

## Chapter 7 - Industrially Employed Physicists: Primarily in Engineering

### Employers

This chapter is based on the responses of 179 mid-career physicists who were employed in industry and were working primarily in engineering. Many were employed by companies making sophisticated technological products with a wide range of industrial or consumer applications, enhancements for existing technologies, or novel solutions to problems. Some companies that employed PhD physicists specialized in computing technology like the manufacturing of semiconductor devices, computer hardware, or hard drives. Other companies developed software to harness computing power for specific purposes, commonly for internet applications but also to make use of real-time information to enhance the functionality of a product. Other companies specialized in measurement instrumentation utilizing a variety of technologies including optics, radio frequency, electromagnetism and biosensors. Mid-career physicists working primarily in engineering were employed by many well-known corporations including Intel, IBM, General Electric, Seagate Technology, Agilent Technologies, and Boeing.

### Job titles

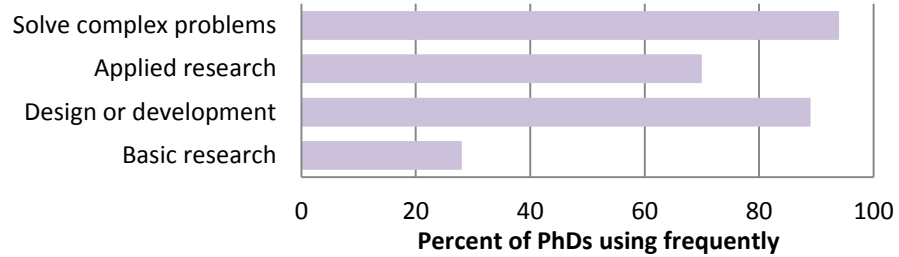
Technical job titles were often preceded by words like “senior”, “principal” and “chief” to indicate levels of experience and responsibility.

<b>Table 7.1: Common Job Titles of Industrially Employed Physicists in Engineering, 2011</b>	
<i>Technical Titles</i>	<i>Management Titles</i>
Engineer	Manager; Engineering Manager
Design Engineer	Director
Scientist; Physicist	President; Vice President
R&D Engineer; Systems Engineer	Chief Technology Officer
<b>PhD Plus 10 Study - <a href="http://www.aip.org/statistics">www.aip.org/statistics</a></b>	

### Job duties

The field of engineering attracted the largest group of industrially employed physicists who utilized their background of basic physics principles and a range of other skills to solve complex problems in various subfields of engineering. For instance, physicists described working on processes to develop new and improved materials, often related to growing, doping, and etching silicon crystals used in electronics; developing computer chips and accompanying software; enhancing magnetic recording devices; utilizing radio frequency, wireless technology, and optics in communication systems; and devising algorithms for measurement devices. Some PhDs were responsible for optimizing the process from design through production, testing the quality of final products, and sometimes training the end-user. Others directed their companies' intellectual property initiatives and managed patent portfolios.

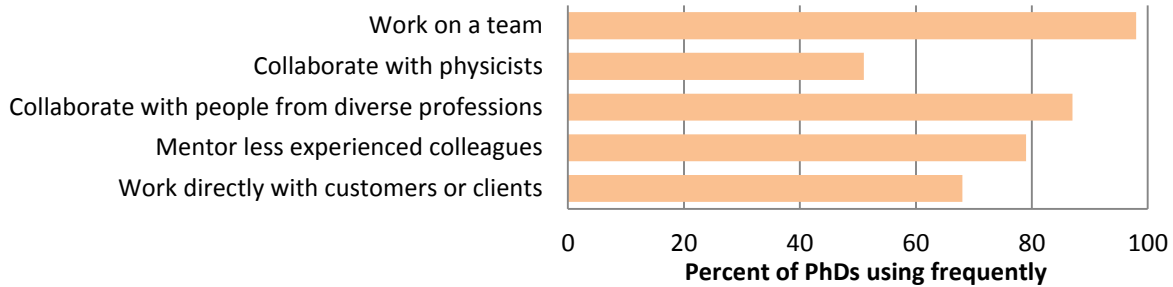
**Figure 7.1: Cognitive Skills Used Frequently by Industrially Employed Physicists Working Primarily in Engineering**



“Frequently” combines response of “daily”, “weekly”, and “monthly” from a 5-point scale to the question “How often do you use the following in your current job?” Data include US-educated physicists who earned their PhDs 10-15 years earlier, who were working in the US in 2011, and whose primary field of employment was engineering.

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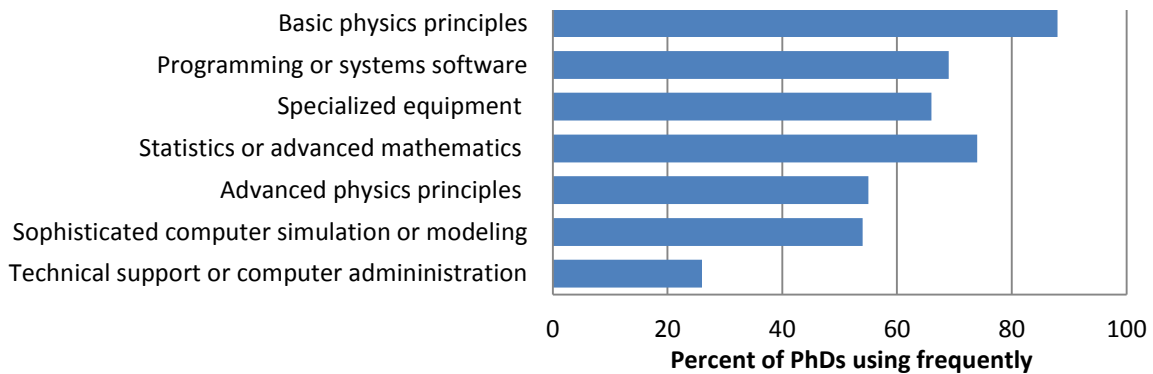
**Figure 7.2: Interpersonal Skills Used Frequently by Industrially Employed Physicists Working Primarily in Engineering**



“Frequently” combines response of “daily”, “weekly”, and “monthly” from a 5-point scale to the question “How often do you do the following in your current job?” Data include US-educated physicists who earned their PhDs 10-15 years earlier, who were working in the US in 2011, and whose primary field of employment was engineering.

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**Figure 7.3: Scientific and Technical Knowledge Used Frequently by Industrially Employed Physicists Working Primarily in Engineering**



“Frequently” combines response of “daily”, “weekly”, and “monthly” from a 5-point scale to the question “How often do you use the following in your current job?” Data include US-educated physicists who earned their PhDs 10-15 years earlier, who were working in the US in 2011, and whose primary field of employment was engineering.

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**Knowledge and skills used on the job**

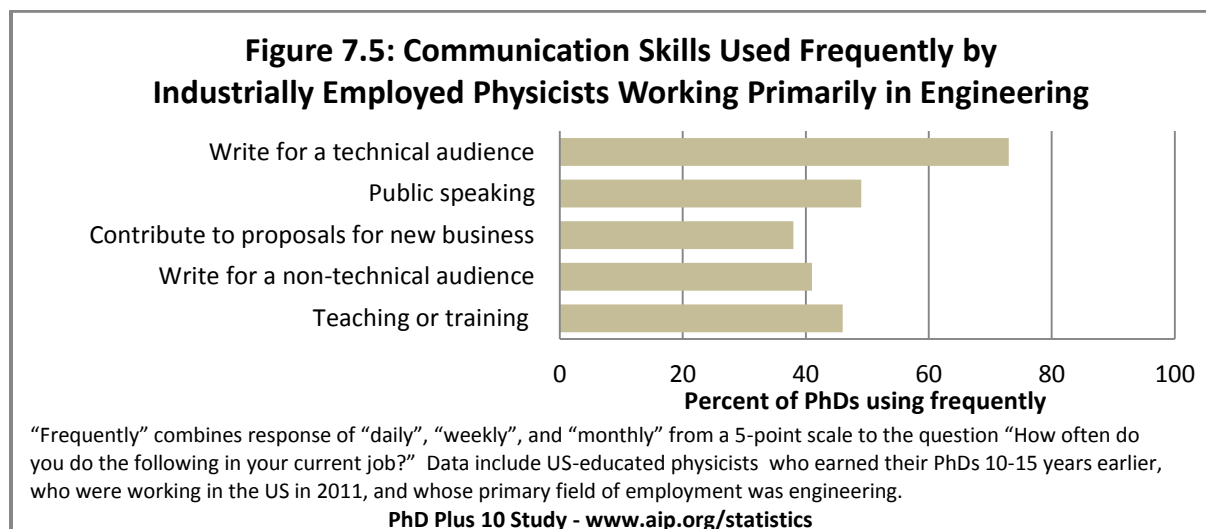
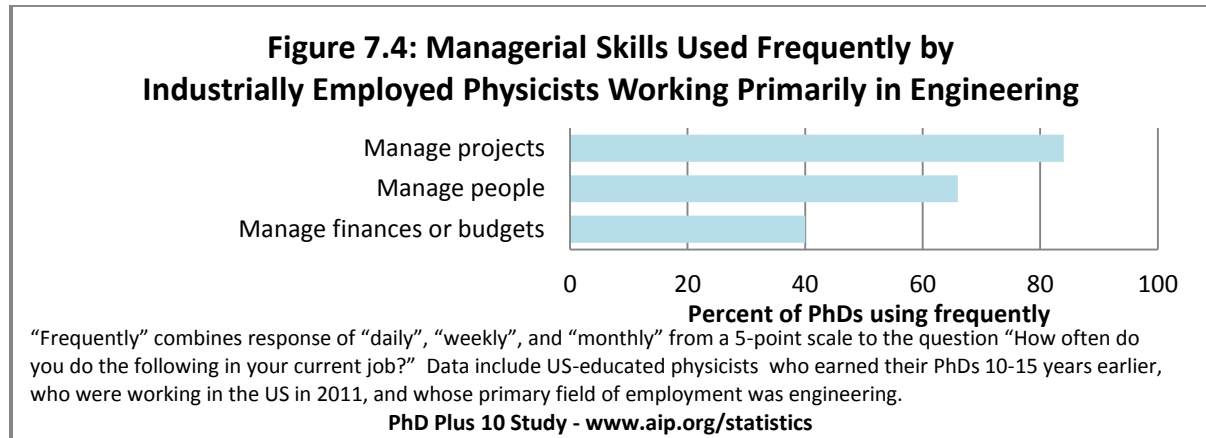
The mid-career physicists who worked in engineering frequently worked on teams, collaborated with colleagues from diverse professional backgrounds and mentored less experienced colleagues (Figure 7.2). These physicists frequently solved complex problems. Many worked on design and development, and many were engaged in applied research (Figure 7.1). More than 80% of the physicists who worked in engineering reported that they frequently used their knowledge of basic physics, and many regularly used advanced mathematics (Figure 7.3).

More than 80% of these mid-career physicists reported that they frequently managed projects (Figure 7.4), and many of them were regularly required to write for a technical audience (Figure 7.5).

**Most rewarding aspect of their jobs**

Physicists who were working in engineering were asked to describe the aspects of their work that were most rewarding. The verbatim comments written by these physicists were consistent with the knowledge and skills data in Figures 7.1 through 7.5. The following were the most common stated themes:

- Physicists working in engineering wrote that they enjoyed their work because it was intellectually stimulating. They enjoyed that problems were complex and tested their ingenuity. They also appreciated how often they got to work on new problems, which could vary greatly in terms of content and scope. They used phrases like “working at the leading edge” and “intellectual stimulation.”
- Mid-career physicists appreciated that the problems they were helping to solve had a real-world impact. It was important to many physicists that their work be “useful to the world”. A few physics PhDs even described the joy of seeing innovations “come to life.”
- It was also common for physicists to describe the benefit of working with smart people as rewarding. Physicists used words like “talented”, “stellar”, “competent”, and “diverse” to describe other team members with whom they worked. One PhD listed “camaraderie” among the rewards of his job.
- A few physicists working in engineering described the satisfaction of contributing to the success of their company. Many led research teams and some helped direct their companies’ technology and research agendas.



<b>Table 7.2: What Are the Most Rewarding Aspects of Your Job?</b>
Selected verbatim comments from PhD physicists working primarily in engineering, 2011
<p><i>Challenging projects which require real scientific detective work to solve and bring about real world products. Excellent community of scientists and facilities to work with. Great teams to work on with a broad spectrum of different backgrounds and abilities.</i></p> <p><i>Working with motivated people to develop products with a wide range of applications. Recognizing the impact of the products we manufacture on other products and services such as cell phones, LCD TVs, computers, medical devices, research, photovoltaic devices, etc.</i></p> <p><i>I work with some extremely talented physicists, engineers, chemical engineers, and software engineers. However, the most rewarding aspect is seeing the incredibly diverse applications developed with instrumentation that I designed.</i></p>
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