3.1 Introduction

3.1.1 Overview

This chapter addresses best practices for research thrust leaders, the research team leaders who are positioned on the Engineering Research Center (ERC) organizational chart between center directors and individual faculty researchers, with responsibility for one of several "thrust" areas within the center's overall research program. Although aimed at ERC research thrust leaders, the chapter's content may also be of value to other members of a center's leadership teams (e.g., directors and deputy directors, faculty, testbed leaders, and industrial partners).
This section begins with background summarizing the quarter-century experience from which these best practices have emerged, followed by an explanation of the importance of research thrust leaders and the challenges they face. Perspectives on the types of best practices discussed in this chapter are then followed by a roadmap of the remaining sections.

3.1.2 Background

The National Science Foundation's ERC Program has, since the mid-1980s, supported centers to join universities and technology-based industries in focusing on next-generation advances in complex engineered systems (see Endnote 1). To enable a long-term collaboration, ERCs are funded for 10 years (11 years in the early days of the program). Of the more than 50 ERCs formed since the program began, 13 are currently being supported as of late 2010, with five more planned for initiation in early 2011; 29 of the 35 "graduated" centers are still in operation and self-sustaining (Endnote 2).
ERC activities are at the interface between the discovery-driven culture of science and the innovation-driven culture of engineering. ERCs have created synergies between science, engineering, and industrial practice while facilitating industry collaboration with faculty and students. Through ERCs, partnerships that strengthen academic contributions to U.S. industrial competitiveness have been formed, many undergraduates have become involved in focused research, and the knowledge and experiences of engineering graduates have been broadened.
Against the backdrop of an increasingly global economy in which U.S. competitive advantage rests heavily on innovation, five third-generation ERCs were established in 2008. These Gen-3 ERCs reflect the proven results of earlier ERCs but, with a greater emphasis on innovation, look to establishing more and stronger partnerships with small firms and startups, other entrepreneurial organizations, and foreign universities.

3.1.3 The Importance of Research Thrust Leaders

As the name implies, research and engineering are at the heart of ERCs. *Within the ERCs, research thrust leaders are at the heart of research management. They are the ones expected to lead a diverse group of researchers to deliver on ERC research and technology-translation goals in a timely manner and within a limited budget.*
Being a research thrust leader is challenging—a far cry from a simple research advisory role. It is the classic middle-management situation. Often research thrust leaders are:

- not in control of their research budgets;
- not involved in all decisions or interactions affecting their projects;
- not (in many cases) at the same location as the main lead institution; and are
- not provided additional compensation for time spent in their leadership role.

Despite these challenges, they are responsible for organizing a team of relatively independent investigators to deliver on a common thrust-level goal and are expected to lead the projects in their areas of responsibility to successful completion. The success of the ERCs in the overwhelming majority of the cases proves that they are able to accomplish this task.

3.1.4 Best Practices for Research Thrust Leaders

Many general management principles have proven useful over the years to guide research, development, and engineering endeavors and create competitive advantages (see, for example, Endnote 3). These principles include:

- Good top-level leadership with demonstrated commitment
- Strategic organizational vision and planning
- Adequate human capabilities and financial resources
- A customer focus
- Value creation
- An enduring focus on quality
- Good metrics for measuring inputs, outputs, and outcomes over time.

This chapter accepts such principles as valid bases for successfully managing highly technical efforts. However, it reaches beyond these layers of generality to describe the "how-to" methods that practicing ERC research thrust leaders have found to work in their real world. In other words, this chapter focuses on "best practices" gleaned from years of ERC experience.
The following list sets forth broad areas in which best practices are addressed in this chapter:

- Defining the roles and responsibilities of research thrust leaders in the context of developing strategic plans at ERCs
- Executing pragmatic approaches for strategic plans, such as sustaining buy-in of plans, enhancing communications up and down the ERC leadership chain and across the various thrusts, and developing and using metrics to assess ongoing projects
- Integrating the center's research efforts, both with the long-range needs of industry partners and with the education activities of partner universities.

Naturally, all of this has to recognize that ERCs vary in many ways. For instance, there are differences in numbers and locations of partnering universities and industries; internal organizations, policies, and procedures; heterogeneity in problem solving; and types and numbers of disciplines involved, as well as in the basic technology fields and industrial sectors on which the centers focus.
In other words, best practices for research thrust leaders at one ERC are not necessarily the best fit at another. So, *in considering the best practices that follow, research thrust leaders must adapt the concepts to the particulars of their own ERC.*

3.1.5 Chapter Roadmap

Sections 3.2 and 3.3 tackle two of the most important elements of good research management—development of a strategic plan and its execution. Section 3.4 deals with integrating the research and the industry partners. Section 3.5 addresses the integration of education and research. In each of these sections the emphasis is on best practices—solutions that have been found to work in real ERC situations. Practical examples or case studies are included in each section to illustrate the best practices.
Recognizing the newness of Gen-3 ERCs, Section 3.6 looks into similarities and differences in best practices that might apply to these partnerships. This section also suggests ways to develop Gen-3-specific best practices. Section 3.7 identifies the key contributors to this chapter, and Section 3.8 furnishes sources and references in the form of endnotes.