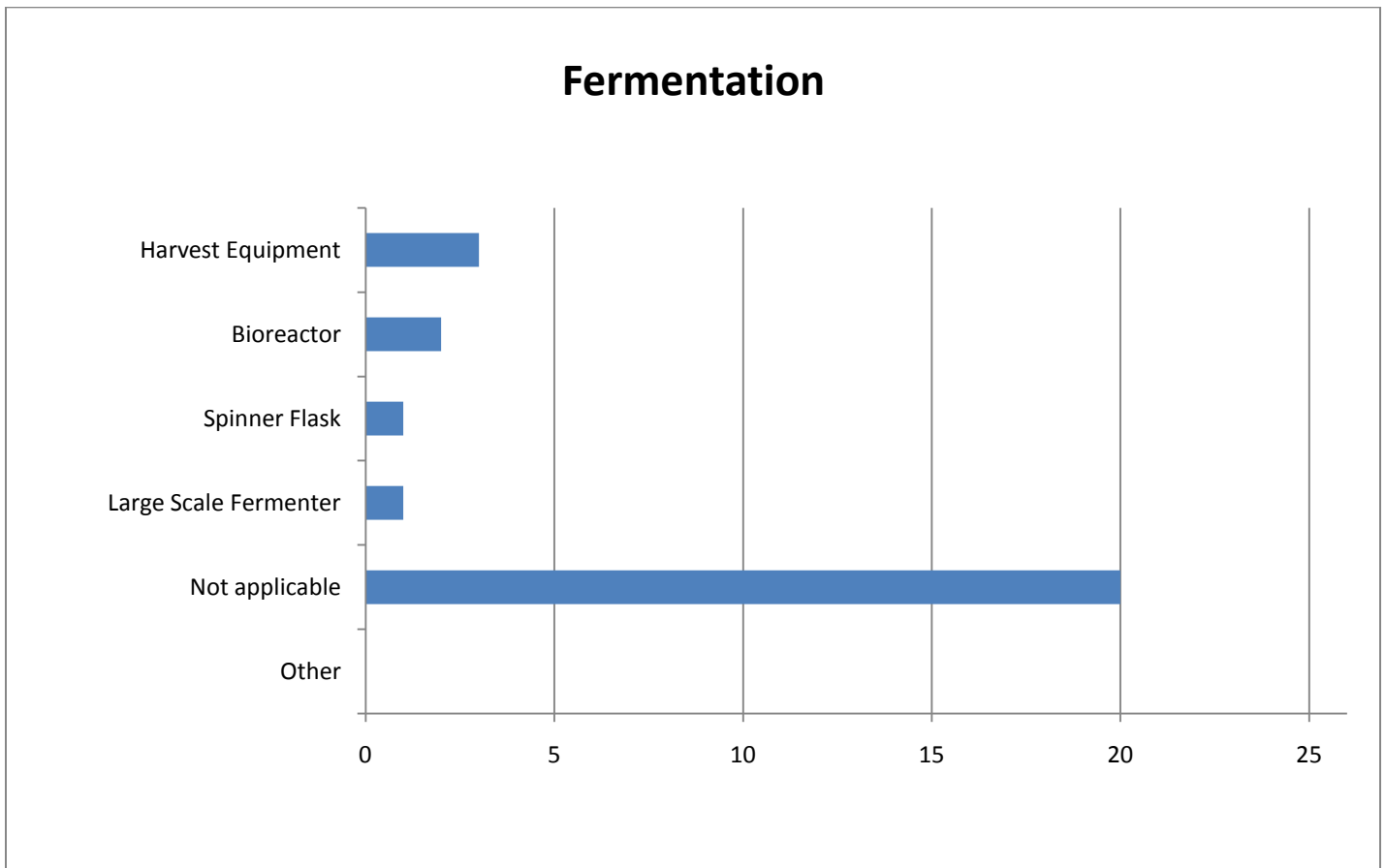
Seventy-one percent (71%) of respondents selected weighing knowledge and skills. Sixty-three percent (63%) of respondents selected pH determination knowledge and skills, while 54% of respondents selected cleaning room procedures knowledge and skills. Fifty percent (50%) of respondents selected work area organization, scientific notebook entry, and pipetting knowledge and skills. Forty-six percent (46%) of respondents selected reagent preparation, micropipetting, and media preparation knowledge and skills. Forty-two percent (42%) of respondents selected molarity calculations, centrifugation, autoclaving, and aseptic technique knowledge and skills. Thirty-eight percent (38%) of respondents selected sterile filtration, serial dilutions, and recognition of symbols knowledge and skills. Twenty-five percent (25%) of respondents selected gel electrophoresis knowledge and skills. Seventeen percent (17%) of respondents selected chemical synthesis, lyophilization, and DNA Sequencing knowledge and skills. Eight percent (8%) of respondents selected pressure measurement and flow measurement knowledge and skills. Seventeen percent (17%) of respondents indicated that general laboratory skills do not apply. Survey participants were allowed to choose more than one response.

### Culture Techniques



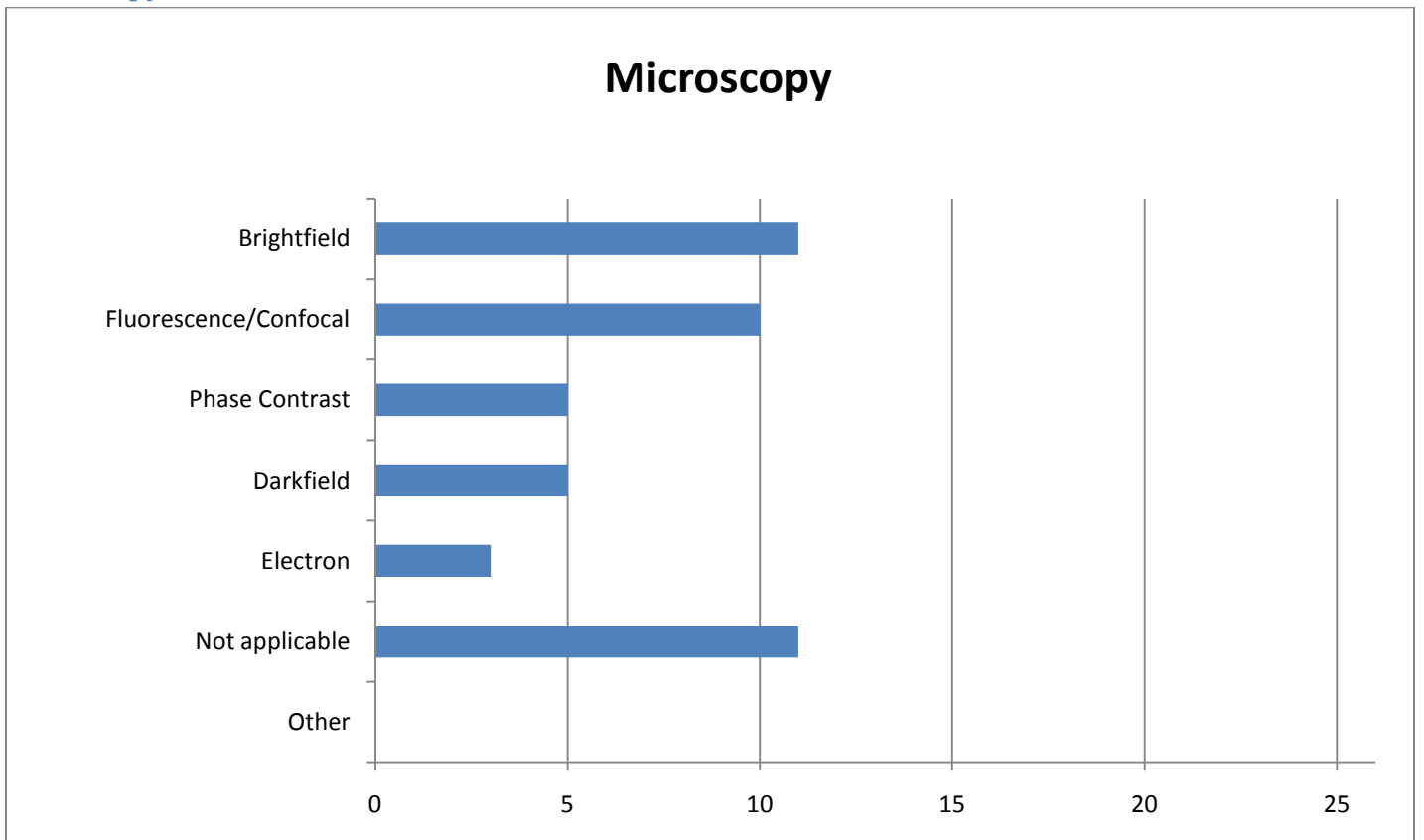
Forty-six percent (46%) of respondents selected bacterial culture knowledge and skills. Thirty-three percent (33%) of respondents selected human cell/tissue culture knowledge and skills, and 21% of respondents selected yeast culture knowledge and skills. Eight percent (8%) of respondents selected viral culture knowledge and skills, while only 4% of respondents selected hybridoma culture knowledge and skills. No respondents selected plant cloning knowledge and skills. Forty-two percent (42%) of respondents indicated that culture techniques do not apply. Survey participants were allowed to choose more than one response.

## Fermentation



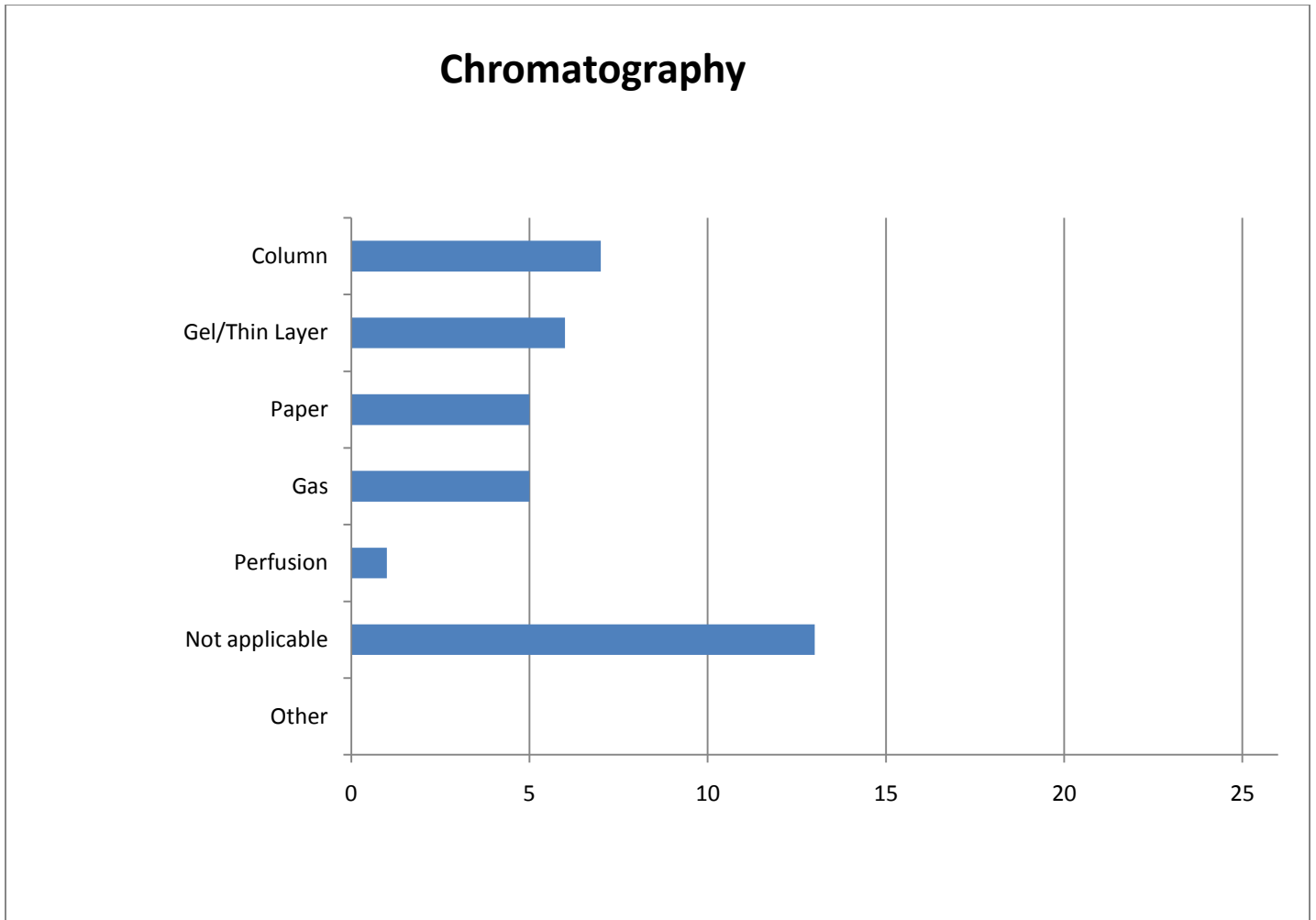
Thirteen percent (13%) of respondents selected harvest equipment knowledge and skills. Eight (8%) of respondents selected bioreactor knowledge and skills. Four percent (4%) of respondents selected spinner flask and large scale fermenter knowledge and skills. Eighty-three percent (83%) indicated that fermentation knowledge and skills do not apply. Survey participants were allowed to choose more than one response.

## Microscopy



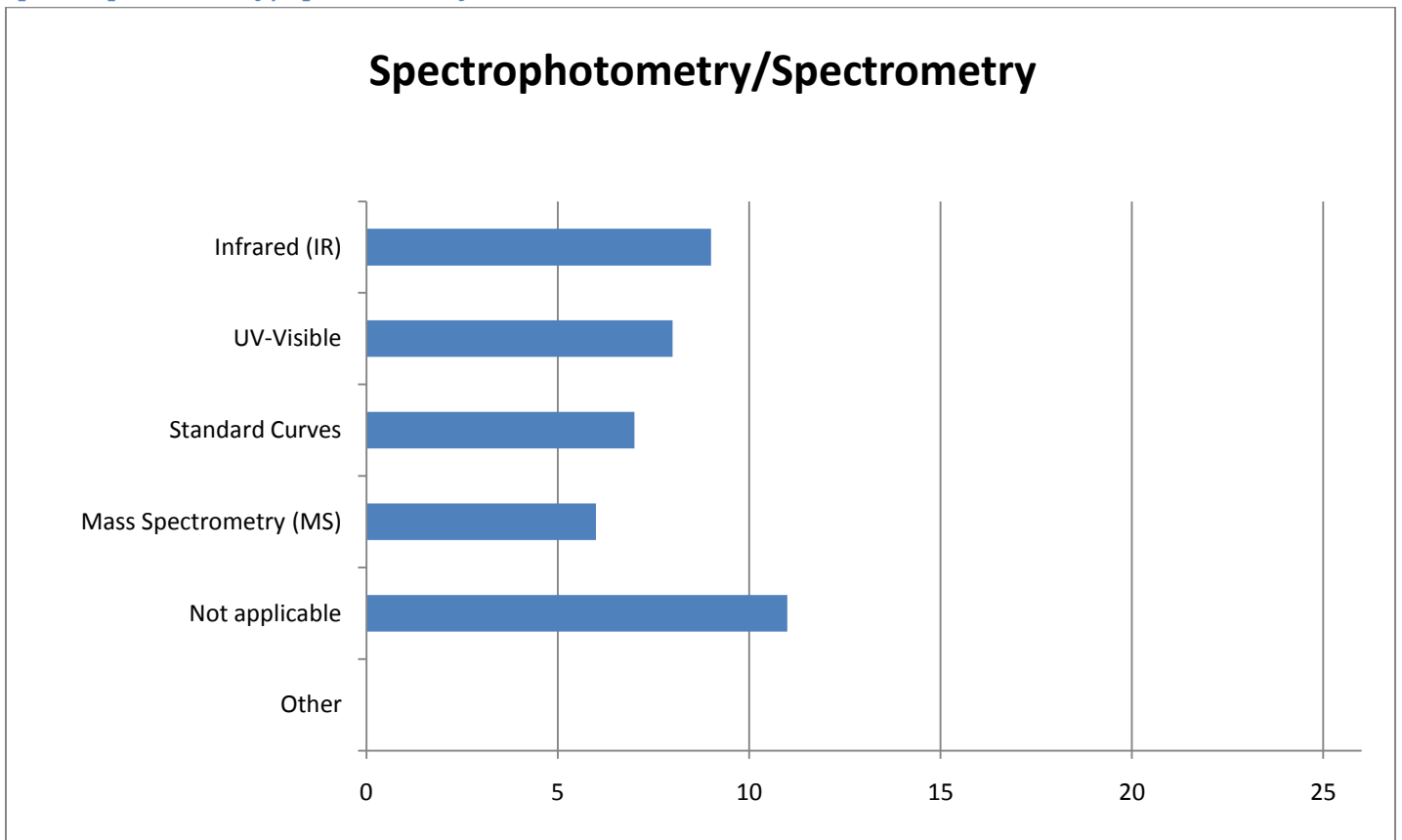
Forty-six percent (46%) of respondents selected bright field microscopy knowledge and skills. Forty-two percent (42%) of respondents selected fluorescence/confocal microscopy knowledge and skills. Twenty-one percent (21%) of respondents selected phase contrast culture knowledge and skills and dark field microscopy knowledge and skills. Thirteen percent (13%) of respondents selected electron microscopy knowledge and skills. Forty-six percent (46%) indicated that microscopy knowledge and skills do not apply. Survey participants were allowed to choose more than one response.

## Chromatography

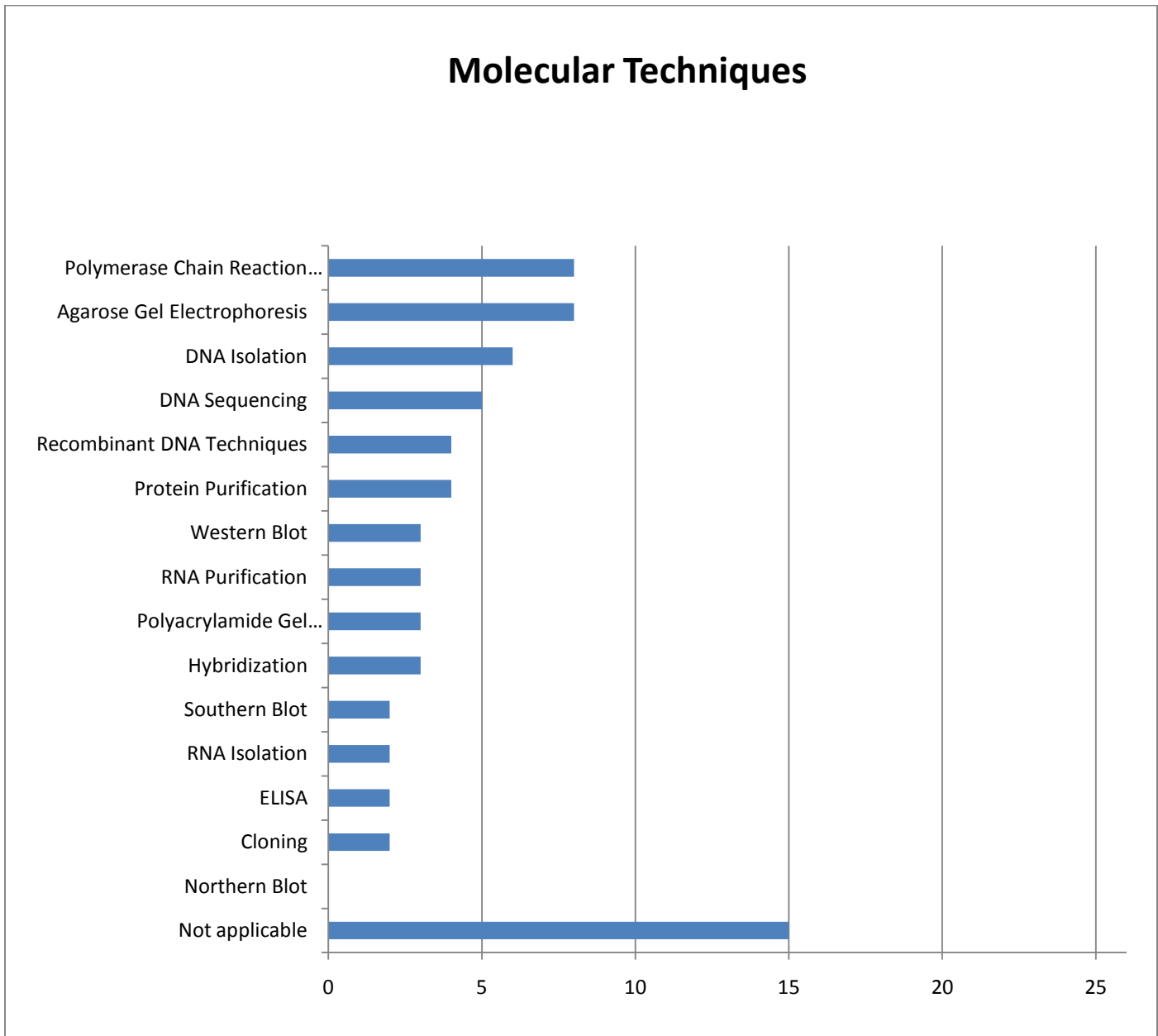


Twenty-nine percent (29%) of respondents selected column knowledge and skills. Twenty-five percent (25%) of respondents selected gel/thin layer, while 21% selected gas and paper chromatography knowledge and skills. Four percent (4%) of respondents selected perfusion chromatography knowledge and skills. Fifty-two percent (52%) indicated that chromatography knowledge and skills do not apply. Survey participants were allowed to choose more than one response.

## Spectrophotometry/Spectrometry

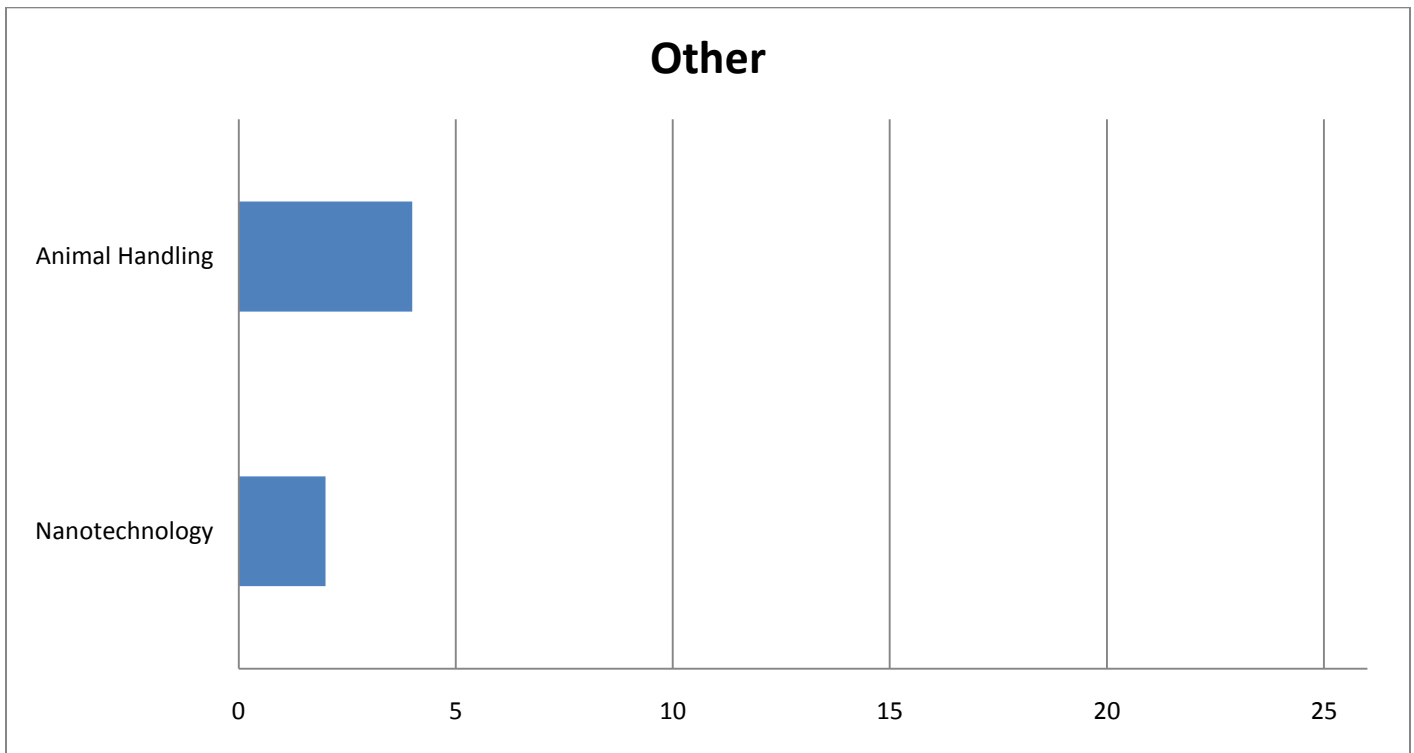


Thirty-eight percent (38%) of respondents selected infrared (IR) knowledge and skills. Thirty-three percent (33%) of respondents selected UV-Visible knowledge and skills. Twenty-nine percent (29%) of respondents selected standard curves knowledge and skills, while 25% of respondents selected mass spectrometry (MS) knowledge and skills. Forty-six percent (46%) indicated that spectrophotometry/spectrometry knowledge and skills do not apply. Survey participants were allowed to choose more than one response.



Thirty-three percent (33%) of respondents selected polymerase chain reaction (PCR) and agarose gel electrophoresis and knowledge and skills. Twenty-five percent (25%) of respondents selected DNA isolation knowledge and skills. Twenty-one percent (21%) of respondents selected DNA sequencing, while 17% of respondents selected recombinant DNA and protein purification knowledge and skills. Thirteen percent (13%) of respondents selected Western Blot, RNA purification, polyacrylamide gel electrophoresis (PAGE), and hybridization knowledge and skills. Eight percent (8%) of respondents selected Southern Blot, RNA isolation, ELISA, and cloning knowledge and skills. No respondents selected Northern Blot knowledge and skills. Sixty-three percent (63%) indicated that molecular knowledge and skills do not apply. Survey participants were allowed to choose more than one response.

## Other



Sixteen percent (16%) of survey respondents selected animal handling knowledge and skills. Eight percent (8%) of survey respondents selected nanotechnology knowledge and skills. Survey participants were allowed to choose more than one response.

## **Types of Skills Which Need Improvement**

Survey participants were asked to identify skills which need improvement among their current employees.

Survey participants indicated that employees with high school degrees needed improved organizational skills and notebook entry skills, as well as improved skills related to manufacturing processes in clean room environment and Good Manufacturing Practice (GMP).

One survey participant indicated that employees with AA/AS degrees need more GMP training.

Survey participants indicated that employees with BA/BS degrees needed improved laboratory, notebook entry, and analytical skills, as well as flow cytometry skills, Good Laboratory Practice (GLP), and OSHA Training. One respondent indicated that holders of the BA/BS degree should have increased familiarity with a wider range of instrumentation, specifically cross training chemists with standard biology assays and biologists with standard chemistry techniques and tools. Other respondents indicated that these individuals should have more practical knowledge, internships, field training, and business skills. Communication skills and increased computer skills such as Microsoft Office (including MS Outlook) were other areas identified as areas that need improvement.

Survey participants indicated that employees with graduate degrees need more thesis experience and animal handling skills, as well as additional GLP and OSHA training. One respondent indicated that business skills are also needed.

## **Currently Unmet Training Needs**

Survey participants were asked to identify currently unmet training needs. One respondent identified OSHA training as an unmet training need. Another respondent indicated that they train their technologists as needed.

## **Industry-Specific Skills Needed by the Workforce of Tomorrow**

Survey participants were asked to identify industry specific skills needed by the workforce of tomorrow. Responses included basic computer competency, increased comfort with computers, laboratory skills, Next Gen sequencing analysis, microarray analysis, GLP practices including notebook entry practices, manufacturing products for sterilization in clean rooms, better understanding of how instrumentation actually works, biotechnology air emissions, and better communication skills.

## Summary

The biotechnology industry, which includes diagnostic and medical laboratories, medical device and equipment manufacturers, pharmaceutical companies, and research and development companies, has established itself in the Tampa Bay region with ample room for growth. Many of the start-up companies identified have found the region to be a good location and expect to be at home and thrive here because of the presence of the University of South Florida (USF), H. Lee Moffitt Cancer Center, and the Tampa Bay Technology Incubator's resources. The responses from this survey indicate that there are a high number of small companies in the region that are in the operational stage. This profile of a large number of small to midsize companies also mirrors that of all manufacturing and production industries in the Tampa Bay area and entire state. The small and/or young companies with 10 or fewer employees also drove the survey response to the tuition reimbursement question. Although these companies benefit greatly from a well educated employee, they can not afford this employee benefit at this time. Slightly less than half of the companies that participated in the survey have internship programs, and over half of those are paid internships.

Collectively, biotechnology is represented in this survey by 26 companies. This survey data reflects the population of pharmaceutical and medical devices in the *Florida's Top 50 Merchandise Exports* list. With respect to these companies and their training delivery mode, many of the companies provide necessary training for employees to stay current with their skills or job requirements. OJT training ranked the highest, followed by classroom and computer/web-based training. Some of these companies are currently reducing "down time" and increase productivity making OJT more attractive and practical since it can be done at the worksite with tools and equipment already in place. It is suitable for developing proficiency skills that are unique to company operations, provides a way to delay the layoff of valued employees, and reduces rehire and retraining expense as the economy slowly recovers. In addition, it also circumvents the issue that many of the skills and knowledge needed to perform specific duties are not taught in traditional educational programs. With respect to the types of training needed, technical training ranked the highest, followed by quality and regulatory training including GLP, GMP, ISO, and OSHA.

Survey participants were asked to select technical job categories within their organization. Research and development, followed by QA/QC and production were ranked highest on the list. The majority of participants selected multiple categories, with nearly each category having a greater than 50 percent participant selection. These categories show the demand for employment and technical education to support these employment specifications. Furthermore, correlating this information with the current need for training supports the importance for keeping relevant educational programs that provide the necessary knowledge and skills needed to be successful in these companies. Although OJT is necessary to train new employees in specific practices, courses that offer more relevant, real-world training could improve the quality of job candidates and reduce time and cost incurred for these companies to train new employees.

Survey participants were also asked to select job functions within their organization. Their response indicated that the laboratory technician ranked the highest. The scientist, QC technician, and chemist functions were placed high on the list to indicate their significance in the biotechnology industry. Furthermore, job functions in microbiology, laboratory technology, manufacturing and engineering all had similar frequencies of selection. This data supports the need for a variety of educational and training programs that support and predict the demands of the industry. As the biotechnology industry grows, the demand for such jobs as technicians, technologists, scientists, and engineers will increase. As this demand rises, so will the mandate for educational programs to support them. These functions have important implications on the availability of programs within the region and their future needs as the industry expands.

The highest ranking workforce skill requirement was computer-related skills. General lab skills and chemistry were the second highest ranking, followed by microscopy, safety, and general education. Competency in how to operate a

computer is an important criterion undoubtedly due to its integration into job functionality. However, laboratory knowledge and practical skills are equally important and span a wide variety of skills and levels of importance. General education in a multitude of laboratory settings serves to support the demand for these skills, while providing more specific opportunities to develop precise skill sets are equally as important. In depth training is critical for entry-level employees to be competitive in today's job market and is supported by the survey findings.

This survey also drilled down into the specific knowledge and skill sets required of entry-level technicians. These results are a strong indicator that additional educational and training programs will be required in the future at several levels.

Survey responses varied among the ten general categories of knowledge and skill sets required by entry-level technicians, but several priorities were identified. As previously mentioned, computer-related skills are important, and specific entry-level skills in spreadsheets and word processing are the highest priorities. An understanding of material safety data sheets (MSDS), common lab hazards, and safety procedures had the highest degree of responses. There were a multitude of important general lab skills for entry-level technicians. Weighing and pH determination techniques were the most significant. However, several non-science skills were also seen as important, such as scientific notebook entry, clean room procedures, and work area organization. Although specific lab requirements varied in range of applicability, knowledge in bacterial culture, bright field and fluorescence microscopy, and spectroscopy and molecular techniques were seen as important. Good Manufacturing Practice (GMP) ranked the highest in terms of regulatory knowledge and skills, followed by GLP and ISO. Additional training in these three areas would greatly benefit entry-level technicians and their potential employers.

Feedback from the survey participants indicates that biotechnology degree programs need to be implemented in the Tampa Bay area to fill the gaps in workforce needs. Not only do more biotech programs need to be created but also specific skill sets such as general and specialized laboratory experience, regulatory, safety, mechanical, manufacturing, communication, and computer skills need to be addressed as part of future curriculum development. This will provide the necessary education to ensure a skilled and proficient labor pool that is ready to enter or re-enter the biotechnology workforce.

## Appendix

### Appendix 1 – Survey Respondents and Classifications

Company	City	Classification
Agile Genetics	Tampa	Diagnostic & Medical Laboratories
All Children’s Hospital	St. Petersburg	Diagnostic & Medical Laboratories
Genzyme Genetics Tampa	Tampa	Diagnostic & Medical Laboratories
Bausch and Lomb	Tampa	Drugs & Pharmaceuticals
CoreRx	Tampa	Drugs & Pharmaceuticals
DCI Biologicals Temple Terrace	Tampa	Drugs & Pharmaceuticals
Thar Pharmaceuticals	Tampa	Drugs & Pharmaceuticals
Intezyne Technologies	Tampa	Drugs & Pharmaceuticals Research & Development
ALPS South	St. Petersburg	Medical Devices & Equipment
Anodyne Therapy	Tampa	Medical Devices & Equipment
BioDerm	Largo	Medical Devices & Equipment
ConMed Linvatec	Clearwater	Medical Devices & Equipment
CorinUSA	Tampa	Medical Devices & Equipment
KeriCure	Tampa	Medical Devices & Equipment Research & Development
NDH Medical	St. Petersburg	Medical Devices & Equipment
Tampa Bay Research Institute	St. Petersburg	Research & Development
DCA Systems	Tampa	Research & Development Other (HVAC Homeland Security)
Saneron CCEL Therapeutics	Tampa	Research & Development Other (Cellular Therapy)
Biodyne	Sarasota	Other (Environmental Biotechnology)
Cryo-Cell International	Oldsmar	Other (Cellular Therapy / HCTP)
Life Sciences Advanced Technologies	St. Petersburg	Other (Enzyme & Reagent Manufacturer)
Magellan BioScience Group	Tampa	Other (Microbial Biotechnology)
MTS Medication Technologies	St. Petersburg	Other (Manufacturing)
Natura Therapeutics	Tampa	Other (Nutritional Products)
Nulab	Clearwater	Other (Nutraceutical)
VLOC	New Port Richey	Other (Manufacturing)

## Appendix 2 – Survey

Industry Name  
Date

Representative  
Title

Phone  
Email

**Please complete the following survey by selecting ALL that apply to your organization.**

### Industry Sector

- Drugs & Pharmaceuticals
- Medical Devices & Equipment
- Diagnostic & Medical Laboratories
- Research & Development (R&D)
- Other

### Do You Have Tuition Reimbursement?

Yes  No

### Do You Have an Internship Program?

Yes  No

If Yes, Is Internship Paid?

Yes  No

### Education Requirements & Preferred Percentage

- High School \_\_\_\_\_%
- Technical School \_\_\_\_\_%
- Associate's Degree \_\_\_\_\_%
- Bachelor's Degree \_\_\_\_\_%
- Graduate+ \_\_\_\_\_%
- Professional Certifications/Lic \_\_\_\_\_%
- Training Certificates \_\_\_\_\_%

### Technical Job Categories

- Analysis
- Production
- Quality Assurance/Quality Control (QA/QC)
- Research & Development (R&D)
- Technical Support
- Other \_\_\_\_\_

### Computer-Related Knowledge and Skills for Entry-Level Technicians

- Database
- Electronic Medical Record (EMR) Software
- Laboratory Information Management System (LIMS)
- Programming
- Spreadsheets
- Word Processing
- Other \_\_\_\_\_

### Market Base

- Local
- Statewide
- Regional
- National
- International

### Training Practices

- In-House
- Consultant/  
Vendor
- None

### Job Functions

- Biologist
- Botanist
- Chemist
- Ecologist
- Engineer
- Environmental Technician
- Field Technician
- Internal Support Technician
- Laboratory Technician
- Laboratory Technologist
- Manufacturing Technician
- Microbiologist
- Phlebotomist
- QC Technician
- Scientist
- Other \_\_\_\_\_

### Company Stage

- Start-up
- Development
- Operational

### Training Delivery Modes Available

- Classroom
- Closed-Circuit TV (CCTV)
- Computer/Web-Based
- On the Job Training (OJT)
- College/University

### # Years in Existence

- ≤ 5
- 6-10
- 11-15
- 16-20
- 21-25
- 26-30
- 31-40
- 41+

### Total Workforce (Part- & Full-Time)

- 1-10
- 11-20
- 21-30
- 31-40
- 41-50
- 51-100
- 101-150
- 151+

### Types of Training Currently Needed

- Technical
- OSHA/Safety
- Quality Assurance
- Regulatory
- Other \_\_\_\_\_

### Workforce Skill Requirements

- Chemistry
- Chromatography
- Computer Related
- Culture Techniques
- Fermentation Technology
- Flow Cytometry
- General Education
- General Lab Skills
- Microscopy
- Molecular Biology Techniques
- Nanotechnology
- Safety
- Spectrophotometry
- Other \_\_\_\_\_

Industry Name  
Date

Representative Name  
Title

Phone  
Email

**Please select ALL that apply for entry level technicians.**

**General Lab Knowledge & Skills**

- Aseptic Techniques
- Autoclaving
- Chemical Synthesis
- Clean Room Procedures
- Common Lab Bench Procedures
  - Centrifugation
  - Gel Electrophoresis
  - Media Preparation
  - Micropipetting
  - pH Determination
  - Pipetting
  - Reagent Preparation
  - Serial Dilutions
  - Sterile Filtration
  - Weighing
- Flow Measurements
- Lyophilization
- Molarity Calculations
- Pressure Measurement
- Recognition of Symbols
- Scientific Notebook Entry
- Work Area Organization
- Other \_\_\_\_\_

**Culture Techniques Knowledge & Skills**

- Bacterial Culture
- Human Cell/Tissue Culture
- Hybridoma
- Plant Cloning
- Viral Culture
- Yeast
- Other \_\_\_\_\_

**Fermentation Technology Knowledge & Skills**

- Bioreactor
- Harvest Equipment
- Large Scale Fermenter
- Spinner Flask
- Other \_\_\_\_\_

**Microscopy Knowledge & Skills**

- Brightfield
- Darkfield
- Fluorescence/Confocal Electron
- Phase Contrast
- Other \_\_\_\_\_

**Chromatography Knowledge & Skills**

- Column
- Gas
- Gel/Thin Layer
- Paper
- Perfusion
- Other \_\_\_\_\_

**Spectrophotometry/Spectrometry Knowledge & Skills**

- Infrared (IR)
- Mass Spectrometry (MS)
- Standard Curves
- UV-Visible
- Other \_\_\_\_\_

**Other Knowledge & Skills**

- Animal Handling
- Nanotechnology
- Other \_\_\_\_\_

Industry Name

Representative Name

Phone

Date

Title

Email

**Please select ALL that apply for entry level technicians.**

**Molecular Knowledge & Skills**

- Agarose Gel Electrophoresis
- Cloning
- DNA Isolation
- DNA Sequencing
- ELISA
- Hybridization
- Northern Blot
- PAGE
- Polymerase Chain Reaction (PCR)
- Protein Purification
- Recombinant DNA Technologies
- RNA Isolation
- RNA Purification
- Southern Blot
- Western Blot
- Other \_\_\_\_\_

**Safety Knowledge & Skills**

- Common Lab Hazards
- Experience with BSL-2
- Material Safety Data Sheets (MSDS)
- Proper HazMat Handling
- Radiological Techniques
- Recognize Safety Symbols
- Safety Procedures
- Use of Personal Protective Equipment
- Other \_\_\_\_\_

**Regulatory Knowledge & Skills**

- College of American Pathologists (CAP)
- Clinical Laboratory Improvement Amendments (CLIA)
- Good Laboratory Practice (GLP)
- Good Manufacturing Practice (GMP)
- Institutional Animal Care and Use Committee (IACUC)
- International Organization for Standardization (ISO)
- Other \_\_\_\_\_

**Future Workforce Skills**

**Are there industry-specific skills needed by the workforce of tomorrow?**

- Yes  No

If Yes, Please Explain \_\_\_\_\_

**Key Industry-Specific Skills for Current Employees That Could Use Improvement**

**Please indicate what type of skills need improvement among employees with:**

- High School Degree Please Explain \_\_\_\_\_
- AA/AS Degree or Certificate Please Explain \_\_\_\_\_
- BA/BS Degree Please Explain \_\_\_\_\_
- Graduate Degree Please Explain \_\_\_\_\_

**Do you have any currently unmet training needs?**

- Yes  No Please Explain \_\_\_\_\_

## End Notes

1. Milken Institute. Biopharmaceutical Industry Contributions to State and U.S. Economies, October 2004.
2. Milken Institute. Florida Life Sciences Road Map, June 2007.
3. Milken Institute. State Technology and Science Index 2010: Enduring Lessons for the Intangible Economy, January 2011.
4. Enterprise Florida. [http://www.eflorida.com/Life\\_Sciences](http://www.eflorida.com/Life_Sciences)
5. Florida High Tech Corridor. <http://www.floridahightech.com>
6. The U.S. Food and Drug Administration. <http://www.fda.gov>
7. Tampa Bay Technology Incubator. <http://www.usfconnect.org/Incubator.asp>
8. University of South Florida Research Park. <http://isis.fastmail.usf.edu/researchpark>
9. Tampa Bay Innovation Center. <http://www.startecflorida.com/programs>
10. University of South Florida Downtown Center. [www.outreach.usf.edu/conted/downtown](http://www.outreach.usf.edu/conted/downtown)
11. University of South Florida Polytechnic Blue Sky. <http://usfpbluesky.com>