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The Human Element in Technology Transfer

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THE HUMAN ELEMENT IN TECHNOLOGY TRANSFER

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ABSTRACT

Technology transfer involves change and, hence, alteration of human behavior. Consequently, the human aspects of transfer must be carefully considered. Such consideration can be based on a transfer model composed of three roles (user, agent, source) and their linkages. This model and a growing body of experience can be analyzed to provide guidance in the human elements of technology transfer. For example, criteria for selection of technology transfer agents can be described, and some needed working-climate factors are known. These concepts have been successfully applied to transfer activities.

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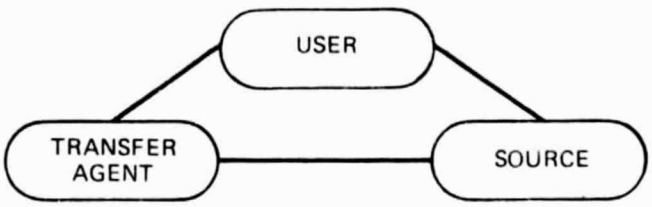
INTRODUCTION

Change is intrinsic to technology transfer. Humans and their reactions to change—fear, insecurity feelings, resistance—are thus vital considerations in the design of transfer attempts.

The human element in technology transfer appears in three principal roles.* One is the potential user, also variously labeled needer, client, decision-maker, etc. Another is the technology source; this role may be called supplier, manufacturer, vendor, or the like, as appropriate. The third role is the transfer agent who at times may perform the role(s) of technologist, innovator, adviser, broker, or catalyzer.



The nature and strength of the roles, and of the linkages between them, can vary widely from setting to setting and from case to case. Further, the roles and linkages in a specific case will most likely change with time, i.e. as a transfer proceeds from idea to completion. Human behavior, particularly as influenced by a process as complex, diffuse, non-linear, and difficult to measure as technology transfer, is such that many authors assert that transfer is a complicated politico-socio-economic phenomenon that defies clear understanding or analysis. Fortunately this is not always the case. What does seem to be the case is that, for successful transfer to occur, there must be a rather remarkable set of circumstances throughout the process. It also seems proper to say that technology transfer is a dynamic and fragile social process.

*W. H. Lambright and A. H. Teich, "Federal Laboratories and Technology Transfer: Institutions, Linkages, and Processes," a Syracuse University Research Corp. report, March 1974.

INTERGOVERNMENTAL TRANSFER

In an important set of transfers, the user is likely to be an elected or appointed official in a state, county or city department. Such users may be aware of technology's potential, but generally there is not the know-how to assess technological susceptibility, to identify alternative choices, and to select technology to apply to problems and situations—these latter items are the essence of the role of the transfer agent, or technologist. Thus the importance of the user-agent linkage may be noted. The coupling here is between two quite dissimilar roles conditioned by disparate working climates. Contrariwise, there is the binding force of shared purpose: beneficial use of technology. The user-agent couple then, representing whatever balance or mix of forces that it may, usually determines what actions are taken regarding technology transfer.

As the transfer process continues, the source role emerges. This role varies quite widely. In some instances the source role may actually be to supply a stock item or service. In other instances the role may involve design, development, experimentation, and even research. The nature of the source role in a transfer seriously affects its two linkages. For example, if the role be essentially to supply, the coupling to transfer agent will be loose or missing, and the coupling to user will be the primary one. On the other hand, where research is involved, the source-agent coupling will likely be rather tight, particularly in the early stages of a transfer effort. In the latter stages, the source-user linkage will strengthen as the research progresses toward application of results.

Two additional features of the source role are noteworthy. First, the source will in most cases be the only role which includes profit-making as a goal. Second, the source role may be performed as part of the transfer agent role. For example, a Federal Government representative (agent) might describe to a county government official (user) the applicability of a computer program listed in the NASA (source) catalog of available programs.

The transfer process, if it is to happen at all, must of course be initiated by someone. Furthermore, the initiator largely determines the essential character, and the probability of success, of a transfer effort. User-originated attempts comprise the category of technology "pull." Here the needer identifies his own problem, then looks for candidate solutions, perhaps with the assistance of an agent, or by going directly to a manufacturer or vendor. It is worth noting that the user-pull category is "problems looking for solutions" and is therefore consistent with the rational problem-solving process. The same cannot be said for the technology "push" category of transfer attempts. Here the attempts to transfer technology is originated by either the transfer agent or the source. In such instances the originator is attempting to "sell" or advocate the use of his idea, product, or service. Hence technology push is "solutions looking for problems," i.e. a non-rational process.

EXPERIENCE

Technological assistance has been attempted by a variety of Federal entities, chiefly mission-oriented agencies. In most instances a Federal employee is designated as the technology agent to interface with state and local government decision-makers. Backup support is usually provided by the agent's home organization. The actual amount of support and encouragement provided to transfer agents by their employers varies greatly. Generally, such support is accorded rather low priority—fortunately, there are few exceptions.

Intergovernmental transfer attempts which involve proven technology succeed far oftener than do attempts which involve significant research, development, or experimentation. Cities and states generally do not have the staff and resources to conduct developmental or experimental projects. Operating officials, in their quest for improved efficiency and effectiveness of services, cannot afford the risks involved in research or development.

Selection of personnel for the technology transfer assignment is occasionally done with considerable care and thought—in some instances, however, selection is based on administrative convenience. Some agents manage to work very effectively with users, and to catalyze beneficial transfers in a variety of technologies. On the other hand, there are cases in which the transfer agent promotes the utilization of a narrow range of technologies, usually those identified with his employer's main mission.

Experience indicates, particularly for routine applications, that the agent's role may be replaced by a broker role, or the broker may be interposed between user and agent. Again, the nature and strength of the roles and linkages vary widely and are related to user orientation and the level of technology involved.

ANALYSIS

In spite of the growing experience in technology transfer, no clear path to success is evident. In fact, as evaluators stoutly proclaim, there are serious difficulties in setting criteria for success, in devising measurement methods, and in collecting data. But evaluation is (fortunately) not the objective of technology transfer—the objective is benefit to people. This objective should be achievable by appropriate social activity. Furthermore, by examination of transfer experiences, and by application of some knowledge of human behavior, it should be a straightforward matter to describe the social activity appropriate to successful transfer of technology.

The roots of technology transfer lie in a single basic function—the effective coupling of user to source. The coupling function is invariant; what varies is the detailed nature of the schemes devised to achieve the coupling. For intergovernmental transfer then, the basic requirement is to couple a public official (user) to one or more sources of available, usable Federal technology. The users and the sources are already "in place"—the transfer agent is the "new kid on the block." Thus agent selection and support are of highest importance.

AGENT SELECTION

The selection of good (or better) transfer agents is not different from, although perhaps more difficult than, other technical personnel staffing selections.

The process by which good (or better) transfer agents are selected is the same as any valid process for selection of technical staff. Selection of agents may, however, be perceived as more difficult than most other personnel choices. After all, a transfer agent ideally takes a vast inventory of skills into a (usually) strange working climate for the purpose of benefiting a client. Nonetheless, although the situation may be uncustomary, it is still appropriate to follow the usual sequence of (1) job description, (2) person description, and (3) selection.

The transfer agent job description should have the usual content (major duties, interrelationships, authority, required skills and knowledges, etc.), with particular thought given to (a) choice of administrative home, (b) designation of primary interface in client organization, and (c) independent authority granted to tap resources of sponsoring agency. Analysis of an agent's job yields a job profile as follows:

Abilities

- Analysis/Evaluation
- Organization/Planning/Priority-setting
- Translation
- Interpersonal Relationships
- Persuasion
- Communication (oral and written)

Relationship

- Coordinator/Facilitator/Crusader/Evangelist

Subject Matter

People/Relationships

Technical/Scientific

Problems/Challenges

Results

To Fill Needs/To Serve Causes

This job profile at least points up the social, even evangelical, nature of the transfer agent's activities. Further examination and analysis of the job description must be carried out to provide the basis for a person description.

The following list of factors attempts to portray the required characteristics of transfer agents. These factors are not presented as any final or model set, but rather as representative of the attributes to be sought in candidates for agent duty.

REQUIRED CHARACTERISTICS
of
TRANSFER AGENT CANDIDATES

Background Factors

ABILITY—Is there demonstrated capacity to carry out challenging assignments?

EXPERIENCE—Does the candidate have an extensive record of work involving a broad variety of technologies?

EDUCATION/TRAINING—One or more degrees in engineering? Has there been continuing education in engineering, science, the arts? Is there evidence of training for useful skills?

OUTSIDE ACTIVITIES—What are the nature and variety of hobbies, interests, social activities, and community affairs participation?

ACCOMPLISHMENTS—Are his achievements novel or routine; did they occur uniformly or in spurts?

PERFORMANCE—What is the evaluation of the production record? Has it varied with time?

RECOGNITION—What is the level and frequency of formal awards, honors bestowed? How about peer recognition?

Personal Traits

MOTIVATION—Is there a genuine inner urge to serve humanity, to contribute, to aspire?

SENSITIVITY—Does the candidate relate to different authority levels, to various types of clients, to the feelings of others? Is he a good listener?

MENTAL DISCIPLINE—Does he exhibit a disciplined, rational, but flexible thought process? Is there honest inquiry and curiosity? Is time budgeted wisely?

HONESTY—Does he have the personal and professional integrity to "do the right thing," even in autonomous situations?

ANALYTICAL ABILITY—Can he determine problem sources, set priorities, sythesize pertinent data?

DECISION-MAKING—Is he able to make quality decisions in reasonable time? Does he employ intuition in solving problems?

COOPERATIVENESS—Is he a non-authoritarian who does not resent authority?* Are client goals held above personal goals?

LEADERSHIP—Does he have that personal quality (charisma) that inspires others to task accomplishment?

APPEARANCE—The transfer agent will be making a lot of first impressions; will his look and mien help or hinder?

INTEREST—Does the candidate exhibit a ready willingness to set aside vested interests and to enter into unaccustomed situations?

INITIATIVE—Will he work effectively for long periods without supervision; is he a "self-starter" who acts to influence events?

STRESS TOLERANCE—The agent's life can be physically and emotionally exhausting; does he have the required stamina and the ability to alter behavior to meet varying demands and pressures?

*E. Raudsepp, "Are You a Creative Executive?", Management Review, February 1978, pp. 10-15

SOCIO-POLITICAL AWARENESS—Does he, unlike most technologists, have a good understanding of the social impacts and political aspects of technology transfer?

DISCRETION—Will the candidate tactfully handle sensitive information and situations?

IMAGINATION—Is he discontented with habit and the status quo; is he innovative, able to adopt new perspectives, a flexible thinker?

VERBAL SKILL—Is he clear and persuasive in presenting ideas and facts, both orally and in writing?

POISE—Is there self-confidence (and not arrogance) born of appropriate self-esteem? How will he do in meeting the press, public gatherings, radio or TV?

With the list of required characteristics in hand, the person description can be completed by assigning relative weights to the rating factors. By the judgmental process, then, the candidate profile or specification is completed. There follows the task of rating individuals against the profile.

To perform the final step, selection, a list of candidates is of course required. The longer the list the better, up to a point—thus solid effort should be expended to assure a goodly number of prospects. Here it is important that top management issue a call for candidates. This brings widest publicity to the opportunity and, more importantly, shows management's endorsement of the activity. In addition to the volunteer candidates responding to an organization-wide call, the candidate list can be meaningfully added to by personal referrals on the part of working associates, acquaintances, and the like.

When the list is complete, rating and ranking of candidates should be assigned to a panel of two to five persons; one should be the person in charge of the transfer agent activity. A panel of two, carefully chosen, is completely adequate, and of course most convenient. The panel must collect sufficient information about each candidate to either screen him out of further consideration, or, for those remaining, to arrive at valid ratings on all factors in the candidate profile. In addition to the customary sources of information—supervisors and associates, personnel files, unstructured interviews, etc.—it is useful to employ some method for determining which of an individual's abilities are motivated abilities. One method employs a combination of personal inventory and structured interview; the results can be valuable data on candidate motivations and other personal attributes.

The panel's ratings produce the top one or more (rank ordered) candidates for transfer agent duty. The panel's findings are then subjected to any required review or approval authorities to arrive at the final selection.

TRAINING AGENTS

The process of transfer agent selection brings up a question: Is there any way to educate or train technology transfer agents? If this could be done, say in the same manner that institutions now produce engineers and scientists, then there would be a supply of candidates prepared for entry into technology transfer careers. And indeed some thought and action are being devoted to devising appropriate (broad-based) curricular exposure. However, it still seems doubtful that we will be able to turn students into technology transfer agents in the same sense that we turn students into engineers. Whatever else the agent needs, he needs many, varied facilities which seem to be achievable only by experience. So the development of technology transfer agents seems, for the time being, to be best accomplished by starting with the practicing professional technologist and exposing him to carefully selected educational offerings and job assignments.

A related area pertains to the counseling and briefing of transfer agents after selection and before entering their first assignment. It is particularly important that the new agent understands his administrative and technical accountabilities. The matter of dual subordination (to client and to employer) can be especially confusing if it isn't clearly understood. Administrative items (e.g. pay arrangements, travel, report requirements, etc.) should be fully discussed and agreed upon. Other useful items to cover are sources of help and consultation, and of course information about the city, county, or state the agent will serve.

THE WORKING CLIMATE

The behavior of transfer agents, like other human organisms, is conditioned by their environment. Now the client governmental entity constitutes a major part of the agent's total environment. This part of the total is, in fact, a given condition; i.e., it is up to the agent to learn a great deal about the user-related environment and to optimally adapt to it. The other major environmental segment involved is the agent's backup organization, usually his home organization and employer. This part of the climate should be as supportive of the agent as practicable, and should include easy access to specialists and facilities, and active encouragement and support by top-level executives.

CONCLUSION

The required attributes of transfer agent candidates can be reduced to two critical ingredients: human relations ability, intellectual competence.* And the human relations ability carries more weight than the intellectual factor. After all, even the finest technological brilliance will never be brought to bear on public sector problems unless there is an appropriate agent-client relationship based on mutual trust. But a personally well-equipped agent, going into a user-pull situation, taking with him a problem-solving orientation, backed up by a supportive and nearby technology-based activity, not fettered by awkward administrative arrangements, report requirements, and the like. . . . such an agent will almost certainly come to know the exciting sense of accomplishment derived from technology beneficially applied.

*J. A. Newman, "Effective Appraisal of Engineers," Electrical Engineering, June 1957, pp. 463-468.

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