STRIVING FOR EXCELLENCE:

THE ART AND THE SCIENCE OF INSTRUCTIONAL DESIGN

by

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"Intelligence, imagination, and knowledge
are essential resources, but only effective-
ness converts them into results. By them-
selves, they only set limits to what can be
attained."

<div align="center">Peter Drucker</div>

There are encouraging signs that American industry and business

are rolling again after a recession that has lasted some four years.

Costs are down and profits are up. Operations are streamlined,

efficiency is climbing and labor relations are less combative than

in the past. Increasingly, products and services take on a new

sparkle consistent with our age of technological innovation and change.

Yet, the real testing lies ahead.

<div align="center">THE CHALLENGE OF PRODUCTIVITY</div>

Ironically, a sense of growing optimism may lull managers into

a spirit of complacency well before the transformation of business

and industry is complete. It could erode the hard earned cost cutting

efforts and productivity gains of the last few years, and encourage

a return to former values and ways of doing things. New technologies,

strong foreign competition, and the length of the last recession

(four years in the auto-industry compared with the usual six months

or so), all signal a need for us to change our ways to doing things.

Industry and business, government and military, as well as the

service sector, must improve; and improve both consistently and

constantly. The willingness is certainly there, but it must be

maintained if productivity is to grow in any significant way. Training

and development, too, must play their part, but in an enhanced and

more central way. It has been estimated that it may take up to a generation to complete all the changes that are needed. Pairing costs will always be essential, but increasing productivity and improving quality remain the ultimate goals if the economy is to be made strong again.

After an increase of about 3% per year in the 1960's, the annual growth rate in productivity in the 1970's averaged only 1.5%. In order to make up for past losses, an annual productivity growth rate for the 1980's in excess of 5% is essential. This will only be achieved, however, if the bureaucracy in management -- especially in middle management -- gives way to a renewed interest in the human side of enterprise, particularly in the development of the human asset.

A typical strategy for long term productivity involves expensive capital investment. If the growth of fixed costs can be reduced and the volume of sales and services increased, the argument runs, then earnings in business and industry can be improved. The increased earnings, in their turn, will help generate a strong cash flow that can be used to boost productivity through heavy capital investment. However, an additional strategy can be used to enhance productivity, without significant capital outlay. It involves the approach of reliability.

THE RELIABILITY APPROACH

The reliability approach involves a total commitment to excellence. Just as nature spells out the code of life in DNA, so reliability spells out the code for excellence in all human endeavours. Reliability

is the seed of productivity and the generator of quality. As such, the principle has a particular contribution to play in training and development in the 1980's.

All of us seek for reliability in terms of the products we make and utilize, as well for the processes we employ and the services we offer. Human reliability in job performance is just as important as process and product reliability. Each nurtures the other. Yet, while engineers are beginning successfully to convince senior management of the importance of product reliability, the contribution of human reliability is not widely recognized. Yet the conceptual framework of human reliability offers the training and development function an umbrella for its many responsibilities that is rich in meaning and central in its contribution to productivity and quality.

Human reliability is an easy concept for management to understand. It meshes with their other concerns, and contributes positively to the return on investment equation. Training and development, instructional design and media production, on the other hand, are often perceived as cost factors that negatively affect ROI. As such, they do not directly contribute to a strong cash flow, and so militate against any long term strategic plan seeking to enhance productivity through heavy capital investment. Instead of being central to the concerns of management, training and development can be seen as peripheral to the main thrust of the enterprise as a whole.

In all enterprises, assests are used to achieve a particular effect. If the assets are not available when they are required, productivity is lost. Reliability, on the other hand, seeks to increase

availability by focusing on the main causes of down-time. In the process industries, Latino (1980) estimates that 30-50% of production interruptions are due to human error or unreliability. It is also estimated that something like 60-40% of interruptions result from either design problems or are caused by operating beyond the capabilities of equipment or plant. These problems also stem from human error, but of another kind. Only 10% of process interruptions, Latino estimates, are caused by fair wear and tear of equipment.

In other words, something like 90% of the down-time in the process industries is avoidable in one way or another. There is no reason to believe that the figures for other industries and businesses are very different. Indeed, similar data may well apply to the service and public sector, especially as capital investment in new information technologies continues to increase. It is estimated that new technology investment in the service sector showed a 145% increase in 1982 over 1975, after adjustment for inflation (Roach, 1983). During the same period, employment in the service area rose 25%.

TRAINING AS A MEANS OF
ENHANCING HUMAN RELIABILITY

Since a very significant proportion of the down-time in American industry and business appears to be avoidable, it follows that produc-tivity can be increased by systematically reducing interruptions due to the human factor. Not only will this increase the availability of all human and non-human assets, but also help eliminate work necessary to restore conditions to a productive mode. The reliability

approach, in other words, offers managers an opportunity to obtain the effect of capital investment without the need of making actual capital outlays. Furthermore, a significant part of this opportunity can be contributed by people in training and development.

The reliability approach, in effect, adds an additional perspective to the training and development function, particularly to those roles that involve analysis, synthesis or design, and evaluation. It casts trainers with the responsibility for setting up conditions so as:

> systematically to reduce the probability of error both in the acquisition and execution of human performance in work situations.

Such a responsibility includes not only errors of commission, but also of omission. Put another way, the New York City electrical power blackout of July 13, 1977; the near melt-down in early April 1979 of the nuclear reactor at Three Mile Island; the May 25, 1979 crash of a DC-10 at O'Hare; and perhaps the tragic scenario of KAL Flight 007 on August 30, 1983 can all be viewed as catastrophes resulting from human unreliability. More effective training might well have contributed to their prevention.

A human reliability context for training and development demands a re-orientation or re-focusing of the ultimate perspective and goals of the field as a whole. Further progress and advancement of the profession necessitates that the concerns of training mesh more comfortably with the concerns of other managers. The framework of reliability offers an opportunity to question the underlying assumptions of the field, and to develop new sensitivities to the emerging needs of the times. Business and industry are increasingly recognizing that

high technology offers only a partial answer. Also involved is the development of a skilled work force, which is capable of continually improving itself.

In order to serve this need, trainers will increasingly have to consider how they can remain a step ahead of the best training technologies available. Where the necessary technology is lacking, trainers will need to develop it so that productivity goals can continually be met and quality boosted. All of this requires a co-ordinated systems view, in which both the art and the science of training can contribute to state of an art experience for every participant in the training program. Just as changes in industrial design are making significant contributions to productivity through the use of such new techniques as computer-aided design and manufacturing (CAD/CAM), so advances in training design and the production of training materials can make similar contributions.

THE ART AND THE SCIENCE OF
TRAINING AND DEVELOPMENT

Making a contribution to enhanced productivity and improved quality of product or service is a demanding goal. It will necessitate taking some of the focus off our products, and placing it much more on the means we employ to gain the effects that are required by other people. A much better co-ordinated approach will be necessary, and this will entail re-educating ourselves as well as the people with whom we work. Since a total reliability approach involves a multi-disciplinary effort, involving the integration of new and original

techniques, the opportunity is there. Exercising it, however,
necessitates that we use our sensitivities, diagnostic abilities,
decision making skills, style flexibilities, and action skills in
new and demanding ways. Since these are the essence of effectiveness
(see Drucker, 1967), the translation may be easier than it might seem.

The key to a total reliability approach lies in exploiting every
opportunity. Common indicators of an opportunity for trainers and
developers include: naive personnel, poor morale, high turnover,
lack of feedback, excessive pressures, unrealistic time schedules,
too many bosses and too little leadership, searches for one best way,
excessive downtime, high overtime rates, repeated process and equipment
failures, excessive stress etc. Singly or in combination, these
symptoms indicate one or other of three different types of situation.
Each one involves an opportunity, each associated with its own
particular methodology. The ultimate goal, however, remains the
same --- the enhancement of productivity and quality through human
reliability.

The three classes of opportunity for trainers are:

- Opportunities arising from deficiencies. These
  normally involve a failure in human performance.
  They call, therefore, for some type of root-cause
  analysis, with a view to identifying how the
  situation can be repaired and its re-occurrence
  prevented. Deficiencies usually revolve around
  deficiencies in knowledge, skill and/or attitude.
  Invariably the strategy involves some type of
  instruction or experiential learning.

- Opportunities arising from prediction. These normally involve monitoring a system with a view to preventing failure or deviations of any kind. Instead of reacting to failure, this class of opportunities calls for proaction. Usually, this will entail front-end analysis, with a view to preventing problems from arising or, at the very least, in minimizing their seriousness. Invariably, the strategy may involve steps other than instruction or experiential learning.

- Opportunities arising from improvement or renewal. These normally involve situations in which there is a need to introduce change of one kind or another in the work role. Resistance has to be overcome and acceptance obtained. Opportunities of this type call for some type of field-force analysis, with a view to identifying, together with their relative potencies, the driving and restraining forces operating in the situation. Invariably the strategy may involve the management and manipulation of innovation and change.

Regardless of the opportunity offered, it is unrealistic to assume that there is one best way of proceeding.

A systematic view of training, in which distinctions are made between means and ends, planning and implementation, process and product, is idealistic and even misleading. If the dualisms are

maintained, it can be argued that training is nothing more than a
craft (see Davies, 1981). If the dualisms are largely absent, or
at least blurred, then the art side of the enterprise is able to
emerge. Hard work, rigor, disappointment and ceaseless questioning
of results all have their place, but so do imagination, creativity,
cunning and human wit. Science contributes to training and development,
but so do art and craft.

The training and development function involve something more than
a set of step-by-step procedures for solving problems. If there is
no one best way of making tomato soup, it is absurd to imagine that
there is one best way of teaching someone to acquire worthy performance.
A larger and more demanding view of training is required. One that
adds to the reactive stance of problem solution, the proactive one of
ensuring that problems are prevented or their effects circumvented.
Reaction and proaction both involve opportunities of one kind or
another. However, reaction should be a priority of the last resort.
When effort is geared to solving problems that could have been forseen
and so prevented, unnecessary work is involved and availability eroded.

Rather than a systematic view of training and development, a
systematic perspective is required. The two terms "systematic" and
"systemic" are often used interchangeably, but there is an important
difference between them. Not only do they come from different roots
(the one Latin, with the nuance of order and interval: the other
Greek, with the implied meaning of organized whole), but they repre-
sent different ways of thinking about training.

A systematic view tends to emphasize craft: a systematic one tends to emphasize art and science, touched with the essence of creativity. A systemic or systems view implies that there is no rigid series of steps to be followed, that no recipe or algorithm to be imposed on a situation. It allows for both a proactive and a reactive stance, since action is determined by what is required to return a system to a healthy state and to keep it that way. Safeguarding the system, called Terotechnology in Europe, is the essence of what the training and development functions are all about. It both defines our role and our ultimate contribution.

THE ROLE OF MEDIA IN THE ART AND
SCIENCE OF TRAINING

Media are not peripheral, but are central to the concept of human reliability. They lie at the interface or point where people meet and interact, influence each other, learn from one another, communicate one with another. The interface is the plane which separates people from people, people from machine, and machine from machine. The interface is also the space which contains the means of communication, the very media to be employed. The process for determining that the interface is optimal is called "systems design". Media are not imposed on an interface. They are specifically designed so that everyone and everything meshes. In this way, the system can operate in an efficient and effective manner.

Some media are personal (such as the voice in everyday speech and body language); other media are largely impersonal (the printed word,

facts and figures, actual objects, mock-ups and models). It is also possible to think of "Big Media" (involving complex and sophisticated technologies, such as broadcast television, sound films and computer networks), and "Little Media" (simpler tools like slides, transparencies, and audio cassettes). Media can be thought of as self-standing (like a book or picture), or interactive (as in a modern interactive office using the latest technology). The so-called "glass cockpit" of the new Boeing 757, where pilots are supplied with information displayed in full colour on television screens or CRT's instead of traditional electro-mechanical instruments, is an indication of what is possible with the new media.

Regardless of the complexity, cost or the "hi-tech" nature of media, however, the contribution is similar. Without media, communication is impossible: without good media, human error and failure are inevitable. Furthermore, all good communication tends to be multi-media, in the sense that more than one medium is generally involved. The trick is to select media, to design and produce it, and then to combine media in a unique way so as to achieve a particular effect. Since media are involved at the interface where employer and employee, trainer and trainee, colleague and colleagues, client and consultant meet, it is essential that the right message is communicated. No matter how much effort and hard work have been previously involved, the effect will be lost if inappropriate media are used, the media are poorly conceived and designed, or the media are inefficiently managed.

It has long been fashionable in education and training to think of media design and production as something apart from the mainstream.

Even in systems diagrams of the training cycle, "produce media" or something equivalent is often a box apart --- related to the main effort by perhaps one arrow in the flow-diagram. Sometimes, this arises because people have a simplistic view of media; sometimes, it is because people think of media specialists as technicians (producing on demand according to some formula, instead of people who use art in the service of science through the utilization of technology); and sometimes, it is because trainers and developers fail to realize the power of media and so are unable to exploit its full potential. As a result, much is lost. Furthermore, the risk is unwittingly taken of building into communications, the increased probability of human error.

The changing demographics of the American workforce, make the case for the effective exploitation of media even more insistent. If only the single point is taken that "a picture is worth a thousand words", the changing ethnic, religious, value, cultural, language, age and sex backgrounds of the population are not without interest. In the 25 largest school districts, all but two currently have more than 50% minority students. By the year 2000, more than 32 million Americans will be over the age of sixty-five (Hodgkinson, 1983). Changes in demographics, technology and jobs, as well as changing skill needs, necessitate a "friendly" interface if training and development are to make their full contribution.

CONCLUSION

A "friendly" interface is a challenge that is both rewarding and demanding. Human performance is a function of the complex interactions that occur there. The 5M interaction between man (people), machine, mission, management and medium requires special attention and optimization. Training and development, for the most part, are faced with that responsibility. Setting up conditions so as systematically to reduce the probability of error both in the acquisition and execution of human performance becomes an essential part of the role.

Such a perspective casts training design as an integral part of media production. Furthermore, media design becomes an integral part of training development. By contributing to the realization of opportunities arising from deficiencies, prediction, and improvement and renewal, media specialists, as part of a multi-disciplinary team, seek to enhance human reliability. As such, media is central to the concept as a whole, and cuts across every other function. In media, science, craft and art are enjoined; through media, opportunities are realized; and as a result of media, productivity is enhanced.

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