PART IV

APPLICATIONS

Part I provided the organization, management, and cultural context for HSI applications, Part II provided the HSI framework for applications in the systems engineering and systems acquisition processes, and Part III provided descriptions of the methods and technology available for systems application by human systems integration (HSI) practitioners. The purpose of Part IV is to describe a wide range of HSI applications to systems. Many of the HSI systems applications presented in this part are drawn from military, aviation, and commercial environments that provide representative samples of the types of organizations and cultures HSI professionals are likely to find themselves working in the future. Seven chapters comprise this part, with major applications drawn from the U.S. Army, the U.S. Navy, the Federal Aviation Administration, and small-system developments such as appear with new commercial products. Four of the chapters primarily present the results of past HSI applications and three of the chapters provide general guidance for future HSI applications to system and product design.

Chapter 18 by Booher and Minninger, reviews the results of HSI applied to U.S. Army systems acquisition over the past decade. It explores two different approaches in describing the army's experience with Manpower and Personnel Integration (MANPRINT), the army's HSI program. First, specific system examples are provided for each of 10 HSI principles described in Chapter 1 to illustrate how applying the principles have helped system acquisition programs meet cost, performance, and schedule requirements. The examples cover major systems and modifications, nondevelopmental systems and some small rapidly procured systems to demontrate a wide range of systems design influence from HSI. Second, the chapter describes the results of four case studies of army systems illustrating the large number of performance and cost benefits to the army that have come from applying the HSI factors. Booher and Minninger categorize the benefits into four areas: acquisition process efficiencies, system design improvements, casualty reduction, and cost avoidance. The chapter concludes by projecting the relevance of HSI factors to future weapon systems.

In Chapter 19 Miller, Crowson, and Narkevicius bring the reader a comprehensive description of human characteristics and measures important to system design. In particular, this chapter presents an overview of characteristics, measures, and techniques that exist to describe and quantify a variety of human factors categories, including

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anthropometrics, sensation and perception, mental abilities, social abilities, physiological attributes, and operator states under varying environmental conditions. Underlying this discussion of human characteristics and measures for system design is the aim of recognizing, understanding, and accounting for the human performance variance in HSI applications.

Chapter 20 by Osga describes the approach and results of applying a particular type of human-centered design method called a *task-centered design approach* to the Navy Multi-modal Watchstation (MMWS) project. The HSI participants created an integrated set of decision support and user interface designs to support mission execution and management. The project represents a software-based prototype applied within a simulation-based acquisition started early in the conceptual design stage of a shipboard command-and-control system. During the design stage, concepts are tested and refined before they are passed on to advanced engineering development. The designs are validated by iterative performance and usability tests indicating improvements in task response time and accuracy, with lower workload and increased situation awareness. The set of requirements used to generate the MMWS designs can be applied within other mission domains resulting in consistent quality of user support across a variety of shipboard functions and tasks.

In Chapter 21 Pierce and Salas note that the military acquisition process is a highly structured process with milestone decisions at regular intervals between developing a mission needs statement and system fielding. Capabilities are defined and captured in system and operational requirements, and elaborate tests and experiments are conducted to evaluate the equipment and the operational procedures. Even the need to improve the system after it is fielded is formally recognized in a product improvement plan. Yet when information systems are acquired under this process, more often than not, they do not meet the needs of the military command-and-control decision maker. Information systems are particularly weak in meeting human performance requirements that frequently determine success or failure at meeting mission requirements. The contributors believe it is possible, however, to design more reliable and capable information systems through HSI. Their chapter, therefore, provides a description of those issues, concepts, principles, guidelines, and tools available to help integrate the human component into the HSI process for information systems design.

Klesch and Stembler in Chapter 22 raise the question: Why is it that many program managers of new systems recognize the importance of HSI yet tend to trade off HSI considerations in their investment strategy and assume more risk in system performance? They state this approach is particularly true with the training domain, where even promising technologies such as interactive multimedia instruction (IMI) that can reduce training costs are seldom applied to new systems. They acknowledge that the application of training technology to new systems is a difficult issue to resolve not only because of cost but also because of timeliness and quality. This chapter first addresses the reasons that training, and in particular training technology, frequently loses out in new systems trade-off exercises, even though program managers may be aware of the serious performance costs from inadequate training investments. In particular, it examines why promising technologies such as IMI are not fully utilized in new systems training. Then, based on HSI principles, Klesch and Stembler suggest a systems integration approach to training for new systems that can harness both modern technology and traditional means of efficiencies in training. They show how an HSI training production design can lower both cost and risk, thereby helping managers to solve the training dilemma.

Between 1994 and 1998 the National Academy of Sciences' Panel on Human Factors in Air Traffic Control Automation conducted a study that examined the relationship between controllers and automation in a variety of systems under development by the Federal Aviation Administration (FAA) using principles of human-centered automation. Chapter 23 by Mavor and Wickens, reexamines the panel's findings in view of the HSI principles for successful organizational implementation. The primary purpose of the chapter is to illustrate the challenges and benefits of applying a human-centered design philosophy to a large sociotechnical system such as the National Air Traffic Control System. As an example of the mixed results, which frequently come from attempts to implement human factors recommendations into large complex organizations, particular emphasis is placed on one system studied by the Panel—the Center TRACON Automation System (CTAS). In closing, the chapter discusses the types of coordination and integration issues that are frequently associated with harmonizing several systems (some already in existence and some under development) for an organization as complex as the FAA.

In Chapter 24 Rouse considers HSI issues in the context of private-sector new product development (NPD) efforts where market considerations and profit motives drive HSI-related design decisions. The chapter contrasts the characteristics of private- versus public-sector product and system development and discusses product management practices in terms of multistage decision processes and human-centered design. In this chapter, methods and tools are considered for market research, product lines and platforms, product evaluation, NPD project evaluation, and product planning. Results of empirical assessments of best practices are summarized in terms of characteristics of projects, project management, organizations, and individuals.