Technology Transfer in Saskatchewan: Operational Use of the Canadian Forest Fire Danger Rating System

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Abstract

In 1985, Forestry Canada and the Saskatchewan Department of Parks, Recreation and Culture initiated a technology transfer program in fire management under a federal-provincial forestry agreement. A main goal of this program was to deliver recent research and development information on the Canadian Forest Fire Danger Rating System (CFFDRS) to the field level. In this case, the technology transfer process had three phases. Firstly, field staff were made aware of the capabilities of the CFFDRS through information sessions. Next, training courses were developed to instruct in the use of the CFFDRS. This was done through case studies which utilized historical information from Saskatchewan wildfires. The final step was to demonstrate its application in the field during actual campaign fire situations. These steps eventually led to the implementation of a provincial Fire Suppression Preparedness System based on the CFFDRS. This paper provides an overview of the technology transfer activities during the period 1985-1989 which resulted in the operational use of the CFFDRS.

Résumé

En 1985, le Service canadien des forêts et le ministère des Parcs, des Loisirs et de la Culture de Saskatchewan entreprenaient un programme de transfert de la technologie en matière de gestion des incendies de forêt dans le cadre d'une entente fédérale-provinciale de foresterie. L'objectif de ce programme était de fournir l'information sur les résultats de recherche et développement récents sur la Méthode canadienne d'évaluation des dangers d'incendie de forêt (MCEDIF) au niveau des opérations. Dans le cas présent, le processus de transfert technologique comportait trois étapes. La première consistait à informer le personnel dévoué aux opérations des capacités de la MCEDIF grâce à des séances spécialement conçues à cette fin. La deuxième étape prévoyait l'élaboration de cours de formation sur l'utilisation de la MCEDIF. Les cours présentant des études de cas fondées sur des données historiques sur des feux de friches survenus en Saskatchewan. La dernière étape consistait à démontrer son application aux opérations lors de véritables incendies de forêt. Ces étapes ont éventuellement menées à la mise en oeuvre du systéme provincial de mise en alerte de la suppression du feu basé sur la MCEDIF. Le présent article décrit les activités du programme de transfert technologique durant la période 1985-1989 qui ont amenée l'utilisation opérationnelle de la MCEDIF.

Introduction

In 1984, the province of Saskatchewan (Dept. of Parks, Recreation and Culture) and the Canadian federal government (Forestry Canada) entered into a five-year Forest Resource Development Agreement (FRDA). A primary objective under the FRDA was to assist in the maintenance of timber supplies, which included a program of enhanced forest protection (Anon. 1984). The fire management component of this program included the upgrading of the provincial fire weather station network (with remote automatic weather stations) and the lightning locator system (i.e., additional direction finders). However, the major effort to enhance fire management capabilities under the FRDA was in technology transfer.

In the prairie provinces, research and development has historically been the primary focus of the federal forestry service fire research group at Edmonton, Alberta (Alexander and McAlpine 1989). Although a few studies in Saskatchewan were aimed at research applications[1] (Ogilvie 1989), technology transfer activities in fire research/management were not undertaken in Saskatchewan on a full-time basis prior to the FRDA. The need for technology transfer was reflected by a lack of use of the Canadian Forest Fire Danger Rating System (CFFDRS) (Canadian Forestry Service 1987, Stocks et al. 1989) in the daily decision-making process. In particular, general field knowledge and use of the Canadian Forest Fire Weather Index (FWI) System (a sub-system of the CFFDRS) was minimal, at best. This was despite the fact that the FWI System was operationally useable since 1970, and that a tremendous amount of research and development had gone into the CFFDRS[2]. Therefore, it was decided that the FRDA would be used as a vehicle to transfer CFFDRS research and development to the managerial and field levels of Saskatchewan's fire management organization.

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The Technology Transfer Plan

The most critical step in technology transfer is the first one - planning (Marx 1986). In this case, technology transfer was to be completed using three phases. Firstly, field staff (and managers) needed to be informed on the capabilities of the CFFDRS. Secondly, they were to be shown how this system could be integrated into their daily operations to make tasks easier or decisions/results more accurate. This phase required instruction in the use of the CFFDRS. The final phase was to take this new technology into the field, and into management operations, and demonstrate its use in actual working situations. Documentation of this technology for operational (as opposed to research) use was done during each of these phases. This technology transfer plan is quite similar to that described by Blatchford (1972) as being required for effective transmission of information - i.e., conversation, demonstration, participation, and publication. The approach taken in this plan follows a technology marketing situation, or 'supply-push' (Callaham 1984, Cayford and Riley 1986). This approach is used when technology is available and the information is not in immediate demand. This is not an indication that the CFFDRS, or fire danger rating in general, is of no use to the user. However, it clearly points out to researchers that user groups are not necessarily well-informed about research products and their capabilities. It was believed that with promotion of the CFFDRS, this would turn into a 'demand-pull' situation where its application would be requested in order to solve current problems. The problem-solving approach has virtually the same steps as the product-marketing approach, except that the impetus comes from technology demand (Callaham 1984). The problem-solving situation is much more desireable since acceptance of new technology and committment to change is much easier. The strategy for this technology transfer plan was to change a 'supply-push' situation into 'demand-pull' so that the program would eventually be driven by the value of the product.

Technology Transfer Activities

PHASE I - INFORMATION SESSIONS

The initial step towards informing management and field staff of the CFFDRS and its capabilities, was to travel to each of the regions. Discussions with operational people provided information on daily procedures, management and field suppression needs, the exact level of understanding of the CFFDRS, and most importantly - attitudes. There wasn't a great deal of difference between the regions (and the provincial fire centre) on any of these topics. The province operates a de-centralized fire management system with only staff at the provincial fire centre being committed to fire operations on a full-time basis. The FWI System (Van Wagner 1987) component values were received by the regional fire centres, but seen of little value and not understood. There was no knowledge of the Canadian Forest Fire Behavior Prediction (FBP) System (Lawson et al. 1985), another sub-system of the CFFDRS. Decisions were made almost entirely on past experience. There was great need for a time-saving device that would simplify regional fire operations, as most staff had other duties to perform. However, there was skepticism about the abilities of the FWI and FBP Systems to fill this need. For most people, this was the first time they had met anyone from the fire research community.

Although the situation didn't seem too promising, it provided a starting point. The fact that fire researchers actually travelled to the field to ask questions and find out needs added credibility to technology transfer efforts, and made acceptance a little easier to gain. Obviously, if this was to become a 'demand-pull' situation, the needs of management and field staff would be the focus.

As previously mentioned, time constraints were perceived as being a major problem in operations. Providing a simple decision-aid, such as the FWI or CFFDRS System, could solve this problem. Most importantly, this decision-aid could address a more serious problem: lack of a formalized decision-making process, or decision by pure judgement. Operations were being run by staff with 20-30 years experience who were able to retire in a short period of time. Extensive fire experience beyond this small group of managers was extremely limited. Use of a formalized decision-aid system would allow new staff to fill key roles, and it would also ensure that experienced managers could properly evaluate burning conditions through the use of a common, unbiased measuring stick. Obviously, those people with more experience would be able to use this decision-aid more effectively.

Formal and informal information sessions were provided at every opportunity. The information being supplied was not dealt with in a purely technical sense for fear it would be rejected because of its complexity. Rather, it was presented in a simple theoretical way using basic examples. Again, the key approach being used was showing how it filled their needs. Something which wasn't directly identified by operations staff, was the need for a method of justifying presuppression resource levels. There was concern about the disparity in amount and distribution of resources during the fire season. A formal system for assessing burning conditions across the province provided the means of distributing resources. Although this wasn't a clearly identified need, it was important for jurisdictional strength and autonomy in this de-centralized system. This need was used to its fullest potential in creating a 'demand-pull' situation.

Information sessions were used to deliver this message, and they were presented at regional locations whenever possible. These sessions took the form of seminars, committees, formal and informal meetings, introductory presentations at courses, and a lot of ad-hoc personal contact. This phase continued simultaneously with the other phases throughout the five-year period of the FRDA.

PHASE II - COURSE INSTRUCTION

The primary goal of the first phase was to create interest and gain a commitment to further examine use of the CFFDRS. For the second phase to be successful, it had to be presented using practical examples of everday operations. A thorough understanding of fire operations at the field, district, regional, and provincial levels was required in order to present this phase with any credibility. This understanding was gained by going to these locations to discuss operations, or by directly participating in operations.

Instruction on the FWI and FBP Systems was given by the author who was employed as a fire research officer working under the FRDA. Courses were generally 1-2 days long, and utilized a workshop approach as much as possible in order to give students 'hands-on' experience in doing calculations and making decisions. A certain amount of theory was necessary, but it was kept to a minimum and presented early in the course. Students were also given practical training on computers using various software programs dealing with the CFFDRS[3] (McAlpine 1987).

There were a number of publications produced during the FRDA which served as excellant training aids during courses. A color poster illustrating fire behavior in relation to the FWI System (Alexander and De Groot 1988) proved popular with course participants (Alexander et al. 1989). As well, a poster illustrating FBP System fuel types (De Groot 1987a) and the Fire Growth Calculator (McAlpine 1986) assisted with instruction on the FBP System.

Over the course of the FRDA, a total of 19 instructional courses were presented in Saskatchewan (Anon. 1988). Classes generally had 15-30 people in attendance (Table 1), with every district and region eventually being represented. Credibility and acceptance of the CFFDRS grew considerably as Phase II proceeded.

PHASE III - FIELD USE

Up until this point, technology transfer had taken a theoretical approach. Specific examples of CFFDRS applications were based on historical situations where hindsight was always 20/20. Final acceptance would not be achieved until its usefulness could be proven in real-time. Perfect application was never expected at the first attempt because of an operational 'learning-curve'. However, this was overcome in a short period of time. During the final year of the original FRDA, an opportunity occurred which provided for the secondment of the author to the provincial fire management organization. This allowed the province to utilize the Forestry Canada employee as a fire behavior officer (a previously non-existent position) on campaign wildfires, and to assist duty officers at the provincial and regional fire centres. This situation enhanced technology transfer efforts, and accelerated the process.

Table 1. Summary of CFFDRS course presentations given in Saskatchewan during 1985-1989.

Date	Location	Course/Session Title	Number of Attendees
Nov. 29, 1985	Kelsey Institute, Saskatoon	FWI System	25
Jan. 14, 1986	Prince Albert	FWI System	16
Jan. 21, 1986	Prince Albert	FWI System	16
Feb. 12, 1986	Prince Albert	FWI and FBP Systems	15
Feb. 19, 1986	Prince Albert	FWI and FBP Systems	16
Mar. 13, 1986	Kelsey Institute, Saskatoon	FBP System	25
Apr. 16, 1986	Prince Albert	FWI and FBP Systems	30
Jan. 15, 1987	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	23
Jan. 22, 1987	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	25
Feb. 5, 1987	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	30
Oct. 20, 1987	Northern Institute of Technology, Prince Albert	FWI, FBP Systems and Fire Growth Calculator	25
Mar. 3, 1988	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	18
Mar. 10, 1988	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	23
Apr. 26, 1988	Melville	FWI, FBP Systems and Fire Growth Calculator	22
May 4, 1988	Prince Albert	FWI System	15
Feb. 13, 1989	Prince Albert	FWI and FBP Systems	15
Feb. 20, 1989	Prince Albert	FWI and FBP Systems	17
Mar. 9, 1989	Prince Albert	FWI, FBP Systems and Fire Growth Calculator	22
Apr. 7, 1989	Prince Albert	FWI and FBP Systems	15

As a fire behavior officer, the author was supplied with a portable fire weather station, and a battery operated lap-top computer (with various CFFDRS software) and printer. This allowed the author to make hourly fire behavior predictions using the CFFDRS and site-specific weather information. The first opportunity to make fire spread predictions under an actual field situation was in 1987 when the Elan fire grew to 70 000 ha during a 30-hour period. Although this fire amassed most of its final size during a relatively short time interval, it provided the opportunity to prove that fire spread could be predicted with a fair degree of accuracy by using the CFFDRS[7]. After this point, 'demand-pull' drove the technology transfer program.

The 1987 and 1988 fire seasons were record-setting years for Saskatchewan. As the value of CFFDRS information became apparent, there were constant requests for the assistance of the author in the fire behavior officer role at campaign fires. The largest fire of 1988 was the Coffee fire (32 000 ha). Its major run (25 km) was predicted hours before it started, and the forward spread distance was predicted within 6% of the actual spread. This information was used to plan suppression strategy, and for safety and evacuation considerations for firefighters and the general public. The CFFDRS was also used on this fire to plan the location and timing of backfire operations. A provincial review of the Coffee Fire concluded that the province requires a fire behavior specialist on staff to provide CFFDRS information and predictions.

PROVINCIAL PREPAREDNESS SYSTEM

Following the 1988 fire season, field use and application of the CFFDRS was accepted. However, application to management operations was still somewhat limited. The basics of the FWI System were well-understood and it was constantly used by duty officers for deploying resources. This was a considerable change from before, but the planning power of the FBP System was not being used to its fullest extent.

This led to development of Saskatchewan's Fire Suppression Preparedness System[8]. This system utilizes the FWI and FBP Systems to plan resource levels and deployment in anticipation of burning conditions. It uses forecast FWI System values and determines attack time requirements based on predicted head fire spread rates and frontal fire intensity. Again, acceptance was limited during the initial stages of development, but quickly grew once input from management and field operations staff was solicited. Also, a retrospective review of the 1988 fire season showed that additional helicopters were not hired until after several major fires had become established. This system provides for increases in helicopter levels prior to the onset of serious burning conditions (and fire starts to a certain extent). Once this was explained, 'demand-pull' quickly followed.

Although this system was not an original goal of the technology transfer program, secondment provided the opportunity to develop it. It will be used for the first time during the 1989 fire season, and an operational 'learning-curve' is expected.

Discussion

Reviews of other technology transfer programs show similar results and conclusions (e.g., Cayford and Riley 1986, Kill et al. 1986). There are a number of key points which seem to be universal to successful technology transfer programs. Credibility is often first and foremost on the list of requirements. In a 'supply-push' situation, the research community is required to prove the value (or credibility) of the product. A survey in Cayford and Riley (1986) shows that the most effective technology transfer approach is through field demonstration so that results can be convincingly shown. In this case, all information sessions, demonstrations and courses were aimed at integrating the CFFDRS into management and field operations. This was done to remove any suspicion of application problems and usefulness. Showing how it benefited operations fostered a shift towards a 'demand-pull' situation which made its credibility easier to accept.

Along these same lines, personal contact and communications are critical for success. This creates credibility and is the key to acceptance of the product. Moeller and Seal (1984) have prepared a list of recommendations for improving technology transfer in forestry. Communication between researchers and operational people is the most prevalent requirement on the list. Better communication was facilitated under this program by designating a 'linker', or liaison, between research and operations.

Even though a technology transfer plan is is place, it is also important to be flexible (Kill et al. 1986). Every technology transfer situation is different, so adjustments must be made from the original plan as circumstances dictate. As well, opportunities arise which require deviation from the original plan. In this case, secondment of the author to the provincial fire centre offered an opportunity to increase personal contact (and therefore, credibility and acceptance) with the user group. This increased communication lead to an acceleration of the technology transfer process, as well as a 'demand-pull' for a provincial preparedness system. Interchanging staff was another key recommendation by Moeller and Seal (1984).

Finally, proper publication of technology is also important for success. Research papers are seldom read by user groups (Blatchford 1972 Cayford and Riley 1986), although the information is still in demand. This technology transfer program recognized the need to produce operational-level technology publications, and attempted to do so whenever possible.

Technology transfer also has a few dangers. One is that research participants may become too engrossed in field application. The user agency becomes comfortable with this situation, and the result is that research turns into a service organization working for operations. The same could happen in reverse, with a member of the user agency becoming too involved with the science of the information and neglecting practical field applications. To avoid this, both parties should understand the goal and set a reasonable timetable to achieve it.

The necessity for this program stemmed from an acknowledged lack of direct, formal communication between federal research and provincial operations. There are numerous forums where these two groups meet to discuss fire management problems and possible avenues of research. However, it seems that completed research products do not always make it to the field (or office) where they were intended. If transfer to these levels is to occur, it is the responsibility of the federal fire research group to present and explain these products to client agencies, while these agencies are responsible for operational implementation. In this case, a backlog of incomplete transfer of the CFFDRS necessitated a program which assumed both these responsibilities.

Complete transfer of current CFFDRS information will occur by the end of 1989, and at that time the provincial and federal organizations will resume their regular roles in technology transfer.

There is no doubt that having a fire research officer position in Saskatchewan facilitated the success of this program. Prior to 1985, fire researchers made considerable effort towards transferring CFFDRS technology in Saskatchewan, but it still required a full-time liaison or 'linker' in close proximity to provincial operations to assist and follow-up on new information. This liaison position is the most important key to successful technology transfer. It makes no difference whether this position is provincial or federal. However, it is in the best interests of the user agency to provide a liaison because it is the user's forest that is burning. As well, federal funding of fire-related liaison positions has historically been unsure. The results and success of this program show the critical importance of technology transfer. Commitment of a full-time research/operations liaison is a small price for the user agency to pay when the enormous benefits of science and technology can be gained.

Conclusion

There were a number of reasons for the success of this three-phased technology transfer program including planning, credibility, proper publication, program flexibility, and a lot of communication with the user group. However, the two key factors to the success of this program were establishing a 'linker', and identifying user needs. Change is often difficult to achieve because of loyalty to traditional practices, and a belief in the adequacy of current procedures. Therefore, it may be difficult to prove a need for new technology. Sutton (1986) believes that acceptance of new technology is highly dependent on the perception of risk. He states that successful technology transfer can only be achieved when researchers use a strategy to show that the risks of not adopting a new technology are greater than of those of adopting it. Regardless of the approach taken, the information can't be transferred without a thorough understanding of the user's situation.

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[3] An unpublished FWI-PC program was developed and provided by B.S. Lee, Fire Research Officer, Forestry Canada, Northern Forestry Centre, Edmonton, AB. Actual case studies of Saskatchewan fires were used to illustrate application of the CFFDRS. Additional publications on the CFFDRS were also produced which dealt with operational situations[6] (De Groot 1987b, 1988a, 1988b). These publications were all written with the operational-level audience in mind.

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