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Role of information and information providers in technology transfer

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Key points

1. Technology transfer requires the following three steps:
 - a) Information must be provided;
 - b) The target audience must become aware of the information;
 - c) The target audience must implement the new technology.
2. Successful technology transfer considers the economic, social and environmental concerns of the audience.
3. Differences in learning methods among and within audiences should be considered.
4. Marketing principles using specific audience data from public and private sources should be used to develop technology transfer plans.

Keywords: knowledge transfer, technology transfer models, information dissemination

Introduction

Technology transfer is an essential component of economic change in society. Developers of new technology often fail to realize that there is a science to technology transfer. This lack of appreciation for the skills involved in information dissemination and in activities necessary to affect a change of action in an audience often severely limits the rate and amount of technology transfer that occurs. Significant differences exist between doing a news release or writing a publication and causing audience acceptance of a new technology. The old standards of expecting adoption of a new technology simply because it “will profit farmers” or because it is tested and recommended by “revered” public researchers has not been, and will not be sufficient to cause acceptance. Instead it is necessary to consider the audience and how its concerns relate to technology adoption, how audiences learn (which varies with different audiences), and match the presentation methods to the learning preferences of the specific audience.

Model of technology acceptance

The increased use of computers and associated software has stimulated significant research into technology transfer and acceptance. Many of the concepts can be applied to other technology transfer scenarios, such as for agriculture. The Technology Acceptance Model (Davis 1989; Davis *et al.*, 1989), adapted from the Theory of Reasoned Action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), offers a useful explanation for user acceptance and usage behaviour. The basic model suggests that user acceptance is determined by two key beliefs: perceived usefulness and perceived ease of use. Perceived usefulness is the extent to which a person believes that using a particular technology will enhance her/his job performance, while perceived ease of use is the degree to which a person believes that using a technology will be free from effort (Davis, 1989). Further research has suggested that perceived quality of life and subjective norms also have significant influence on technology acceptance (Venkatesh & Morris, 2000). Subjective norms include factors such as

individualism/collectivism, masculinity/femininity, power distance (decentralised vs. centralised power) and uncertainty avoidance.

There are several practical lessons that can be learned from studying these models. Some key concepts that apply to agriculture are:

- That perceived not actual benefits are the inputs to the models.
- Gender differences can be significant. Feminine culture individuals tend to place more importance on perceived ease of use and quality of life, while male culture individuals place more emphasis on perceived usefulness.
- Some groups place more importance on receiving and considering input from peers/superiors than others.
- Uncertainty avoidance may be a strong factor in certain socio-economic audiences and may significantly limit willingness to make changes.
- Age of target audience may be a significant factor as younger audiences may place more emphasis on extrinsic rewards, and older audiences may be more influenced by social concerns.
- Social influences are more important for a mandated effect (e.g. environmental concern) than a voluntary effect (e.g. selecting a new variety).

Thus understanding the target audience is crucial to success in technology transfer. Do technology transfer specialists emphasize productivity benefits, or do they emphasize process/usability issues and social factors? Do specialists emphasize primarily one factor or do they emphasize usefulness issues for men, while offering women a more balanced analysis that includes productivity aspects, process issues, and testimonials from peers or superiors?

The following considers the above target audience differences to consider technology transfer efforts.

Making information available to a target audience

Truly making information available is not a simple task. The first challenge is gathering information. This is obviously much simpler if the information is an improved variety than if a management system change is to be transferred. However, even for the variety information transfer, the information specialist must have the information the target audience needs, in order to accept the change. Information providers must be closely associated with the applied researchers. Often extension is a separate federal agency that does not have close ties to the federal research branch or to the universities. Such distancing hurts information transfer in several ways: (1) research information may not get to extension specialists in an expedient manner, (2) extension personal may not fully understand the conditions associated with the research information, and (3) feedback from extension to researchers about needed research or applicability of research is often lacking (Murray, 1999). Further, when extension is part of an agency that has regulatory function, acceptance of technology is reduced because of the inability of the audience to distinguish between the regulatory and educational functions. Information must be made available in a form and from a source that is respected by the intended audience.

The second step is for the audience to become aware of the information. This can be a major problem if information is provided in a form that is not received by the target audience (e.g. a publication that is not well distributed or a non-user friendly website). Considering learning differences and preferences, it is imperative that information is made available by via several

different methods. For example, the successful release of audiotapes in Australia allowed farmers to listen to them while driving, which allowed information to flow even when individuals didn't have time to read a publication (Hartley & Hayman, 1992). Multiplicity of release formats increased the audience that was exposed to the information. In this regard it is important to consider the age effect, on the form information is most readily received by the target audience. As shown in Figure 1, reading is declining among younger generations.

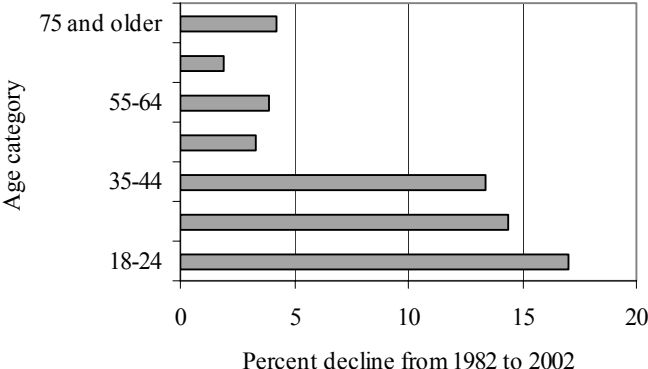


Figure 1 Young adults read less

It is generally accepted by marketing agencies, that the average person must be exposed to information a minimum of five times before he or she fully becomes aware of it. Too often public agencies distribute information once and think everyone should know what is being taught. Information disseminators need to be aware of where the target audience is receiving information and attempt to place information accordingly. Table 1 is a survey of information sources indicated by farmers in different regions of the U.S by a private company. Only the top three sources are listed. While University/extension was high, it was not always first. Thus it is necessary to be working with multiple groups and sources in order to make information available, and that the importance of difference sources varies with different audiences.

Table 1 Ranked sources of information of farmers in regions of the USA

Region	Rank of importance				
	University/extension	Seed dealer	Farm publication	Crop consultant	Other farmers
Midwest	2	1	-	3	-
Plains	1	2	-	-	3
Northwest	2	1	-	-	3
California	-	-	2	-	1

Marketing plans divide potential audiences many ways. A common method is to consider at least three groups: leaders, followers and nonresponders. In the first instance the target group

has to be identified, and then characterised. The size of each group varies slightly depending on the type of trait being transferred and the specific farm audience. Leaders often comprise about 10 to 15% of most farm audiences, followers comprise 40 to 50% of farm audiences and nonresponders are about 40 to 45%. Leaders are identified in marketing efforts by factors such as farm size, participation in farm organizations, and certification/training. For some types of information, such as environmental management issues, the audience may truly be the entire agricultural sector, but for most improved technology and/or management concepts, the audience is likely to be only the first two groups. While public agencies may feel some need to address all groups, causing change in the nonresponder group is very time consuming and expensive. Change in this group is often only accomplished by a combination of information, support (both financial and intellectual) and regulations.

The third step occurs when the target audience implements the new technology. This step is really the completion of the information transfer and depends on the information itself, its value (both real and perceived) to the audience and the method of presentation. From an evaluation process, this should be the final evaluated result. It can be as simple as how much of a particular variety was sold or more complex considerations such as the number of individuals implemented specific environmentally sound practices, or feed budgets?

Social economic and environmental concerns of the audience

Methods of delivery and content for effective technology transfer differs among audience groups. For example, leader will tend to be more fact and data oriented (as are scientists) but other groups may be more influenced by factors such as status or images of green fields or healthy animals.

Demographics of the intended audiences are critical in technology transfer efforts and key to success. For example, what is the make-up in terms of age, gender, income level, education, beliefs and values and what activities is the target group currently involved in? If a large portion of the audience is at the subsistence level, attempting to transfer technology that has a relatively high cost may not be feasible, even if the economic returns are good. Another example is a situation where additional profit is not the first objective of farmers who may be satisfied with their situation, work effort and income, and have no desire to increase cattle herd size. Some farmers may desire self reliance more than wanting to purchase feed and so will use stocking rates below carrying capacity to avoid purchases in periods of low production, even though the latter may actually increase profit.

It is also worth considering characterising audiences by specific knowledge and other shared similarities. In audiences where certain educational efforts have been exceptionally strong, it may be possible to build on the general knowledge level. The technology transfer specialist should be aware of such effort to be able to build on them by using the same terminology and phrases. For example, companies marketing *Medicago sativa* (lucerne) in the U.S. have learned that farmers are more knowledgeable of diseases and disease resistance in some regions than others. This knowledge leads to different approaches in selling product.

Who are the decision makers within the farm unit? All too often educators/extension workers etc. have targeted the senior male when others may be involved. Results of surveys in Wisconsin (Zepeda *et al.*, 1997) revealed that individual goals and contributions to decision making within families were related to the time allocated to tasks. That is, day to day decisions tended to be made by the person performing the task, whereas, long-term decisions

tended to be made jointly. The most male-dominated activity was crop production where 90% of both men and women say that men or mostly men make these decisions. Feeding decisions (82%), decisions regarding pasture (66%), capital purchases (60%) and those regarding the dairy herd (58%) are all predominately made by men. Longer term decisions however, e.g. whether or not to switch to grazing from confinement feeding and beginning of off-farm work, tended to be joint decisions. Regional and age differences also appeared to play a role in decision-making. Thus effective technology transfer should consider who in the family unit is targeted.

The same study found that a greater proportion of men than women (52 vs. 32.2%) were likely to seek out information. The preferred information source for almost half of both men and women was reading (87% of men and 79% of women preferred farm periodicals, 5% of both men and women preferred newsletters, while extension publications were preferred by about 3% of women and less than 2% of men). Open discussion was the second most preferred option, cited by nearly a third of women and a quarter of the men. 'Seeing' was the third most preferred method (20% of men vs. 12% women), and 'hearing' preferred by fewer than 10% of both men and women. (Note the difference between 'discussion' and 'hearing'.

In addition to demographics, the social concerns of the audience must also be embraced. This has become particularly true as many farmers are motivated by factors such as time spent with the family (does new technology take more time, or save time?), religious beliefs and social concerns e.g. Genetically Modified Organisms (GMOs). The GMO issue is both a social issue (do I want to grow/consume a crop with an incorporated gene?) and a market issue (will I be able to sell the product?). In addition, many farmers are concerned about risks associated with a new technology or practice; they may not be able to afford failure.

The history of many technologies is that potential benefits are less at farm level than was originally promised by research. This occurs because benefits are determined from controlled studies, and numerous factors (environment, inputs, management etc.) are often very different at farm level, where things are not done exactly right or at the right time due to knowledge of the user, time constraints and conflicting priorities. Also, only early adopters tend to benefit economically from new technology while others adopt to remain economically viable.

Technology is growing rapidly and the issue of information overload is real. This affects implementation of new technology because farming is a complicated system that involves many facets. Many farmers simply do not have enough time to absorb all the information presented to them. Additionally, adoption of a technology often involves other changes in the farming operation: can the technology be incorporated into an existing system as a package rather than be put out as separate technology where the user must figure out how to integrate into his or her system? Incorporating the technology into a system also avoids some of the problems of mixed signals given to farmers e.g. harvest early for quality but later for higher yield and persistence. Side effects of too much information include anxiety, poor decision-making, difficulties in memorising and remembering, and reduced attention span (F. Heylighen, 1999). These effects add to the stress caused by the need to constantly adapt to a changing situation.

Specific audience characteristics that impact learning

Understanding adult learners and adult learning is a critical component of providing information for technology transfer. The different ways in which learning occurs must be

recognised. For technology transfer to succeed, the learner must be understood and provided with meaningful information rather than simply providing information in ways familiar or easily available to those disseminating the technology.

Table 2 illustrates this point where; data are from a private company survey of its customers. The best-received activity was a field day where people could see a technology or product first hand, and talk with experts about it. Newsletters ranked higher in the previously reported study of the general public (Zepeda *et al.*, 1997). The major difference between general customers and those characterised as price conscious was the enhanced use of the web by price conscious individuals.

Table 2 Communication strategies considered valuable

	% responding	
	General public	Price conscious
Plot tours/field days	87	87
Newsletters	80	83
Magazine articles and advertisements	79	77
Toll-free number with technical support	75	82
Brochures or other mailings	74	74
Interactive website	33	62
Email message or online newsletter	24	47
Radio advertisements	23	25

It is clear (data not shown) that, while field days ranked highest, a number of those who did not attend gained the same information from reading either print or electronic material.

Experience with web-based courses also stresses the need and value of allowing for variation in the time of learning and methods among audiences. A web-based course allows for ‘on-demand learning’ where the course is available whenever the learner wants rather than available at a specific time and place. This leads to students taking the course when interested rather than when available, and increases their retention of learned material. By tracking when individuals sign on the web to take lessons, clear learning differences emerge. Some individuals take lessons over lunch, some right after work and some in the late evening (after the children are in bed). A web-based course allows the learner to pick and choose what parts he or she wants rather than having to sit through familiar material, and get to their specific areas of interest. In this context, teachers must allow some flexibility and concentrate on objectives (i.e. to cause learning, not necessarily to have student exposed to all lessons).

Lastly it is appropriate to consider new ways of using technology to facilitate learning. Technology does not present a new way of learning (Leamson, 2001). All learning is biological brain change and all teaching is an attempt to encourage and stimulate students to do what it takes to make those changes, that is, to focus their attention and to practice. However, computers and associated technology, and the access they afford, can constitute a new way of studying. It is important to recognise that expected learning outcomes remain unchanged when new technology is utilised. What changes is the ability to reach new and old audiences in different ways. What humans think *about* changes almost daily, but the *way* we think has not changed in many thousands of years.

Technology should be considered from the aspects of:

- Does it improve the users' problem-solving abilities?
- Does it encourage concentration?
- Does it enhance engagement with content?
- Does it build facility with language?

The last decade has seen great increases in the use of the web, email, and interactive TV as well as CDs and DVDs. Each of these technologies must be developed independently, but if used properly can have a significant place in information transfer (Unknown, 2002). The leader group of individuals is particularly more adaptive of modern learning technology.

A major mistake with use of the web has been institutions, organizations, or companies thinking organisationally (e.g. by department) rather than to think how the user would access the information. This has resulted in some wonderful and rich websites that are severely limited by the ability of clients to access the desired information. Another common mistake is to change medium without redesigning the message format – it is not appropriate to switch from print to video without reformatting, but it is often the case that the printed work is placed on the web without any consideration of the audience. If the material was designed for print medium, it is unlikely to be as effective as it could be for the web. Material should not be transferred from one media to another without specifically redesigning for the new medium.

Lastly, it is necessary to consider what types of material work well for the different media. Every medium (print, web, email, radio, video and interactive TV) can be useful in technology transfer, but some are stronger for certain types of messages than others. For example print media can be useful for everything from promotional flyers to reprints of refereed journal articles. However, as all of us know, the space needed to keep the items is significant and expensive, and locating a specific fact or detail may be difficult. The web can easily handle different levels of material through layering, and can find specific points with search engines, but may not be available to everyone. Also, the audience may not know the web address. Email and radio are good for short messages or alerts. Interactive TV will be useful for providing ancillary data to a main message (on the video), e.g. information on identification or control characteristics of an insect, disease or weed being discussed, or containing a web address for ordering or obtaining more information.

In summary, technology transfer is key to the economic development of any society, but lags far behind technology development. Typically many agronomic researchers and educators, whilst well versed in their subject matter, often lack expertise in how best to transfer the information (Murray, 1999). Information dissemination is a critical component of technology transfer. The goal is not just to distribute information, but also to cause awareness and change within the target audience. To be effective information must be presented with the audience in mind. Therefore it is important to know and understand the target audience. The message must be based on the social and economic concerns of the audience, and multiple media chosen with the audience in mind. Learning differences of individuals and of audiences must be taken on board. New technology should be used where appropriate, but only after considering the different design considerations of each medium. Information should only be distributed with appropriate marketing principles to be effective in causing change.

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