

# Impacts of COVID-19 on the Work Environment of Professional Workers: Implications for Educators & Human Resource Managers<sup>1</sup>

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## ABSTRACT

The impact of COVID-19 on the work environments of professional employees was evaluated during the first six months of the pandemic. In order to isolate the work environment effects, survey participants were employed in biotech firms whose business operations were less severely affected by the pandemic. A survey was administered with 156 respondents representing a range of jobs and experience. Results were analyzed using qualitative and text mining approaches. Impacts differed according to a respondent's job type and experience. The number of positive comments addressing the impacts of COVID-19 on the work environment was 22-29% higher than the negative comments. Human resource managers can use the results to enhance their hiring and training processes, job enrichment and communication practices, and remote working technologies. Educators can use the results to better prepare students for the competitive job market by requiring remote collaboration in their courses.

## 1. Introduction

The nature of work has constantly evolved over time. This evolution has many causes, such as technological advances (e.g., the invention of the computer, the establishment of the internet), economic realities (e.g., shifts from manufacturing to services in developed countries), and demographic shifts (e.g., due to immigration, birth rates, etc.). At times, disruptive events have resulted in dramatic shifts in how work is done. Most of these events are regional or national - such as the Industrial Revolution in the West (circa 1760), the dissolution of communist's states in Eastern Europe (circa 1989), and the implementation of free market reforms in China (circa 1979). Other disruptive events have global impacts - such as World War II (circa 1939), the Great Depression (circa 1929), the Spanish flu pandemic (circa 1918), and lately the COVID-19 pandemic (2020-2021).

COVID-19 has presented several challenges for workers and their employers. The almost instantaneous change from an on-site office workplace to a remote work environment was not unprecedented. However, the indefinite and long-term nature of this change was unprecedented. For some employees, long-term remote work increased the usual conflicts between work requirements and family demands, such as child and elder care. For Human Resources Management (HRM) practitioners, long-term remote work amplified the importance of integrating

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work requirements and remote interfacing information technology (IT). They were tasked with ensuring that teleconferencing and other communication services were reliable and that workers were trained in their effective use. After experiencing these realities, it is natural for an HR manager to wonder how future decisions, ranging from job description documentation and recruiting to talent management, would need to be adjusted so that their firms maintain an agile workforce whose members have the ability to transition seamlessly between physical and remote work environments.

This article aims to provide insight on how the COVID-19 pandemic needs to inform the integration of higher education, human resource practices, and work force management policies. It focuses on the work environment of professional employees in biotechnology and pharmaceutical firms (for brevity, these firms will be referred to as biotech in the remainder of this article). By implementing a comprehensive survey of biotech employees across a range of jobs, it seeks to understand impacts over the first six months of the pandemic. The synthesis of the survey results is evaluated from the perspective of human resource professionals and educators. The results can be valuable for an HR manager who needs to recruit and train new workers effectively, and help create and manage workplace rules and policies. Educators can use the results to better prepare students for the competitive job market by incorporating new approaches in their lectures, discussions, and assignments.

The biotechnology and pharmaceutical industry was selected because its business was not as severely affected by the pandemic as other industries, as evidenced by continued steady job growth in the United States (Philippidis, 2020). Although this paper focused on biotech workers, the results should be relevant for most professional workers because many professional jobs have similar characteristics across industries. Many of the targeted survey participants were members of professional groups that were located in or about Boston (Massachusetts), where 18 of the 20 largest biopharma firms have a presence. In addition, Boston and nearby Cambridge rank first in National Institutes for Health funding, venture capital funding, and laboratory space (Massachusetts Biotechnology Council, 2020). Therefore, the analysis will address work environments while minimizing biases associated with the COVID-19 impact on workers' employers.

This paper is organized as follows. Conceptual background is provided that frames the current work in the context of previous research, which supports the notion that workforce changes are both evolutionary and revolutionary. Then, the methodology is described, focusing on the development of a survey and the analysis of results, which include statistical routines and text mining applications. Next, the results are provided from the integration of quantitative and qualitative approaches that support and confirm the accuracy of each method. Finally, a discussion provides insights that will achieve the aims set forth for this work. In this section, recommendations are made regarding HRM practices, workforce management policies, and university curricula and pedagogy.

## **2. Conceptual Background**

This work is designed to build upon relevant knowledge from past research and practice. It spans four research streams: the biotech operating environment (2.1), the evolving workforce (2.2), the impacts of external events on work environments (2.3), and methods for analyzing survey results (2.4). Each of these research streams is discussed in the remainder of this section.

### **2.1 The Biotech Operating Environment**

Most professional employees in biotech are scientists, engineers, technicians (and their managers and support staff), who study and experiment with living organisms to develop products that add value for mankind (Shackelford & Moris, 2016). Similarly, Alshawi (2003) described the

intellectually-oriented process flows that constitute most pharmaceutical business activities, including hypothesis-generation, discovery research, clinical trial development, and marketing authorization from regulatory authorities. The management of tangible pharmaceutical process flows (e.g., procurement, manufacturing, packaging, labeling, and distribution) are also coordinated by the types of knowledge workers found in any global supply chain (Bielmeier & Crauwels, 2012). Hence, performance of biotech and pharmaceutical firms is especially linked to the knowledge of the workforce (Zbucnea, Pînzaru, Busu, Stan, & Bârgăoanu, 2019).

From 2015 through 2019, biotech employment in the U.S. grew by about 7% to a total of 296,900 and employment growth is expected to continue its positive trend through 2024 (IBIS World, 2020a). During this same period, total annual biotech wages increased from \$29.0 billion to \$30.1 billion (IBIS World, 2020b). In 2019, about half of all biotech workers were female, although 16% of biotech CEOs were female (Center for Talent Innovation & Biotech Innovation Organization, 2020; Hodgson, 2020). This discrepancy motivated the desire to account for gender in the analyses described below.

Although this research concerns work environments, it is interesting to note that the knowledge and skill requirements of the biotech workforce are changing because of technology and application enhancements. There is increased demand for workers knowledgeable in biochemistry, molecular biology and cell culture, and those with skills to perform sophisticated research (Huxley, 2006). In addition, communication, teamwork, and technological skills have become essential, as well as a multidisciplinary educational foundation (Conicella, Albo, & Dayon, 2015).

## **2.2 The Evolving Workforce**

Workforce evolution is an essential topic for society that affects production, industry development, and economic growth. The year 2020 will likely be considered a watershed moment in this regard, although an evolution was already in process. Frazis (2020) noted that, since 2003, workplace changes have been taking place with an increasing tendency for telecommuting and work-from-home (WFH). This trend, with its associated video conferencing technologies and platforms advances, is a global phenomenon especially in developed countries (Pirc, 2018). Similar increases will also take place in many developing countries that are moving towards universal internet access (Lia, Gina Wong-Wylie, Gwen, & Cook, 2020). During the COVID-19 pandemic period, several video conferencing applications existed for workers and researchers to choose from, including Zoom, Zoho Meeting, Google Hangouts Meet (Lia et al., 2020). WFH for biotech workers had been increasing accordingly (Mena, 2003).

Other business model adjustments (e.g., outsourcing and crowdsourcing) are impacting productivity measurement, in particular the move towards measuring output rather than hours worked (TNS Global Firm, 2012). This trend should continue as it becomes harder to measure working hours for WFH employees. In addition, the qualifications necessary for the workforce to cope with crises will be valued during recruitment and hiring. Educational institutions should pay attention to this trend, by modifying curricula and pedagogy to better meet the needs of industry, employers, and local communities (Jacobs & Worth, 2019). Finally, preparing the workforce for managing digital information will be an important educational component (National Research Council, 2015). These tendencies motivated the analysis of preparedness for the current and future workforce.

## **2.3 Impacts of External Events**

External events affect personal-environment (P-E) fit, defined as the match between the worker's compatibility and their work environment (Kristof-Brown & Guay, 2011), or similarly as the level of congruence between the worker's attributes and their work environment (Kristof,

1996). P-E fit will often be impacted when external events are especially disruptive (Follmer, Talbot, Kristof-Brown, Astrove, & Billsberry, 2018). In this regard, the application of stress-management skills, such as cognitive behavioral therapy, has been shown to have a positive effect on workers' well-being (Blonk, Brenninkmeijer, Lagerveld, & Houtman, 2006). Other positive impacts on workers' well-being were found to be exercise, time flexibility, the ability to apply one's skills to their work, social support from others, and the application of stress-management approaches (Stephan, 2018).

For analyzing COVID-19 impacts, Carnevale and Hatak (2020) suggest that insights can be gained from how entrepreneurs deal with disruptive workplace challenges. Entrepreneurs embrace autonomy in their work which would appear to make them immune to disruptions that may impact other less-robust workers. Brought inside the corporation, these "intrapreneurs" may have a better and more stable work engagement over time (Gawke, Gorgievski, & Bakker, 2017). Managers may need to be aware of job traits that entrepreneurs favor because, for example, more focused jobs would match the entrepreneurship personality better than broadly focused jobs (de Jong, Jeroen, Parker, Wennekers, & Wu, 2015). The impact of pandemics on entrepreneurs has not been studied, although previous research on workplace disruptions have tended to focus on health issues or natural disasters that were personally traumatic (Stephan, 2018).

Work-life conflict, defined as "a form of inter role conflict in which the role pressures from the work and family domains are mutually incompatible in some respect," will also be impacted by additional WFH (Greenhaus & Beutell, 1985). One would expect this conflict to be exacerbated by increases in WFH unless the ability to plan childcare or adjust other familial responsibilities is managed (Giurge & Bohns, 2020). Organizations have shown interest in creating family-friendly work environments by providing services that include flexible work arrangements and on-site child care (Neal, Chapman, Ingersoll-Dayton, & Emlen, 1993). Surveying 454 professional-level employees, Golden, Veiga, & Simsek (2006) concluded that these practices were especially helpful for WFH employees. Organizations can provide additional support mechanisms to their employees during crises, ranging from health and safety updates to training opportunities that help employees adapt to changing work environments (Carnevale & Hatak, 2020). The survey that was initiated in this study was open-ended so that participants could express the need for such services to help them deal with the disruptive changes in their work and family life.

## **2.4 Survey Analysis Methods**

An effective analysis of survey data extracts meaningful insights in an unbiased manner (Liao & Hsieh, 2017). The intent is to avoid intuitive thinking (Kahneman, 2003) in favor of more reasoned logic (Bazerman, 2013). The survey employed below uses ordinal and nominal scales, supplemented with many opportunities for open-ended comments. Ordinal data can have great power for detecting relevant trends of an explanatory variable on the response variable (Agresti, 2012); nominal data is the natural way for people to report actions or opinions (Weiss, 2009). The analysis methodology will extract and categorize information while providing estimates of magnitude associated with the various categories. Affinity approaches are used to consolidate disparate information into categories without pre-determining the categories (Northcutt & McCoy, 2004).

Text mining is also employed for analyzing the qualitative (i.e., free text) information that is not affected by the human bias that can accompany affinity approaches. These approaches have been successfully applied in many environments, including criminal detection and social media content (Heimann & Danneman, 2014). Free text responses can provide more diverse explanations of respondents' experience than the numerical counterparts. For example, free text responses can help explain why certain nominal choices were made (Jackson & Trochim, 2002). Survey text

analysis is often done manually (Roberts et al., 2014), which tends to be biased or time consuming (Grimmer & Stewart, 2013). Automated text analysis routines do not suffer from human bias or inconsistency (Chai, 2019). These routines were employed in the analysis below, including word frequency analysis (Shmueli, 2020) and sentiment analysis (Silge & Robinson, 2017).

### 3. Methodology

A survey was designed and created to capture information from a large number of biotech employees. It is shown below, along with a discussion of the methods used for its analysis.

#### 3.1 Survey Design

The survey included questions that were designed to evaluate the operational and work environment of a typical biotech worker. The questions included a mix of quantitative and qualitative questions that focused on the worker as an essential resource within a business process. The business processes were expected to vary by individual. Most of the questions asked about specific impacts on jobs and work environments. Open-ended questions also asked for recommendations for the education of future workers to prepare them for the post-pandemic work environment.

The survey was designed to require about 10-15 minutes to complete in a comprehensive manner. The survey questions pertaining to jobs and work environment are shown in Figure 1. The on-line survey was distributed to members of biotech professional organizations located mainly in the northeastern region of the United States. Respondents were given a \$10 gift card for completing the survey; the identity of each respondent was verified. In addition to these questions, each respondent was asked to identify their company, the status of their firm (startup or mature), their job title, their gender, their location, and the number of years of work experience they possessed.

Question	Format
How has your job been affected by the COVID-19 pandemic?	Rate and Describe
What are the main negative impacts of COVID-19 to your professional work environment?	Rate and Describe
Do you anticipate any positive impacts of COVID-19 to your professional work environment?	Rate and Describe
What changes have occurred in the operations of your company during the pandemic and how has this affected your job?	Rate and Describe
How much more time do you spend working remotely during the pandemic; describe the transition to remote working?	Rate and Describe
To help us educate students, what skills do professionals in your field need going forward in light of the events of the past several months?	Free text responses
Please provide any other comments, information resources, or other references that you believe would be helpful in this effort.	Free text responses

Figure 1: Survey Questions

#### 3.2 Analysis Methods

The analysis of survey results used a variety of qualitative and quantitative analytical methods, using a construct described in Figure 2. Thematic analysis methods are used to find common themes in a set of qualitative data; a common approach is affinity mapping. For each

qualitative survey question, the authors summarized each comment using consistent terminology (e.g., “Zoom,” “Microsoft teams” and “Teleconferencing” all refer to a means of communicating remotely). Then, each summarized statement was combined into common categories, based on summarized comments having a common focus, intention, or meaning. The benefit of this approach is that categories are not defined in advance, minimizing analyst bias. Visualizations were created that convey the frequency of responses for each qualitative category determined by the affinity approach.

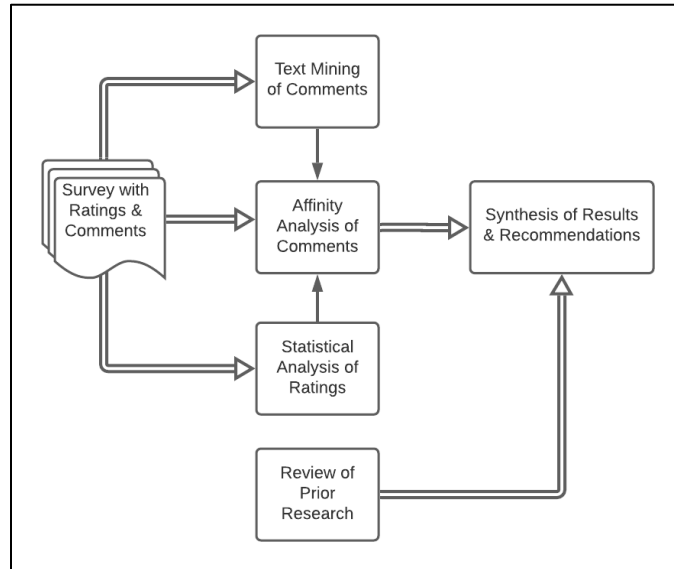


Figure 2: Analysis Construct

MINITAB software was used to perform most of the statistical analyses for ordinal and nominal responses. Because most responses were categorical, the main method employed was to determine significant differences in impact across respondents’ characteristics, such as their job title, years of experience, location, and company status. Chi-square tests were used for this analysis, where some categories were combined to achieve a suitable sample size in each category (e.g., no impact and minimal impact were combined). In the results section below, p-values are shown for each statistically significant effect. A p-value conveys the statistical likelihood that results are random; hence smaller values will occur when the factors analyzed affected a work environment differently.

### 3.2.1 Text Mining

Text mining methods (word frequency analysis and sentiment analysis) were also used to analyze the survey’s free text information. The word frequency analysis included single word counting and bigram counting, where the frequency of word pairs (i.e., consecutive words) are counted. These analyses, performed using R software, can provide additional insight. They were used to confirm that the conclusions drawn using the chi-square and affinity analyses were valid. Because they used automated routines that were void of human bias, they provide an effective counter to the affinity approach that can be biased by the opinions or emotions of the analysts.

The procedure used in the word frequency analysis is illustrated in Figure 3, which includes the R functions used during the various steps. The first step is to extract raw text data and then to clean up the text data to remove irrelevant and special characters. The second step, tokenization, identifies delimiters (e.g., spaces and punctuation) and uses them to separate terms. The third step is preprocessing, which reduces text without losing meaning or predictive power. This step

includes the removal of: (a) words that do not include relevant meanings (e.g., articles, pronouns, auxiliaries, and propositions), and (b) words containing common stems (e.g., home and homes) using a procedure called stemming. The fourth step is to count the frequencies of each word, which is followed by the creation of a visualization (usually a word cloud, which uses font sizes to represent frequencies).

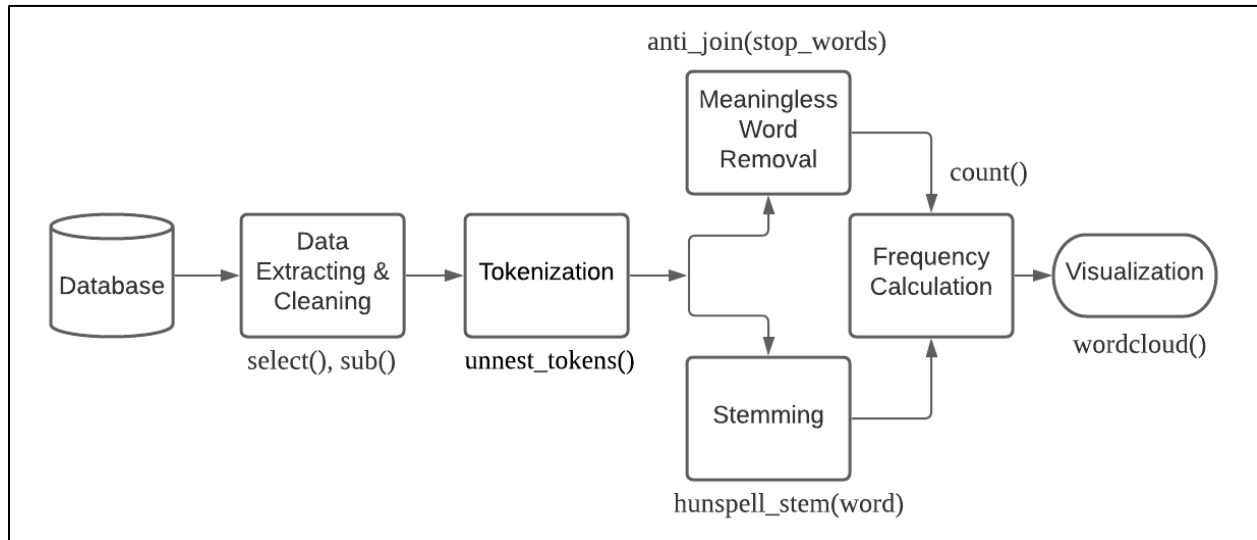


Figure 3: Text Mining: Word Frequency Analysis

Sentiment analysis allows the analyst to quantify the emotional responses of survey participants by scoring each key word based on: (a) categorizing it as positive or negative, (b) rating the strength of its meaning, and (c) counting its frequency of occurrence. Sentiment analysis begins with application of the same data cleaning and tokenization methods described above, which generates a set of word tokens. The word tokens are compared with a large sentiment dictionary, which defines each of its contents as a positive or negative emotion (using the R functions called `inner_join` and `get_sentiment`). Word tokens not found in the dictionary are removed from the analysis, most likely because they are neutral words. Calculations are used to create a weighted sentiment score for each word token based on its sentiment score and frequency. Finally, a visualization is created (using the R function `comparison.cloud`). These results are also visualized as a cloud with font size and colors used to illustrate each word’s positive or negative tendency.

#### 4. Results

The survey was completed by 156 participants, during the period of July 15th through August 20th, 2020. Their work experience ranged from less than one year to 42 years, with a first quartile of 6 years, a median of 14 years, and a third quartile of 25 years. Their jobs encompassed the list shown in Figure 4 (15 participants declined to list their job title).

Respondents’ years of experience varied by job category. The medians were 20 years for program managers and sales staff, 15 years for technical/IT jobs, 7 years for support staff, and 5 years for scientists, as shown in Figure 5. The majority of participants were located in Massachusetts (59.2%). Their employers consisted of startups (28.6%), mature firms (65.6%) and others (5.8%). The mix of genders was 42% female and 58% male. The median time for participants to complete the survey was 652 seconds (10.9 minutes).

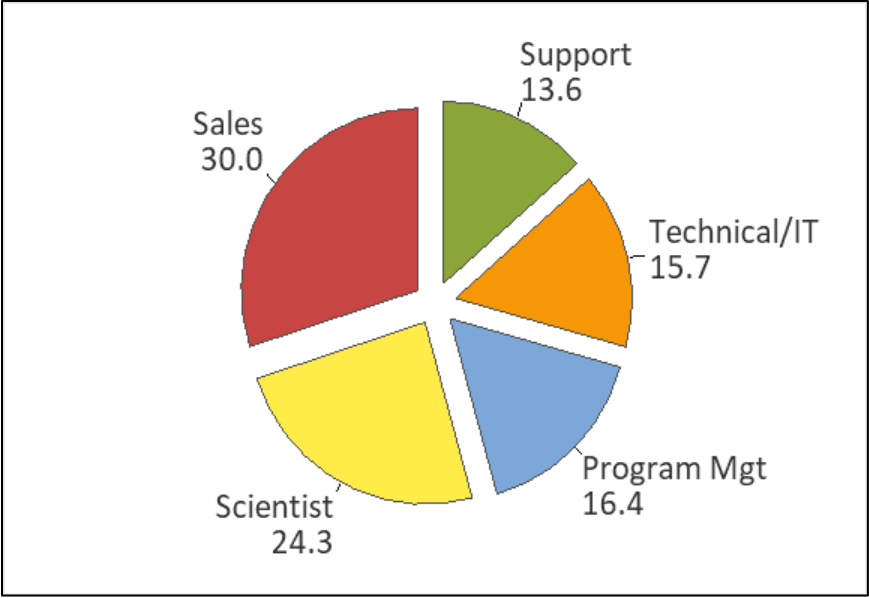


Figure 4: Mix of Job Titles (with Percentage Allocation)

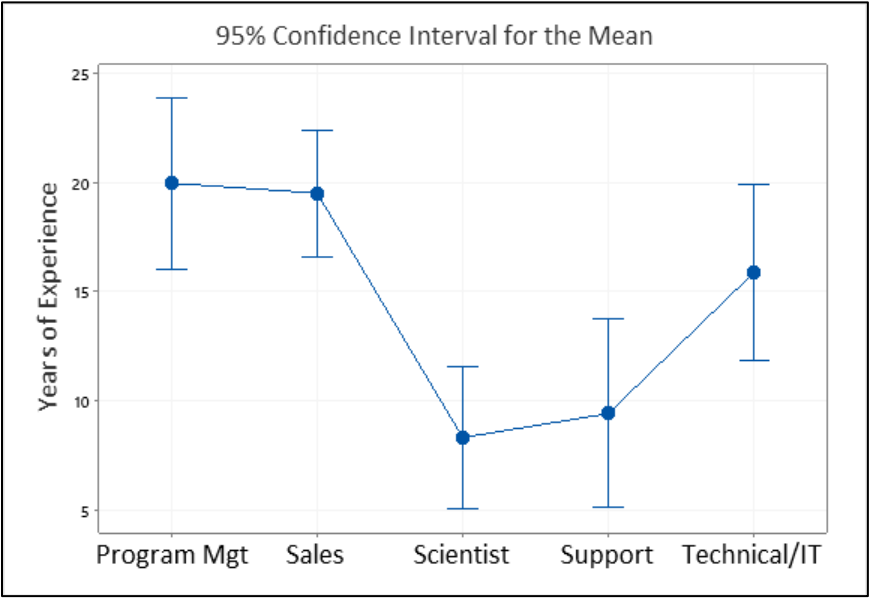


Figure 5: Years of Experience by Job Category

**4.1 Workforce Impacts**

Work environment impacts varied depending on the employee's experience, job type, and company status. There was no significant difference in the impacts on work environment between males and females. Figure 6 shows the relationship of the impact on work environment relative to the years of experience of participants. The impact of the pandemic was directly proportional to the respondents years of experience, with higher impacts on older workers. When comparing workers with 16 or more years of experience with others, the difference is statistically significant (p=0.006).



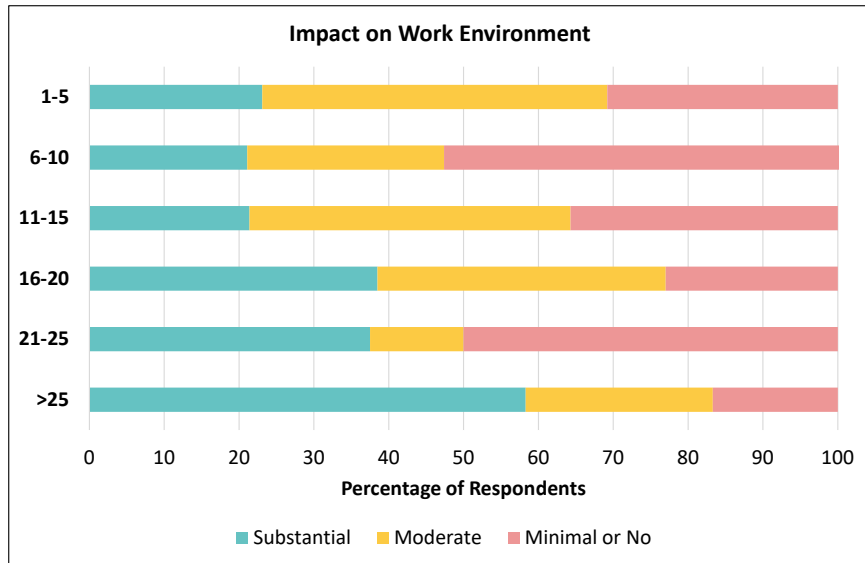


Figure 6: Impact of COVID-19 on Work Environment by Years of Experience

Impacts on work environment also differed by job type as shown in Figure 7 ( $p=0.049$ ), with less impact on those holding jobs categorized as scientists and support staff. Because younger workers held significantly more scientist positions, this effect may be associated with either factor (experience or job type).

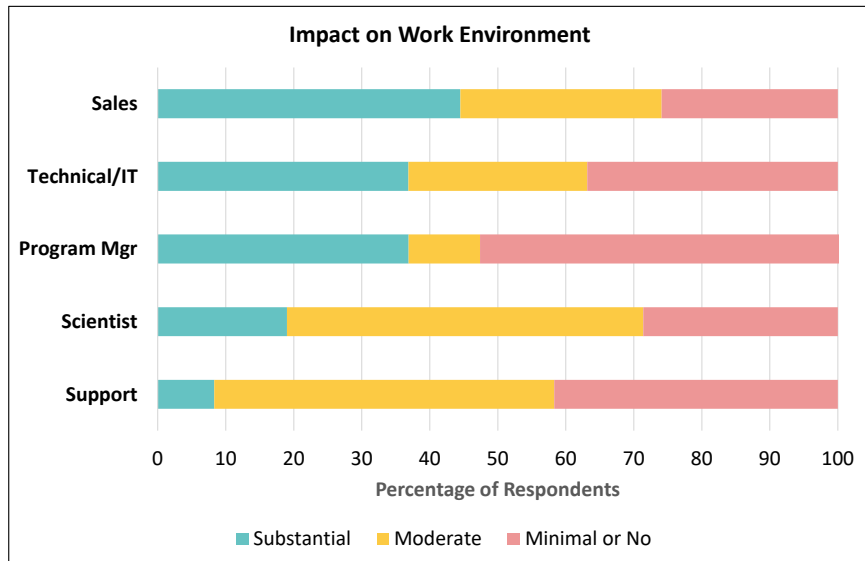


Figure 7: Impact of COVID-19 on Work Environment by Job Type

The impact on work environment also varied by status of employers, with substantial impact noted by 40.0% of workers in startups compared to 31.0% of workers in mature firms ( $p=0.048$ ) – see Figure 8. This result could be due to more startup firms being located in Massachusetts compared to other locations.

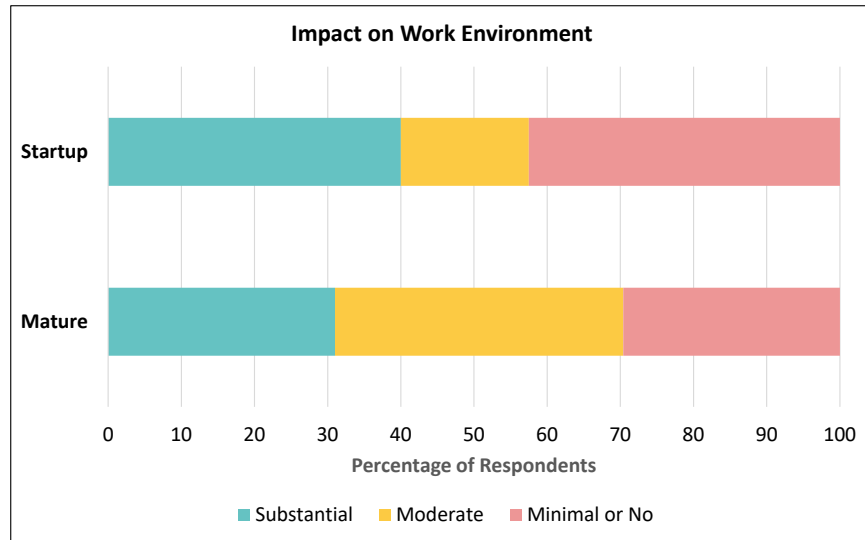


Figure 8: Impact of COVID-19 on Work Environment by Company Status

Qualitative responses concerning impacts on work environment were evaluated using an affinity approach. The results are listed in Table 1. Frequencies associated with each category, in particular the positive or negative reactions of respondents, is analyzed in the next section.

Code	Impact
1-a	More frequent working from home or remotely using teleconferencing
1-b	Save money/time commuting
1-c	Less company travel and outside visits
1-d	Fewer in-person interactions with customers, suppliers, and coworkers
1-e	Availability of technical support & IT infrastructure
1-f	Communication practices and timing
1-g	Work-Life balance issues (e.g., child care, stress, flexibility, productivity expectations)
1-h	Effects on career (e.g., more opportunities, job loss/decreased hours)

Table 1: COVID-19 Impact on Work Environment

#### 4.1.1 Negative and Positive Impacts

Figure 9 shows the magnitude of positive and negative impacts of COVID-19 on the work environment, corresponding to the list shown in Table 1. The bars compare the number of comments made by respondents corresponding to each impact category. In total, the number of comments made regarding positive impacts (126) were about 28.6% higher than comments corresponding to negative impacts (98).

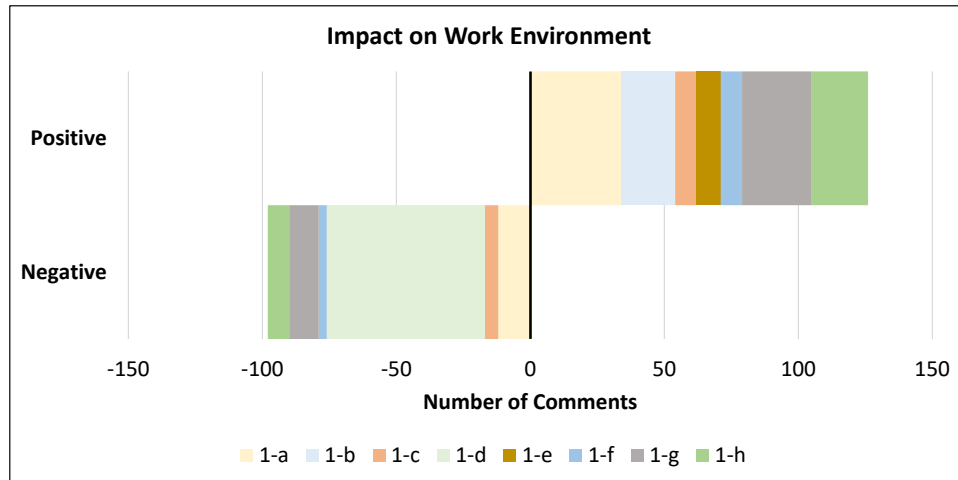


Figure 9: Impact of COVID-19 on Work Environment

The most impactful negative impact was the reduction in the number of in-person interactions (1-d). This category was dominant among the most frequently cited negative impacts. Four categories of positive impacts had similar magnitudes and all were higher than all but one negative impact. Listed in order starting by the highest frequency comments, positive comments were made regarding:

- More frequent working from home or other remote locations.
- Work-life balance benefits, including flexibility and higher levels of productivity.
- Positive effects on careers, including a better sense of fairness for those who have multiple family responsibilities.
- Saving money or time commuting to and from the workplace.

#### 4.1.2 Text Mining Analysis

For the word frequency analysis of impact on the work environment, there are a total 2706 meaningful words after tokenization. After stemming, a total of 902 words with distinct meanings were generated. Figure 10 shows the resulting word cloud, where font sizes are proportional to the frequency of the word's appearance. *Home* was the most frequently used word, appearing almost twice as often as the next highest used words that included *remote(ly)*, *meet(ings)* and *time*. The highest frequency words were consistent with the qualitative analysis.

For the sentiment analysis, 104 words were generated after stemming. The total positive sentiment was 251, while the total negative sentiment was 206. The difference of 45 represents a 21.8% differential in the positive direction. As seen in Figure 11, *difficult*, *hard*, *lack*, and *delay* are the most frequent negative words. These sentiments were consistent with the negative comments analyzed in the affinity method, such as those lack of (and difficulty associated with) in-person meetings. The most impactful positive words were *significant*, *positive*, *effective*, and *flexibility*. These sentiments were consistent with the positive comments analyzed in the affinity method, such as those concerning saving commute time and more flexible working environments.



In summary, the word frequency and sentiment analyses support the conclusions in the affinity analysis. The categories identified by the affinity approach were consistent with the word cloud, and the positive tendency of 28.6% calculated by the affinity method was similar to the 21.8% positive tendency generated by the sentiment analysis. Although the COVID-19 pandemic was an unwelcomed and disruptive event with major global economic implications, there are more positive impacts than negative impacts on the work environments of professional workers.

#### 4.2 Educational Insights

The survey included opportunities for respondents to list and discuss the skills necessary for professionals in their field “in light of the events of the past several months.” The comments were categorized using an affinity approach and their frequencies tabulated. Table 2 provides the summarized list of skills as indicated by survey respondents.

Code	Skills Description
4-a	Ability to work autonomously, while being proactive and disciplined.
4-b	Possess strong soft communication skills (written/oral/etc.)
4-c	Expertise in the implementation of various IT tools for communicating virtually.
4-d	Be flexible in where and how work is done while adapting quickly to new work environments.
4-e	Possess strong time management skills & organize work tasks according to relevant priorities.
4-f	Maintain relationships with colleagues while maintaining a strong professional network.
4-g	Maintain a work-life good balance & a positive attitude, and possess emotional intelligence.
4-h	Be innovative and creative while performing work tasks.
4-i	Have strong data analysis skills and keep abreast of new data analysis developments.
4-j	Be confident and assertive when performing tasks, but ask for help when needed.
4-k	Other skills

*Table 2: Skills Category Code and Skills Description*

A Pareto chart showing the frequency of occurrence for each skill category is shown in Figure 12, using the codes listed in Table 2. The top 4 categories represented about 60% of the total skills listed by respondents. Respondents suggested that individuals entering the workforce should be able to work autonomously, while being proactive and disciplined. They should possess both the IT skills to communicate remotely, as well as the written and oral communication skills to communicate effectively. Finally, they should be able to quickly adapt to new work environments, as new disruptive events can be expected during their careers.

Respondents’ suggestions were also analyzed by counting consecutive pairs of words that appears in free text comments. This method is referred to as bigram counting. The most frequently used bigrams, starting from the most frequent, were: communication skills, time management, soft skills, emotional intelligence, organizational skills, technical skills, and video conferencing. These results are consistent with the affinity analysis and Figure 12.

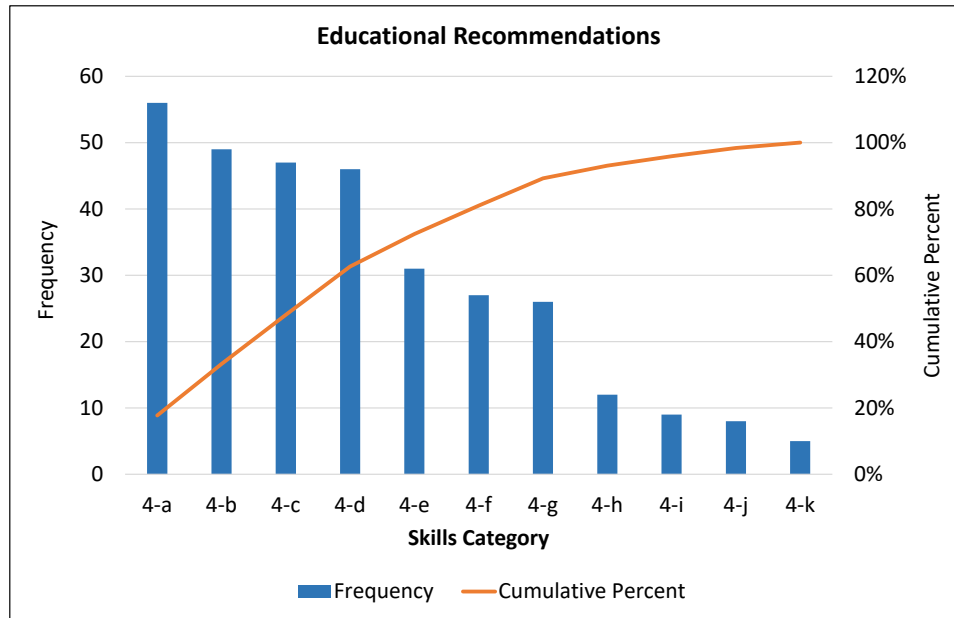


Figure 12: Pareto Chart for Educational Recommendations

## 5. Discussion

The unprecedented COVID-19 pandemic provides a convenient laboratory for learning. The synthesis of past research and the results of the affinity and text mining analyses generated important implications for individuals and organizations that prepare, hire, and manage workforces. Below, some of the more important lessons learned are organized as a set of recommendations for professionals and practitioners in a post COVID-19 workplace. The recommendations are supplemented with quotes that highlight perceptions of survey respondents.

### 5.1 Human Resource Management

An HR manager should appreciate that a significant step in the evolution of the workforce has taken place that affects P-E fits and exacerbates work-life conflicts for many employees. The choice of workers to be hired and worker support structures should change accordingly. HRM professionals should use this opportunity to consider adjustments in their professional practices that will help their firms become more immune to future disruptions. The following recommendations are made:

- a. *Give increased precedence to job candidates who possess characteristics of entrepreneurs.* These characteristics tend to be possessed by individuals who are proactive and work well autonomously, skills that will be welcomed by their supervisors when future disruptions occur. Workers need to be disciplined and independent, but at the same time assertive and be willing to ask for help. A respondent stated that workers need to possess “resiliency, an ability to be self-sufficient while also collaborating with a diverse group of people across all levels of seniority.” Another respondent wrote that “you are not being watched at all times when you are WFH and so to be your own boss, and to drive yourself to be productive in an autonomous way is incredibly helpful if you want to climb at your job.”
- b. *Consider the value of younger workers who may not have significant job experience, but possess strong remote working abilities.* Like all generations, workers of the future will be affected by a P-E fit that differs from their predecessors. The main negative impact identified above was fewer in-person meetings, but many younger workers thrive in this

setting. In fact, they are often criticized for not wanting to meet face-to-face in favor of using technology. The survey indicated that longer term employees as well as employees in certain job categories identified as among the most substantially impacted in this regard. A respondent suggested that an HR manager should seek workers who are “savvy in virtual communication, use of Zoom and MS teams.” Another stated that effective workers will “know how to effectively use various forms of communication tools (Skype, Teams, Zoom, etc.).”

- c. *Find ways to provide employees with at home child or elder care support.* During the COVID-19 pandemic, firms surveyed by the Boston Consulting Group (2020) directly addressed this challenge, mainly by creating more flexible work schedules, reducing working hours, or changing project scope or deadlines. A child or elder care stipend (already offered by some firms) could be supplemented with the hiring of an agency that would provide at-home care on an as-needed basis. Although the need for isolation during the pandemic may make this idea impractical, it would be worthy of consideration for other forms of disruption. Respondents stated that leaders should be aware that “child care, illness and all the things that were previously not as big of a concern can now impact your employees,” and another stated that “The majority of the people in my company have made an easy transition to working remotely. Those people with smaller children have had some issues.”
- d. *Recognize that implicit biases exist that can be overcome when people work remotely.* Several respondents discussed the positive effect that the pandemic had by “leveling the playing field.” One respondent stated that the “workplace can become fairer, because people with family commitments, who cannot travel as much, don't need to travel. To be specific, people who need to take care of families do not have to travel a lot to compete in their careers.” Another stated “The effect of gender bias is minimized because males would do a lot of customer engagement activities because our surgeon customers are mostly male and now they are limited to virtual meetings just like females. Also, there seem to be fewer office politics.” The pandemic may have helped to uncover these biases, but now it should be the responsibility of HR managers to recognize and respond to the underlying problem.

## 5.2 Workforce Management

Organizations should take a proactive approach to workforce management in response to the pandemic. While working remotely, many workers were negatively affected by conditions over which a firm has some control. The lessons learned from the adjustments necessitated by COVID-19 can provide an opportunity to make workforce management practices especially robust, so that the impact of future disruptions will be minimized. The following recommendations are made:

- a. *Companies should pay close attention to the integration of HR and IT.* As organizations transition to hybrid or fully remote work environments, the HR/IT interface will become a fundamental infrastructure requirement. As such, organizations should pay special attention to the training of its more seasoned workforce who are impacted by the pandemic in greater proportions. Communicating during a crisis also needs to be enhanced at all levels from HR through to senior management. This requirement was a common theme in several responses to the survey. One respondent stated that “It took the company a month or so to boost remote access network bandwidth, but now everything is OK”, and another wrote that “our HR department has had some trouble adapting. Communication has been sparse. My boss and I have been doing our best providing guidance to our teams.”
- b. *Companies in high cost regions can leverage WFH policies by stressing that employees can better manage costs of living.* These firms can attract more qualified workers who can now reside greater distances from the office in more affordable locations. As one respondent

stated: “Folks like me still like to go into an office to interact but given the Boston housing market, I know people who are thinking of purchasing homes at the end of the commuter rails because they will probably never work five days in an office again.” Another stated that “work from home gives me more flexibility to balance family, self and work load. I have extra time due to no commute (save 3+ hr. per day). Frankly, there are only a few minor inconveniences due to being away from the office.”

- c. *Encourage employees to network personally with colleagues and professionally with those outside their organizations.* Maintaining a social support network is especially critical for remote workers, and it offers other benefits to both the worker and their employer. The pandemic has provided some counter-intuitive examples of the potential for enhancing social connections while working remotely. As one respondent stated “You can get closer to colleagues (and have more empathy) because you are, in effect, coming into their home.” and “colleagues could see each other’s home environments through remote meetings, which could show more humanity instead of professionals trying to show in the company work environment and thus bring colleagues closer.”
- d. *Expand staff wellness programs to include mental health consequences of remote working.* Remote workers need to be especially mindful of the importance of stress management. They should maintain an appropriate work-life balance through time management and exercise, while maintaining a social support network. A respondent stated that “Although my transition to working from home was relatively seamless, people's personalities can lend well or not so well to working from home.” Another stated “For complete remote working, [you] need to adjust the lack of structure in time and space. Be sure to care for personal physical and mental health.”

### **5.3 Higher Education**

Graduating students are in an enviable position to deal with the complexities of a workplace that is impacted by disruptive events. The survey indicated that younger workers and those with more technical jobs experienced less disruptions than their older colleagues. Interestingly, the environment faced by universities during the 2020 coronavirus outbreak created a learning environment that itself became a useful skill-increasing experience for students. The need to take courses and interact with fellow students on projects using telecommunication technologies gave students first-hand exposure to how much of their future professional work will likely take place. The following recommendations are made:

- a. *Instructors teaching a course should make frequent use of virtual collaboration tools.* Students should be introduced to software applications that enable them to work simultaneously on a shared screen to edit documents, brainstorm ideas, and perform other interactive tasks. Many IT platforms feature breakout rooms that allow for small groups to discuss a topic and report to the larger meeting when they regroup. Becoming accomplished in these applications and features will be valued by future employers. A respondent commented students should learn the ability to “maintain an in-person feel through remote tools.” Another recommended that students should have “Knowledge of digital tools, critical thinking skills, business savvy, relationship building (especially virtually), and presentation skills.”
- b. *Instructors creating assignments should require students to use teleconferencing systems.* During the pandemic, most university students attended courses in which their peers were physically dispersed. In many cases, students located around the world were assigned to the project teams and had to deal with the same communication challenges that many business professionals face. Going forward, purposely duplicating these settings can help



prepare students for their upcoming careers. One of the respondents recommended that: "More resources on remote working should be given to students. It's a major deviation from the past 100+ years of office life, however it's been shown to be effective and I think the one positive thing that COVID-19 has done is shown this on a national scale."

- c. *Students seeking employment should emphasize virtual communications as an important skill.* Graduating students prepare biographical materials for potential employers that convey their qualifications in relation to targeted job requirements. Rarely do they address their ability to be an effective employee (regardless of job title). Therefore, as they enter an ever-more competitive job market, graduates should be encouraged to emphasize their remote working skills on the resume, cover letter, and professional networking web sites. Many respondents expressed the importance of graduates' ability to communicate remotely, both in terms of technology and orally, and to become an autonomous worker. A respondent stated that students should present themselves as a "disciplined self-starter, who can structure a daily routine," and another wrote that they should "be technologically savvy - be ready to communicate globally." And finally, graduates should "learn to communicate and give data presentations effectively and with impact 100% virtual; be adaptable"
- d. *Students preparing for a job should be cognizant of risk and business continuity.* Compared to earlier generations, graduating students will enter an interconnected global economy fraught with risks that will lead to frequent disruptions. Their work environment will be affected, along with the business processes of their employer. A respondent stated that students should "understand what business continuity is and why it matters - we're all learning that now of course. Realize how to use technology and that we still need people who have experience to make decisions and get the technology to work correctly for us." This focus should extend to mitigating the impact of other forms of disruption, including cyber security issues, severe weather, and workplace violence.

## 6. Conclusion

The COVID-19 pandemic has created a unique opportunity for the study of disruptive impacts on business operations, including work environments. This research employed a survey of professional workers in biotech companies, using a quantitative and several qualitative analysis approaches. Although the pandemic had noteworthy catastrophic worldwide impacts, the work environment of biotech professionals was impacted in positive ways. The workers who were affected most negatively included older workers and those workers who had trouble transitioning to a virtual work setting. More positive effects were noted including those associated with P-E fit and work-life flexibility, with younger workers expressing more satisfaction with the new work realities.

Companies have the opportunity to create a workplace that is able to withstand future disruptions, not just those associated with pandemics. HR managers can hire and nurture employees who work well in virtual environments. They should prevent what one respondent mentioned as a "difficult transition because it was sudden." Their practices should provide support and encourage work practices that enhance mental health. Universities can learn to better prepare professionals for the workplace of the future. They should embrace opportunities for students to study in virtual settings while encouraging strong virtual communication skills. Graduates who excel in these settings should make this skill known to future employers.

This work focused on professional workers in biotechnology and pharmaceutical firms, over half of them located in Massachusetts. Although somewhat of a limitation, this focus allowed for the isolation of the pandemic's effects on work environments without confounding effects associated with their employer or location. Seeking to isolate the effect of a disruption is a worthy

research focus; it would be interesting to determine if similar results were obtained in other industries.

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