CHAPTER TWO

The Origins and Evolution of the Field

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The term *performance technology* (HPT) has slowly evolved to define an emerging field of practice in organizations. The adjective *human,* however, is often used in front of this term in an effort to make it refer more specifically to the study of people than to the study of machines. With its roots in what was then the National Society for Programmed Instruction (now known as the International Society for Performance Improvement, or ISPI), the field of HPT is now finding additional professional support and discussion in such professional societies as the American Society for Training and Development and the International Federation of Training and Development Organizations, as well as in such professional journals as *Training.*

In defining any new field, theorists and practitioners alike struggle to decide exactly what the new ideas mean and how concepts and practices from one field can aid in describing another. Moreover, in studying the framework on which any new field is built, it is essential to look at new and creative ideas, as well as at the disciplines of science.

Why is it important to review the foundations of HPT? One reason is that HPT is consistently being described as using the science and techniques of other disciplines. Thus, to apply HPT successfully, it is necessary to understand the foundation on which the practice is built. Another reason is that by understanding the origins and conceptual milestones of HPT, researchers and practitioners can better communicate HPT's role to peers in more established fields, as well as to managers and colleagues in work settings where HPT is a new resource. Because

the HPT field is still in an emerging and changing state, a grounding in its foundation and history will be crucial to any future attempts to define and set the parameters of HPT itself. Finally, as HPT is implemented globally, an understanding of its conceptual and historical origins provides common ground for practitioners as they apply HPT across borders, cultures, and economic systems.

In this chapter, the emerging field of HPT will be described from both a process and a management point of view. Specifically, this chapter will examine the significant contributions and viewpoints of the discipline's pioneering practitioners, as well as the more established scientific fields from which they came. This chapter will also note the significant contributions of learning psychology, instructional systems, analytical systems, information technology, cognitive engineering, ergonomics and human factors, feedback systems, organizational development, and change. The importance of model building (a clarifying technique used successfully by other, related fields during their evolution) and the relevance of this process for HPT will be discussed. Finally, this chapter will take a look at how the field may evolve over the next ten years as it gains acceptance in organizations around the world.

SIGNIFICANT CONTRIBUTIONS TO THE PROCESS OF HPT

According to Brethower (1995, p. 17), "HPT has enjoyed a 30-year record of achievement," but just where did it come from? A definitive answer is probably some years away, but several major influences can be clearly identified.

Systems

A *system* is a group of interrelated elements forming an entity and usually operating toward a purpose or goal. The use of systems, or the systems approach, is essential to HPT. Without a systemic framework, it would be extremely difficult to achieve improved performance. In fact, it may be impossible to engage in any form of engineering or technology outside a systemic context.

Banathy (1968) provides an excellent overview of the relationship among systems. A system can be either a subsystem or a suprasystem; which one it is depends on the perspective adopted. For example, the internal combustion engine is a subsystem to the suprasystem of the automobile, which in turn is a subsystem to the transportation suprasystem. In the HPT suprasystem, instructional technology is a subsystem, and HPT is a subsystem in the overall management suprasystem (Mager, 1988, p. 10).

According to Jacobs (1988, p. 7), "No one use of the systems approach defines the field," but the relationship among systems allow HPT to be placed in its proper perspective. This paradigm is helpful in understanding the components of HPT and how the field fits into the larger world. Because HPT is composed of

and uses the concepts and techniques of many disciplines—for example, Svenson and Wallace (1989) suggest that HPT uses an engineering-science metaphor—a systemic framework is crucial to fitting its components together, developing models of how they will work and interact, and implementing HPT in practice.

Learning Psychology

For most of recorded history, learning occurred in the mode of apprenticeship. Until about five hundred years ago, all the knowledge and skill of one person could be passed on individually to another. When, through discovery and invention, the amount of available knowledge increased substantially, and when the number of people who knew it all correspondingly decreased, a way had to be found to make learning more efficient. The newly invented medium of writing helped for a while, but soon classroom-based or group instruction was born. Thus information could be imparted to many learners at one time.

In the twentieth century, the pace of discovery and invention, coupled with the population explosion, soon made it necessary that learners spend more and more years acquiring an ever-growing body of skills and knowledge. The classroom teaching model had to be made more efficient. In response to this need, learning psychologists began to merge new techniques of instruction with audiovisual technology (media) (Rosenberg, 1982).

There appears to be general agreement that HPT ultimately stems from the work of a number of behavioral psychologists who began, in the 1950s, to experiment with innovative methods of enhancing learning. This research also led to new perspectives on how people learn. To learning psychologists concerned with prescriptive theory, instructional efficiency and effectiveness were functions of how information is structured, presented, and received by the learner.

Most of the pioneers in the field point to the work of Skinner (1954, 1958), who proposed the revolutionary idea that small-step instruction, coupled with extensive feedback, could significantly enhance learning. Skinner's ideas led directly to the development of the first teaching machines, which made use of a format known as *programmed instruction* (Crowder, 1960). Programmed instruction is one example of the early attempt to marry the principles of learning psychology to audiovisually based instruction. Research and practice in this area led to the important concepts of *instructional feedback* and *reinforcement.*

Out of this work came two important events. First, in 1961 and 1962, Thomas F. Gilbert, a former student of Skinner's, published the *Journal of Mathetics* (the term *mathetics* comes from Greek and refers to learning). In the only two volumes of this journal that were ever published, Gilbert laid the foundation for what was later to develop into the field of instructional technology. In 1962, many of the researchers who had contributed to the *Journal of Mathetics* came together to form the National Society for Programmed Instruction (NSPI). In the

development of any discipline, an important milestone is the point where ideas begin to be shared, especially through publications and meetings of professional societies. Hence the second event to come out of the early research and practice in this new field: NSPI's first meeting. As the 1960s moved into the 1970s, the new discipline began to emerge in the literature, and the use of a systematic approach to creating and delivering instruction has now come to be known as *instructional technology* or *instructional systems design* (ISD).

There were also significant contributions from cognitive psychologists in identifying the nature of skills and knowledge. It was Bloom (1956) who first organized objectives along a taxonomy related to what the learner was supposed to do. Glaser (1966), Bruner (1969) and Gagné (1970) provided seminal work to link the learning process to instructional events.

Instructional Systems Design

The concepts, theories, and practices of ISD are among the most significant underpinnings of HPT, especially when it is viewed from a historical perspective. Reiser (1987) points to the work of Skinner, and to the work of others from the orientation of behavioral psychology, as being a significant contribution to the systematic process that includes programmed instruction (already discussed), task analysis, behavioral objectives, and criterion-referenced evaluation.

Task analysis became critical as instructional technologists realized the need to identify, before instruction was designed, what they intended to teach people to do. Behavioral objectives, popularized most notably by the work of Mager (1975), infused the designers with the realization that the outcomes of instruction must be identifiable, observable, and measurable. Criterion-referenced evaluation was adopted as a way of providing practitioners with techniques for proving that learning had taken place.

ISD, the systems approach applied to learning, directly attacked the problem of inefficient and ineffective instruction. As the demands of society and the exponential growth in knowledge continued to require new approaches to teaching and learning, especially during the two world wars, the need to train large numbers of people in short periods of time had led to the advent of audiovisually based instruction, of which film was a primary example. Research consistently showed that audiovisual media could teach as well as people could, and this finding was a significant breakthrough.

Researchers and practitioners in the field of ISD have been able to use these important concepts in describing a generalized systematic model for their field. First, the instructional requirements of both the learner and the task or job are analyzed, to determine the precise instructional need. Next, an instructional program is designed, with objectives and testing that are linked to the preceding analysis. Instructional materials are then produced and delivered according to the design. In each phase, evaluation data are collected and revisions are

made so that the outcome of the process meets the identified need as closely as possible. One such systematic model has come to be known simply as ADDIE: analysis, design, development, implementation, and evaluation. Today many operational ISD models exist in practice, but most either can trace their roots to ADDIE or accept the ADDIE concept as a foundation.

The development of ADDIE-like models for ISD was crucial to the establishment of the HPT field. As instructional programs depended more and more on the analysis of a need, and as instructional evaluation became more refined, in order to reflect the degree to which the instruction had met that need, it became apparent that a variety of needs could not be met through instructional programs alone. No matter how well the programs were designed, learning did not always result in improved performance. As practitioners became better and better at identifying problems, they soon discovered that their repertoire of instructional solutions could solve only a small set of those problems. A broader paradigm was required.

As practitioners and theorists worked to describe and use this newly expanded paradigm, they relied in part on their extensive experience with the ADDIE model. Because they recognized the limitations of ISD, most notably in the phases of analysis and evaluation (Richey, 1995), important questions surfaced: Analysis of what? Design, development, and implementation of what? Evaluation of what? A new and more analytical paradigm was needed.

Analytical Systems

While working on a variety of government-sponsored training and education projects in the 1960s, many of the earliest learning psychologists and instructional technologists, such as Harless, Gilbert, and Mager, began to develop strategies that dealt with an important realization: if training and education did not accomplish what was expected, then there must be other strategies that might be more effective. They worked on describing ways to analyze problems as a means of determining appropriate solutions.

Harless (1970) coined the term *front-end analysis* when he realized that analysis of an instructional problem often comes too late in the process. When analysis is pushed forward, ahead of an instructional program's design, it becomes possible to look at a particular performance problem in isolation from any perceived solution. Harless and other researchers began to realize that instructional technology was not, after all, the superordinate concept; thus they brought the relationship between instructional and performance systems into proper perspective.

Gilbert (1996) reached several conceptual milestones in describing performance and how it is analyzed. He articulated a process of assigning value to performance by measuring its accomplishments, thus providing a framework for assessing impacts of HPT beyond changes in behavior. Gilbert's behavior-

engineering model also identified six general aspects of behavior that can be manipulated to improve performance: data, instruments, incentives, knowledge, capacity, and motives. Gilbert's model, in one form or another, plays a critical role in the analysis and evaluation of performance.

Rummler and Brache (1988b), using systematic analysis techniques to examine organizational structures, found that individual performance is influenced by organizational performance, and vice versa. They describe organizations partly as collections of integrated systems (for example, the finance, manufacturing, and marketing systems). To this list they add a performance system and suggest that all these systems (and their subsystems) are influenced by a complex and ever-changing variety of outside forces. These systems dynamics require organizational analysis, and the analysis of performance problems requires the analysis of the organization in which those problems occur; thus the "analysis tree" grows larger.

Collectively, the work of Gilbert, Mager, Harless, and Rummler forms a large part of the foundation on which performance analysis and HPT are built. Mager and Pipe (1984), Kaufman and English (1979), Rossett (1987), and many other practitioners have used this work to develop practical suggestions for analyzing performance problems (or opportunities) and their causes.

Cognitive Engineering

The field of cognitive engineering is an interesting example of how multiple fields combine to form a new discipline for dealing with new challenges. Woods and Roth (1988, p. 415) define cognitive engineering as "an applied cognitive science that draws on the knowledge and techniques of cognitive psychology and related disciplines to provide the foundation for principle-driven design of person-machine systems." This new field shows how adaptable learning psychology is when it is confronted with new vehicles (machines or computers) of knowledge delivery. When the old models no longer fit, they can be adapted, borrowed from, or redesigned to create a new approach. This is how cognitive engineering was born.

Cognitive engineering's domain is more limited than that of HPT, but its goals are quite similar. The cognitive engineer links the world of learning with that of computer technology and measures success in terms of the human-machine interface and the resulting productivity. Woods and Roth (1988) stress that their field deals with improved performance. These authors advocate analysis as the first and most important step in achieving this goal. They are emphatic in their argument that knowing how to use a new machine or technology is far less important than accomplishing something with the new tool. They also see their field as systemic. The critical system here, however, is the human-machine system (that is, the interface between humans and machines) rather than the machine and its electronic and mechanical components.

Information Technology

The concepts embraced by cognitive engineering have profoundly influenced the relatively new field of information technology. In addition, the advances made in information technology have had a significant impact on HPT. Gilbert (1996) notes that the effects of a good information system can be staggering. The overwhelming amount of complex information required to perform work at a competent level has placed considerable strain on traditional education and training systems. This situation has led to the development of job aids, computer databases, and electronic training systems as well as of structured text design (Horn, 1982). It has also had a significant impact on work design and organizational structures.

Electronic performance-support systems (EPSS)—linking training, information systems, computer applications, and so on (Gery, 1989)—will have a significant impact on the design and operation of an organization, and on human performance. According to Rosenberg (1995), HPT and EPSS will have essentially the same future; he predicts that "they will be integrated directly into the key processes of an organization" (p. 98). This prediction has been borne out in the growing use of these tools to support increased productivity and quality in a variety of jobs, such as customer care, sales, manufacturing, project management, and even in the HPT field itself.

Eucker (1989) notes that "our assumptions regarding information systems in traditional organizations are out of date" (p. 87) and that "the potential influence of information technology on human performance is likewise limited by inadequate organizational strategies and structures" (p. 89). In his analysis of the influence of information technology on human performance, Foshay (1989) also sees such systems as potentially having a profound impact on organizations. New work routines, changed career orientations, redesigned job environments, and, perhaps, new missions for training and education require a new approach to managing and evaluating such changes. Foshay suggests that HPT may be that new approach, and these developments are already affecting the field. Foshay notes that the traditional view of HPT, in which particular jobs are a given and interventions for improving performance in the jobs are developed, may give way to the design of "organizational structures and information architectures" (p. 125). In other words, it may be necessary to redesign the jobs themselves.

The explosion of information available through the World Wide Web has drastically changed the role and impact of information technology. New fields of knowledge management and information design radically expand the HPT practitioner's toolkit. Having access to just-in-time information and knowledge databases is a capability essential to the modern organization. Access to information clearly has an impact on performance, and the power of the Internet and of company intranets has profoundly increased capabilities in this area (Hinrichs, 1997).

Ergonomics and Human Factors

Ergonomics and human factors are disciplines that developed in response to the world's increasingly complex technology. They can be seen as companion disciplines to information technology and cognitive engineering. According to Phillips (1989, pp. 44–45), "ergonomics and human factors link our quantitative skills to the integrated systems of people, machines, and materials." The fields of ergonomics and human factors help in ensuring that the design of systems complies with the requirements of users. From desk chairs to computer systems to automobiles, the most successful products—those used to their fullest potential—are those that are easily operated, maintained, and understood.

There is an important implication for HPT here. Ergonomics and human factors are concerned with the design of machines, but their primary goal is to improve human performance. According to Shephard (1974, pp. 8–9), "Systems are examined to see (1) how their purpose can be achieved with minimum damage to either operator or machine, and (2) how their design may be improved to facilitate transfer of energy, materials, or information across the man-machine interface." It is clear that in a complex, technological world, human performance is enhanced through the proper application of ergonomics and human factors. For the HP technologist, then, the field encompasses more than the role of human beings; it includes their interactions with their tools.

Psychometrics

Psychometrics is the measurement of human achievement and capabilities. In the past, it was used primarily to measure learning and general ability. Many standardized tests are administered each year to millions of public school and college-bound students. These normative tests were designed to predict performance in learning environments. More recently, valid and reliable tests have been developed to predict performance in task accomplishment or in the demonstration of sets of behaviors. It was only natural that these techniques would be found useful in the development of methods for selecting people to fill jobs or for certifying competence in a job.

Leibler and Parkman (1986) and Ross (1986) provide a good overview of the use of assessment techniques in personnel selection and staffing. Techniques for accurately predicting performance have become important HPT tools. Ross notes that the preliminary purpose of selection is cost-effectiveness, and the implication for HPT is that it may be more cost-effective to select people who are already classified as high performers than to train or motivate mediocre performers. The development of more accurate assessment devices (such as

paper-and-pencil tests, expert or peer evaluation, assessment centers, and so on) relies in part on the advances made by psychometricians.

Feedback Systems

In an extensive review of the literature on feedback systems, Ilgren, Fisher, and Taylor (1979, p. 349) note that "feedback about the effectiveness of an individual's behavior has long been recognized as essential for learning and for motivation in performance-oriented organizations." These researchers see feedback as an essential feature of interpersonal relations and as an appropriate tool for improving performance.

Feedback is a unique type of information. It is reflected in praise, criticism, corrective instruction, nonverbal communication (smiling, anger), and so on. It can be informal, as in a supervisor's daily behavior with subordinates, or formalized, as in a system for performance appraisal. Feedback is directly related to motivation, incentives, and rewards. According to Donald Tosti and Stephanie F. Jackson (see Chapter Twenty of this volume), the critical characteristics of feedback are tied to who gives it, what the content the feedback is, and when and where the feedback is given (see also Tosti, 1986). The literature on supervision devotes considerable space to feedback as a management tool, and HPT embraces performance feedback as an effective and efficient strategy for improving performance.

Recognition of the substantial impact that feedback systems have on overall performance improvement has had a tremendous effect on HPT. Feedback is an essential ingredient of the new performance management systems, which incorporate many other HPT interventions. These include interventions concerned with training, participative decision making, teamwork, quality, incentives, and rewards, among other elements.

Organizational Development and Change

Much of this chapter has considered new approaches to instruction, information, and management as having a significant impact on the organization. Organizational development (OD) is a large field that seeks to deal with this impact. It encompasses many interventions, including organizational design, team building, culture change, leadership, strategy development, management systems, and a variety of techniques designed to transform an organization's beliefs, values, operations, or interrelationships. OD practitioners are extremely people-oriented. They consistently look for opportunities to make the human part of a system work better and thus focus on humanistic rather than behavioristic strategies. The field draws its theory from psychology and organizational behavior.

In an extensive review of the literature, Beer and Walton (1987) look at organizational development from several perspectives. Each perspective has its own implications for HPT. From the first perspective, where the view is of *OD as general management*, attention centers on the operation and general management of an organization. Of specific concern is the culture of the organization, especially the issues of how to manage it and change it. Sometimes an organization's culture can enhance performance by espousing the ideal of a supportive environment. At other times the culture may inhibit performance by inhibiting risk, change, or growth. The performance technologist must understand the culture of the organization in order to implement the interventions most likely to succeed. Another concern is leadership. Research shows that true leadership can be an effective vehicle for change, including change in performance. The HP technologist can use leaders to set a vision, model behaviors, and challenge others.

From the second perspective, OD is seen as *creation of an adaptive organization.* Here we find the component of organizational redesign. Innovative, responsive, and flexible organizational structures can enhance workers' performance; in turn, workers' enhanced performance can help create adaptive organizations. Organizations that are more flexible and more adaptive are more likely to respond to HPT-related changes. Inflexible or rigid organizations, by contrast, make it difficult for new performance improvement strategies to succeed, especially if they involve changes in work patterns, the introduction of new tools or methods, or realignment of jobs.

The third perspective, from which OD is viewed as *human resource management*, gives insight into the effort to "develop high commitment work systems that will attract, motivate and retain superior employees" (Beer and Walton, 1987, p. 353). Such issues as compensation, benefits, and labor relations are important here. For HPT, the challenge is to use these human resource functions appropriately in an integrated approach to improving performance.

OD as implementation of change, as it is viewed from the fourth perspective, embodies much of the research on change and how to make it happen. Change theory and processes are at the very heart of HPT. Lasting, positive change in the workforce's productivity and competence is the goal of any performance improvement system. Change-oriented strategies have been instrumental in enabling the HPT field to expand its goals from individual to organizational results.

Nevertheless, the influence of organizational development and change on HPT has been hampered by the conflict between the imprecise, solution-oriented focus of the OD field and the more rigid, systematic, and measurement-oriented focus of many of the other disciplines. Beer and Walton (1987, p. 363) note that "tension has always existed in the [OD] field between a concern for effectiveness and a concern for the well-being of employees." In the conclusion to their review of the literature (such as it was more than a decade ago), they suggest that the OD field look at a broader array of interventions, moving away from structured, preprogrammed, consultant-centered interventions; and, similarly,

that HP technologists with roots in training obtain more exposure to the OD field. In the future, perhaps, integration between HPT and OD will help achieve these ends.

Intervention Systems

From the intervention side, "human performance technology represents the use of the systems approach in a number of different forms, depending upon the problem of interest and professional activity required" (Jacobs, 1988, pp. 6–7). Interventions are responses to identified causes of human performance problems or to opportunities for improving performance. They are often referred to as *solutions*, although it is difficult to determine whether the problem is "solved" before the intervention is developed. Some practitioners refer to interventions as *strategies*, *tactics*, or *human resource functions*.

The conventional wisdom holds that if some form of individual or organizational change can be designed, implemented, and evaluated with respect to a performance analysis, then it can be considered an intervention. Examples (taken from the preceding discussion) of areas in which interventions can be used are training and education, job design, feedback systems, incentives and rewards, selection and staffing, and environmental engineering. Many practitioners use some type of derivative of Gilbert's behavior-engineering model as an organizational framework.

How many interventions are there? No boundary or categorization scheme has yet been established for determining what is and what is not an intervention. Rosenberg (1990) elaborates on the ISPI model as a strategic overview of HPT. Rothwell and Kazanas (1997), Hutchison and Stein (1997), and Rothwell (1996) provide the most recent attempts to identify and categorize interventions at both the strategic and the tactical level.

HPT is emerging as a two-sided coin. On one side, analysis is concerned with identifying specific problems and opportunities. On the other side, interventions seek to fulfill the recommendations of the analysis. Many contributions from established disciplines have been expansions of intervention options. By looking at the field of HPT, it is possible to identify the initial set of skills necessary for conducting a performance analysis. Determining appropriate interventions is not so simple, however. For example, expertise in instructional systems design is adequate knowledge if training or education is the only intervention used. If, however, performance analysis indicates the possible applicability of dozens or hundreds of different interventions, it quickly becomes apparent that no one person will possess the expertise needed to design, implement, and evaluate them all.

This is a dilemma in HPT: although it is now possible to identify myriad performance problems (or opportunities) and their causes, it is also true that the number of options at a practitioner's disposal has significantly increased. What

can be done? Is the practitioner limited to analyzing a performance problem or an opportunity but not recommending an intervention? If an intervention is recommended, can the HP technologist design, implement, and evaluate it? Is the practitioner essentially a manager or a designer of interventions? Does the practitioner belong to a larger team of experts beyond the still undefined boundaries of the profession? Is HPT not also a superordinate concept? These questions and others are causing the management of HPT to emerge as an important area for study.

MANAGEMENT OF HPT

Where the process of HPT is concerned, much has been contributed by more established fields, but there has been little discussion of the management of that process. It is generally agreed that managing a performance improvement system that is based on HPT is more complex than managing a single intervention, but the information is sparse on how to do this more complex kind of management.

Bullock (1973, p. 3) suggests that HP technologists may not offer a "unique total capability for solving human performance problems" but that the field "brings together a variety of individuals whose combined skills offer a total capability." Hutchison (1990) recognizes this concern by distinguishing between the practice of HPT and the design of specific interventions. She identifies two types of HPT practitioners: the *HP technologist*, concerned primarily with analysis, management, and evaluation, and the *intervention specialist*, concerned primarily with the design and implementation of specific interventions. These roles may be performed by one or more individuals, according to the expertise of the individual and the parameters of the performance gap.

Hutchison stresses the importance of the interrelationships between HPT and other specialist strategies, and she points to the significance of process management in the role of the HP technologist, especially as process management involves the phased and integrated implementation and evaluation of combined interventions. According to Hutchison, it is crucial to distinguish between the practices of HP technologists and those of intervention specialists.

What makes HPT unique is that it is emerging as a field characterized by the integration of the disciplines on which it is built. The usefulness of this integration lies in the assumption that combinations of interventions, taken from a variety of fields, provide greater value when applied to a performance problem or opportunity than does any specific intervention when used alone. This necessary integration will be a cornerstone of how human resources, training, and other such departments are restructured in the future (Robinson and Robinson, 1998).

Gilley (1989) notes that career development in an organization is enhanced when strategies are linked to training and organizational development processes.